The INSPIRE Journal

Volume 13 Number 1

November 2004

In this issue:

Robert Bennett of Las Cruces, New Mexico, describes how he went about finding a new observing site (Page 6).

Assistant Professor Bjorn Gitle Hauge of Østfold University College Norway relates the history of the "Hessdalen Phenomena", strange lights that appear in the Hessdalen Valley in Norway (Page 16).

Assistant Professor Leif Lervick of Østfold University College Norway describes Science Camp held for Norwegian junior high school students in the Hessdalen Valley (Page 29).

Two special offers for those who like to build INSPIRE receivers:

Purchase a VLF2 INSPIRE receiver for $50. This is the version that preceded the LF3.

Purchase a printed circuit board for the RS-4, the original INSPIRE receiver, for $10

Details are on Page 4.

Table of Contents

Miscellaneous Notes 3
- INSPIRE VLF2 Receiver Close-out Sale
- Build a Piece of History: An INSPIRE RS-4 Receiver
- Coordinated Observation Program Resumes!
- Field Observations are Another Way to Participate!
- Subscription Information Included on the Address Label
- Write for *The INSPIRE Journal*

Permanent Coordinated Observation Schedule 4

Field Observation Schedule 5

Site Selection for Monitoring Natural Radio signals 6
- Robert Bennett, Las Cruces, NM

10 Years of Scientific research of the Hessdalen Phenomena 16
- Bjorn Gitle Hauge, Østfold University College, NORWAY

Science Camp 29
- Leif Lervik, Østfold University College, NORWAY

Report on Coordinated Observations 33
- Shawn Korgan, Gilcrest, CO
- Robert Bennett, Las Cruces, NM

Report on Field Observations 45
- Linden Lundquist and Brian Cowan, Watrous, Saskatchewan, CANADA

INSPIRE Log Forms 48

INSPIRE Order Form 50

The INSPIRE Journal
Volume 13 Number 1
November 2004

The INSPIRE Journal is a publication of The INSPIRE Project, Inc., a nonprofit educational/scientific corporation of the State of California. The purpose of the INSPIRE Project, Inc., is to promote and support the involvement of students in space science research. All officers and directors of the corporation serve as volunteers with no financial compensation. The INSPIRE Project, Inc., has received both federal and state tax-exempt status (FEIN 95-4418628). The *Journal* is published two times per year: November and April.
Submission deadlines: October 1 and March 1

Contributions to the *Journal* may be sent to:

Bill Pine
1348 N. Quince Ave.
Upland, CA 91786

email: pine@mail630.gsfc.nasa.gov

Fax: 909 931 0392

INSPIRE VLF2 Receiver Close-out Sale!

A few VLF2 INSPIRE receivers are available for sale. The price is $50 including shipping! The kit comes complete with all electronic components and assembly instructions. If you would like to purchase one, first send an email message to:

pine@mail630.gsfc.nasa.gov

and I will set one aside for you. Send your order to the address shown at the bottom of Page 2 in this *Journal*. When payment arrives, I will ship the kit.

Build a Piece of History: An INSPIRE RS-4 receiver

I have a small supply of RS-4 receiver printed circuit boards (PCBs). The "RS" in the "RS-4" stood for Radio Shack because it was originally designed using parts available from Radio Shack. I cannot guarantee that all parts are still available from Radio Shack, but I think that Mouser would be able to fill any gaps. The PCB comes with a set of assembly instructions and the price is $10 including shipping. If you have experience building electronic devices and some spare parts, you might be interested in this offer. If you would like to purchase one, first send an email message to:

pine@mail630.gsfc.nasa.gov

and I will set one aside for you. Send your order to the address shown at the bottom of Page 2 in this *Journal*. When payment arrives, I will ship the PCB.

Coordinated Observation Program Schedule Available

See Page 4 for a complete description of the new Coordinated Observation schedule.

Field Observations are Another Way to Participate!

See Page 5 for a description of field observation procedures.

Write for *The INSPIRE Journal*

The procedure for contributing articles for *The INSPIRE Journal* could not be simpler! Just send it in! Any format is acceptable. Electronic format is easier to work with. A Word file on disk for either the PC or Mac platform is preferred. An email message will work, too. If that does not work for you, a paper copy will do. Any diagrams or figures can be scanned in.

What about topics? Anything that interests you will probably interest most INSPIRE participants. As long as the topic is related to natural radio or the equipment used, it will get printed. The deadlines for submissions are March 1 for the spring edition and October 1 for the fall edition. Don't worry about the deadlines, though. If you miss a deadline, you will just be very early for the next edition!

