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Magnitude −8 Leonid fireball photographed with a 20-mm lens by Josep M. Trigo on November 17, at $3^h38^m24^s$ UT from Spain. The photograph was exposed from $3^h32^m08^s$ to $3^h38^m30^s$ UT. A train was visible, for 3 minutes with the naked eye, and for 5 minutes with 7 × 50 binoculars.

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Useful Information

The February Issue *(WGN 26:1)*

The *February issue* will be mailed during the second week of February. Contributions are due on *January 23* at the latest. They should be sent to *Marc Gyssens*.

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In Memory of Jože Prudič

Marc Gyssens

Too often lately, this Journal has been the messenger of bad news.

Recently, we learned of the tragic death of Jože Prudič, who died in an accident, which involved his car and a truck, in the evening of December 2, 1997. Jože Prudič was one of the Slovenian participants to the latest IMC, and all who had conversations with him were impressed by his commitment to meteor astronomy and his clear vision on the subject. After we learned of what had happened, we were surprised to find out that this young meteor observer—still in his twenties—was actually not (yet?) an IMO *member. Perhaps this was just a matter of time; in any case, amateur meteor astronomy suffered a great loss.*

This last thought, however, was not on the mind of those who knew him and with whom I communicated after finding out the terrible news. They were completely devastated because of the very likable person he was. To Mihaela Triglav, his girl-friend, to his family and friends, and to all who had the privilege of knowing him, I offer on behalf of the IMO *my sincerest sympathy.*

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Ina Rendtel

General information

Please help us in keeping our records straight by renewing right now. In this way, you insure that your subscription is processed well in time before the February issue has to be sent out and you save the already overloaded *IMO* officers to have to run on and off to the post office to mail back issues. All relevant information is concisely summarized below.

International payments invariantly involve costs. Therefore, if you also wish to buy other *IMO* publications (outside back cover), it is a good idea to combine this with your renewal in one order and one payment. *New* IMO *publications* are Report 9 containing the 1996 visual observations, and the Proceedings of the 1996 and 1997 *IMC*s, the latter of which will appear shortly and can already be ordered. You can also pay your subscription for *two* years, which is particularly interesting this time, because higher rates are expected for 1999!

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Letters to WGN

compiled by Marc Gyssens

The Leonids in 1966

The 1966 apparition of the Leonids has already sparked several lively debates in this Journal. Joe Rao has some interesting comments to add to this discussion.

First of all, I want to draw attention to an article that was originally published in *Proceedings 69—a Joint Convention of the Western Amateur Astronomers and the Association of Lunar and Planetary Observers* on August 21–23, 1969, at San Diego, California. The article in question concerns the Leonid Meteor Storm of 1966 and was written by a witness of that incredible display, Mr. Dennis Milon.

While a few quotes and comments, including his oft-cited 150 000 meteors per hour for the 1966 Leonids, have appeared in a number of journals, this particular article is—to my knowledge—*the only full account of what went on that night in Milon's own words*. Sadly, Mr. Milon is no longer with us, having passed away a couple of years ago. I am sure that, were he still alive as we now move into a new Leonid epoch, he would have been increasingly sought-out to write or talk about that memorable display over thirty years ago.

I also want to use this opportunity to rebut a couple of remarks made in the June 1997 issue of *WGN* by Martin Beech ("Public Perception, Meteor Astronomy, and Leonid Storms"). In his well-written article, Mr. Beech, commenting on the 1966 Leonid storm, wrote *"...few astronomers were aware of the possibility that such an event might take place. As for the public, most were completely unaware that anything was going on."*

This, however, was *not* the case in the Greater New York Area. Quite the contrary! Most New Yorkers were quite aware that an unusual astronomical phenomenon was a possibility late on the night of November 16-17, 1966.

During October and November of that year, the *American Museum Hayden Planetarium* presented a sky show titled "The Night the Stars Fell." The show dealt with the Leonid Meteor Shower of 1833 and its impact on astronomy. I was 10 years old then, and fondly remember the excitement of attending that show and seeing a re-enactment of the 1833 Leonids in the planetarium's Sky Theater. Toward the end of the show, the audience was told of the "potential" of another spectacular Leonid shower late on November 16-17.

This was further driven home in the local news media on Wednesday, November 16, with announcements on radio, television, and newspapers of a possible big meteor shower that night. Figure 1 shows part of a clipping from the *New York Times* of that day.

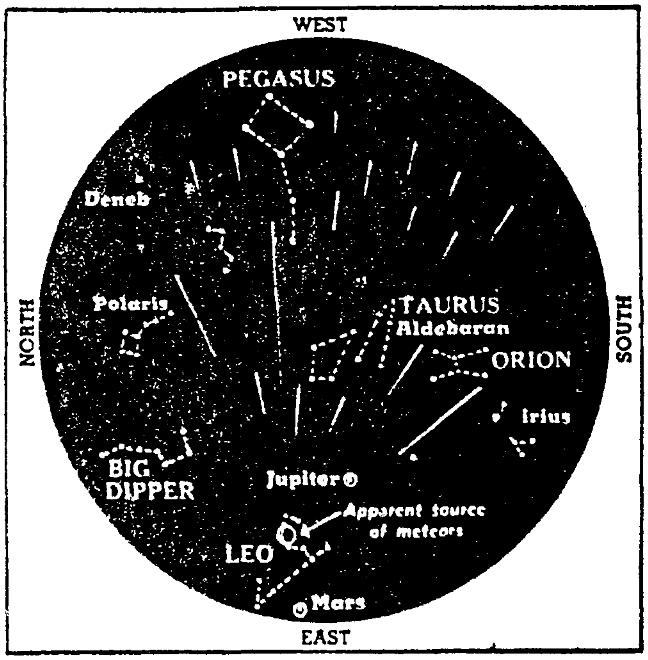
That prediction of a significant Leonid shower came from *Hayden Planetarium* astronomer, Dr. Kenneth L. Franklin (who, with B.L. Burke, was the first to discover radio emissions from Jupiter a decade before). From the *New York Times* article, Dr. Franklin *"... noted yesterday that the position of the parent comet, Tempel-Tuttle, is now roughly what it was in 1833. This has led him to suspect that a dramatic shower, like the one of that year, may be in the offing."*

In the summer of 1992, I wrote to Franklin—who was by then retired and living in Florida—and asked what he based his prediction on. On August 17, 1992, he wrote back the following: *"I investigated the value of the mean anomaly of the comet at the storms of 1833, 1866, 1899, and 1933. The value for 1966, around* 135°, *as I recall, was close to the values for 1833 and 1866, but not for the years with poor displays. My prediction of a good shower was published in an editorial by Charlie Federer in* Sky and Telescope *in 1996, but Brian* [Marsden] *still says he did not understand what I did."*

Unfortunately, cloudy skies thwarted any views of the Leonids from New York that night. The New York Park Commissioner Thomas P.F. Hoving had invited the public to view the Leonids from Central Park's vast Sheep Meadow. Despite the inclement weather, over 10 000 people turned out. The reactions to the disappointing visibility were varied: one man said he thought it was a *"rotten deal."* Meanwhile, a woman looked at the huge crowds surrounding her and observed that it was *"... marvelous. All these people in the Park after midnight and no one is getting mugged."*

Meanwhile, Dr. Franklin was on board a special flight sponsored by *Trans World Airlines* to carry reporters and photographers above clouds and haze. D. Franklin periodically gave life status reports on the shower direct from the aircraft on radio station *WNBC-AM 660*. As many readers know, the shower had only begun to build towards the kind of display that Dr. Franklin was hoping for when sunrise put an end to observations in the eastern US. Over the western US, as Mr. Milon's observations from Kitt Peak, Arizona, attest to, it indeed was a dramatic shower!

Meteor Shower Is Due Tonight



Adapted from drawing by American Museum-Hayden Planetarium

Map shows star positions at 1:30 A.M. tomorrow, when meteor shower is considered possible. Dotted lines delineate the constellations, unbroken lines how the shower may radiate. For proper orientation, reader should hold this map over head with the map's lower part facing the east.

Astronomers Drawn Here For Show

By WALTER SULLIVAN

During the hours following midnight tonight it may look, at first glance, as if the stars are falling from their fixed positions in the sky.

Astronomers believe that a heavy shower of Leonid meteors — so-called because their streaks of light all radiate from a point in the constellation Leo — will occur. A number of precedents account for this expectation roughly every 33 years.

On the night of Nov. 12, 1833, the sky seemed to be raining stars. Some were brighter than Jupiter or Venus.

One was said to be as large as the moon. The flashes awakened people. Some thought the world was coming to an end, for the nature of meteor showers was little understood.

The display did, however, lead to better understanding. Since all the meteors originate in the direction of Leo, it is believed that the fragments are all flying the same orbital path around the sun.

Figure 1 – Excerpt from the *New York Times* of Wednesday, November 16, 1966.

Mr. Beech also stated that *"... the Draconid meteor storms of 1933 and 1946 arrived unpredicted and unbeknown to the general public..."*

While I would agree with Mr. Beech's comments concerning 1933, that was not the situation in 1946. The October 1946 *Sky and Telescope*, in fact, contained several articles about an impending Draconid (or "Giacobinid") storm. One *Sky and Telescope* columnist, alluding to the poor timing of a nearly-full Moon coinciding with the predicted peak of the shower sarcastically commented that thanks to the bright moonlight *"... we might only see a rate of a thousand per hour!"* In addition, as was the case with the 1966 Leonids, there was considerable media excitement surrounding the 1946 Draconids. In fact, the *ABC Radio Network* had one of their reporters on the rooftop of a building in Chicago, giving a blow-by-blow account of the short-lived spectacle (through a scattered-to-broken cloud cover) to a nationwide listening audience.

Joe Rao, November 1997

The 1997 International Meteor Conference

Petnica, Yugoslavia, September 25–28, 1997

Alastair McBeath

It has become something of an *IMC* tradition in the last few years that those living in south-eastern Europe end up having a lengthy, adventurous journey to attend the Conference. This time, we had very sensibly tried to make things a little easier for them by choosing a site in Yugoslavia, at the Petnica Science Center, just outside the town of Valjevo, around 100 km south-west of the capital Belgrade. Consequently, as someone from those little offshore islands of north-western Europe (Britain!), my round trip was about 5000 km or so, taking in seven countries on the way. Much of my trip was by land from Berlin with Rainer Arlt, who had offered me the chance of joining him on such a fascinating, and wonderful, trans-Alpine journey. It was all well worth it.

Figure 1 – Dragana Okolić, one of the principal organizers of the 1997 *IMC*, addresses the participants in the bus enroute for the excursion.

Petnica is a most interesting and pleasant place, reckoned to be one of the longest continuously-inhabited sites in Europe, for about the last 7000 years, since a neolithic cave-dwelling can still be visited within easy walking distance of the Center.

We reached Valjevo shortly after watching the Sun drop like a crimson eye behind the western hills on the evening of September 25. Soon after, we were settling in to the Center, before dinner at 8 p.m., as ever, a time to let the food cool while friends new and old were met, and the true atmosphere of the *IMC* started to blossom. One thing those of us coming from the virtually all-male meteor astronomy world of northern Europe noticed with great delight was the large number of stunningly beautiful young Balkan ladies in attendance, most notably from Serbia and Bulgaria. The *IMC* as a whole was very notable for the large number of young people present, in fact, a good sign for European meteor astronomy as a whole. I am reliably informed the average age of the participants was 17, for instance.

