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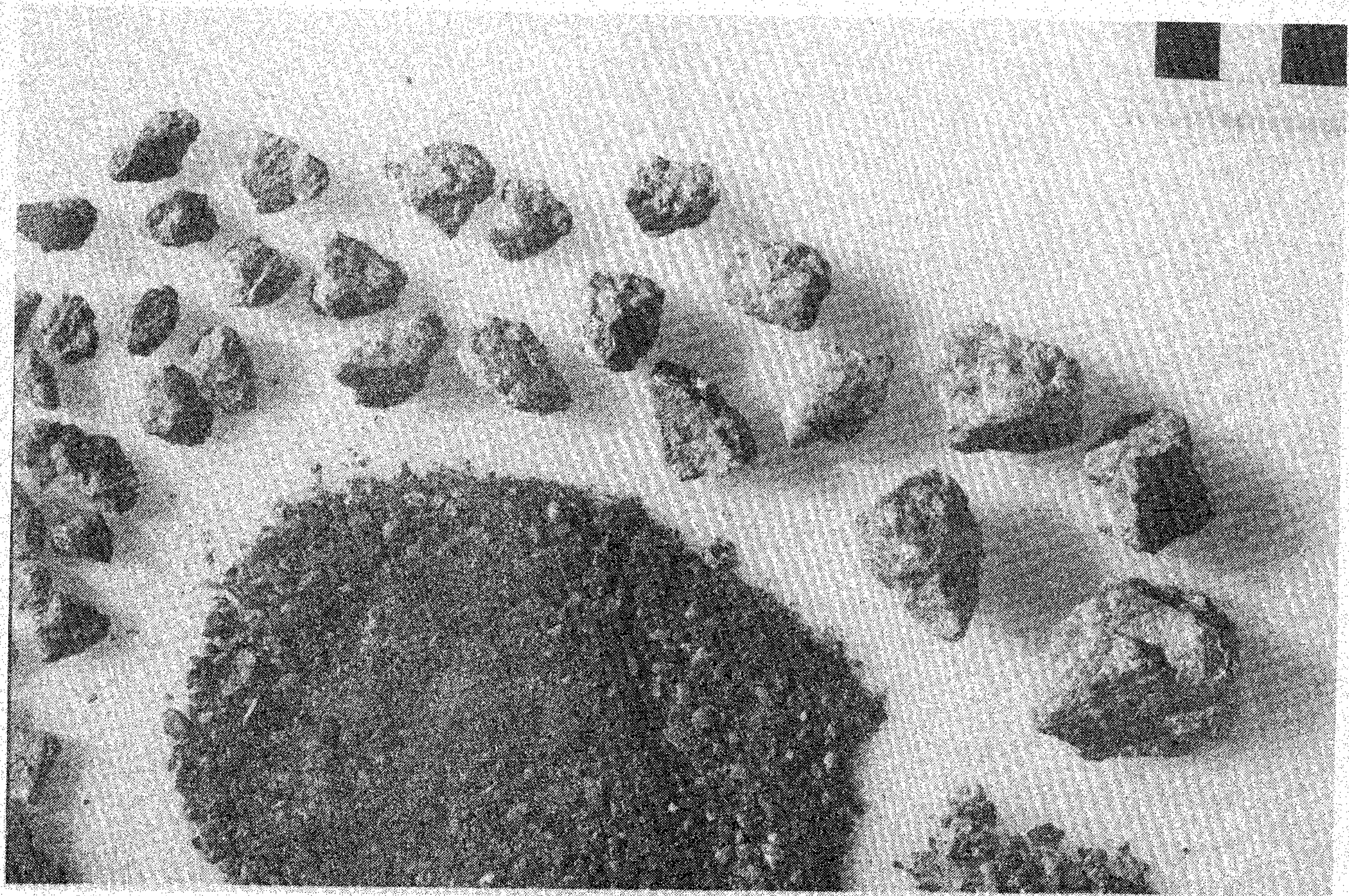

These are the remains of a meteorite which fell on a house in Glanerburg, the Netherlands on April 7, 1990, at 18^h32^m UT. For more details, please refer to the article in this issue on pp. 89–90. The photograph was communicated to us by Hans Betlem, Dutch Meteor Society, and is courtesy of the National Museum of Natural History, Leiden, the Netherlands.

In this issue:

In case of non-delivery, return postage guaranteed. Please return to:
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WGN, volume 18, nr 3, June 1990, pp. 71–96

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Useful Information

The August Issue *(WGN 18:4)*

The *August issue* is expected to be mailed during the first week of August, may be a little earlier. Contributions are also due a little earlier than usual, say *June 22*. They should be sent to *Marc Gyssens* or to any member of the editorial board (addresses on the inside of the back cover).

WGN Subscription/IMO Membership 1990

The subscription rate for volume 18 is 400 BEF or 12 USD for six issues. It is anticipated that volume 18 will contain over 240 pages. Subscriptions should be paid to Ann Schroyens or, for the USA and Canada, to Peter Brown, or, for Japan, to Masahiro Koseki (all addresses on the inside of back cover). Please make sure we retain the full amount due after deduction of bank and/or exchange charges. Therefore it is recommended to pay by international postal money order. Additional gifts are of course welcome.

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.

About the Editorial Policy

Marc Gyssens

It is now about three and half year since I took over the editing of WGN from Paul Roggemans. This relatively short period has been very rewarding to me because I could see WGN grow from a Belgian-Dutch circular with input from abroad to the reputed journal of an international organization. The numerous contacts built up by serious amateurs during the last two decades, both among themselves and with professionals, are largely responsible for this evolution.

Much more people than in the past submit contributions to WGN. It is for instance no longer an exception to see an article from a professional in this journal and also the number of high-level papers by serious amateurs has increased. On the other hand, we also receive more contributions from less experienced persons the conclusions of which are sometimes questionable. In this respect, an article in the previous issue received severe criticism (see this issue's letter section). The writers of this criticism also question the editorial policy in this matter. Since in the last few years so little has been said on this subject and so much has changed, I wish to open a broad discussion. All comments on my personal view below are most welcome!

When Paul edited WGN, many of the international contributions were actually observational reports sent to him from all over the world as a consequence of the extensive correspondence he established. In order to make these generally known, they were published. However, as WGN grew, more articles were explicitly submitted as such, and now the latter constitute the main bulk. During the same period, the nature of these contributions has gradually changed from pure data reports to articles that also elaborate on the interpretation of the data. This evolution was even encouraged, because the spectacular increase in observational reports left us no choice but to shift the raw data to separate publications, the first of which has now appeared as announced in the previous issue.

This evolution in part caused articles in which questionable interpretations are made by the authors, due to a lack of either observational experience or theoretical background . The editorial policy towards these articles, however, has not changed. In principle, we publish almost everything, unless of course obvious errors occur or if the matter is of no interest to the vast majority of the readership. If necessary, an editorial warning is added. However, in view of the changes the journal underwent the last few years, it is legitimate to ask whether such a liberal policy is still in conformity with the present status of the journal.

Of course, it must be our aim to continuously raise the standard of WGN. Anything less would be an insult to our readers. The International Meteor Organization is an important tool in realizing that goal. It allows to reach meteor workers all over the world, to standardize observational methods, to collect observations, to make global analyses and to give the observers the necessary feedback. In the short period that IMO exists, a tremendous amount of work has already been done. IMO's visual observing method got internationally accepted and is available as a handbook from a major astronomical publishing house. A database has been established for efficient storage of observations and fast analyses. The efforts of IMO received widespread recognition from the professional community.

All of this however should not be a cause for euphoria. Much work still has to be done. As far as visual work is concerned, we must not forget that although the IMO method is now generally accepted by most of the prominent meteor observers, it has still not yet found its way to several more isolated national and regional astronomical associations. Several of them use older methods for many years already and hesitate to switch over. Convincing individual observers of changing their method is often difficult. First of all, there is in many cases a language barrier (many observers do not understand English!). Secondly, the observers trust their local organization. Sometimes, it even gets worse when a national organization using an outdated method has to give advice to an international project. As a consequence of such a course of events, the η-Aquarid and Orionid observations collected by the International Halley

Watch are useless for further analysis. Worst of all, the respectability of the IHW confused many observers that switched over to the IMO method early and made them adopt the old method again. Needless to say, it takes us several years to undo the damage!

However, even if we still have to construct an entire building, as far as visual observations are concerned, we did complete the basement. For other fields of meteor observing, we merely collected a few stones. Although there are many amateurs with great expertise in photographic observing, it seems presently impossible to come to international coordination. And in radio astronomy, the situation is even much worse. This promising field for amateurs still largely remains terra incognita, because it requires at the same time extensive observing efforts, a good theoretical background in meteor astronomy and technical expertise. A lack of international publications in these fields—a gap the filling up of which should be one of IMO's top priorities—does not make life easier for the observers.

What I want to say is that although I have no objection in principle to abandon the quasi-automatic acceptance of articles and thus raise the standard of WGN we may not lose our sense of realism: the level of WGN should be in line with the level of IMO as a whole. As to now, there are only a few handfuls of observers that are both very experienced and well-educated in meteor physics. These observers alone can never produce enough data to allow significant statistical analyses. It must be IMO's primary goal to help increase the number of highly qualified observers. Therefore WGN must encourage observers. A too rigid editorial policy may scare away promising newcomers. Thinking back to my own situation, I and most meteor observers in Belgium of my generation had misconceptions in their first years of meteor observing and even carried out some of these in amateur publications. Due to their enthusiasm, which was beyond any doubt much stimulated by the possibility to communicate their ideas and findings to others, they eventually overcame these misconceptions!

So, this is not a plea for leaving everything as it is. We must work hard to raise the general level in IMO but we must realize at the same time that this is a growing processing in which we just passed the stage of birth! As the level of IMO is raised, the standard of WGN must be increased at the same pace. Meanwhile, WGN must remain the journal of the entire IMO; otherwise it is doomed to fail the very cause of its existence.

Letters to WGN

compiled by Marc Gyssens

Aurora-like displays

Although we announced in the previous issue that we intended to close the discussion following the short article in WGN 17:4, pp. 115–116, we will make one last exception for a reaction of Pekka Parviainen. Since his view, that was criticized in the last issue, was originally communicated by Christian Steyaert, we feel we have to give the possibility to reply personally.

As my photographs seem to have raised some confusion in the discussion of the mysterious trains, I will mention here a few facts about the photo (which is not the only one I have taken or seen myself). First of all the photo was made deep in the night against the background of our city some 4 kms away. The photo is originally a color slide and it clearly shows stars in my SW direction. So it is not an ordinary cloud effect. Instead, it handles about an ice-cloud drifting between me and some lights at the horizon, behind trees. This type of icecloud is practically transparent until it is lit (i.e. it reflects light) by strong lights. It has nothing to do with weather front systems and halos born in them. This cloud is born when dew in the atmosphere cools and crystalizes, and then slowly drifts in light, low winds near the ground. This sort of phenomenon is hard to understand until one has seen it. Also my first impression when seeing these is aurora, but to an experienced observer it soon becomes easy to recognize one from the other.

Let me summarize a few arguments against aurora explanations.

1. First of all, it seems to me that those taking part in the debate have never witnessed icecloud phenomena and note *I do not mean* ordinary Sun or Moon pillars. It is strange to hear arguing against something that one has never experienced.
2. In using aurora explanation one needs a form that is totally anomalous: a fraction of compact aurora ray that is not moving at all, although extending to near zenith which would mean an active display: no other aurorae are visible.
3. Using icecloudss we only need a normal phenomenon without desperate hypotheses.
4. Inspection of a picture made by xeroxing a black and white picture which is again made of a slide does not result in anything relevant. Rather it can be seen as a helpless attempt to use data intentionally for biased arguing.