We at INSPIRE are looking forward to hearing from you.

Permanent Coordinated Observation Schedule

The Coordinated Observations will be held on the first weekend of October and the last weekend in April. This schedule will apply to all future Coordinated Observations. There will not be a separate schedule published in each *Journal*. All data is welcome and should be submitted even if the conditions are quiet. Any data you can contribute is valuable. The procedure to use for Coordinated Observations will be as follows:

1. Use the Data Cover Sheet and Data Log forms found at the end of the *Journal*. (Make copies as needed.)
2. Put a voice introduction at the start of each session indicating your name, your INSPIRE Team name (and number, if assigned), the date, local time and UT time.
3. Record for 12 minutes at the start of each hour that you can monitor on the specified days. Keep a detailed written log of all signals that you hear and indicate any items of interest. When you submit your tapes, spectrograms will be made of any parts of the tape that you indicate.
4. Place a time mark on the tape on the hour and each two minutes for the next 12 minutes. Use Coordinated Universal Time (UTC) for all time marks.

Local Time to UT Conversion Table

EDT + 4 = UT
CDT + 5 = UT
MDT + 6 = UT
PDT + 7 = UT

Next Coordinated Observations:

April 30 – May 1, 2005

5. Record at 8 AM and 9 AM **LOCAL** time.
6. In addition, record on other hours to compare results with those in neighboring time zones. For example, an observer in the Central Time Zone might record at 7 AM (8 AM EDT), at 8 and 9 AM CDT and at 10 AM (9 AM MDT).
7. Use 60 minute tapes (30 minutes per side) with two sessions per side. It is preferred that you record on one side of the audio tape only.
8. Label all tapes and logs to indicate the sessions monitored and send to:

   Bill Pine
   1348 Quince Avenue
   Upland, CA 91786

9. Your tapes will be returned with spectrograms of your data. An article reporting on the results will appear in the next *Journal*.
10. SPECIAL NOTE: If you are hearing whistlers, replace the data tape after 12 minutes with a "Whistler" tape and continue recording with time marks every two minutes. If we get whistlers, this would be a good opportunity to try to determine the "footprint" of a whistler (the "footprint" is the geographical area where a whistler can be detected).

Field Observation Schedule

Field observations may be made according to the following schedule:

ANY TIME !

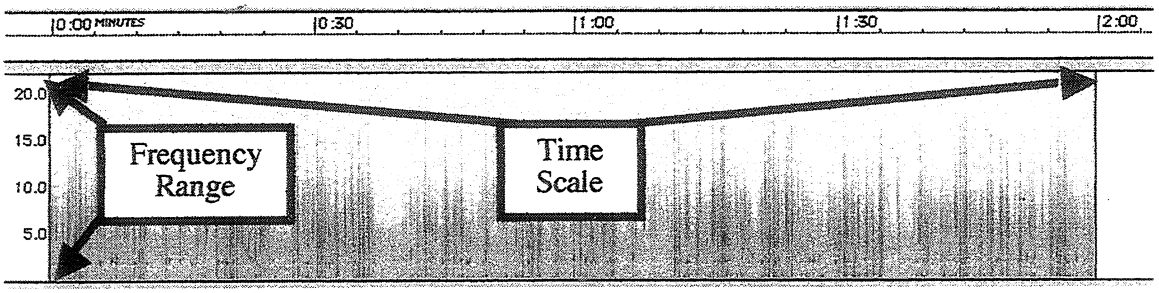
In addition to an article reporting on the Coordinated Observations, will be an article on Field Observations. These observations may be made at any time and submitted for inclusion in the next *Journal*.

Use the same procedure as described for Coordinated Observations (Page 4). Since field observations can be made any time of year, the following table is provided for conversion from local time to Coordinated Universal Time (UTC).

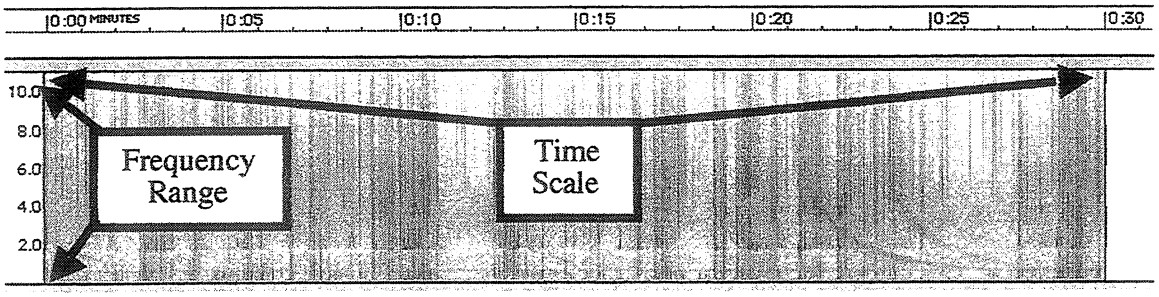
Local Time to UT Conversion Table

EST + 5	=	UT	EDT + 4	=	UT
CST + 6	=	UT	CDT + 5	=	UT
MST + 7	=	UT	MDT + 6	=	UT
PST + 8	=	UT	PDT + 7	=	UT

Sample Spectrograms:



This spectrogram is for two minutes using a frequency range of 0 - 22 kHz.



This spectrogram is for30 seconds using a frequency range of 0 - 11 kHz.

Site Selection for Monitoring Natural Radio Signals

Robert Bennett
Las Cruces, NM

For the past 15 years, I have used a location on the USDA Jornada Experimental Range about 20 miles from my home for monitoring. Permission to use the site was obtained from the range manager through an informal agreement. However, in 2003, the USDA decided to increase security at all their facilities and I was told that I would no longer be allowed access without formal authorization. I attempted to obtain the necessary authorization but was not successful. I will miss the convenience of this location.

Thus I was forced to search for alternate sites. New Mexico is a very large state and it didn't seem a good idea to try sites at random in a hit or miss fashion. In my former job, I had the opportunity to become familiar with the tools and techniques used by intelligence organizations to search for and evaluate potential radio intercept sites. So, I decided to apply some of these tools to my search for a new monitoring site.

This paper discusses the techniques and tools that I used over the past 12 months to find acceptable places for a natural radio monitoring station. Most of this material is applicable to any region; however, there are a few specific items that apply only to desert locations.

The first step in the process was to develop some criteria that potential sites must meet. The criteria can be derived by answering the following questions:

1. *What do I want to monitor?*
2. *When do I want to monitor and for how long?*
3. *How far am I willing to travel to get to the site?*
4. *What safety issues must I address?*

My answers to the above questions are in the following paragraphs.

1. What do I want to monitor?

There are two natural emissions of interest to me. The first is the INSPIRE observations of lightning induced sferics, whistlers, tweeks and chorus. The second is Radio JOVE observations of the noise bursts generated when electrons spiral in planetary magnetic fields. The frequency bands of interest are the VLF band (about 100 HZ to 20 KHZ) and the upper HF band (20-30 MHZ).

It is well known that natural radio signals are easily masked by various man-made electromagnetic emissions (e.g. interference). The most troubling interference source is the 60-cycle AC power grid. AC Power lines tend to radiate broadband signals that will easily mask natural radio signals for a mile or more. Although it is possible to reduce the 60-cycle interference by filtering and other signal processing techniques, I am of the opinion that the best cure to the AC problem is to monitor from a site that is as far removed from AC power lines as possible.

Other sources of interference that have to be considered are AM broadcast stations, LORAN transmitters, government and commercial VLF/LF/HF communications facilities,

ignition noise from motor vehicles, generators, and arc welding.

Additional noise sources exist but are less severe than the above and can usually be dealt with. These include buried pipelines, electric fences, underground telephone cables and people walking near the natural radio antennas.

To find a suitable site, one must know how far away from the interfering sources is far enough. I developed the following separation distance criteria. Some of these are based on my 15 years experience monitoring in desert terrain and others are extracted from the literature (see references).

Table 1 Initial Site Criteria.

SOURCE of INTERFERENCE	DISTANCE (minimum).
AC Transmission lines	5 miles
AC Distribution lines	1 mile
Loran Transmitters	20+ miles
Other VLF transmitters	20 miles
AM broadcast transmitters	10 miles
Arc welding	1-5 miles
Roads with traffic	100 yards
Running motor vehicles	100 feet
Stationary engines (generators and pumps)	100 Yards
Electric fences	100 feet to 1 mile (Depends on type)
Other fences	100 feet
Buried pipelines (Safety Issue)	1 mile
Buried telephone cables	100 feet
Trees	2 times height

Discussion:

a. AC Transmission lines are high voltage (100,000 volts or more) 3-phase lines that are usually supported on metal towers. These lines connect generating plants to major substations (transformer yards) that are normally close to cities. Not all substations are located in cities. I have found substations located "in the middle of nowhere".

b. AC Distribution lines are the lines that connect the substation to the consumer. These lines are normally 10,000 volts or less and supported on wooden poles. One way to identify a distribution line is to follow the line and if you find a pole-mounted transformer with wires going from the transformer to a building, then it is a distribution line.