At 9 p.m., Petnica's Director Vigor Majić, and *IMO* President Jürgen Rendtel opened the Conference, and then announced that free drinks were available, which almost emptied the lecture room, as expected! After this interval, Sirko Molau showed a video of a trip members of the German *Arbeitskreis Meteore* team had made to Jordan in May this year, to make contact with, and help to encourage, the Jordanian meteor observers, as well as to make observations of the η-Aquarids from a more favorable site than northern Europe. Then, more discussions and talks continued long into the night. I vaguely recall falling into bed and sleep almost instantly soon after 2 a.m.

The next morning was to be the fullest day of the Conference, with lectures and workshops throughout, but never such a crowded program that the meetings with fascinating people from across Europe, and Japan (we were delighted that Nogami Nagatoshi was again able to join us, as he did in 1996), ever felt rushed.

I was up at 7 a.m. to set up my poster presentation, and also, in theory, to work on preparing a fireball report from New Zealand which Graham Wolf—unable to attend himself—had sent to the organizers, but of course, I met some people around even then, and so only just had time to set up my poster before breakfast at 9 a.m.

Felix Bettonvil chaired the opening session, which was devoted to the 1997 Perseids. Jürgen and Rainer presented a short overview of recent Perseid activity, including a preliminary report based on the 25 000 Perseids already on-hand in the global database from this summer's event, barely a month after the shower ended. Next, Stefan Berinde from Romania gave a short presentation on some Romanian Perseid results, followed by his fellow-countryman Valentin Grigore, who spoke about the annual Romanian three-week festival of astronomy centered around this shower, called *Perseide*. This has been held every year for some time, but the 1997 event was the largest and most successful to date.

A break after this allowed us to be fortified with some excellent Turkish-style strong, sweet coffee, typical of the Balkan region, and, during this, Jürgen and I set up the *IMO* bookstall, which, in the absence of *IMO* Treasurer Ina Rendtel, I also ran during most of the Conference. Felix continued as chair for the second morning session, which opened with Sirko Molau, not this year on his special topic of video work, but on the status of the *European Fireball Network*. His presentation included numerous impressive fireball photos, and explained how this professional network, which began to be set up in 1959, continues to function today with professional and amateur support across much of central Europe.

Regrettably, Gennady Andreev from Tomsk University, who was to have presented a paper during this session, was unable to attend, so Sirko and I had been invited to feel free to expand our original talks somewhat, and my own presentation on forward scatter meteor results across the entire year, based on data from August 1993 to early 1997, filled the final hour. A lively questions session concluded the morning's proceedings, particularly useful as we gradually begin to see what forward-scatter observing may be capable of. Indeed, the discussions continued informally well beyond the scheduled session time.

Naturally, this meant I was a little late getting to lunch, but this was not a problem, as the food was always plentiful and well-prepared, and gave us a real taste of Yugoslavian cuisine. At lunch, I sat deep in discussions with one of the Belgian radio experts Jean-Marc Wislez, and we were joined by Vesna Slavković from Yugoslavia, whose charming presence enabled us to broaden our talks to include another of my favorite subjects, dragons, and many other things besides. This was a typical *IMC* feature I always find, that the people attending have common interests that span far beyond meteors, and communication is never difficult. Indeed, the Serbians especially seemed to have a particularly impressive command of English.

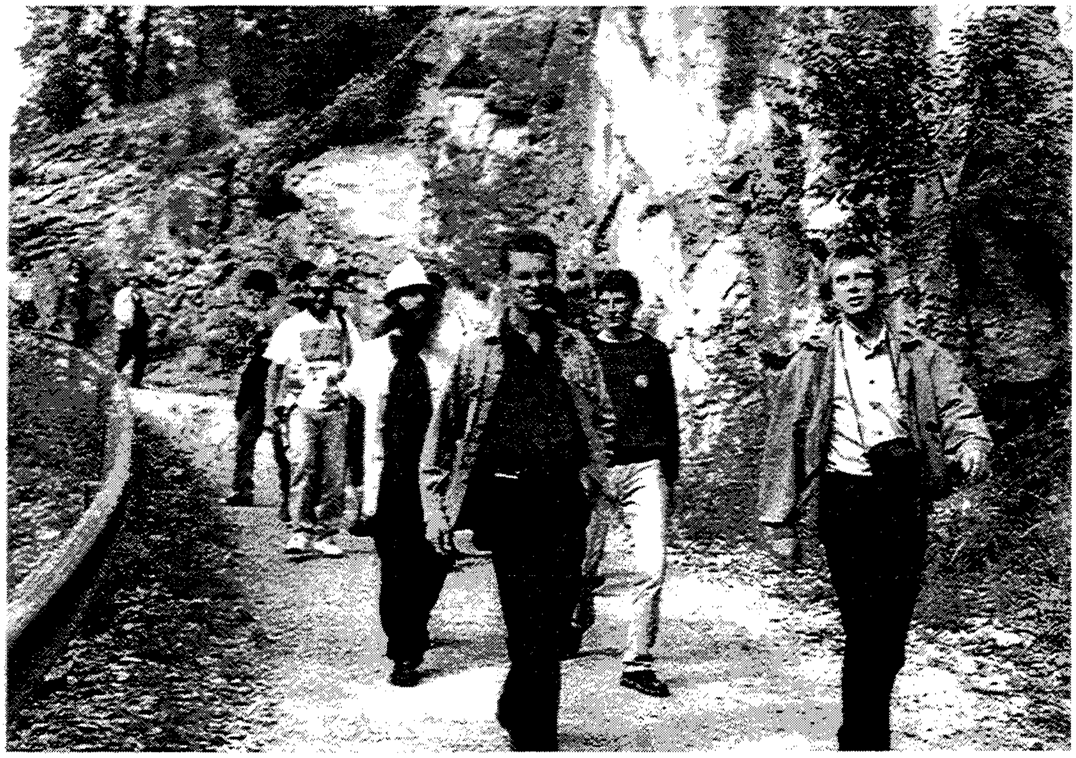


Figure 2 – Some of the participants walking down into the picturesque valley in which the monastery visited during the excursion was situated. In the foreground, we recognize (*from left to right* Jürgen Rendtel, Valentin Grigore, Sirko Molau, Stefan Berinde, and Mirko Nitschke.

The *IMO* Council meeting took up much of the afternoon, although for those not involved, there was a good selection of poster papers to examine and discuss, and a video presentation by the Croatians on Korado Korlević. The posters notably included some superb photo displays from Bulgaria and Romania, the Romanian exhibit containing prose and poetry too. This latter, as a (to many) novel means of expression, was very favorably received, provoking much comment at, and since, the event.

The Council's main decisions were that the 1998 *IMC* will be held between two professional meteor science meetings in Slovakia, from August 20 to 23, and that a new Video Commission was founded (at 15^h16^m UT!) to help coordinate such work on a global scale. Naturally, the leading *IMO* expert in this field, Sirko Molau, was appointed as its first Director.

At 5 p.m., Marc Gyssens took the chair, and Jürgen presented some details on the 1997 η-Aquarids, expanding upon the paper in *WGN* 25:4, and comparing it with some earlier results going back to the 1920s. Peter Zimnikoval, one of next year's *IMC* organizers, discussed some problems of telescopic meteor observing, including some news from recent experiments carried out in Slovakia during the Perseids. Next came a presentation by Chris Trayner from the UK, on hand-held automatic meteor counters rigged-up to a PC, to save writing down meteor details during counting observations, which provoked a lively discussion.

After a brief break, Marc chaired a workshop on the Leonids, which had contributions from Jürgen, describing the predicted returns of 1998 and 1999 and what may happen with the shower; Petra Rendtel, with details of the area and climate of eastern Asia most likely to see the best from the Leonids in 1998 (eastern Siberia, Mongolia, or China); Nikola Biliškov from Croatia, who used his own experience of cold-temperature observing to provide suggestions in combating the low temperature extremes expected in this region in November; and Daniel Očenáš from Slovakia, with some details on transport problems in this same region. I concluded the discussion with a reminder to observers that although the 1998 Leonids are important, the 1998 Draconids need to be observed too, since they may also produce high rates.

Dinner followed, and then the day's final lecture presentation was a very entertaining and enjoyable one on meteorites by Professor Jelena Milogradov-Turin from the Mathematics Faculty of Belgrade University. This was very well-received by the audience, and got the longest ovation of the Conference.

A short break, and we came back to the lecture room for three items from the Romanians, two prize-winning songs from *Perseide '97* on tape, and a comic drama about meteors given by Andrei Dorian Gheorghe and Gelu-Claudiu Radu. They also showed some video footage of the *Perseide* event, and some views of the impressive countryside in the regions they observe from. Then, talks and discussions continued far into the night—the group I was with made for our beds around 3 a.m., but some were still going until well after six we discovered later!

September 27th dawned beautifully sunny and warm, and I was up by 8 a.m., again unsuccessfully trying to get some items prepared before the majority of the Conference participants were up and around. After breakfast, whose only lack was the vital coffee (especially the Turkish-style available here!), so essential to anyone from northern Europe used to having such assistance to start their days, Cis Verbeeck from Belgium took the chair. Firstly we had Sirko giving a report on the *IMO*'s WWW pages, which was very encouraging for all the contributors, as the pages are clearly being very heavily used around the globe. Then Andrei Dorian Gheorghe gave a joint paper with myself on Romanian meteor mythology, continuing the work in this area already begun in papers in *WGN* and elsewhere during this past year.

Then—ah!—coffee, and so now properly awake, I was able to chair the morning's last session. André Knöfel gave some fresh results from the combined video-radar observing Detlef Koschny had first described last year (Detlef was unfortunately not able to attend this *IMC*). The first trials have been very encouraging, and it is hoped that soon the system will be producing even more valuable data. Chris Trayner also gave some new details—completed a matter of days before attending the Conference—on his work with Hough transforms in automatic video equipment set-ups. It is always useful to have such follow-up work, and see what new features and problems have occurred in the intervening year.

After lunch, we had the traditional *IMC* excursion, this time visiting a small monastery in a very tranquil mountain-valley setting, and then trekking up a circa 1500 m high peak to see one of the Yugoslav observing sites. At the mountain-site, we were also treated to drinks to toast one another and the superb scenery, including the excellent local old plum brandy, Šljivovica, which necessitated several refills to fully appreciate... This was a wonderful way to see parts of Yugoslavia, especially surrounded by people who knew all about the area, and kept up a running commentary on what we were passing.

Back at Petnica, after dinner, we held the *IMO* General Assembly, with all the usual reports of activity and news from the Council meeting, including the appointment of Bob Lunsford in the USA as the new Secretary-General on the retirement of Paul Roggemans. Paul will also be offered an honorary life membership of the *IMO*, as a token of thanks for the unceasing and excellent efforts he has made over many years to ensure the establishment of *IMO*, as its initial driving force, and as one of the leading figures in world meteor astronomy this century, bringing together so many people into one cohesive group for the first time.