However, to avoid an extra long letter I will only state that I have photographed auroras for 15 years, noctilucent clouds for 13 years, halos and other related phenomena for more than 15 years, all of this systematically in good and bad conditions. I have carried cameras with me for 10 years every day, at every place to catch everything visible on the day and night sky. This resulted in a collection of atmospherical phenomena slides exceeding 12 000 items and a lot of experience. And in the light of this and examining Kristensen's photo carefully I conclude it cannot be anything else than what I have explained. It can definitely not be aurora. I wish someone would take the trouble to ask Kristensen's opinion of all this. Those still unsure could take a look at Greenler's book "Rainbows, Halos and Glories", pp. 72–73 (with photograph), and also note in the text how people have mistakenly thought they have seen aurorae, where in reality they witnessed artificial light pillars.

Pekka Parviainen, April 1990

The zenith correction factor

In response to Ralf Koschack's criticism in the previous issue about Paul Roggemans's contribution on the 1989 Quadrantids in WGN 18:1, pp. 12–18, Rainer Arlt has some comments about the use of the zenith correction factor.

Currently, the correction factor for the zenith distance of a shower radiant is calculated from the altitude h of the radiant at the middle of observation:

$$C_z = 1/\sin h \tag{1}$$

Note that C_z is dependent on the sidereal time θ at the middle of observation. However (1) is not a correct approximation since the value of X_z does not change linearly with time. The real value equals the mathematical mean of function (1) over the entire observation, i.e. over an interval $[\theta_b, \theta_e]$. This corresponds to the mean slope of a function:

$$F(\theta) = \int f(\theta) d\theta \tag{2}$$

Now $\overline{f(\theta)}$ is the slope of a chord through $(\theta_b, F(\theta_b))$ and $(\theta_e, F(\theta_e))$:

$$\overline{f(\theta)} = \frac{F(\theta_e) - F(\theta_b)}{\theta_e - \theta_b}$$

Hence, with (2), we get:

$$\overline{C_z} = \overline{f(\theta)} = \frac{\int_{\theta_b}^{\theta_e} C_z d\theta}{\theta_e - \theta_b} \tag{3}$$

Reconsidering (1) with $\sin a = \sin\delta\sin\varphi + \cos\delta\cos\varphi\cos(\theta-\alpha)$, we can rewrite the integral in (3) as:

$$\int C_z d\theta = \int \frac{1}{a+b\cos x}dx \tag{4}$$

where $x = \theta - \alpha$, $a = \sin\delta\sin\varphi$ and $b = \cos\delta\cos\varphi$. There are two solution formulae:

$$\int C_z d\theta = \frac{2}{\sqrt{a^2-b^2}}\operatorname{arctg}\frac{(a-b)\operatorname{tg}\frac{x}{2}}{\sqrt{a^2-b^2}} \tag{5}$$

for $a^2 > b^2$, and:

$$\int C_z d\theta = \frac{1}{\sqrt{b^2-a^2}}\ln\left|\frac{(b-a)\operatorname{tg}\frac{x}{2}+\sqrt{b^2-a^2}}{(b-a)\operatorname{tg}\frac{x}{2}-\sqrt{b^2-a^2}}\right| \tag{6}$$

for $b^2 > a^2$. The systematic error of the conventional zenith correction raises up to approximately 13% in central Europe if the duration of the observation is shorter than three hours and the altitude of the radiant at the middle of the observation exceeds 20°, which is often a selection criterion for analyses. Should somebody have the idea to observe on the equator he would have a maximum error of 30% under the same hypotheses. Of course, this is not the only systematic error. The deviations in the case of the so-called zenith exponent $\gamma \neq -1$ are indicated in Ralf Koschack's letter on p. 33 of the previous issue. Now why should we produce errors if the exact solution is known? True, the expressions are not made for users of pocket-calculators, to be sure, but when using computers this does not mean too much work. Notwithstanding, this contribution is less a proposal than a note on what is to be considered when correcting the zenith distance.

Rainer Arlt, April 1990

Visual counts from radio echoes

Dr. M. Šimek of the Astronomical Institute of Ondřejov in Czechoslovakia has some comments on the article of Dr. T.R. Manley "Visual Counts from Radio Echoes of the Geminid Meteor Shower" in WGN 18:2, pp. 66–67. A reply from the author follows.

The problem of the meteor shower activity profile determination as presented in the paper is very simplified. Echo counts (the term "visual counts from radio echoes" is misleading) depend on the combination of:

- the zenith distance of the shower radiant,
- the antenna gain in the direction towards the reflection point of the meteor,
- the trail activity of the shower,
- the activity of the sporadic background, and
- the duration of the observing interval (resolution).

Insertion of missing values using the sinusoidal interpolation followed by rolling connection is artificial and, as a consequence, leads to loss of the fine structure of the shower. Both profiles in Figure 2 should be plotted versus solar longitude (the same equinox must be used). The difference is 0°.237 which represents about 5^h36^m. The maximum activity in both years will then occur quite closely. One of the methods of solving this problem was presented and applied in [1,2].

[1] M. Šimek, *Bull. Astron. Inst. Czechosl.* 36, 1985, pp. 270–278.
[2] M. Šimek, B.A. McIntosh, *Bull. Astron. Inst. Czechosl.* 37, 1986, pp. 146–155.

Dr. M. Šimek, Astr. Inst. Ondřejov, April 28, 1990

The following is the author's reply:

According to Milos Šimek, my graphic method appears to be very simplified. He also states that my method is artificial and leads to a loss of fine structure in a shower. In my experience as a practicing geophysist, I have found that sometimes, the opposite occurs. I developed a simple graphic method for the analysis of resistivity results that was far superior to the existing methods that supposedly took into account all the physical factors. This was because, at that time, the physical factors were too complicated to obtain reliable repeatable results. Sometimes a simple graphic precursor is necessary until most of the related factors are known and understood.

I now have almost two years of continuous meteor shower data from television Channel 4 as received in Sebring, Florida. My station runs 24 hours a day and is nearly completely computerized. My 1988 and 1989 results of the Perseid meteor shower clearly show the double peak of this shower. Also, Michael R. Owen's 1985 Perseid data from a television station in the vicinity of Canton, New York, clearly shows a double peak when my graphic method is applied to it. Up to now, I have been unable to see the double peak in existing radar meteor shower data of the Perseids. Possibly, Šimek's statement that my graphic method leads to loss of the fine structure of a shower is incorrect.

There are some important differences between radar data and radio reflections from a distant television or FM station. Radar reflections are poor at low altitude and mucher better at the higher elevations in the sky. Radio reflections from a distant TV or FM station react in nearly an opposite manner. When the shower radiant is low in the sky or even somewhat below the horizon, radio reflections from TV or FM stations are at their best. When the radiant is higher in the sky, the TV and FM reflections disappear completely. These reflections that have disappeared have to be replaced either by a graphic method such as I have presented or by mathematical formulae. However, in using mathematical formulae, one must thoroughly understand most of the factors that are mentioned in his criticism. At this point in time, we do not know all these factors well enough to use them. We need an international effort to determine and resolve them. Hard core visual data must be used to unravel and solve these problems.

Thomas R. Manley, May 3, 1990

Evidence for Cassiopeids?

We received a severe criticism on Peter Aneca's article "New Evidence for a Cassiopeid Meteor Shower?" in WGN 18:2, p. 68. As to the editorial policy towards such articles, please read my comments on pp. 71–72 of this issue.

When we first saw the article on the Cassiopeid shower, we thought it was an April joke, but it was not. As *VMDB*-responsible, Paul knows about several observations around the date mentioned, including November 4–5. Nobody noticed anything like Cassiopeids. The observations from the VVS were not communicated to *IMO* and somebody who participated in their Weekend told Paul that no meteor observations took part at all! The description that Peter Aneca gives is absolutely useless. Since meteor science works using statistics any reliable conclusion is possible only if it is based on a significant number of observations. Thirteen meteors observed by a single observer are not a new shower. Regular observers know that little groups of meteoroids having similar orbits meet the Earth from time to time causing a short-time shower. Most of these groups are observed only once; new showers have to be detected independently by more than one observer.

If somebody thinks that there is a new shower he should plot as many candidate shower members as possible in the vicinity of the radiant onto a map (most preferably a large-scale gnomonic map, such as in the *Atlas Brno*) and/or, at least, fill out a report form and send it to the *VMDB* or to the Visual Commission. If every observer is going to write an article based on vague impressions of this kind, *WGN* will degrade to the level of a pure hobby nonsense journal. Articles such as Aneca's cannot contribute anything to meteor science. For comparison, it should be mentioned that the article [1] in the same issue covering a similar subject is based on nearly 1000 man hours of observing and analyzing. Of course, we are amateurs and want to have fun in our work and in reading *WGN* too. Therefore impression reports are an important part of *WGN* in order to tell each other what people experienced in meteor observing and to encourage each other rather than to prove any conclusions.

It may be interesting to know that Paul received the original Cassiopeid report from Mackenzie some 10 years ago. It was a map from an ordinary star atlas with trails starting in the Cassiopeia/Cepheus region plotted as if a child had drawn some lines over the map in a few minutes. Mackenzie interpreted this to be a new shower outburst. The few minutes of effective observing time were extrapolated to a ZHR of 120! The BMS catalogue is a collection of this kind of phantom showers and Mackenzie can be considered as a pure pseudo-scientist who accidentally fell on meteors instead of UFOs.

Since this article was received in January, the Editorial Board is to be blamed for having published this nonsense. The classical excuse that the authors are responsible for the contents of their papers should not be used to accept everything including pure nonsense. If an amateur submits such a questionable article, the Editorial Board should at least check facts and not publish without any control everything they receive.

R. Koschack and P. Roggemans, May 4, 1990

New Earth-Grazing Asteroid

Chris Steyaert

Information is provided on the recently discovered Apollo-type asteroid 1990 HA.

The discovery by A. Mrkos, Klet Observatory, of a fast-moving asteroidal object appeared in IAU Circular 4998. Daniel W.E. Green communicated in the same circular the following orbital elements, based upon observations between April 17 and 23 of 1990 HA (Eq. 1950.0):

$T = 1990$ Feb 23.95 ET	$\omega = 307.^\circ14$
$e = 0.6287$	$\Omega = 185.^\circ02$
$q = 0.8000$ AU	$i = 3.^\circ64$

The asteroid's orbit approaches that of the Earth on Dec 5.7 ($\lambda_\odot = 252.^\circ8$) at a distance of 0.058 AU. As usual with low inclination orbits, associated meteors would have a low speed of 18.3 km/s, and a radiant with right ascension $\alpha = 54^\circ$ and declination $\delta = +19^\circ$.

There is a second, closer approach on April 3.8 ($\lambda_\odot = 13.^\circ2$), with a shortest distance of 0.0090 AU or 1.4 million km. The corresponding velocity is 18.4 km/s, and the theoretical radiant has $\alpha = 31^\circ$ and $\delta = +3^\circ$. This is too close in the direction of the Sun to allow any observability apart from by radio.