c. Loran, AM broadcast and VLF/LF transmitters are often a problem and the separation distance given above may not be adequate to eliminate interference. However, the distance given should be adequate to get out of line-of-sight of the interfering station and provide some terrain shielding. Other techniques such as filtering can then be used to reduce the interference.

d. Buried pipelines and telephone cables are listed because I have found that some have AC power lines buried alongside them to operate pumps and repeaters at remote locations. The author unknowingly set up a natural radio whip antenna above a buried telephone line and was surprised to hear not only AC hum but also telephone conversations. Also, pipelines are a potential safety hazard due to possible leaks and they should be avoided. All pipeline companies in this area recommend that people stay well away from their pipeline right of way and all above-ground facilities.

e. Be wary of fences. I have observed increased pick-up of interfering signals close to fences, especially long fences. Be cautious if the fence wires are insulated from ground and their support posts. It might be an electric fence. These will give a nasty shock and depending on the type of fence charger, may radiate interfering signals.

f. Trees. Here the issue is placing the natural radio antenna under the drip line of a tree. This will usually cause a significant drop in received signal levels. This discussion has nothing to do with using the tree itself as the antenna.

2. When do I want to monitor and for how long?

The answer to this question is basically implied by what I want to listen to. In the USA Southwest Desert Regions, the best natural radio-monitoring period is usually from about 0500 to 0900 local time. Radio Jove monitoring is usually from about 2000 in the evening to just before local sunrise.

These times imply that either I arrive on site in the late afternoon or early evening and spend the night or else leave home in time to arrive before about 0400 local time (assuming that an hour will be required for equipment set-up and adjustment). I much prefer to arrive in the early evening and spend the night at the site. I don't enjoy driving over desert trails in the dark.

As for how long I will remain on-site, I usually keep the on-site stays to 12 hours or less due to family commitments. I will normally use the site four to six times per year.

3. How far am I willing to travel to get to my quiet site?

First, I don't like backpacking and prefer to use a truck to get to the site. For my initial search, I set a limit of 150 miles from home. I also set a secondary limit of 4 hours travel time. In my area, almost all potential sites will require a combination of freeway, secondary road and desert trail driving. The desert trail portion often consumes a lot of time, as speeds on the trails are only 5-10 MPH.

4. What are the safety considerations?

Under safety considerations, I lumped several issues. The first is site access. All proposed sites should be accessible by a road that is passable in dry weather by a 4-wheel drive vehicle. Wet weather access is not generally required.

The proposed site should have a clear flat area close to the road to park the truck and set-up the antennas and other equipment. An area of 20x20 feet is adequate. The access road should have no more traffic than one vehicle per hour and preferable none after dark.

The proposed site should not be in a campground, picnic area, or close to hiking trails. These areas normally have a fair amount of man-made radio noise and people walking around. It

has been my experience that deploying antennas and cables near where people walk is asking for trouble; someone is likely to trip on a cable or knock over an antenna and possibly injure themselves.

As my radio monitoring often requires late night observations, personal safety must be considered. It is best to avoid areas were people tend to congregate and party. In New Mexico, young people will sometimes congregate in the desert and spend several hours or all night drinking beer and doing other activities. Sometimes these parties can get out of hand and become violent. There are some trails and roads in the desert used by "illegals" to avoid Border Patrol checkpoints. I checked with the Border Patrol to find out which areas, roads and trails should be avoided.

The final safety issue deals with communications. As many of the potential sites are likely to be remote and isolated, some means of calling for help is desirable. It has been my experience that in New Mexico, cell phone coverage is at best spotty and usually unreliabable when one gets more that a few miles from the major freeways and towns. I always check to see if a proposed site is in the coverage area of an amateur repeater and if so will deploy a 2-meter transceiver. If no 2-meter coverage is available, I will take along an HF transceiver. I usually arrange a check-in schedule with a friend or family member. It is very important that someone know the exact location of the site (including GPS coordinates) and the roads being used to access it.

Selecting a Site

The next step in the process was to apply the above criteria and identify some potential sites. On my first attempt at this. I found that two criteria (travel time and vicinity to power lines) have overriding importance and will tend to eliminate many areas. The process that follows is formally called a "site survey". A complete site survey consists of five steps:

1. Map Survey
2. Reconnaissance
3. Identify Potential Sites
4. Sample Monitoring
5. Analysis Phase

1. Map Survey. The first step is to obtain the necessary maps (not easy in small towns). I used three different types of maps: large scale (1:500,000) maps such as the landscape maps found in a state atlas for initial planning, 1:250,000 scale terrain maps such as the USGS N1 series for potential site selection, and, once a potential area for the monitoring site has been found, small-scale digital terrain maps with a scale of around 1:50,000. It is important that all the selected map sheets have the latitude and longitude grid printed on it. Road maps of the area of interest are also useful. I used both paper copy maps and computerized digital maps.