A video presentation from the Italian group who are hoping to host the 1999 *IMC* near Rome was given too (this even included a review of the toilet and bathroom facilities, which we were accidentally treated to twice thanks to a mistaken rewind!), together with a further proposal from the Romanians to be *IMC* hosts in 1999 or later. A slide-show by the Croatians showing the Slovenian Alps and a visit they made there formed an extra part of the evening, but the best-received item was undoubtedly a comedy sketch by two young Bulgarians, Ivan Gradinorov and Gentchev Galin. They discussed a series of results based around the problems of cloudy nights and the alcohol consumption which accompanies these, including a brilliant invention, the "trinocular," consisting of three beer bottles taped together, so the observer can always be sure of an unusable sky to look at, and simultaneous liquid refreshment. The questions session which followed was particularly brilliantly handled, and the whole was a perfect parody of a scientific paper presentation. The two youngsters received the loudest ovation of the Conference for their efforts.

The Saturday night at an *IMC* is often given over to a party, since it is the last evening most people will still be there for, and so it proved again this year. At some stage well after 3 a.m., most of the available drinks were exhausted, as were many of the people, and quite a lot decided to call it a night then, but a few of us sat on discussing all manner of topics. As the Sun rose red on the Sunday morning, only five of us were left—Tijana, Vesna, Cis, Jean-Marc and myself—and at this point, most of our happy band broke up to catch a little sleep. I realized it was pointless going to bed by then, since I knew I had to rise barely an hour later anyway, so I did not bother even trying to sleep, and worked on getting Graham Wolf's fireball report ready to present instead.

After breakfast—and the incredulous comments of people on discovering I had not slept—Rainer chaired the last session, which contained just two presentations. The first was by Valentin Grigore, and concerned the ideal lunar conditions the 1999 total solar eclipse will create for the Perseids, especially as the eclipse track crosses Romania at its longest duration. Then I concluded the lecture program, with the New Zealand fireball details, mentally noting that of our final five who were still up at dawn, I was the only one actually present for this talk!

Sadly, because of our long drive, our party (Rainer, myself, and Mihaela Triglav and Jože Prudič, who had traveled with us from Ljubljana in Slovenia) had to leave before lunch, and the closing ceremony in the early afternoon, so it was with heavy hearts we set about the final task of saying goodbye to old and new friends. We departed Petnica around 12:30 p.m. in bright sunshine, and sped away through Yugoslavia. Somehow, the journey seemed much shorter all the way back, our minds filled with joyous images of the events just passed, plus, of course, we now knew what to expect, so there was not so much sense of adventure as when we were still en-route the first time. I was ordered to the back seat of the car and told to get some sleep, however! A sensible idea, but I could only doze for a while, since there was still so much to see and recollect.

My most grateful thanks are extended to Rainer Arlt for his many kindnesses and faultless hospitality, as well as for offering me the chance to travel with him on such an adventure; to Jürgen and Ina Rendtel for their support and assistance, also to Jürgen for his hospitality in Germany; to our companions Jože Prudič and Mihaela Triglav for their company and help along the route to and from Yugoslavia, as well as to Jože's parents for their unstinting hospitality; to the organizers of the *IMC*, notably Vladimir Lukić (who was unfortunately unable to join us for the Conference) and Dragana Okolić, for their hard work before and during the *IMC*, and for making sure everything ran smoothly; to our hosts at Petnica Science Center; and finally to all the Yugoslav *IMC* participants who gave their friendship and help so freely to all the visitors. I sincerely hope that we will not have to wait too long before there is another *IMC* in Yugoslavia. I look forward to this, and also to next year's *IMC* in Slovakia. If you have never been to an *IMC* before, my only question is—why not?

The 1998 International Meteor Conference

Stara Lesna, Slovakia, August 20–23, 1998

Daniel Očenáš and Peter Zimnikoval

The 1998 *IMC* will take place in Stara Lesna, in the High Tatra Mountains, Slovakia, from August 20 to 23, 1998. The *IMC* will be held in conjunction with two professional events: the International Conference *Meteoroids 1998* (August 16–21) and the Colloquium *Sources of Asteroids ans Comets* (August 24–28). The *IMC* will be located in a hotel near the building of the *Astronomical Institute* of the *Slovak Academy of Science* (the professional events will be located in this place).

The full registration fee amounts to 170 DEM. This payment includes accommodation, meals, proceedings, and an excursion. The participants may send the full fee or a prepayment of at least 100 DEM to Ina Rendtel. Please use the form on the next page (or a copy of it if you do not want to damage your copy of this issue) for registering!

For further questions, the authors, who organize the event, can be contacted at the electronic-mail address `hvezdar@isternet.sk`.

International Meteor Conference

Stara Lesna, Slovakia, August 20–23, 1998

Registration Form

Each individual participant should fill out a form and return it to *Ina Rendtel, Mehlbeerenweg 5, D-14469 Potsdam, Germany*, as soon as possible.

Your registration will be guaranteed only after Ina Rendtel has received the minimum pre-payment of 100 DEM. If you wish to participate, but cannot yet decide, simply return this form with the proper option checked to stay on the mailing list for further circulars.

Name: ______________________________ Birth date: ____________

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____

____

Phone: ______________ Fax: ______________ E-Mail: ______________

- ○ wishes to register for the 1998 *IMC* from August 20 to 23;
- ○ intends to participate, cannot yet register, but wishes to stay on the mailing list.

I intend to travel by ________, together with ______________________________

Additional requests:

- ○ I need travel information from ______________ to Stara Lesna;
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For participants wishing to contribute to the program:

Lecture: ____

Duration: ________min. Required equipment: ______________________________

Workshop or discussion: ______________________________________

Poster presentation: ______________________________ Space: ________ m^2

Either the entire fee of 170 DEM or a pre-payment of at least 100 DEM should be sent to the Treasurer, *Ina Rendtel*. Follow the payment instructions below. Participants paying only 100 DEM have to pay the remaining 70 DEM upon arrival in Stara Lesna.

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- in Japan: pay to Masahiro Koseki, 4-3-5 Annaka, Annaka-shi, 379-01 Gunma-ken, Japan.
- all others pay in USD to Robert Lunsford, 161 Vance Street, Chula Vista, California 91910, USA. In case you pay by bank check, make it payable to Robert Lunsford, *not* the *IMO*!

People wishing to pay in other currencies should contact the appropriate IMO *contact person for exchange rates.*

The Video Commission of the International Meteor Organization

Sirko Molau

After a one-year preparation phase, the Video Commission of the *IMO* was founded at the 1997 *International Meteor Conference* in Petnica, Yugoslavia. With this step, the *IMO* acknowledges the growing importance of this relatively new observing technique. By now, more than 50 image-intensified video systems are operated by amateur astronomers world-wide. Still, the contacts among the different groups and the availability of information for beginners in this field are not yet satisfactory. With a Video Commission of its own, the *IMO* intends to overcome these problems and wants to support further progress of this rapidly evolving technique.

The current state of video observations and a number of projects to be worked on have been introduced in *WGN* recently [1]. In the ensuing discussion, our aims were strongly supported by different meteor observers. There was a suggestion of one more project to be included in our working list, namely the development of completely autonomous observing systems. The idea is to overcome the large gaps of visual night-sky monitoring between the major meteor showers by autonomously working video systems. A first system of this kind was introduced a few months ago [2].

As the Director of the new Commission, I hereby wish to present our goals for the near future.

The main tasks will be the international coordination of video activities and the support of fruitful cooperation with other observing techniques. We intend to intensify the contacts among the different video groups in the world. The exchange of ideas and data with the Japanese observers will have highest priority, since, in Japan, video observation has the longest tradition, and most video systems are currently operated in the Far East. First steps in that direction have already been carried out, and I am optimistic that our discussions will be of benefit to all participating observers.

Another step towards better communication among the observers will be a list of video systems and observers I am currently compiling. This survey will provide an overview of the technology available at this time, and help to find the right contact for specific observations or questions. On a longer time scale, a direct comparison of the available systems may help to better evaluate different set-ups and result in improved technical recommendations for present and future video observers.

The encouragement of new observers is another focal point on the working list of the Video Commission. This will be done by introducing the abilities of video observations in lectures and papers at different occasions, and by providing the know-how of video work. The second point includes technical hints and construction plans for video cameras, addresses of suppliers of the different components, suggestions for observation targets and support for the data analysis. Different platforms like *WGN*, the WWW video homepage, electronic mailing lists, and private contacts will be employed for this task. We also intended to put all the information together in a special booklet.

Another task is the creation of a video database with free access to reduced observing data of the different groups. First steps have already been carried out, as you can access video data of the *DMS* as well as of the Japanese group of Y. Shigeno and the German MOVIE system in the Internet. Those databases provide an excellent tool for everybody who wishes to examine meteor showers and meteoroid streams. I hope that others will follow in sharing their data with us, too.

Finally, the Leonids of 1998-99 will hopefully produce one of the most spectacular displays of our days, and it will be the first time that the activity can be monitored with an appropriate observing technique. By now, several experiments with video systems are in preparation. I hope that the Leonids will become an example of good cooperation between the individual groups. Let us obtain a maximum of high quality data from the upcoming return of Comet Tempel-Tuttle and make it a real success for amateur work world-wide!

Of course, with a working list like this, the Video Commission cannot be run by a single person. I hereby want to encourage experienced video observers to become an active member of the Commission and fill it with life. The Commission wants to support active and potential observers, but needs also their help. I am looking forward to hearing from you!

The Video Commission can be contacted through its Director, *Sirko Molau, Weidenweg 1, D-52074 Aachen, Germany*, phone +49-241-878900, fax +49-241-8888219, and e-mail `video@imo.net`. The URL of the *IMO*'s WWW video homepage is `http://www.imo.net/video`.

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Ongoing Meteor Work

Using Astronomical Equipment in Cold Climates

Chris Trayner

Severely cold observing environments present hazards to optical, mechanical, and electronic equipment, to recording media and to the observers. The need for precautions against these hazards is addressed. Some suitable precautions are described. These remarks are with particular reference to observations of the Leonids in 1998 from Siberia or Mongolia.

1. Introduction

The *IMO* intends to observe the Leonids intensively in 1998. For various reasons, the observations will be best conducted from regions of Siberia or Mongolia around 50° N and 115° E [1]. The *IMO* therefore intends to mount an expedition to a location in this region. These parts are severely cold at the time of year (November), requiring many precautions to protect observers, recording media, and equipment. This paper addresses some of these problems. They affect mechanics, materials, electronics, and people. Experience of solar eclipses in cold climates is irrelevant, as eclipses last only a few minutes during the day. Although concerned principally with the particular place and season, the information may be relevant to other cold-climate observations.

2. Nature and extent of the problems

Many processes behave differently at different temperatures, either operating at different rates or in different ways. In particular, lower temperatures slow down chemical reactions. These include the production of electrical energy by batteries and the metabolism of the human body. Other changes include the flowing of lubricants in cameras and the mechanical strength of some materials.

Table 1 – Expected minimum night-time, maximum day-time and diurnal average temperatures in November at several locations of interest.

Location	Latitude	Longitude	Temperatures from [2]			Temperatures from [3]		
			Min	Ave	Max	Min	Ave	Max
Chita	52°01′ N	113°20′ E	−32° C	−15° C	+ 3° C	−38° C	−14.3° C	+10° C
Ulan-Ude	51°48′ N	107°26′ E				−38° C	−12.7° C	+10° C
Ulan Bator	47°56′ N	106°59′ E	−29° C	−13° C	+ 7° C			

Table 1 shows temperatures for three locations in the region of interest. These are taken from two works [2,3] which differ slightly; the lowest is taken, i.e., −38° C. This is about 50° C below temperatures typically found comfortable by western Europeans, a fall of 1/6 of the way to absolute zero. These temperatures were presumably measured in sheltered conditions. Any wind adds a "wind chill factor," which can lower the temperature by tens of degrees further, especially for objects with moisture to lose, such as human skin.