Free places at Lardiers in 1990:

There are still free places at Lardiers for meteor workers who like to observe in Southern France. Two periods are still available:

- *from July 14 to 28:* 2 places, price: 80 FRF per day.
  write to: Mark Vints, Acacialaan 35, B-3940 Beringen, Belgium.
- *from August 10 to 24:* 2 place, price: 100 FRF per day.
  write to: Evelyne Blomme, 5 avenue Pablo Picasso, appt. 217(1), F-94120 Fontenay sous Bois, France or phone her at +31-1-48733448.

Observers' Notes: July–August 1990

Jeff Wood

1. Introduction

The period July–August is the most consistently rich period for meteor rates of the whole year. On a dark night an observer can expect to see over 20 meteors per hour for much of this time. During the last few days of July and around August 12 with the maxima of the major showers the South δ-Aquarids and the Perseids respectively, the total number of meteors exceeds 50 per hour and rates much higher than this are not uncommon at these times. With all this activity then, meteor workers are encouraged to get out and observe the many showers that occur. Table 1 below lists the more important showers that occur during July and August.

Table 1 – A list of some of the meteor showers to be seen in July–August 1990.

Shower	Activity	Max	Radiant			Drift		V_∞	r	ZHR
			α	δ	Diam.	$\Delta\alpha$	$\Delta\delta$			
Pegasids (Jul)	Jul 07–Jul 11	Jul 09	340°	+15°	5°	+0°.8	+0°.2	70	3.0	8
Phoenicids (Jul)	Jun 24–Jul 18	Jul 11	21°	−43°	7°	+1°.0	+0°.2	47	3.0	
Piscis Austrinids	Jul 09–Aug 17	Jul 28	341°	−30°	5°	+1°.0	+0°.2	35	3.2	
α-Capricornids	Jul 03–Aug 25	Jul 30	Table 4		8°			23	2.5	8
δ-Aquarids S	Jul 08–Aug 19	Jul 29	Table 4		5°			41	3.2	20
δ-Aquarids N	Jul 15–Aug 25	Aug 12	Table 4		5°			42	3.4	5
ι-Aquarids S	Jul 15–Aug 25	Aug 05	Table 4		5°			34	2.9	3
ι-Aquarids N	Aug 11–Sep 20	Aug 20	Table 4		5°			31	3.2	3
Perseids	Jul 17–Aug 24	Aug 12	Table 3		5°			59	2.6	100
κ-Cygnids	Aug 03–Aug 31	Aug 18	286°	+59°	6°			25	3.0	5
π-Eridanids	Aug 20–Sep 05	Aug 28	52°	−15°	6°	+0°.8	+0°.2	59	2.8	
α-Aurigids	Aug 24–Sep 05	Sep 01	84°	+42°	5°	+1°.1	0°.0	66	2.5	15
Piscids S	Aug 15–Oct 14	Sep 24	8°	0°0	8°	+0°.9	+0°.2	26	3.0	3

Table 2 – Moonlight and observing conditions in July–August 1990.

Date	k	Date	k
Friday June 29	0.41+	Friday August 3	0.87+
Friday July 6	0.96+	Friday August 10	0.87−
Friday July 13	0.76−	Friday August 17	0.15−
Friday July 20	0.06−	Friday August 24	0.16+
Friday July 27	0.26+	Friday August 31	0.75+

New Moon:	June 22, July 22, August 20
First Quarter:	June 29, July 29, August 28
Full Moon:	July 8, August 6, September 5
Last Quarter:	July 15, August 13, September 11

The illuminated part of the Moon is always given for 0^h UT on the date indicated. The dates of the phases of the Moon are also given in UT.

The Visual Commission of the *IMO* although requiring data on all showers realizes that practical considerations such as work, study, family, moon and weather prevent people from observing regularly on a day by day basis throughout most of the year. With this in mind, it has been decided to encourage everyone who has time to observe to concentrate on a few showers per month rather than the whole lot. This means we should be able to get a good set of data for these few rather than sparse data on many showers. The showers chosen for special investigation are the Piscis Austrinids, π-Eridanids, Aquarids/Capricornids, κ-Cygnids and the α-Aurigids.

2. The Perseids

This shower is active from July 17 to August 24 and reaches a maximum ZHR of about 100 on August 12. Due to the Full Moon on August 6 observing conditions are most unfavorable. Useful observations are possible from July 17–August 3 and August 15–24 only. The time of maximum and the maximum activity can be *estimated* by means of observations around the maximum. Since the Perseids have been well studied previously, *IMO* would encourage meteor workers to spend their observing time concentrating on the other July–August showers that are not moon-affected in 1990. However, for those who wish to study the Perseids, the relevant positions are listed in Table 3 below. As they have a high declination, the Perseids are best seen in the Northern Hemisphere.

Table 3 – Radiant positions of the Perseids.

Date	α	δ	Date	α	δ	Date	α	δ
Jul 17	15°	+44°	Jul 30	30°	+52°	Aug 15	50°	+59°
Jul 20	18°	+46°	Aug 04	36°	+55°	Aug 20	57°	+60°
Jul 25	24°	+49°	Aug 10	43°	+57°	Aug 24	62°	+61°

3. Aquarids/Capricornids

This rather complex group of showers were subject to intense scrutiny during 1989. Despite poor weather interfering with Southern Hemisphere skies, observers there and in particular in Europe and America contributed about 1200 meteors plotted. A lot was learned about the radiant structure, but much more still needs to be investigated. Therefore, with favorable moon conditions in 1990, *IMO* wants these showers to be monitored again.

The 1990 investigation should be carried out in two sections separated by the Full Moon on August 6. The first of these is from July 17 to August 3. This takes in the maximum of the South δ-Aquarids (July 29) and the α-Capricornids (July 30). At this time rates from the complex are at their highest. The second period is from August 15 to 25 and includes the maximum of the North ι-Aquarids (August 20). Overall activity from the complex is decreasing at this time and your observations this year should be able to determine the date at which each shower ceases.

Table 4 – Radiant positions for the α-Capricornids, the δ-Aquarids South and North, and the ι-Aquarids South and North.

Date	α-Cap		δ-Aqr S		δ-Aqr N		ι-Aqr S		ι-Aqr N	
	α	δ	α	δ	α	δ	α	δ	α	δ
Jul 05	290°	−14°	321°	−21°						
15	296°	−13°	329°	−19°	311°	−11°	310°	−19°		
25	303°	−11°	337°	−17°	321°	−09°	321°	−17°		
Aug 05	312°	−09°	345°	−15°	332°	−06°	335°	−15°		
15	318°	−06°	353°	−13°	342°	−04°	346°	−13°	322°	−06°
25	324°	−04°			352°	−02°	356°	−11°	332°	−06°
Sep 05									343°	−04°
15									353°	−02°

The visual observing program requires a good observational experience and an observing site south of 45° N. Looking at Table 4, it is obvious, that the observer has to look at a point between the radiants of the δ-Aquarids N and the ι-Aquarids S in order to distinguish meteors of these southern showers. This will be quite impossible for observers situated north of 45° N. Observations of this program should start only if the radiants have a sufficient altitude. If possible, two observers should look into the same field simultaneously. This could allow estimates of the accuracy of the data.

Only meteors possibly radiating from the Aquarius/Capricornus-region should be plotted. It is necessary to consider the direction, trail length and angular velocity. All other meteors are counted only.[1] Any Aquarids or Capricornids appearing outside the map's field are also counted after careful association to the radiants given in Table 4.

In doing so, we are able to calculate ZHRs based on the tabulated radiant positions, and to analyze the radiant position using the plotted meteor trails only. We want to draw the attention to the relationship between the angular velocity of shower meteors, the altitude of their beginning point h_b and the distance between their end point and their radiant D. This criterion is as important as the alignment and the trail length and has to be used carefully in the case of countings.

Table 5 – Angular velocity (°/s) for the Aquarids as a function of the altitude of the meteor's beginning point h_b and the distance D between the end point and the radiant.

	ι-Aquarids (N+S), $V_\infty = 33$ km/s					δ-Aquarids (N+S), $V_\infty = 42$ km/s				
	$h_b = 10°$	20°	40°	60°	90°	10°	20°	40°	60°	90°
$D = 5°$	0.3	0.6	1.1	1.4	1.7	0.4	0.7	1.4	1.8	2.1
10°	0.6	1.1	2.1	2.9	3.3	0.7	1.4	2.7	3.6	4.2
20°	1.1	2.2	4.2	5.6	6.5	1.4	2.8	5.3	7.2	8.3
40°	2.1	4.2	7.9	11	12	2.7	5.3	10	14	16
60°	2.9	5.6	11	14	17	3.6	7.2	14	18	21
90°	3.3	6.5	12	17	19	4.2	8.3	16	21	24

Table 6 – Id. for the Capricornids ($V_\infty = 25$ km/s).

	$h_b = 10°$	20°	40°	60°	90°
$D = 5°$	0.2	0.4	0.8	1.1	1.3
10°	0.4	0.9	1.6	2.2	2.5
20°	0.9	1.7	3.2	4.3	4.9
40°	1.6	3.2	5.9	8.0	9.3
60°	2.2	4.3	8.0	11	13
90°	2.5	4.9	9.3	13	14

The maps used for regular meteor plottings (scale factor $R = 75$ mm) are unfavorable for exact plottings of short trails in the vicinity of the radiants. The map of the *Atlas Brno* ($R = 160$ mm) is suitable for our purposes. We ask you to use only this map. (*Information about ordering the Atlas Brno can be found in the previous issue, p. 31, ed.*) Your reports must include for each date:

1. copies of your maps with the meteors plotted on them (X and Y coordinates should be measured with respect to the frame of the map), and
2. a report using the *IMO* Visual Observing Forms *(cfr. the previous issue, pp. 36–38, ed.)*.

The shower association should be done at the desk using all criteria, including path length, position w.r.t. the radiant and angular velocity.

[1] Observers in the Southern Hemisphere should also plot any Piscis Austrinids seen. For further details please refer to the section on the Piscis Austrinids.

4. Piscis Austrinids

This Southern Hemisphere shower is active from July 9 to August 17 and reaches a maximum ZHR of 5 to 10 meteors per hour on July 28. With favorable moon conditions in 1990, southern observers are encouraged to observe this shower as part of the Aquarid/Capricornids project. Observers should plot all Piscis Austrinids occurring on the part of the sky covered by the map and count those appearing outside the map's field after careful consideration of path length and angular velocities.

Table 7 – Radiant positions of the Piscis Austrinids.

Date	α	δ	Date	α	δ	Date	α	δ
Jul 13	326°	−33°	Jul 28	341°	−30°	Aug 12	356°	−27°
Jul 18	331°	−32°	Aug 02	346°	−29°	Aug 17	1°	−26°
Jul 23	336°	−31°	Aug 07	351°	−28°			

Table 8 – Angular velocity (°/s) for the Piscis Austrinids (V_∞ = 35 km/s) as a function of the meteor's beginning point h_b and the distance D between the end point and the radiant.

	$h_b = 10°$	20°	40°	60°	90°
$D = 5°$	0.3	0.6	1.1	1.4	1.7
10°	0.6	1.1	2.1	2.9	3.3
20°	1.1	2.2	4.2	5.6	6.5
40°	2.1	4.2	7.9	11	12
60°	2.9	5.6	11	14	17
90°	3.3	6.5	12	17	19

5. The π-Eridanids

The π-Eridanids radiate out from the "Loop of Eridanus" during the latter part of August and early September. They reach maximum on August 28. Observations to date indicate that activity varies from year to year. At best they produce ZHRs of around 10 and at worst they are almost non-existent. π-Eridanids are fast meteors and they frequently produce trains. Observers should watch for these meteors in the pre-dawn hours when the radiant is high in the sky and the First Quarter Moon has set. They are best seen in the Southern Hemisphere.

Table 9 – Radiant positions of the π-Eridanids.

Date	α	δ
Aug 20	46°	−17°
Aug 28	52°	−15°
Sep 05	60°	−13°

All π-Eridanids should be plotted.

6. The κ-Cygnids

This shower is active from August 5 through to August 31 and reaches a maximum ZHR of 5 on August 18. The radiant position of $\alpha = 286°$ and $\delta = +59°$ is virtually constant throughout the activity period due to its proximity to the North Ecliptic Pole. Its diameter is 8°. For the period August 15 to 25 observers north of latitude 45° N should concentrate on the κ-Cygnids. The κ-Cygnids are noted for their slow moving often bright meteors. All possible shower members should be plotted. Observers should ensure that the center of their observing field is located at a distance less than 40° from the radiant.

7. The α-Aurigids

The α-Aurigids are active from August 24 to September 5. They reach maximum on September 1. The α-Aurigids produce variable activity from year to year and urgently require attention from meteor workers in the Northern Hemisphere where they are best seen. The α-Aurigids are fast moving meteors comparable to the Perseids in speed. Intending observers should take into account that the radiant reaches it greatest elevation during the latter part of the night. Around the maximum, the Moon allows observations in the second half of the night until September 2. Unless the α-Aurigid maximum exceeds a ZHR of 10, all possible shower meteors should be plotted. Observing fields should be centered no further than 40° from the radiant.

Table 10 – Radiant positions of the α-Aurigids.

Date	α	δ	Date	α	δ
Aug 24	75°	+42°	Sep 01	84°	+42°
Aug 28	80°	+42°	Sep 05	88°	+42°

The α-Aurigid Meteor Shower

Jürgen Rendtel

Visual observations of the α-Aurigids associated with the comet Kiess 1911 II are analyzed. This shower appears annually and reaches its peak ZHR of about 10 at solar longitude $\lambda_\odot = 157°.8 \pm 0°.4$ (August 31-September 1). ZHR and number density data are presented indicating the α-Aurigids not to be a dense particle cloud. Further observations are needed, especially photographic data allowing the calculation of meteoroid orbits.

1. Introduction

During July and August all observers in the Northern hemisphere are active. The attractive Perseid shower focuses their interest. Having passed its maximum the interest lasts another few days and after that all observers sit indoors at the desk happy with their bulk of Perseid data, while the next noticeable shower appears: the α-Aurigids. Here we present a series of data mainly from the *Arbeitskreis Meteore (AKM)*, demonstrating that this shower is worthwhile observing and that further data are needed.

2. History

Teichgraeber and Hoffmeister in Sonneberg, Germany [1] as well as Vrátnik, Vlček, and Štěpánek in Prague, Czechoslovakia [2] observed an enhanced meteor activity in the morning hours of the night of August 31–September 1, 1935. They reported a significant radiant near ν and τ Aurigae. The positions were given as follows:

$$\alpha = 85° \quad \delta = +40°.5 \quad \text{(Eq. 1925.0)} \quad [1]$$
$$\alpha = 87° \quad \delta = +40°.5 \quad \text{(Eq. 1925.0)} \quad [2]$$

Neither Denning's catalogue of radiants nor observations in Sonneberg in previous years gave any hint on an earlier appearance of meteors from this radiant or this region. The rates, corrected for the zenith position of the radiant but not to any limiting magnitude, were as high as 26 for Sonneberg, and 29 for the Prague team, respectively.

A first calculation of the orbit by Guth [2] shows a good coincidence between the parabolic elements of the meteor shower and the comet Kiess 1911 II.

There are no further regular observations of this shower to be found (I checked several libraries as well as the Bibliographic Catalogue of Paul Roggemans). Only in 1986, Tepliczky [3] reported an enhanced activity lasting for 1.4 hours in the night of August 31–September 1 ($\lambda_\odot = 157\overset{\circ}{.}82$, Eq. 1950.0). Furthermore, a rather questionable coincidence exists with one of Denning's radiants [4] in Auriga (1881 August 27, 5 meteors from $\alpha = 75°$, $\delta = +33°$).

3. Aurigids and the comet Kiess

The comet Kiess 1911 II is a long-periodic comet according to Marsden [5]. Its orbital elements are:

$T = 1911.49$	$\omega = 110\overset{\circ}{.}4$
$e = 0.996$	$\Omega = 158\overset{\circ}{.}0$
$q = 0.684$ AU	$i = 148\overset{\circ}{.}4$
$a = 1/(0.0054161\ \mathrm{AU}^{-1})$	

This corresponds to an orbital period of 2500 years. At least the recent observations indicate a permanent appearance of the α-Aurigids. The theoretical radiant for September 1 should be $\alpha = 91°$, $\delta = +39°$ [6]. According to Marsden et al. [7] who calculated the osculating orbital elements, comet Kiess has made many trips through the inner Solar System.

4. Contemporary observations

As already mentioned there is a lack of meteor observations at the end of August until mid-September. In the *AKM* we obtained a good quantity of data during the past 10 years. All plottings were revised, at least a sample of them, in order to prove that they meet the criteria set by the Visual Commission of *IMO* recently [8].

The radiant seems to be situated very favorably for observers in middle northern latitudes. However, many observers start too early in the evening; only observations from the second half of the night are certain enough. Nevertheless, there were found 230 intervals with a total correction factor C for the ZHR less than 3. Furthermore, only observations with a radiant elevation of more than 25° at the middle of the interval were selected.

The main contribution came from the *AKM* data, but I also obtained ZHRs from other observers using the *VMDB*.

The following observers contributed with data to the final analysis:

> ARLRA (R. Arlt), BADPI (P. Bader), BALPE (P. Rendtel), BELLU (L. Bellot), BROPE (P. Brown), KNOAN (A. Knöfel), KOSRA (R. Koschack), KUSRA (R. Kuschnik), MULKN (K. Müller), PLEFR (F. Plesier), PLEGH (G. Plesier), RENAN (A. Rendtel), RENIN (I. Rendtel), RENJU (J. Rendtel), SCHDA (D. Schroyens), SCHPA (P. Scharff), WUNNI (N. Wünsche).

Figure 1 presents all ZHRs with a total correction factor $C \leq 3$ and $h_R \geq 25°$ at the middle of the observing interval. For Figure 2 all rates lying close together in solar longitude were averaged (weighted with $1/C$ each). Since the data are distributed very inhomogeneously, I did not use a sliding mean. The error bars were calculated according to the proposal of de Lignie [9]. It does not make sense to try to derive any fine structure from these data, since samples are too uncertain. In particular, there are a few intervals for which we have no data at present.

According to the observations, the maximum occurs at $\lambda_\odot = 157\overset{\circ}{.}8 \pm 0\overset{\circ}{.}4$ showing a ZHR of about 10. The ZHRs obtained before August 27 seem to be unreliable because most observers do not observe the α-Aurigid radiant directly (rather east or southeast direction) and thus accidentally aligned Perseids and sporadics may pollute the α-Aurigid sample from this period (even if $h_R > 25°$) significantly [10]. I would not use α-Aurigid data from this period for calculations of either a ZHR or the population index r.

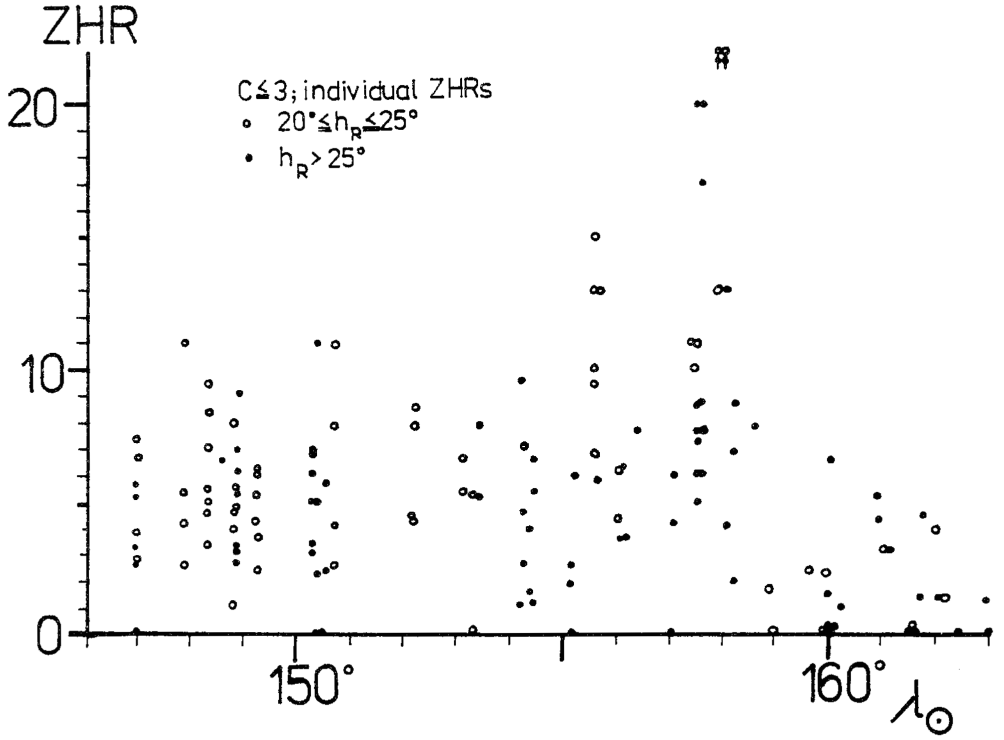

Figure 1 – Presentation of all ZHRs available for the α-Aurigids. Dots represent ZHRs used for the present analysis ($C \leq 3$, $h_R > 25°$, $T \leq 3^h$); Circles show ZHRs of lower importance (mostly obtained under bad sky conditions or with low radiant elevation).

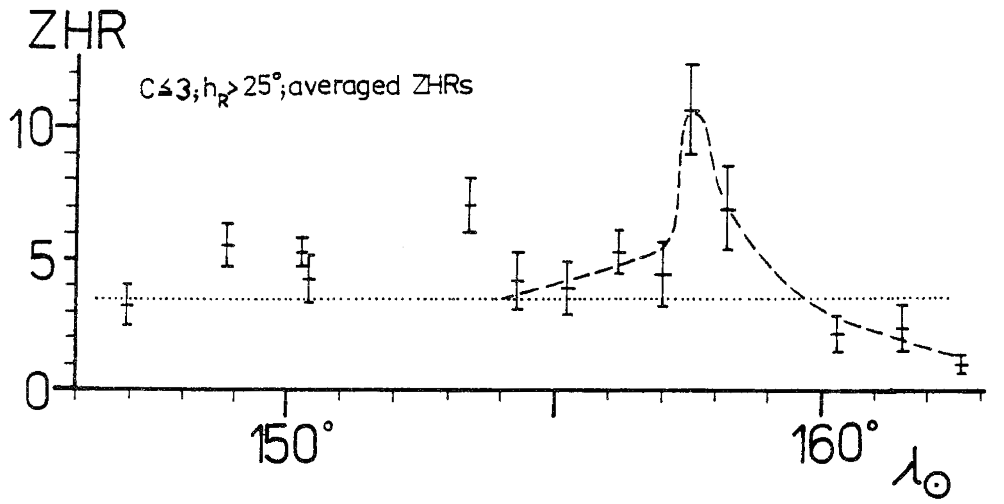

Figure 2 – Activity curve derived from the selected observations. The values before August 27 are very probably "polluted" by accidentally aligned Perseids or sporadic meteors. α-Aurigids and Perseids, for example, can only be distinguished if the observers looked directly to these radiants (see [8])!