3. Film Cameras

By these are meant film as against videotape; they include still cameras. The comments here are taken largely from [4], an excellent paper which the reader would be well advised to study.

Cameras

Cameras suffer from several low-temperature problems:

1. batteries have poor output (affecting metering, autofocus, motor drives, and electrical shutters);
2. some parts, especially plastic, can become brittle and break easily;
3. lubricants (oil and grease) become more viscous and can flow too slowly;
4. dew (condensation) can form on the lens; and
5. dew can form in the viewfinder system, often inaccessibly (this may be a minor problem for the present expedition, where cameras will be set up on tripods while still warm and left unmoved).

These considerations argue for fully manual, mechanical cameras rather than electrically driven, electronically controlled automatic ones. (In particular, some autofocus mechanisms fail totally when presented with a night sky and hunt continuously, seeking focus.)

Russian cameras are designed for a domestic market including cold climates [4], though it is possible that export models will have different lubricants.

Second-hand pre-bayonet SLR cameras and lenses tend to be very cheap; a sensible option might be to buy several of each. Old Zenit bodies are Russian-made and rugged; no light meter is needed and only the Bulb shutter speed need work. (Check for 42-mm Pentax lens thread: very old ones used the Leica thread.) Pentax Super-Takumar lenses with 42 mm thread are excellent; the iris need not work, as it will be left wide open. For those with more money, the old Nikon F is built like a battle tank and is an object of beauty...

It may be necessary to provide a lens heater [5] to prevent condensation. This will require testing at low temperature (see Section 11 below). Its electricity must also be budgeted for when choosing batteries.

Film

Film becomes brittle at low temperatures; vigorous winding on and rewinding can snap it. This is another argument against motor drives, which are designed to wind fast. Estar base film can give an opposite problem: it can be stronger than brittle camera parts. It has been known for forceful winding of Estar film to damage cameras.

Cold air tends to be dry, and film moving against insulators (e.g., plastic camera parts and the cassette mouth) can generate static electricity. When this discharges the spark can fog the film, especially fast film. Once again, this argues for slow, manual (re)winding.

Cooling film reduces reciprocity failure [4,6]. This is probably a disadvantage for meteor photography, where reciprocity failure favors meteors over unwanted stars.

Film operational considerations

Organize yourself to minimize low-temperature operations. Load the first film before the night gets cold; unload the last one the next day, after the camera has warmed up. Keep spare film stock in a thermally insulated container, so it is loaded warm. After the night's operations, wrap each camera in a plastic freezer bag to prevent further condensation; do not open it until it has warmed up the next day. (Freezer bags do not become brittle at low temperatures.)

Ideally, film should be developed soon after exposure; this will be impractical on the expedition. It may be worth leaving the film cold as long as possible before the journey home to reduce loss of the latent image.

Do not assume that any film can be purchased on the expedition. Buy plenty of stock and take it with you.

If a film does break, remove it from the camera and store it in a black plastic film can; remember to label it clearly as containing bare film. This operation can be conducted in lit conditions by using a photographer's black bag (known as "Granny's Knickers"). Leave several empty black cans ready inside the bag.

4. Video equipment

Cameras

The above electrical problems apply here, but electricity is inevitable so they must be solved. Additionally, some camcorders have a dew detector which will prevent recording if dew is detected.

Whereas a reasonable strategy with film cameras is to choose them capable of withstanding the cold, for video a better strategy might be to insulate (lag) them (see Section 9). It would be desirable to have the viewfinder visible from outside to check for correct operation.

Camcorders may operate for many hours per night. This might favor a small number of large batteries (e.g., 12V 6 Ah sealed lead-acid, see Section 6), rather than several standard camera NiCd packs. If several such lead-acid packs are used, they could be arranged inside a single lagged container. The packs in the middle, where the cold will penetrate last, could be used last. Changing small packs on the camera lets the cold in through the insulation.

It is highly desirable to use intensifiers with the high-voltage supply entirely enclosed: if dew causes shorts, the personal hazard will be less.

See also the comments on use of electronics (Section 8), batteries (Section 6), and lens warming (Section 3, Cameras).

Videotape

These comments are again largely from [4], a paper worth reading. Some comments apply to audio tape, though this application is less demanding.

Poor-quality tape can shed some of its oxide. As well as losing information, this can adhere to the tape head and cause snow on later recordings. It might also damage tape and head. It would be worth examining tape specifications to see whether any claim a lower temperature limit.

It could be worth getting the camcorder professionally cleaned before the expedition. For those able to strip down their camcorder, cleaning heads with (e.g.) cotton buds (Wattestäbchen, higijenski pamućni štapići, coton-tige) is simple. A solvent such as iso-propyl alcohol helps.

Video operational considerations

Tape is more brittle at low temperatures, so minimize its use at night. Tapes can be rewound during the day when they have re-warmed. (This may also reduce the chance of accidentally over-recording a tape.) It is probably worth viewing at least one tape during the day-time to find any recording problems before the next night. The last tape would seem the obvious choice, as (*i*) all non-temporary problems should be present, and (*ii*) this was probably when the camera was coldest.

Electrical equipment generates heat while it is running; this will help to keep the equipment warm. The greatest benefit will occur if the equipment is lagged (Section 9). If batteries allow, it might be worth running a camcorder from the moment it is taken outside until operations cease, even if it is playing rather than recording.

5. General operational considerations

Before leaving home, make sure you can operate all the equipment under the expected conditions of use. This will probably include using it in the dark with thick gloves on. Operation includes mounting and dismounting cameras on the tripod and changing film or tape. Ideally, learn to do this on both snow and icy ground.

6. Batteries

All common batteries are less effective when cold. This affects capacity, which is measured in Ampère-hours (Ah) [7]. This measure is based on the simplifying assumption that, if twice the current is taken, a battery will last half as long. This breaks down at heavy currents, where less than the expected lifetime will be obtained.

Using batteries

There are four types most likely to be used:

1. Alkaline-Manganese (MnAl) cells of AA size, about 2.5 Ah (e.g., Duracell). To use lower quality on an expensive expedition would be false economy;
2. Nickel-Cadmium cells (NiCds) of AA size, about 0.8 Ah. Many camcorder packs contain these or similar sizes;
3. Car batteries, 12 V lead-acid batteries of about 40–60 Ah. It may be possible to tap off a local vehicle battery; and
4. Small sealed 6 V and 12 V lead-acid batteries of from 1 Ah to 100 Ah (e.g., Sonnenschein and Yuasa).

The temperature variation in capacity of these three chemistries is shown in Figure 1. For instance, a NiCd battery at −20° C has half the normal capacity, so if 1 Ah would be needed at normal temperatures, then 2 Ah must be provided. This may be achieved by having a larger battery or more batteries (assuming that power breaks to change batteries are acceptable).

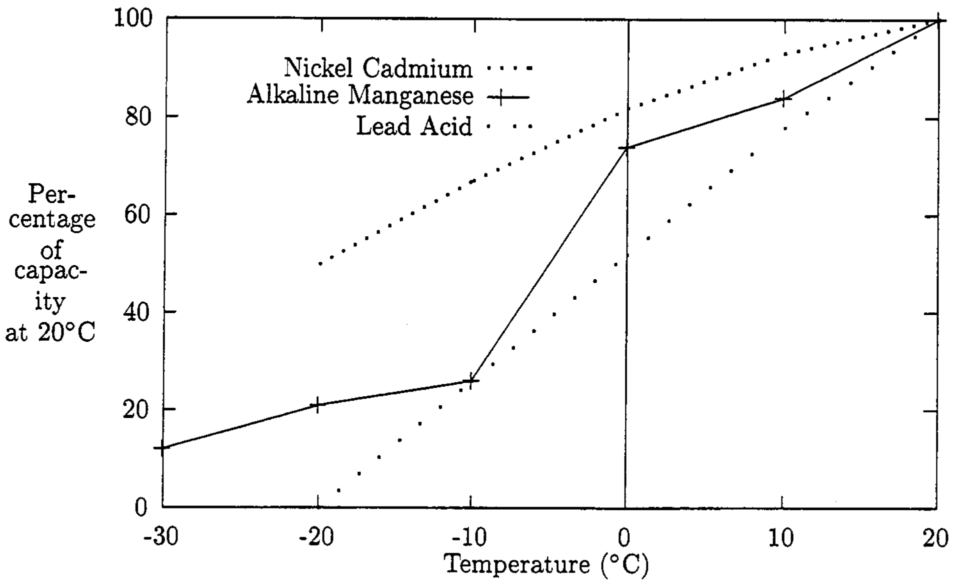

Figure 1 – Ampère-hour capacities of various cells depending on temperature, expressed as percentages of the capacity at +20° C (MnAl from Duracell data sheets; others from [8]). See text for details.

The information may also help choose battery type. Cells of sintered construction have better low-temperature performance than other types [9]. The newer Nickel/Metal Hydride batteries, which promise to be superior to NiCds in many respects, are said to be slightly worse than NiCds at low temperatures [8], though no figures are available.

Freezing of electrolyte

The freezing point will depend on the electrolyte used and on its concentration, but will be well below 0° C.

With lead-acid batteries, the concentration depends on the state of charge: as the battery discharges the concentration falls. Deep discharge can raise the freezing point as high as −8° C [10]. The initial stages of ice formation raise the battery's internal resistance, giving the appearance of a battery going flat. If the user reacts normally by changing battery, no immediate harm should result. Note, however, that the freezing point will remain high until the battery is recharged: if the night temperature continues to fall, more ice might form, expand and crack the casing. It would be wise to remove the discharged cell to a warm place or at least away from people and equipment which might suffer. Even without destroying the battery, ice can harm the electrodes.

NiCd batteries are less susceptible; the freezing point is normally below −30° C [11]. NiCds at the lower end of the expected temperature range might freeze. Again, the onset of freezing will produce an apparently flat battery, motivating its replacement.

Thermal insulation (lagging) for batteries

In some circumstances it may be possible to avoid problems by using batteries remote from the equipment and connected by a cable. The batteries may then be kept warm, for instance by being kept under the operator's clothing near the skin. Money belts and "bum bags" are possible containers; the batteries should be loaded into these before nightfall. A fuse next to the battery is advisable, as a short can cause a battery to get hot and explode—not desirable near the parts of the body where it is likely to be fastened.

Spare batteries should be stored warm. There is little point in replacing a flat battery with another so cold that it is effectively flat.

Batteries generate heat as they discharge, though the benefit may be negligible at the low discharge rates for electronic equipment. For a large lagged battery, it is conceivable that it might be worth using some of its power to run a small heater next to the battery, if this keeps the efficiency from falling. This would need a careful optimization study.

Recharging batteries

Apart from MnAl batteries, which are primary cells, the expedition's batteries will need to be recharged for the following night. If possible, this should be done at normal temperatures (say 10–30° C). This is probably easiest in the day. Batteries not thermally insulated will take some time to warm up, especially larger types. If batteries are recharged cold, there are various precautions which need to be taken regarding rates and maximum charging voltages [12].

Some pieces of equipment (e.g., camcorders) may use several batteries per night; all these need to be recharged before the next night. One option is to take one charger per battery and trickle-charge. Another is to fast-charge all batteries on a few chargers; this requires them to be at normal temperatures, and may require careful logistic planning.