5. Discussion

The already mentioned outburst in 1986 yields a ZHR of 40. The years 1911 (discovery of the comet), 1935 (first shower observation), and 1986 (outburst) can be fitted with a period of about 25 years as mentioned by Jenniskens [11], but I would not speculate about such a periodicity for the α-Aurigids, since they were not observed regularly through the decades. Therefore we have no consecutive data of the activity. Beyond any doubt the α-Aurigids appear annually now. This indicates an orbit with much smaller semi-major axis than that of comet Kiess 1911 II. The conclusion of Marsden et al. [7] supports the assumption of a nearly closed particle stream. The theoretical radiant of the meteoroids at the orbit of comet Kiess given by Drummond [6]

($\alpha = 91°$, $\delta = +39°$, with $V_\infty = 66$ km/s) is not far from the data derived from the observations ($\alpha = 85°$, $\delta = +41°$).

Because of the high geocentric velocity there are only very few α-Aurigid meteors photographed. A search in orbital data catalogues has been decided. Systematic efforts are needed. Visual as well as photographic observers should not finish after the vanishing of the Perseids!

Nevertheless, the meteoroid cloud of the α-Aurigids is not a dense one. Taking into account $r = 2.5$, $V_\infty = 66$ km/s, and a ZHR of 10, we obtain a spatial number density of particles with masses $m \geq 10^{-3}$ g of $\varrho_M = 0.774 \times 10^{-9}$ km^{-3} and even a ZHR of 40 corresponds only with $\varrho_M = 3.097 \times 10^{-9}$ km^{-3}. (0.774 and 3.097 are the numbers of meteoroids with mass $m \geq 10^{-3}$ g within a cube of 1000 km edge length). For comparison, the peak values for some showers are given in Table 1.

Table 1 – Number densities of meteoroids with masses $m \geq 10^{-3}$ g for several meteor showers.

Shower	r	ZHR_{max}	V_∞ (km/s)	ϱ_M (km^{-3})
Orionids	2.9	25	66	1.855×10^{-9}
Perseids	2.4	100	59	12.10×10^{-9}
Geminids	2.6	100	34	220.9×10^{-9}
α-Aurigids	2.5	10	66	0.774×10^{-9}
α-Aurigids	2.5	40	66	3.097×10^{-9}

The α-Aurigids are thus thinner than the Orionids which the Earth passes about 0.15 A.U. from the core of the Halley's meteoroid cloud. According to Drummond's calculations [6] the minimal distance between the orbit of comet Kiess and the Earth amounts to 0.10 A.U. Since we do not know details about the structure of the meteoroid cloud of the α-Aurigids, further comparison with other showers or their behavior are of no value.

6. Conclusions

The α-Aurigids seem to form a permanent minor shower. Its regular peak ZHR reaches about 10. Single observations (1935, 1986) showing higher rates (about 30 to 40) were reported. A reliable periodicity cannot be derived yet. In order to determine a certain profile and the actual orbits of shower meteors, further data are urgently needed.

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Determining a Meteor Stream's Density from Visual Observations in the USSR

A. Grishchenyuk and V. Mozhzherin

Methods are indicated to determine particle influx and spatial densities of meteor streams from both group and individual visual observations.

1. Introduction

The main purpose of any professional meteor observation in the USSR is the determination of meteor stream characteristics expressed as a function of mass. The most important such characteristic is the cumulative particle influx density $\mathcal{I}$, defined as the number of meteoroids having a mass greater than M (gram) perpendicularly crossing the normal area S per unit of time. As visual observations determine characteristics as functions of visible brightness, we have to switch to absolute brightness, that is corrected for atmospheric absorption and distance to the observer. Such corrections have been calculated by I.S. Astapovich [1]. Table 1 gives an example of the result of such calculations.

Table 1 – Reduction of visual to absolute magnitudes.

Zenith distance	< 30°	40°	50°	60°	70°	80°	90°
Correction for distance	0.2	0.4	0.8	1.2	1.8	2.7	4.0
Correction for absorption	0.2	0.4	0.9	1.4	2.2	3.6	10

The differential law of meteor mass distribution (B.Yu. Levin [2]) is:

$$f(M) = \frac{dN(M)}{dM} \tag{1}$$

This expression derived from observations and following reduction to the absolute magnitudes can be written in the integral form:

$$\log \mathcal{I}(M) = \log \mathcal{I}(1) - (s-1)\log(M) \tag{2}$$

or,

$$\mathcal{I}(M) = \mathcal{I}(1) M^{1-s} \tag{3}$$

where $\mathcal{I}(M)$ is the influx density of meteors with mass greater than M, $\mathcal{I}(1)$ is the influx density of meteors that have mass ≥ 1 gram, and s is the mass exponent. The last is connected with the index of luminosity function κ and $\mathcal{I}(M)$:

$$s = 1 + 2.5\log(\kappa) \tag{4}$$

$$\log(\kappa) = \frac{\log \mathcal{I}(M_1) - \log \mathcal{I}(M_2)}{M_1 - M_2} \tag{5}$$

When $s < 2$, the main contribution in shower activity is due to bodies of larger mass; when $s > 2$, the bodies with smaller mass are predominant.

If the value of $\mathcal{I}(M)$ is known one can evaluate spatial density and distances between particles:

$$\mathcal{D}(M) = \mathcal{I}(M)/v \tag{6}$$

$$R(M) = 1/\sqrt[3]{\mathcal{D}(M)} \tag{7}$$

Here v is the velocity of a particle. P. Babadzhanov [3] gives a mass for magnitude 0 meteors for Perseids with the radiant in the zenith. He found that $M = 0.01$ g corresponds to brightness 0, and that particles of mass $M = 1$ g produce meteors of brightness $m_v = -4.5$. Taking into account the mean zenithal distance of the radiant, the average mass of meteors of magnitude $m_v = 0$ will be 0.017 g. If we know a connection between the mass and the star magnitude of the meteor we can find $\mathcal{I}(1)$ from observations:

$$\mathcal{I}(1) = \mathcal{I}(M(0))/M(0)^{1-s} \tag{8}$$

where $M(0)$ is a value for the mass of a particle producing meteors of magnitude 0.

P. Babadzhanov found from radio and photographic observations in Dushanbe for the Perseids [4]:

$$\log \mathcal{I}(M) = -14.2 - 0.67 \log M$$

2. Group observations

During the processing of observations of 1980, V.V. Martynenko proposed some simplified method of calculation for the group observations. This method is based on the assumption that a group of observers notices 99% of the meteors of $m_v = +2$ and about 98% of the meteors of $m_v = +3$. This method can be considered to be more reliable than the method using perception coefficients as it makes defects of the observations clearer.

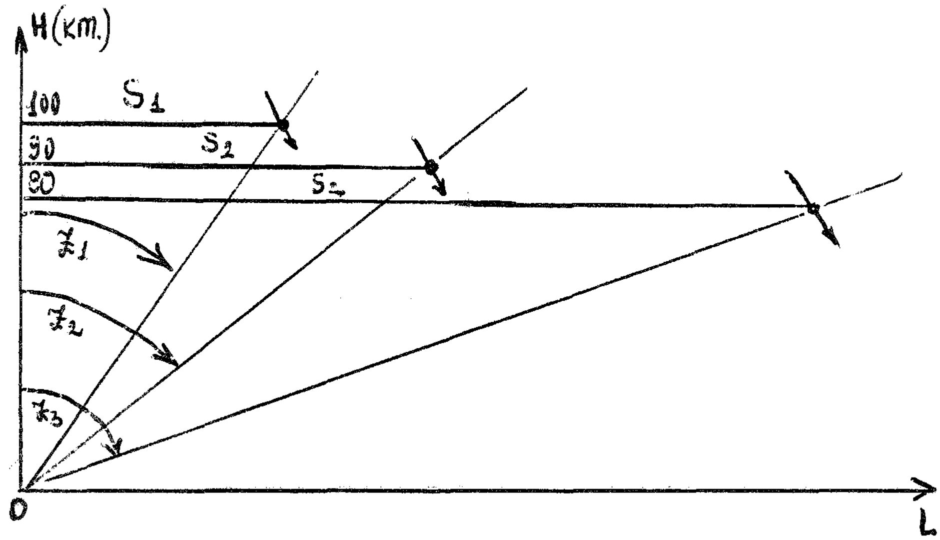

Figure 1 – Three circular zones used for processing.

The group of 8 persons observes the whole sky without any limits to the field of view. In the processing, three circular zones are picked out (Figure 1):

1. m_v from -2 to $+3$; $Z = 35° \pm 5°$,
2. m_v from -3 to $+1$; $Z = 50° \pm 5°$,
3. m_v from -7 to -3; $Z = 70° \pm 5°$.

The meteors of a different brightness are counted for each of these zones. The correctness of the subsequent calculations was checked by comparing the relationships obtained for different zones separately. The calculation leads to values $\mathcal{I}(M)$ by taking cumulative values of $N(M)/ST$. With the values of $\mathcal{I}(M)$ thus obtained one can calculate κ and s. Results of such calculations are given in a table and/or in a graph that shows most clearly the value of $\mathcal{I}(M)$ as a function of M (Figure 2).

As an example we give below the result of the calculation for August 1989. A group of six experienced observers worked in the village L'govskoye (in the Crimean region) under nearly perfect conditions (limiting magnitude of 6.2–6.5). The calculations were carried out for the zone of $Z \leq 35°$. The net observing time amounted to 3 hours (from 22^h00^m to 1^h00^m UT) on the night of August 12–13, 1989. As we had $Z \leq 35°$, the corrections for the absorption and the distance were not used. After reducing the magnitude distribution to classes of an entire magnitude, we can calculate the necessary differential and cumulative distributions (Table 2).

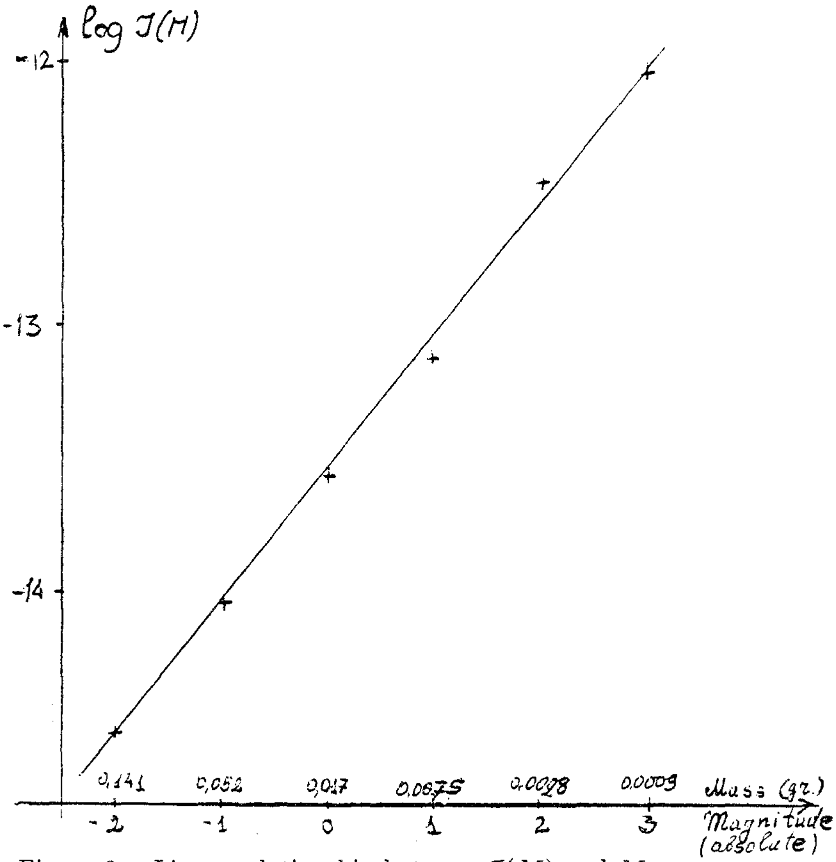

Figure 2 – Linear relationship between $\mathcal{I}(M)$ and M.

Table 2 – Computing the cumulative density influx from visual observations.

Magnitude	−2	−1	0	+1	+2	+3
$N(M)$		1	3	8	47	87
$(N(M)/ST) \times 10^{-15}$ (dif.)		6	18	48	280	517
$\mathcal{I}(M) \times 10^{-15}$ (cum.)	3	9	27	75	357	847
$\log \mathcal{I}(M)$ (cum.)	−14.52	−14.04	−13.57	−13.12	−12.45	−12.06

The cumulative value of 3 for $m_v = -2$ follows from the "a priori" assumptions, i.e. it is a assumed that at least the half of the meteors of $m_v = -1$ should be seen. This argument however is extremely uncertain and therefore it was not used in further calculations. We will now determine κ and s from (4) and (5):

$$\log \kappa = \frac{-14.04 - (-12.06)}{-1 - (+3)} = \frac{-1.98}{-4} = 0.495$$

whence $\kappa = 3.13$ and $s = 1 + \log \kappa = 2.23$. In Table 2, we see that $\mathcal{I}(M(0)) = 2.7 \times 10^{-14}$. Using $M(0) = 0.017$ g, we find using (8):

$$\mathcal{I}(1) = \mathcal{I}(M(0))/M(0)^{1-s} = 2.7 \times 10^{-14}/150.2 = 1.79 \times 10^{-16}$$

whence $\log \mathcal{I}(1) = -15.74$. Finally, equation (2) yields:

$$\log \mathcal{I}(M) = -15.74 - 2.23 \log M$$

3. Individual observations

These observations demand the use of processing methods taking into account perception coefficients. I.S. Astapovich [1] gives data of Öpik. He found that one observer sees 46% of the meteors of $m_v = +4$, 88% of the meteors of $m_v = +3$, and 98% of the meteors of $m_v = +2$, if he/she observes in a restricted area of the sky. In the USSR studies of perception coefficients were made many times. From the studies in Simferopol during the period 1957–1958 the values of coefficients were obtained for an individual observer and these values are closer to the values used in *IMO*. We found 0.98 for $m_v = 0$, 0.80 for $m_v = +1$, 0.62 for $m_v = +2$, 0.43 for $m_v = +3$ and 0.25 for $m_v = +4$ [6]. These are the lowest values of perception coefficients obtained in the USSR. Taking into account the values of these coefficients the results of observations are processed as described above. It is necessary to pay attention to the restriction of the field of view for each individual observer; correction rules are very important.

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Fireballs and Meteorites

Crimean Fireball in 1986

V. V. Martynenko, V. Mozhzherin

An account is given of a fireball seen in the Crimea (USSR) on March 12, 1986, at 17^h53^m UT.

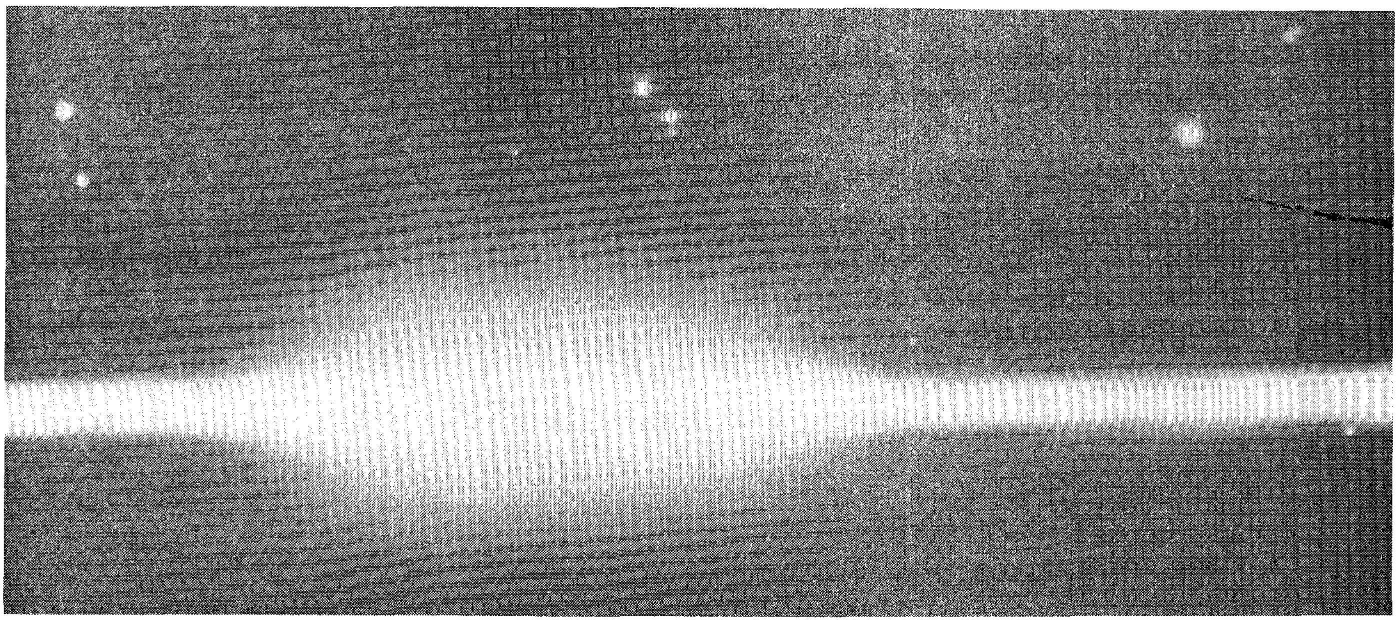

Figure 1 – Fragment of the fireball accidentally photographed in a 100 mm refractor while observing M 42.

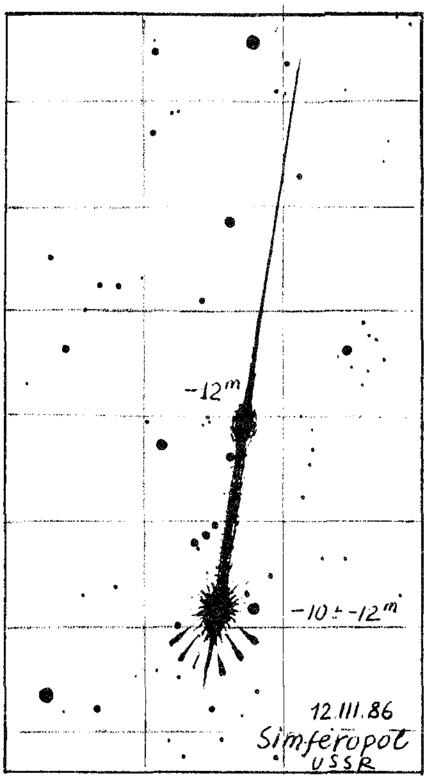

Figure 1 — Visual observation of the fireball.

On March 12, 1986, a fireball was seen at $17^h53^m \pm 0^h03^m$ UT from many places in the Crimea (USSR). A flare was very strong. *It was as if all search lights in the stadium were switched on,* said V. Abramenko from the Crimean Astrophysical Observatory, in the settlement Nauchny. Many witnesses of this phenomenon in Simferopol compared its brightness to that of the Full Moon, and obtained values ranging from -10 to -12 (D. Kalaida, I. Kruzman, M. Groznov, Yu. Matyushkin et al.). D. Poklad noted that at the moment of the flare, only stars of magnitudes 1 and 2 were seen.

The fireball trail from Simferopol started about 2° from α Aurigae and ended just South of Orion. The total length was about 30°. It looked like Bengal fire with sparks. During the disintegration, three or four fragments, comparable in brightness to Sirius, as well as several slightly fainter fragments were seen. A few people thought the fireball was a rocket with two explosions. After an explosion near κ Orionis, two bright red fragments continued their path for about 4°.

A tail and a train were observed. The train was bluish and resembled an inversional train from an aircraft. The train drifted and lasted for about 3 minutes. The color of the fireball itself changed from green-blue before the explosion to red afterwards. It lasted for about 1.5 s.

At that time, Igor Salnikov began an exposure of M 42 in Orion through a 100 mm refractor of the Crimean Youth Astronomical Observatory. The shot contained a part of the fireball at the time of the second explosion.

Meteorite Impact in the Netherlands

Hans Betlem

An account is given of a meteorite impact in the Netherlands that occurred on April 7, 1990, at 18^h32^m UT.

A stone meteorite of about 500 grams came down on the roof of a house at position 6°57′04″ E and 52°13′05″ N in the city of Glanerburg in the Netherlands on April 7, 1990, at 18^h32^m UT.

The meteorite fragmented in several hundreds of fragments, the largest being a few centimeters in size. *(See also the photograph on the front cover, ed.)* The biggest fragment has a weight of 34 grams. The meteorite perforated the roof and nearly all the material could be recovered at the garret of the house, within a few days after the fall. Investigations are being carried out at the Netherlands National Museum for Natural History in Leiden (by Dr. C.E.S. Arps) and at the State University of Utrecht (by Dr. L. Lindner). The first petrographic investigations revealed that the meteorite is a chondrite.

Several hundreds of people in the Netherlands and Germany reported the fireball. As it came down only ten minutes after sunset, no all-sky photographs of the Dutch network are available. The fireball was brighter than the Full Moon (which was just a few degrees above the horizon) and was visible for only a few seconds. It was white in color and changed to red and yellow in the end. Only a few people reported fragmentation. No flares were observed along the trajectory and no relevant sounds were reported. Preliminary computations carried out by the *Dutch Meteor Society (DMS)* indicate a flight direction from northeast to southwest.

On Easter Sunday, April 15, members of the DMS organized a search in the immediate vicinity of the impact. About 40 acres of grass land were inspected, but no more fragments were found.

We are now busy in reducing trajectory, radiant and orbits from about 150 visual observations a great number of which look promising. The reductions are being carried out in close cooperation with the Observatory of Leiden (Peter Jenniskens). Additional visual observations of the fireball are welcomed by the author. *(Addresses are on the inside of the back cover, ed.)*

Radio observing

Meteors by Radio

M.J. Morrow and B.R. Moore

Observing meteors by making use of airport 75 Mhz beacons has advantages over other electronic methods for those on a very restricted budget. The major benefit is that the observations are compatible with visual observations and hence extend the period of useful data collection beyond the hours of darkness.

In recent years, in the United States, meteor studies by professional astronomers have become nearly nonexistent. This void may be adequately filled by the enterprising non-professional using not only the old tried and true visual methods, but new technologies in photography, in video cameras, in television, in radio frequencies in the standard FM band, and by use of already in place radio beacons located in the vicinity of major airports. The latter is the main subject of this paper.