The requirement for recharging probably argues for the expedition being based somewhere with a mains supply, e.g., in a town, rather than camping in the wilds. Avoid assumptions about mains sockets available: take distribution boards, a traveler's adaptable plug, and some tools. Chargers take little current. Recharging from a vehicle could be considered, but will need some technical preparation.

Most battery types deteriorate if left fully discharged. If time is short after the last night, it is better to charge all batteries for 1/4 or even 1/10 of the normal time than to leave some discharged.

7. Design of electronics

Many electronic components other than batteries are affected by temperature. The following comments are addressed to those who may design equipment for the expedition; since they will be a minority, the notes are brief with pointers into the literature. The section is also addressed to users of electronics so they may appreciate why electronics suffers from cold.

Integrated circuits are specified for operation within a certain temperature range. The lower limit is very variable; figures ranging at least from 0° C (typical for TTL) to −40° C or −55° C (for CMOS) are found. Equivalent components are available to military standards which will operate over wider temperature ranges.

Other components such as resistors, capacitors, transistors, Zener diodes, and crystals have values which change with temperature [13–15]. The change is specified by the temperature coefficient: the proportional change per degree Celcius increase in temperature. Resistor coefficients range from a few to nearly a thousand ppm/K (parts per million per degree). Capacitors are generally worse.

Techniques exist to reduce these effects [13–17]. Sometimes both positive and negative temperature coefficients are encountered, for instance with capacitors. Rather than use a single capacitor in a critical place, two may be combined, one of positive and one of negative temperature coefficient. These can be arranged for a small net temperature coefficient. Crystals (used for accurate timing) are often placed in Crystal Ovens, thermostatically controlled to an optimum temperature. Zener diodes can be arranged to have zero temperature coefficient [15].

Some cable insulation is brittle at low temperatures. At our temperatures, PVC and Polypropylene are poor. Other plastics and most rubbers are good. The best are PTFE and Silicone rubber [18].

The rate of change of temperature can be a problem: fast changes imply higher temperature gradients. These can set up mechanical stresses in constructions of more than one Temperature Coefficient of Expansion [13,16,17].

Both these thermal effects can be reduced by thermal insulation (see Section 9).

One should also consider moisture (see Section 10). Techniques of soldering can contribute to reliability too [19].

8. Use of Electronics

In principle, it is easy to use the information above to help make the right purchase of equipment. In practice, (*i*) it may have already been bought; (*ii*) the specifications may not mention temperature; (*iii*) no available equipment may give adequate cold performance; and (*iv*) other quality criteria may be more important. It may be necessary to live with poorly specified equipment by good operational practice.

One such practice is lagging (see below). Some of the suggestions made there involve equipment modifications. Many are simple but, if the reader does not feel capable of them, another expedition member or a friend could probably do the work. Other ideas involve the way that batteries (see Section 6) and camcorders (see Section 4) are used.

9. Thermal insulation (lagging)

Realistic lagging is unlikely to keep equipment at room temperature but could raise the temperature usefully. Equipment consuming more electricity will keep itself warmer. The advantage of keeping equipment running was discussed in the context of video (see Section 4).

A flexible container ("jacket") might be devised to contain the equipment. Possibilities for the insulating material include material intended for mountain clothing (maybe cut from discarded clothes) or bubble-pack as used for shock-proof packaging. This could be stitched to an outer cloth case fastened shut with Velcro. All other things being equal, the heat loss will be proportional to the temperature difference, proportional to the surface area and inversely proportional to the thickness of the lagging. (This assumes conduction to dominate; even if convection or radiation contribute, it should be approximately true.)

For lenses, to avoid heaters, several stacked UV filters could be fitted to the front as double, triple, or higher glazing. Too many may vignette; if uncoated, light loss may be significant.

Rather than opening the lagging or operating controls through the flexible material, it might be better to have a remote control outside the insulation. If this were home-made it could have large, widely spaced switches, easy to operate with cold, gloved hands. It could be worth buying a manufacturer's remote-control lead and rebuilding it in a different box with better switches. A wire connection would probably be more reliable than a radio or infrared link. See the comments (Section 7) on wire brittleness.

If the lagging is good, the main heat loss may well be through a few small, highly conductive places. Possible examples are the following:

1. any optical components (e.g., lens, viewfinder). These will probably present a major problem as they are essential and may be large. They may also be black and radiate efficiently in the thermal infrared. "Multiple-glazing" should help, as glass transmits little thermal infrared;
2. any tripod mount (probably metal); it might be worth making a tripod fitting extender of insulating material;
3. Any controls. Remote controls are preferable; or
4. Any other way of getting data in or out (e.g., microphone, loudspeaker). If possible, these could be put on extension leads.

Some of the suggestions involve exporting components outside the insulation; these must then be capable of operating at low temperatures. By and large the components exported will be simple and non-critical in operation, such as switches, rather than sensitive ones such as rotating video heads.

If equipment with highly efficient lagging is operated at normal temperatures, it may over-heat and suffer damage.

10. Moisture

Another environmental effect of a cold night is precipitation (dew, hoarforst). Dew is distilled water, but may pick up ionic solvents from the surface of any circuit it condenses on. Such conductive liquids could pose a threat to equipment reliability [13], especially with CMOS circuitry which is sensitive to small currents. This can be avoided by building the equipment in waterproof boxes. One measure of waterproofness is the IP (Intrusion Protection) rating [16,17]. The ratings are of the form "IPij," where "i" indicates resistance to solid objects and "j" to liquids, higher numbers being better. Containers to IP65 are splash-proof but not water- (and therefore air-) tight, but will probably slow ingress sufficiently to last a few nights. Better containers to IP68 are now readily available.

Desiccatives such as silica gel can be included in the equipment container, whether waterproof or not, to delay the effects of moisture. For the purposes of the expedition, only a few nights' protection is needed, and the equipment could be opened and dried during the daytime.

An alternative suggestion from the cave radio community, where waterproofing is always a problem, is to wrap the equipment within its case in disposable babies' diapers (Gill, *personal communication*). These contain highly absorbent material.

11. Testing the equipment

Few of the expedition members will have encountered the extreme conditions anticipated. It is highly advisable to perform such equipment testing beforehand as can be arranged. The wilds of Mongolia at the height of a meteor storm are no place to decide that one needs to return to Potsdam to buy a better-quality videotape or an extra battery. The author's experience in a different context (electronics in caves, another demanding environment) is that equipment will normally fail until the designer has made three or four trips to the environment, improving construction techniques each time. The failures are normally annoyingly minor, such as moisture, broken connections, and batteries which had been thought to be properly charged.

Equipment can be tested at low temperatures (typically $-18°$ C) in a domestic freezer [4]. The suggested procedure is as follows. Load the film, videotape, or audio tape. Seal the equipment in a plastic freezer bag to exclude moisture. Leave it in the freezer to equilibrate, preferably overnight. While the equipment is still cold, operate it; replace in the bags after the tests. Check that camera irises will operate smoothly and instantly; the oil can become sluggish. Gloves can be tested for insulation and flexibility at the same time. If the results are satisfactory and the freezer allows, the temperature can be lowered and the tests repeated. When finished, allow the equipment twelve hours to warm up before opening the bags. The recordings can be examined. In the case of film, no prints are needed; examine the negatives for unusual exposure patches which might indicate stress or static electricity. The author [4] warns against risking expensive equipment in such a test. On the other hand, the cost of a middle-price camcorder may be small compared with the cost of going on the expedition.

Reality normally presents practical problems not encountered in such tests. (See, for instance, Maunder's comments [4] on getting tripod legs to stay still on ice.) It would be advisable to try the equipment out in snow conditions as cold as possible, for instance high in the Alps. Winter 1997-98 will be the last opportunity before the expedition.

12. Redundancy

It may be a fact of life that equipment will fail on the expedition. Some protection against this can be achieved by redundancy, that is by having spare equipment. This can be achieved by taking extra pieces. It can also be achieved less expensively by arranging that different items of equipment can use each others' components, for instance lenses, batteries, and videotapes. If equipment is bought for the expedition, these considerations might affect the purchase decisions. This probably requires liaison between the potential expedition members during the first three quarters of 1998, to allow testing in the following winter.

One way of sharing batteries is to have adaptor leads to connect external batteries to pieces of electronics. This leads to dangers to the equipment. There is a small number of connectors commonly used to feed power into equipment and little standardization of voltages or even polarity. To make things worse, many of these types of connector will fit each other (often making unreliable contacts). It would be entirely possible to feed a video-camera with too high a voltage or even reversed polarity, probably destroying it. Mistaken connections will be easier to make in the dark and during the hurry and excitement of a spectacular shower. Some form of protection, whether by connector type or visible marking, would seem worthwhile. It might also be wise to agree beforehand how such accidents are to be regarded, for instance as misfortune to be accepted without rancor.

13. Medical dangers from cold

Almost everyone knows of cold as a form of discomfort. Those who are used to mountains know of it as a condition which can kill. The expedition will be to low altitudes, but most of the thermal conditions of mountains will occur. The effective temperature also depends on the wind speed (Figure 2).

The temperatures anticipated for Siberia and Mongolia could be below anything normally experienced in Europe or America: they deserve respect and adequate precautions. With such precautions, knowledge, and cautious behavior, there should be no serious danger.

The following is a summary. More information is available in [20]; a copy of this will be supplied for the expedition.

Hypothermia

Normal body temperature is 37° C, though some people are slightly above or below this. The body reacts to cooling in several ways. Shivering generates heat. Control valves on blood vessels reduce blood flow to the skin. This saves the heat for the vital organs in the body core (brain, heart, lungs, kidneys) at the expense of the less important limb muscles and skin. If these reactions are inadequate, the vital organs will cool further and the victim may die.

Children, adolescents, the elderly, and the drunk are more at risk from hypothermia than others. Hunger reduces the body's ability to fight cold. Do not wait until suffering before eating: digestion takes energy, so the immediate result will be to make things worse. Mountain climbing is strenuous: the body produces heat which helps combat cold. Astronomical observation involves nothing more active than standing up, so conditions will be worse.

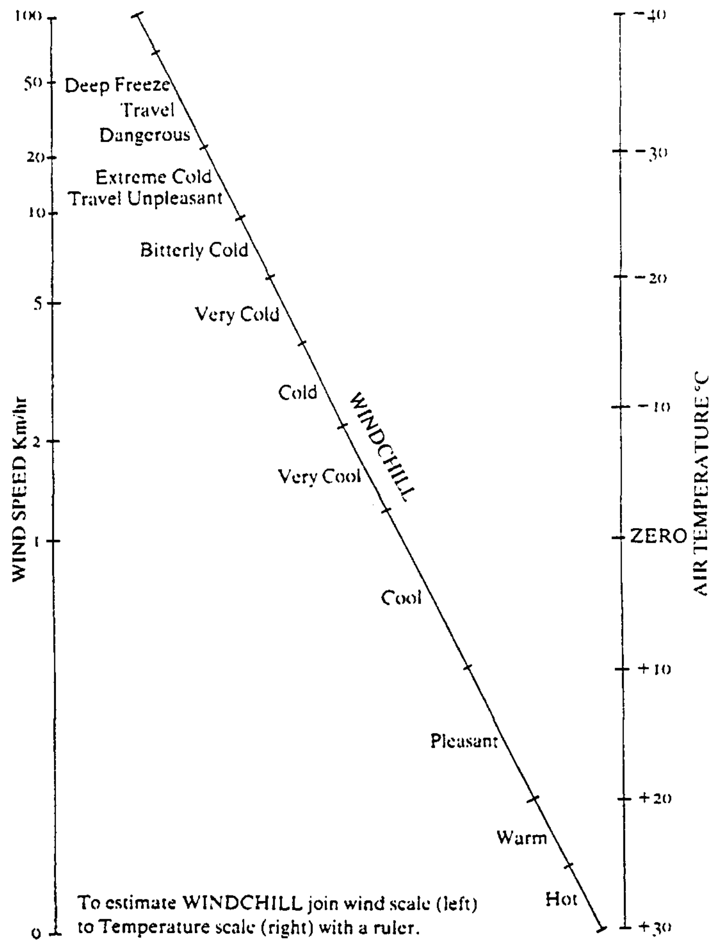

Figure 2 – Wind chill: effective conditions as a function of temperature and wind speed (from [20]).