Here we present one method which with patience, perseverance, and a minimum of tears has worked well at our location. Our system may be operated on a 24 hours a day basis, through overcast and moonlit nights, week-in-and-week-out. Permanent recording of data collected may be done in several ways. If a meteor radar is not in your future, a system monitoring 75 Mhz airport beacon transmissions certainly can be. It is not planned here to repeat the construction of the electronic components of the system, the antennas, or other technical description of the basic equipment. This may be obtained from the publications of organizations listed at the end of this paper. However, all serious inquiries directed to the writers or their colleagues will be answered or forwarded to those who can best answer the query.

There are many frequencies which are capable of detecting meteors. Amateur radio beacons operating at 6 or 10 meters would be nice and work well, but these are not always available. Operation of such beacons requires a government license. An easy method, perhaps we can call it quick and dirty, is to use the 15 Mhz or 20 Mhz frequencies of WWV, WWVH, or similar frequencies from CHU, Canada. These work nicely at times, but are limited to nighttimes, sun spot minima, and receiver sites inside normal ionospheric "skip" zones for these frequencies, or within 150 to 500 km of the transmitter.

Successful meteor work using television or commercial FM broadcast is dependent on having a weak signal from some distance over the horizon. In locations such as Hawaii, this is not possible since several stations seem to be trying to be heard round the world! 100 000 W next door smears through the entire FM band available on a normal receiver, (that is 88 Mhz to about 108 Mhz). In many populated areas finding suitable TV or commercial FM clear channels is almost impossible. This is particularly true when amplifiers are used to hear faint meteor signals. Another difficulty is that many commercial FM and television stations do not broadcast 24 hours a day.

Perhaps the greatest problem with modes of observation using remote stations is that the meteors heard may be anywhere within a radius of several hundred kilometers. Most echoes heard, given a sensitive receiver, are beyond the visual brightness range. These data yield numbers that cannot easily, if at all, be correlated to those obtained over years of visual observation. On the other hand, a system using 75 Mhz aeronautical beacons probes what a visual observer would see under good observing conditions. What we are saying is that fifth or sixth magnitude meteors can be detected with sensitive enough equipment.

Meisel, with the help of a little mathematics, shows that at 75 Mhz a magnitude 5 meteor perpendicular to the line of sight at the zenith, will give an echo of approximately 10^{-16} W, while the same meteor 10° above the horizon reflects 5×10^{-19} W if one assumes 12 W radiated from the local 75 Mhz beacon. It should be noted that most individual 75 Mhz beacons radiate between 2 and 20 W in an elliptical pattern. The major axis is perpendicular to a given runway and the minor axis coincident or parallel to the given runway. In reality, this is a 60° × 45° elliptical pattern which at 100–160 km altitude produces a reasonable area from which to receive echoes. In Honolulu, two beacons are located in such a way as to have their pattern overlap, so the usable area becomes larger. This may be to our advantage.

The beacons available to the *Meteor Group Hawaii* are seven in number: one on the island of Kauai, two in Honolulu, two on the island of Maui, and two on the Big Island of Hawaii—one at Hilo and one in Kona. These give us several areas throughout the state from which the echoes can be received. This helped make 75 Mhz a reasonable choice for our group. Also favoring 75 Mhz was the manageable size of the antenna needed, whereas an antenna used with a 50 Mhz system would be very much harder to handle. While the 75 Mhz powers seem puny compared with commercial FM and TV transmitters, this frequency is internationally protected and mutual interference is never a problem. *Almost never!*

After deciding on the frequency to be used, other aspects of the project must be considered, such as location, antenna number and design, additional equipment, and a method or methods of recording data obtained. They all interact so one advantage may counteract another.

The observing site at first glance might be thought the least worrisome in the list of things to be considered. This is not the case; in fact, it may be the most important factor once a listening frequency has been chosen. The observing site must be located where the ground wave from various radiators is minimal. One site was in a a gulch with a hill of just over 30 m between it and the nearest beacon, which was 11 kn distant. The site was acceptable for convenience, but certainly not optimal from a ground wave point of view. It was discovered that the Waianae Mountains, several kilometers west of the site, actually focused the ground wave through the gulch. At the time, only one antenna was in service. While echoes were heard, they had to be strong to overcome the focused ground wave. Alleviating this problem to a large extent could be accomplished by orienting the lone antenna 90° to the focused wave.

A fine location was found to be in Kalama Valley on eastern Oahu. This site has mountains on the three sides and the ground wave can hardly be detected. However, strong constant trade winds pointed out limitations to the original antenna mounts. Operation on the island of Oahu is possible and not really inconvenient. Due to receipt of ground waves from the 75 Mhz beacons, both of which are located near Honolulu on the leeward side of the island, it becomes necessary to travel to the windward side, thus placing the Koolau Mountains between the closest beacon and the receiver. Even this has not been cure-all. Knife-edging and reflections through mountain valleys have made several lovely sites unsuitable.

The condition of the atmosphere is an item for consideration. While we have had success in most types of Hawaiian weather, it appears that heavy showers or thundershowers have a negative effect on the number of returns heard. Attenuation must certainly play a role here.

We have not had enough experience thus far to be able to distinguish what effect, if any, lightning might have using the 75 Mhz system. We do know that lightning is heard on 15 Mhz equipment, but interestingly enough not all lightning is heard. It should be added that lightning and meteors sound much different. Proper grounding of all antennas is a matter which must be done, and done properly.

In general, the climate in Hawaii is somewhat more placid than the climate at higher latitudes. Therefore, our experience with harsh weather conditions will be limited even after some period of time in continuous operation. The main problem is local or synoptic winds and heavy precipitation.

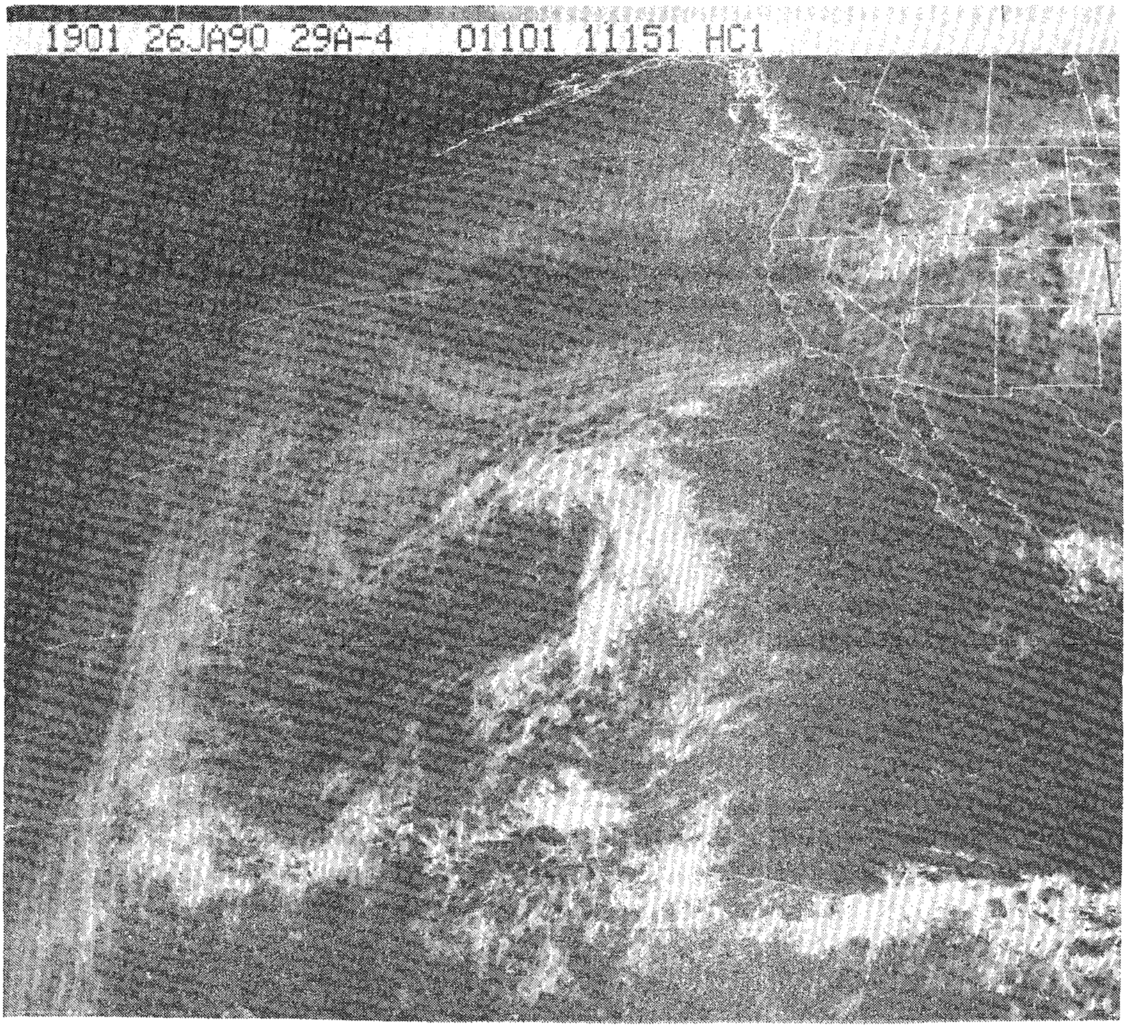

Figure 1 – Weather situation over Hawaii, the northeastern part of the Pacific Ocean, and the western part of North America on January 26, 1990, 19^h01^m UT.

The type of antenna suggested by Swenson in his *Sky and Telescope* series was a four element Yagi. He was interested in a different type of signal originating from a small section of sky and requiring a narrower beam width than which is needed for meteor observations. We tried a log periodic or TV antenna which very quickly proved unsatisfactory. Following this a two element quad was put into service. This, too, was not suitable. It was discovered that the quad was susceptable to unwanted polarization effects and many echoes went, we have no doubt unheard. Finally, a three element Yagi with a beam width of about 68° was tried. We had our first satisfying success with this type of antenna.

If one antenna is used only the height above the ground or above roof level is critical. This must be an odd number of quarter wavelengths. For example, at 75 Mhz the wavelength is about 4 m. The height of the driven element or the point where the wires are connected to the antenna also has to be an odd number of quarter wavelengths above the ground. One quarter of a wavelength will not work. Three quarters a wavelength, works well. Three quarter wavelength work out to be about 3 m. An allowance of about five per cent is acceptable. Of course, if it were possible to put the antenna much higher, so much the better.

The situation becomes a bit more difficult if multiple antennas are employed, for not only must the height be proper, but also the spacing of the antennas. The spacing turns out to be one wavelength or about 4 m. Back to back spacing is not so critical. About two wavelengths is a good figure.

All connecting wires must be of equal length. Matching the antenna to the converter is a problem which will have to be tackled by every builder. Our amplifiers have an impedance of 50 Ω and hence all else must be 50 Ω. The antennas we use are 300 Ω and matching devices or balans are required. However, with six antennas the match is natural, since it equals 300 divided by 50. Mismatches of as much as 20 Ω can be tolerated. More detailed information on impedance matching can be found in Dr. Swenson's articles and in amateur radio handbooks.