There are three levels of hypothermia (mild, severe, deep); their treatments are different. In all cases, the aim is to remove the source of danger (the cold) and allow the body to re-warm, normally by its own resources. There are dangers in warming the casualty through the skin: the control valves will re-open and send still cold blood to the core, initially cooling it further. In some cases this can cause heart problems, especially to the young, the elderly, and anyone with a history of heart problems. Stimulants (tea, coffee, alcohol) also dilate the surface blood vessels and turn off this natural defense mechanism. Do not rub the hands: this warms them but not the core. Exercise can prevent hypothermia, but, once someone is seriously hypothermic, exercise can be dangerous: it is better to conserve their reserves of energy. Treatment of hypothermia can involve awkward compromises and guesswork about how bad the casualty is.

1. *Mild hypothermia* (core temperature 37° C–33° C). Casualty complains of cold. Skin is cold, pale, and blue-grey. Behavior may be unusual, e.g. excited or lethargic. Coordination and decision-making may be poor. Treatment: get the casualty into shelter. If clothing is wet, change it; if inadequate, add more. (If this is someone else's, beware of making them a second casualty.) Supply hot food or drink, but preferably not tea or coffee. If they are only slightly hypothermic, they may wish to exercise to warm up; if they are worse, conserving their energy may be better. Lying down is better than sitting which is better than standing, but, if there are only cold surfaces to lie on, a compromise must be made.
2. *Severe hypothermia* (core temperature 32° C–29° C). Shivering stops. Behavior may be irrational, apathetic, or aggressive. Muscles are rigid, movement is uncoordinated, breathing is rapid, eye pupils are dilated. Possible unconsciousness and irregular heart-beat may occur. Casualty will get worse with frightening speed. Treatment: get the casualty into shelter,

probably a vehicle. Take them immediately to hospital, even if they start to recover. On the journey, or while waiting for an ambulance, put them fully clothed into a sleeping bag. If unconscious, they may be stiff, so it may be impractical to change wet clothing. A fit expedition member should strip down to underwear and climb into the sleeping bag with them. Replace this person before he becomes hypothermic.

3. *Deep hypothermia* (core temperature 28° C or below). Breathing and heartbeat are almost undetectable. Casualty may appear dead. Treatment: as for severe hypothermia. Do not assume them dead—people sometimes recover from this condition.

Immersion hypothermia

Should anyone fall into water, they should be treated immediately without waiting to see whether they become hypothermic. Cold water can cool people extremely fast, prevent the muscles from working, and cause the victim to drown. Do not assume they can get out of the water unaided. However, going in to help risks a second casualty.

Frostbite

This is localized freezing of surface tissues. In practice it normally affects the extremities: fingers, toes, nose, ears. It is not fatal but can cause permanent nerve injury or even amputation.

1. *Superficial frostbite*. The most obvious symptom is painful coldness; the boundary between acceptable coldness and frostbite may be uncertain. Skin is white and waxy; it feels cold but is still soft. Treatment: act early to prevent frostbite starting. Jump up and down, wriggle toes, clap hands, swing the arms. Put a cold hand under your armpit, a cold foot on someone else's chest (if they will let you!). Cover ears or nose with warm hands. Avoid rubbing any cold part vigorously.

2. *Severe frostbite*. Skin blisters with blue patches occur; it feels solid. Cold feelings disappear: as with hypothermia, this is a sign of danger. Treatment: get the casualty into shelter; rest the limb. Cover the part with a plain, dry, non-sticking bandage. Do not burst blisters; avoid walking on blisters under the foot. If in any doubt, get medical attention later.

Frostbite of the hands should be obvious on this expedition, as most people will be operating cameras or at least writing notes. The feet require more conscious attention, especially if they start to go numb.

Precautions: clothing and equipment

Modern cold-climate clothing is excellent and quite capable of coping with climates far worse than the expedition expects. It is easily available from out-door sports shops, though small ones may lack the range of types. Much is expensive, especially jackets, good trousers, and boots. Some items could perhaps be borrowed.

1. *Upper body*. This needs several layers. At the bottom is a foundation layer of, preferably, thermal fabric such as Duofold. Over this come several pullovers or sweatshirts; many thin ones are better than a few thick ones. Next, a fleece is an excellent addition if available. On the top, a jacket will add insulation and normally waterproofing. Although rain is not expected, this top layer must be windproof. Some so-called windproof jackets, if not also waterproof, slow rather than exclude the wind. Since meteor observation is not strenuous, breathable fabrics are probably not needed.

2. *Lower body*. Again, this should begin with a foundation layer like that above. This should be full-length, coming down to the ankles. Excellent insulated trousers are available (e.g., Rohan Hot-Bags), some of which are also waterproof. Wet jeans are efficient heat exporters; jeans are well-known as being dangerous for mountain activities. Lightweight plastic over-trousers can add a water- and wind-proof top layer. The legs could be the weak point, as mountain climbing normally exercises them, and clothing thickness allows for this. Two or more pairs of trousers could be an advantage.

3. *Feet.* Heavy-duty walking boots will be best. They must be waterproof as snow can be melted by trampling; day-time will be above 0° C, and pools might not freeze before being stepped in. If possible, boots should be large enough to take two pairs of thick woolly socks; one pair is a bare minimum. Boots can be leather or plastic; there is much debate about which is better. Leather can freeze, especially if wet. Plastic boots are normally warmer [21], but have been known to shatter at extremely low temperatures [22]. Gaiters to cover the top of the boots and the bottom of the trousers can help keep snow out.
4. *Head.* This can lose more heat than the rest of a well-clad body. Bald people should take especial care. A woolly Balaclava hat will leave only the eyes and mouth exposed. A scarf can then be tied round the mouth: the damp breath will freeze in this, reducing loss of heat. If the jacket has a hood which can be put over the hat, so much the better.
5. *Hands.* Ordinary gloves will be inadequate; ones sold for mountaineering or maybe skiing will be needed. Mittens are better than gloves with fingers as they reduce the surface area, but operation of equipment will be difficult. A pair of silk or thin polypropylene gloves under the main ones is an advantage. They provide an extra layer, and the outer ones can be removed to operate delicate controls. Extremely cold metal can freeze to the skin if touched. Do not underestimate the effect of removing gloves briefly. The author once did so to change a lens part way up the Matterhorn. The gloves were off for less than 30 seconds, but it took almost 15 minutes before the hands stopped hurting from cold.
6. *Sleeping Bags.* Some will prefer to observe within one. If lying on the ground, think about heat loss into the ground. If sitting, remember dew. If not fully waterproof, the sleeping bag can be put inside a plastic survival bag. Avoid lying on anything (e.g., thorns) which might puncture it. If water soaks through, get out immediately. A camper's roll-up plastic mat will add insulation. An air-bed (Lilo) may be useful, if the plastic does not crack in the cold. A wider waterproof area will probably be needed behind the head and under the arms, should these be out of the bag to write notes.
7. *Sundry Equipment.* Plastic survival bags are cheap and useful in an emergency. A space blanket can make a tent round a hypothermia casualty. If boots get wet, plastic bags over the socks might help. Large plastic dustbin bags can keep wet clothes from soaking dry ones in a suitcase. Take easily digested high-energy foods such as chocolate and dextrose tablets (e.g., Dextrosol).

Operational considerations

A group provides safety, in that people can keep an eye on each other. Conversation enables people to detect if others are becoming miserable or acting strangely, but, if they stop talking, this may not be noticed. It may be sensible for one person to have the responsibility of assessing everyone regularly; all should worry if this person becomes silent! Standing may be better than sitting as it is more active and unconsciousness will be obvious.

Plan ahead. Will there be a vehicle with you all night? Will it start? How would you keep a casualty warm in the vehicle (maybe a lorry with metal seats)? How long is the journey to town? Where is the hospital, and is it open all night? Can you get into your hotel at any time of the night? If the vehicle takes a casualty away, what if a second person becomes hypothermic? An emergency is no place to realize you have not prepared well enough.

14. Conclusion

The proposed 1998 Leonid expedition will encounter extremely low temperatures, possibly as low as −38° C. Electronic equipment will behave differently. So will mechanical equipment: lubricants will be sluggish and some materials will be brittle. The cold will affect film, requiring careful handling, and cameras, arguing for non-electronic ones. Video equipment may need to be thermally insulated. Batteries may need such insulation, and more capacity will be needed.

People will be in danger, unless they are properly clothed and understand the risks.

It appears that all these problems can be solved with proper equipment and techniques.

In the course of writing this paper, the author has identified several areas where technical development will be needed. These include equipment lagging, remote controls, and gloves. Tests on batteries are needed as available manufacturers' information is inadequate. If possible, all important equipment should be tested before the expedition. This should include low temperature tests in a freezer and "moderate" temperature tests in cold winter conditions.

The *IMO* is faced with a significant technical challenge, but one which it appears to have the resources to handle.

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Results of Forward-Scatter Radio Observations

Eisse Pieter Bus

Summaries of forward-scatter radio observations are given for the 1995 α-Monocerotids, the 1996 Perseids, the 1994, 1995, and 1996 Leonids, and the 1996 Draconids. (All solar longitudes refer to eq. 2000.0.).

1. Equipment

Since 1993, meteors were detected by receiving forward-scattered VHF radio waves at a frequency of 66.89 or 72.11MHz. The receiver used was a Bearcat UBC 177XLT scanning radio with a RF sensitivity of 0.5 μV for a signal to noise ratio of 12 dB and an IF selectivity of 50 dB at approximately 25 kHz. The transmitters, Polish broadcast stations are located in Krakow (66.89 MHz) and Wroclaw (72.11 MHz), the receiver is located in Groningen, the Netherlands.

The path length between Groningen and Krakow is about 1000 km, and between Groningen and Wroclaw about 740 km. A three-element Yagi antenna with folded dipole was used at the receiving station. The antenna was directed to azimuth 106° (ESE) with an elevation of 9° towards Krakow and 13° towards Wroclaw. The main lobe of the antenna was directed towards the 100-km level, vertically above the mid-point of the transmitter-receiver path. Because of the long distances between transmitters and receiver, there is no aircraft interference. Also, there was no noticeable interference from other sources, like nearby transmitters or lightning. Some interference was caused by sporadic-E, aurora, atmospheric inversion, or nearby computers, but these interferences were easily recognizable.

2. Observations

"Sporadic" activity was observed by listening and counting in 5-minute intervals on days with no (or low) shower activity. Also on days with shower activity, the total meteor activity was observed by listening and counting in 5-minute intervals. The numbers are corrected for "dead-time." Dead-time marks the period in which a certain signal of amplitude may mask other signals of lesser amplitude. The dead-time corrections were applied according to the "Geiger-counter method."

However, if there are too many long-duration reflections, even with corrections for dead-time taken into account, the total number of meteors can drop below sporadic activity. This phenomenon was first observed with the Leonids in 1994, and also observed with the α-Monocerotids in 1995 and the Perseids in 1994, 1995, and 1996.

Hines [1] has developed the theory of the variation in the number of shower meteors observed by forward scattering of radio waves. In his publication, he gives an expression for the number of shower meteors counted in a given observation period for a given meteor radiant position at the mid-point of a transmitter-receiver path length of 1000 km. The calculated values of this "observability function" were normalized for the given observation period.

The net values of the shower meteors were calculated by subtracting the mean "sporadic" meteor counts as observed during the same observation periods. For each period, this net shower value was divided by the value of the normalized observability function to obtain the estimated true shower activity.

Wrong conclusions may be drawn if only raw uncorrected counts are used and no corrections are applied for the observability function. For instance, the most favorable antenna geometry for detecting Leonids for many West European radio-observers is around 7^h UT. Since wake-up of the Leonids took place in 1994, raw West-European radio-observations always show a peak around this time.

3. 1995 α-Monocerotids

Radio observations of the α-Monocerotids on November 22, 1995, clearly show an outburst with a maximum at 1^h29^m UT. The activity started between 1^h05^m and 1^h10^m UT with 6 long-duration reflections. The "sporadic" background level is below 1 long-duration reflection per 5-minute interval. No secondary or multiple peaks are observed. After 1^h55^m UT, the activity dropped below the "sporadic" background level.

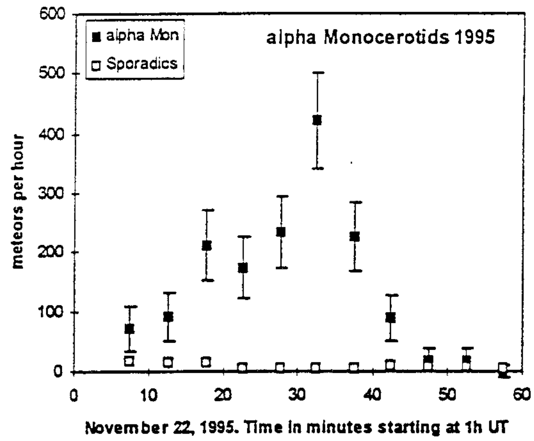

Figure 1 – Hourly α-Monocerotid rates (filled squares) on November 22, 1995. The data are corrected for dead-time, sporadics, and observability function. The bars represent one-sigma errors with the errors of sporadic activity taken into account. Also, the mean sporadic activity is given as recorded on November 24-25 and 25-26, 1995 (open squares).

4. 1996 Perseids

The radio observations of the 1996 Perseids show clearly the "new" and "traditional" peaks. There are no clear indications that the "new" peak shifts to later longitudes. The "nodal" peak around solar longitude $\lambda_\odot = 139.^\circ50$ and the second peak around solar longitude $\lambda_\odot = 139.^\circ63$ are still present. However, since my observations started in 1994, *only* the peak of long-duration reflections (more than 11 seconds = visual bright Perseid), is shifted to later longitudes.

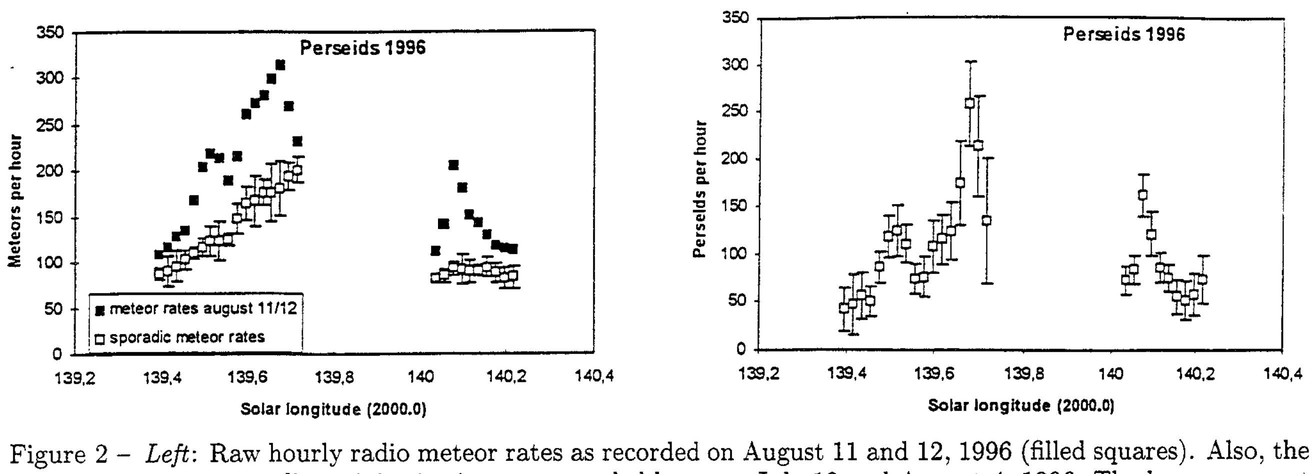

Figure 2 – *Left*: Raw hourly radio meteor rates as recorded on August 11 and 12, 1996 (filled squares). Also, the mean sporadic activity is given as recorded between July 13 and August 4, 1996. The bars represent one-sigma errors. *Right*: Hourly Perseid radio rates of the "new" and the "traditional" peak on August 11 and 12, 1996, corrected for dead-time, sporadics, and observability function. The bars represent one sigma-errors with the one sigma-errors of sporadic activity taken into account.

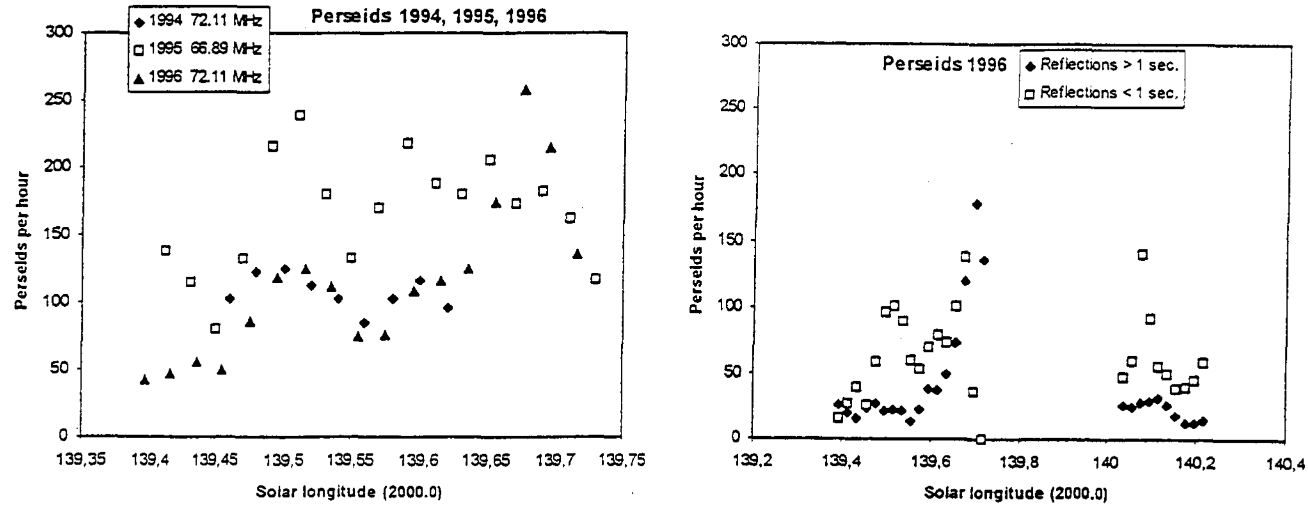

Figure 3 – *Left*: The corrected counts for 30-minute periods show two peaks for the Perseids in 1994 (filled diamonds), several peaks for the 1995 Perseids (open squares), and two peaks for the Perseids in 1996 (filled triangles). *Right*: Hourly Perseid radio rates on August 11 and 12, 1996. The open squares represent reflections of less than 1 second. The filled diamonds represent long-duration reflections (more than 1 second). This figure shows clearly the "nodal" maximum for short-duration reflections (less than 1 second) around $\lambda_\odot = 139.^\circ 50$ and the high maximum for long duration reflections (more than 1 second) around $\lambda_\odot = 139.^\circ 67$. At the end of the observation period the short-duration reflections (less than 1 second) dropped to zero. Probably, this is an artifact because of the unfavorable antenna-geometry at that moment, or probably saturation of the signals caused due the long duration-reflections.

That peak shifted from about $\lambda_\odot = 139.^\circ 50$ in 1994, to $\lambda_\odot = 139.^\circ 65$ in 1995 to $\lambda_\odot = 139.^\circ 67$ in 1996. It is very interesting to note that the solar longitude of the 1996 long-duration reflections coincides with the position found by Lindblad and Porubčan [2] based on bright Perseids in the period 1937–1985. The "traditional" peak is observed with a maximum at solar longitude $\lambda_\odot = 140.^\circ 09$.

5. 1994, 1995, and 1996 Leonids

My radio observations of the Leonids started in 1993, and the observations show evidently that wake-up took place in 1994 with a maximum at solar longitude $\lambda_\odot = 235.^\circ 82$. In 1995, the Leonids were already active on November 17 at 22^h UT and still active on November 18 at 10^h UT. Maximum activity was observed at solar longitude $\lambda_\odot = 235.^\circ 32$. In 1996, a double peak was observed, the first one at solar longitude $\lambda_\odot = 235.^\circ 16$. This position is the same as observed for the outburst in 1966. The second peak, higher than the first, was observed at solar longitude $\lambda_\odot = 235.^\circ 27$. This position is short after the Earth crossed the node of Comet 55P/Tempel-Tuttle ($\Omega = 235.^\circ 258$). It is very interesting to note that the position of the second maximum coincides with the predicted time of the maximum for 1996 computed by Yeomans, Yau, and Weissman [3].

6. 1996 Draconids

Since 1993, around the time the Earth crossed the plane of the orbit of comet 21P/Giacobini-Zinner at solar longitude $\lambda_\odot = 195.^\circ 398$; the number of meteor reflections was slightly higher than on the day before or after. In 1993, 1994, and 1995 this activity never exceeded the "sporadic" background level with more than 2 sigma's. Probably this (weak) annual activity was caused by particles of the comet.

In 1996 on October 8, the observing period was between 5^h00^m and 11^h30^m UT. Until 7^h30^m UT, the total activity was equal to the "sporadic" background level. After 7^h30^m UT, the total activity rose clearly above "sporadic" background level (more than 2 sigma's).