At this point we have about everything needed except a black box to receive the signal and convert it to a usable frequency. This can be pumped into a radio of adequate sensitivity having the frequency to which the 75 Mhz has been converted. A receiver with a sensitivity in the order of 0.5 μV or better may be found in either amateur radio outlets or in some shortwave radios of above average quality. We use a Kenwood R-1000, which by the way is no longer manufactured. Newer models, the R-2000 or the R-5000 are said to be more sensitive. Their price is also more dear. The Hawaii Group uses a Uniden receiver, model CR-2021, as a back-up receiver. This is a digital computerized receiver which is no longer available. When the Uniden was available, the cost was one third of the Kenwood receiver.

The Hawaii group could not find a receiver that operated at 75 Mhz. It may have been possible to obtain a 75 Mhz receiver from an aircraft, however, it is thought that the sensitivity required would not be inherent in this type of receiver. A further objection was the fact that aircraft equipment generally operates on 24 V. Since a 75 Mhz receiver is not easily available, a converter is required. The technical aspect of building a converter may be found in Swenson's paper, mentioned at the end. This necessitates some electronic skill as all parts are not available on the open market. The Hawaii Group listens on 10.5 Mhz instead of the 10.7 Mhz as noted by Swenson. This came about because of what was available in the junk box.

Finally, some amplification of the signal is required. Amplifiers are available commercially on a made to order basis. At first we believed that each antenna would need its own amplifier, so we set about making a batch of the little devils. Later it was discovered that separate amplifiers were not required. Currently double amplification is used. This reduces the number of amplifiers, lowers introduced noise, ans saves lots of work not to mention dollars. Double amplification, as the name implies, consists of using two amplifiers. These are connected in series, making sure the noisier amplifier is the second one.

Our first success came toward the beginning of the Quadrantid shower in January of 1983. Twelve echoes were recorded between 1^h00^m to 3^h30^m UT. All echoes were within a twenty minute period. Subsequent analysis showed we had recorded other echoes prior to that time period. However, because we really had no idea of what we were listening for, we dismissed them and accordingly they became lost. We are trying to build a library tape of echoes which may be reproduced and sent to other observers for comparison and learning purposes.

Once a working system exists there are several ways to preserve your results. Data may be recorded on magnetic tape using various recorders. The problem here is length of tape. At this point we have no system to start and stop the tape when a signal is detected. This, we hope, will be a future acquisition. A chart recorder may also be used and has worked acceptably. Echoes recorded using the chart recorder tend to kick the recording pen to the left on the trace. However, on occasion the pen moves to the right. This is believed to be due to voltage variance in the amplifier used with the chart recorder. Further study is needed. Of the methods used thus far to record meteor echoes, the tape is by far the most satisfying. The sounds are interesting and just plain fun to hear.

Future plans include a safe, unattended location; an oscilloscope or spectrum analyzer to see the recorded audio signal and possibly freeze the picture so it may be photographed. The idea here is to see if certain meteors produce a print from which they can be identified. Last but not least, twenty-four hour operation would allow better coverage for such meteor showers as the η-Aquarids and other showers which occur mainly during daylight hours.

75 Mhz is within the budget and means of the dedicated non-professional. Equipment may be upgraded or added to as time and funds allow. Data collected provide information which would not otherwise be available. Data are available throughout the entire day, not just at night. Light conditions as well as clouds become, for the most part, unimportant. Other than obtaining useful observations, perhaps the most important feature of any system like the 75 Mhz system is the personal satisfaction that comes with hearing the first echo.

Bibliography

Detailed information about constructing a meteor radio detection system may be found in *An Amateur Radio Telescope*, by G.W. Swenson. This book may be obtained from: *Willmann-Bell, Inc., P.O. Box 35025, Richmond, Virginia 23235*. You may receive some help from *Sky and Telescope* by writing *Radio Telescope, Sky Publishing Corp., 49 Bay State Rd., Cambridge, Mass. 02138-1290*. Ask for Dr. Swenson's articles, I–IV, "An Amateur Radio Telescope" and "An R. F. Converter For Amateur Radio Astronomy", by Dr. G.W. Swenson and S.J. Franke (1978-1979). Dr. David D. Meisel's paper, "Radio Scatter Detection of Meteors Using VHF Aeronautical Beacons", may be obtained by writing *Dr. David D. Meisel, Executive Director, American Meteor Society, Department of Physics and Astronomy, State University College, Geneseo, New York 14454*. Finally, you may contact the *Meteor Group Hawaii* by writing to the author *(address on the inside of the back cover, ed.)*

Observational Results

The 1989 η-Aquarids in Southern Brazil

Gilberto Klar Renner

An overview is given of 1989 η-Aquarid observations conducted in Southern Brazil.

Seven observers of Porto Alegre (South Brazil) participated in the 1989 η-Aquarid watch. Observations were carried out during eight nights. The participants were:

Carlos Arlindo Adib, Darlan Morais, Gilberto Klar Renner, Luís Antonio Reck de Araújo, Luís Antonio da Silva Machado, Luiz Augusto Leitão da Silva and Onofre Dacio Dalávia.

All seven observers estimated meteor magnitudes, but only six of them watched for colors and trains. During the observations realized on April 25 and May 10, 13 and 14 the meteors seen were plotted on maps in gnomonic projection ($R = 100$ mm) elaborated by the author in 1985. On the other dates meteors were counted using tape recorders. All in all, 450 η-Aquarids and 465 sporadics were seen. Their magnitude distributions are shown in Table 1.

Table 1 – Magnitude distributions of the 1989 η-Aquarids and corresponding sporadics, as observed from Southern Brazil.

Magnitude	−1	0	+1	+2	+3	+4	+5	Tot	$\overline{m}$
η-Aquarids	7	15	76	124	138	77	13	450	2.45
Sporadics	2	8	40	84	86	237	8	465	3.12

In 1989, 202 η-Aquarids were of magnitude +2 or brighter. Of these, 63% were yellow, 34% were white and 4% were orange. 56% of the η-Aquarid meteors had a train. This is the highest percentage that we have seen [1].

The low number of observations does not permit to determine when the η-Aquarids were most active in 1989. The first date our team watched that shower was May 7. It looks once more as if the η-Aquarids were more active on May 7 than on May 8 in 1989. Similar results were obtained in Australia in 1988 [2].

References

[1] G.K. Renner, "The 1988 η-Aquarids in Southern Brazil", *WGN* 17:4, 1988, pp. 153–154.

[2] J. Wood, "The 1988 η-Aquarids in Australia", *WGN* 17:4, 1988, pp. 155–156.

Non-Periodical Fast Moving Phenomena Report on a Meeting in Tomsk

Jürgen Rendtel

Between April 19 and 30, a conference was held in Tomsk, USSR. It was the second meeting about non-periodical fast-moving appearances in the environment. Some members of *IMO* were invited to attend and the expenses of their stay were covered by the Tomsk State University. André Knöfel, Korado Korlevic and I thought that they would deal mainly with topics like fireballs, ball lightning, etc. But what a disappointment! It was a real UFO-conference, including also parapsychology, bio-sensitivity, Poltergeist, and so on. Besides us, C. Andersson (Onsala Space Observatory, Sweden) and M. Marinov (Bulgaria) were taking part as foreigners.

Nearly a full day was dedicated to the Tunguska event. Unfortunately, no translation was organized for foreign participants, and most speakers tried to break records in fast-speaking. This way even both personal translators of the Tomsk Unversity (one of them being the *IMO* member Dr. Galina Ryabova) were not able to assist us.

A discussion in the Polytechnical Institute of the University was used for preparing the establishing of a network of stations for a sky patrol around Tomsk. We used this opportunity to introduce *IMO* and the international meteor work. Furthermore, meteor work done at Dushanbe, Ashkhabad and Odessa were presented by V. Getman, S. Muchamednasarov and Yu. Medvedev, respectively. But also this meeting soon turned to UFOs. One specialist presented photographs of "UFOs" sent to him which were strongly attacked since they were better used for a book about all kinds of photographic errors and handling mistakes. We could have made plenty of such photographs in a short time and of better quality. Unfortunately, Korado Korlevic was forced to take part in a TV transmission, where he was the only foreigner and the only non-UFOlogist. I will not describe more of that here.

To tell the truth, we also did a useful job. Together with V. Vasilev, G. Andreev, G. Ryabova and partially some more specialists we discussed several aspects of the Tunguska event in order to be prepared for further expeditions which are to become international ones. Until now, all searches for material from the body was carried out in the area of the final explosion. But for sure the cosmic object did not survive the final flash. There exists a small chance that the (possibly non-cometary) body fragmented significantly between the Roche limit and its atmospheric flight. Some of the fragments may have fallen along the trajectory before the final explosion occurred. Of course, one has to assume also the further splitting of the smaller bodies. Furthermore, such particles (hopefully cm-sized) may have survived only if they fell into a lake or a swamp, there being conserved and protected from the climate (which destroys concrete during one winter). Since we do not know the trajectory very well, and since the consistency of the object is totally open, the probability to find any meteoritic material is very small.

Of course, we also has the opportunity to visit Tomsk situated at the banks of the river Tom. When we arrived, the ice cover was just breaking—a weak later, we saw no more ice on the river. We also visited the observatory some kilometers south of the town at a picturesque hill with a panoramic view over the Tom river. And last but not least André and I managed to observe the Lyrids during four nights.

Aspects of the Tunguska event should be discussed at the *IMW* 1990 in Violau—maybe we find some more conclusions for future expeditions.

Book Review

Masahiro Koseki

- *Meteoric Matter in the Interplanetary Space, edited by O.I. Bel'kovich.*

This book was published in 1982 and includes 39 articles which were presented at the symposium held in 1980 at Kazan University. It is unfortunate for us that its circulation was limited (about 400 editions) and that all papers were written in Russian. If I did not find this book in Paul's bookshelf, I would not know about its existence at all. Soviet meteor works are announced in "Novye Knigi" (Soviet books information news) and are left apart from our eyes. So even the most interesting books do not proliferate. We need a regular communication with Soviet meteor workers, especially for exchanging books and reports.

This specific book provides much important information about the level meteor astronomy reached in the late 70ties. The articles are still so interesting that I postpone to thank Paul for sending me a copy, and I engross myself in reading. Most of the material presented is unknown and should be investigated. The working methods and main aims of the Soviet meteor observers are interesting enough for us to know.

The most interesting articles included are: *Problems of obtaining the mass distribution index s of meteor bodies*, by Voloshchuk Yu.I. and Kashcheev L.B., *Radar, photographic, and visual results of the Geminid shower*, by Bel'kovich O.I., Sulejmanov N.I. and Tokhas'ev V.S., *Meteor showers and their structure observed*, by Tkachuk A.A., *Evolution of Meteor streams*, by Babadzhanov P.B., Zausaev A.F. and Obrubov Yu.V., and *Meteor Spectra*, by Bronshten, V.A.

Especially for someone acquainted with the authors, also other short reports are valuable. Some are dedicated to the investigation of particular showers, mainly the Quadrantids and the Geminids. Several articles can be found in slightly modified form in "Astronomicheskij vestnik" the Astronomical Bulletin of the Soviet Astronomical and Geodesical Society.

An important finding is the fact that there is a limit to most modern radio observations: they cannot detect most slow meteors and have a strong bias. This report strongly shows that many meteor streams are waiting for us to be observed by visual, photographic, radar and electric methods (II) and in order to do so cooperation between amateurs and professionals is necessary.

Invitation for the Second General Assembly of the International Meteor Organization

The 2nd General Assembly of *IMO* will take place at the International Meteor Weekend in Violau, on Friday, September 7, 1990 at 16^{h}. All *IMO* members are kindly invited to attend; they will find a detailed agenda enclosed in the August issue.

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