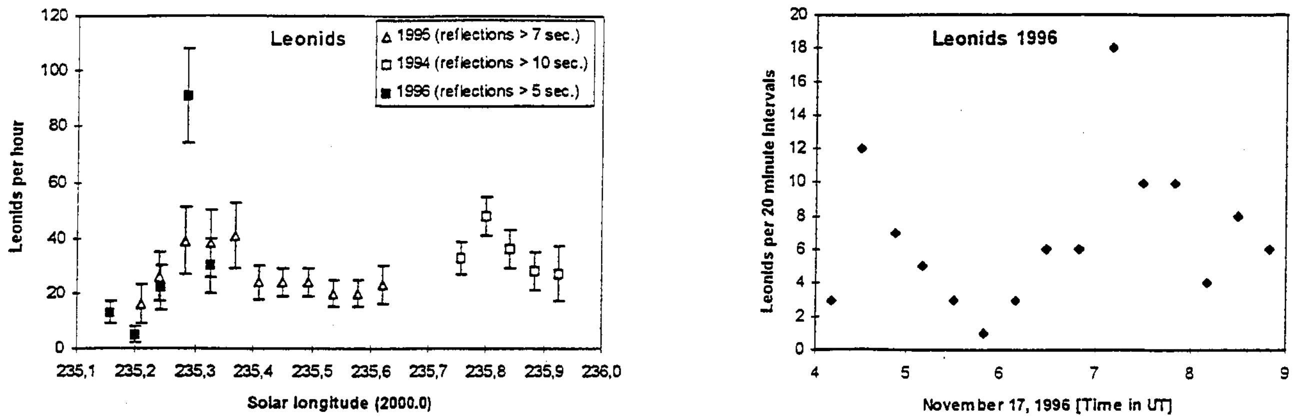

Figure 4 – *Left*: The corrected counts for 60-minute periods of the 1994 Leonids (open squares), the 1995 Leonids (open triangles), and the 1996 Leonids (filled squares). All observations are corrected for dead-time, sporadics and observability function. The bars represent one-sigma errors with the errors of sporadic activity taken into account. *Right*: Uncorrected Leonid rates per 20-minute intervals between 4^h and 9^h UT on November 17, 1996, for reflections of more than 5 seconds. There are two maxima, the first at 4^h38^m UT ($\lambda_\odot = 235.^\circ16$), and the second at 7^h18^m UT ($\lambda_\odot = 235.^\circ27$), with a minimum at 5^h50^m UT ($\lambda_\odot = 235.^\circ21$).

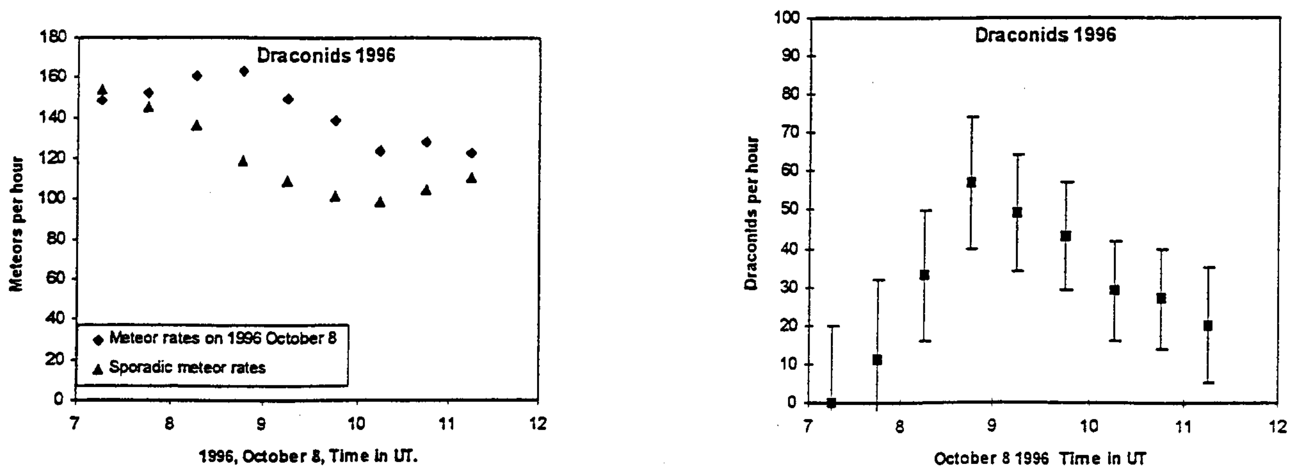

Figure 5 – *Left*: Raw hourly radio meteor rates as recorded on October 8, 1996 (filled diamonds). Also, the running mean of the sporadic activity is given as recorded on September 22 and October 6, 12, and 13, 1996 (filled triangles). On some days, only a part of the whole observation period of October 8 is monitored. *Right*: Hourly radio meteor rates (probably caused by Draconids) on October 8, 1996, corrected for dead-time, sporadics, and observability function. The bars represent one-sigma errors with the errors of sporadic activity taken into account.

A maximum was observed at 8^h50^m UT, almost exactly coinciding with the descending node of Comet 21P/Giacobini-Zinner. Only during one hour after 8^h50^m UT, there was an increase of long-duration reflections (6). In the period before and after that hour, the number of long-duration reflections was equal to the "sporadic" background level. This (weak) activity on October 8 is probably caused by the Draconids.

Acknowledgment

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A New Direction for the American Meteor Society

James Richardson

For more than a year now, I have dreamed of finding a way to bring the fractionated American amateur meteor science community back together again in a cooperative effort. The vision of all of us working together, rather than against each other, seemed a very worthwhile goal to strive for. I began discussing this idea with David Meisel in the spring of this year, and over the following months we worked to develop this vague concept into a workable proposition. During that time, we also solicited input from all of the *AMS* staff and our advisors, as well as taking a hard, serious look at the criticisms raised about our organization in the past. In response to these reflections, all of us worked hard over the course of this year to place the *AMS* house once again in order, and, by the fall, we believed that the time had come to open our doors.

On September 30, 1997, the American Meteor Society staff offered an extensive proposal (outlined below) to the leaders of the other American meteor organizations. After two weeks of deliberation and discussion, we are pleased to announce that the proposal has been accepted by all parties involved.

This is what we have accomplished:

Expansion of the AMS staff such that it includes all of those amateurs who are making a significant contribution to the American meteor science community. Concretely, we have appointed the following individuals to newly-created *AMS* staff positions:

Robert Lunsford, *AMS* International Liaison. As the official representative of the *IMO* in North America, we have asked Robert if he will expand his duties to include acting as the official liaison between the *AMS* and the *IMO*.

Mark Davis, *AMS* Assistant Visual Program Coordinator. Mark combines forces with Norman McLeod for the purpose of producing an active, continent-wide network of amateur visual observers for the purpose of monitoring both sporadic and shower activity, utilizing the most up to date professional level techniques. This will include the encouragement of all visual observers, from beginners to advanced, assisting in the collection, distribution, and archiving of visual data, with the specific goal of helping the *AMS* to shift over to more modern electronic techniques. It is also planned to begin conducting amateur-level analysis of collected visual data, publishing results in the new *AMS Journal*.

Lewis Gramer, *AMS* Assistant Electronic Information Coordinator. We have asked Lewis if he would serve as an assistant to Jim Bedient in coordinating and managing *AMS* Internet and other electronic media activities. Our goal is to utilize the Internet and other information technologies to the best advantage for the American meteor science community.

Serving as an umbrella and support organization for all American meteor organizations by providing research, publication, and archive resources; offering staff assistance and limited funding; and opening up additional avenues for professional-amateur collaboration and communication.

Concretely, we have successfully invited the following organizations to join with the *AMS* as affiliated groups: the *Association of Lunar and Planetary Observers* (*ALPO*) Meteors Section; the *North American Meteor Network* (*NAMN*); and the *New Jersey Astronomical Association* (*NJAA*) Meteors Section. Each of these groups will continue to function autonomously, and their members may choose to affiliate with *AMS* if they so desire. Our overall aim is to bring together our various groups in the spirit of cooperation for our mutual benefit, while continuing to preserve each organization's unique character and emphasis.

Initiation of a much higher level of cooperation between the AMS and the IMO by forming an active, cooperative, and mutually beneficial working relationship. Such a relationship would permit all *AMS* members and affiliates to contribute and participate on the global scale, especially in those areas which utilize visual observations. The cornerstone of this new level of cooperation will be a formal data exchange program between the *AMS* and the *IMO*.

In addition to data exchange, the *AMS* will encourage its visual observers to adopt professionally accepted standards for data collection, and to participate in programs for the global monitoring of meteor showers and meteor shower outbursts. In order to support current *AMS* research interests, we would ask that visual observers in all organizations be encouraged to collect data for sporadic meteor studies, especially during those hours and days which are not frequently covered through visual observation.

Conclusion

We are very sincere and serious in this effort to finally bring the American meteor science community together into an active, cooperative group. It will be especially gratifying to bring this about in preparation for the upcoming approach of Comet Tempel-Tuttle, as well as the beginning of the next century. We believe that this new direction for the *AMS* represents a grand opportunity to pool our various resources and talents to the best possible advantage for the American meteor science community.

I would like to personally thank all of these individuals and groups for joining forces with us to build the best *American Meteor Society* ever!

The International Meteor Organization

Council

President: Jürgen Rendtel, Gontardstraße 11, D-14471 Potsdam, *Germany*,
tel. 49 (331) 960 727, e-mail: `president@imo.net`

Vice-Pres.: Alastair McBeath, 12A Prior's Walk, Morpeth, Northumberld. NE61 2RF, *Engl.*,
tel. 44 (1670) 518 487

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tel. 32 (15) 41 12 25

Treasurer: Ina Rendtel, Mehlbeerenweg 5, D-14469 Potsdam, *Germany*,
tel. 49 (331) 520 707, e-mail: `treasurer@imo.net`
postal (giro) account number: 5472 34-107
bank code: 100 100 10 Postbank D-10916 Berlin
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Other council members:
Godfrey Baldacchino, "Sirius," Triq-Il-Migbha, ZBR 10 Marsascala, *Malta*
Peter Brown, Dept. of Physics, Univ. of Western Ontario, London, *Ont., N6A 3K7, Canada*
Marc Gyssens, Heerbaan 74, B-2530 Boechout, *Belgium*
Ralf Koschack, Innere Oybiner Straße 12, D-02763 Zittau, *Germany*
Robert Lunsford, Vance Street 161, Chula Vista, *CA 91910, USA*
Graham Wolf, Capital City Lodge, 82-88 Hanson St., Newtown, Wellington, *New Zealand*

Commission Directors

Visual Commission: Rainer Arlt, Friedenstraße 5, D-14109 Berlin, *Germany*,
e-mail: `visual@imo.net`

Telescopic Commission: M. Currie, 25 Collett Way, Grove, Wantage, Oxon. OX12 0NT, *Engl.*,
e-mail: `tele@imo.net`

FIreball DAta Center: André Knöfel, Saarbrücker Straße 8, D-40476 Düsseldorf, *Germany*,
e-mail: `fidac@imo.net`

Photographic Commission: Marc de Lignie, Prins Hendrikplein 42, NL-2264 SN Leidschendam,
the Netherlands, e-mail: `photo@imo.net`

Video Commission: Sirko Molau, Weidenweg 1, D-52074 Aachen, *Germany*,
e-mail: `video@imo.net`

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Addresses of authors not mentioned above

J. Rao, 57 Dogwood Lane, Levittown, *NY 11756-1527, USA*
D. Očenas, M. Razusa St. 5, SK-974 00 Banska Bystrica, *Slovakia*
P. Ziminkoval, Tatranska 6, SK-974 00 Banska Bystrica, *Slovakia*
C. Trayner, Electronic and Electrical Eng. Dept., Leeds Univ., Leeds, LS2 9JT, *England*
E.P. Bus, Eerste Spoorstraat 16, NL-9718 PB Groningenm, *the Netherlands*
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