Using travel time and distance criteria information, I began to identify possible areas on a large-scale map. On the map I first excluded any closed areas such as military facilities and impassable terrain (such as sand dunes and lava flows). I identified two regions or areas to investigate further. One area is about 90 miles by 30 miles in size and lies to the north of my home. This area is outlined in Figure 1. I also selected an area of about 50 miles by 40 miles that lies to the northwest of my home. For the sake of brevity, I will only discuss the northern area.

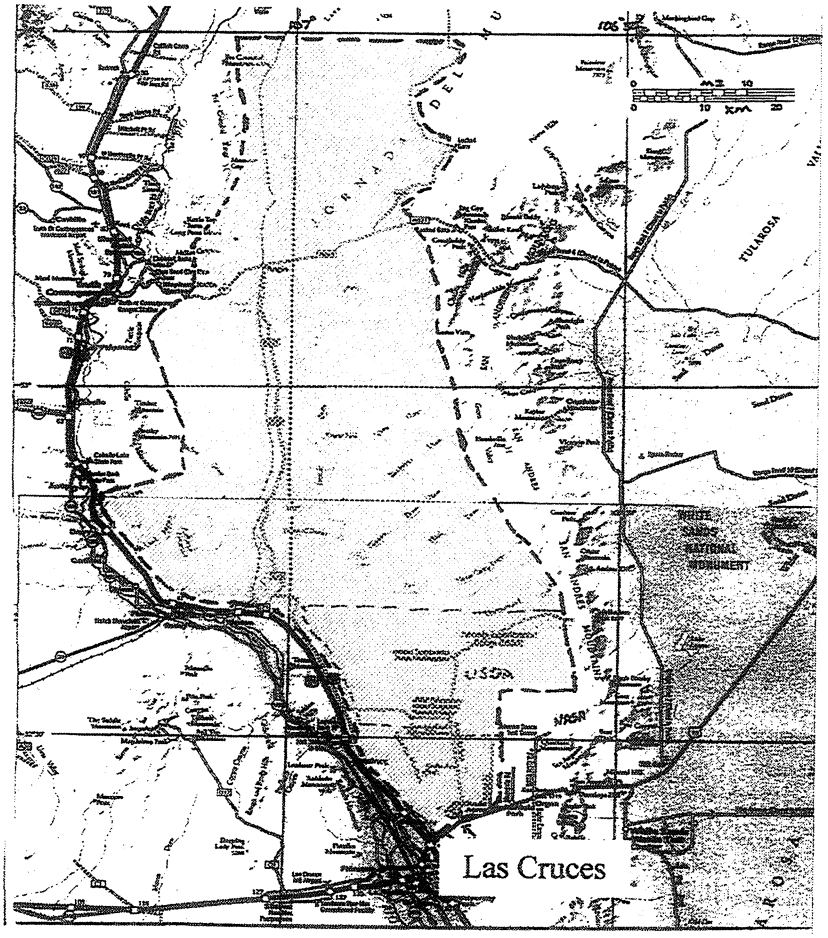


Figure 1

The Northern selected area.

The heavy dashed lines on the map (gray shaded area) identify the area I selected. My home location is shown on the bottom center of the map. There are two areas at the bottom of the map that are closed to the public that I excluded.

2. Reconnaissance. The second step is the initial drive-through or reconnaissance. I started by planning a route through the selected area (using road maps) that utilized as many of the primary and secondary roads as possible. The routes I used are shown in Figure 2. At this point, I attempted to avoid the unimproved roads and trails. The object was to drive the roads and observe the area and its features. I made frequent stops to record observations. During the reconnaissance, I noted the following things and recorded their locations in my log. A GPS unit makes this work much easier.

a. Power lines, both transmission and distribution systems. Also, the location of any substations seen.
b. Railroad tracks.
c. Pipelines. Pipelines can be hard to locate. The best technique is to watch for signs that are placed on both sides of a road where the pipeline crosses.
d. Houses and ranches.
e. Communications facilities. Watch for towers and antennas.
f. Airports and private airstrips.
g. Oil wells and related facilities.
h. All government and military facilities that are not marked on the map.
i. The presence of "no trespassing" signs.

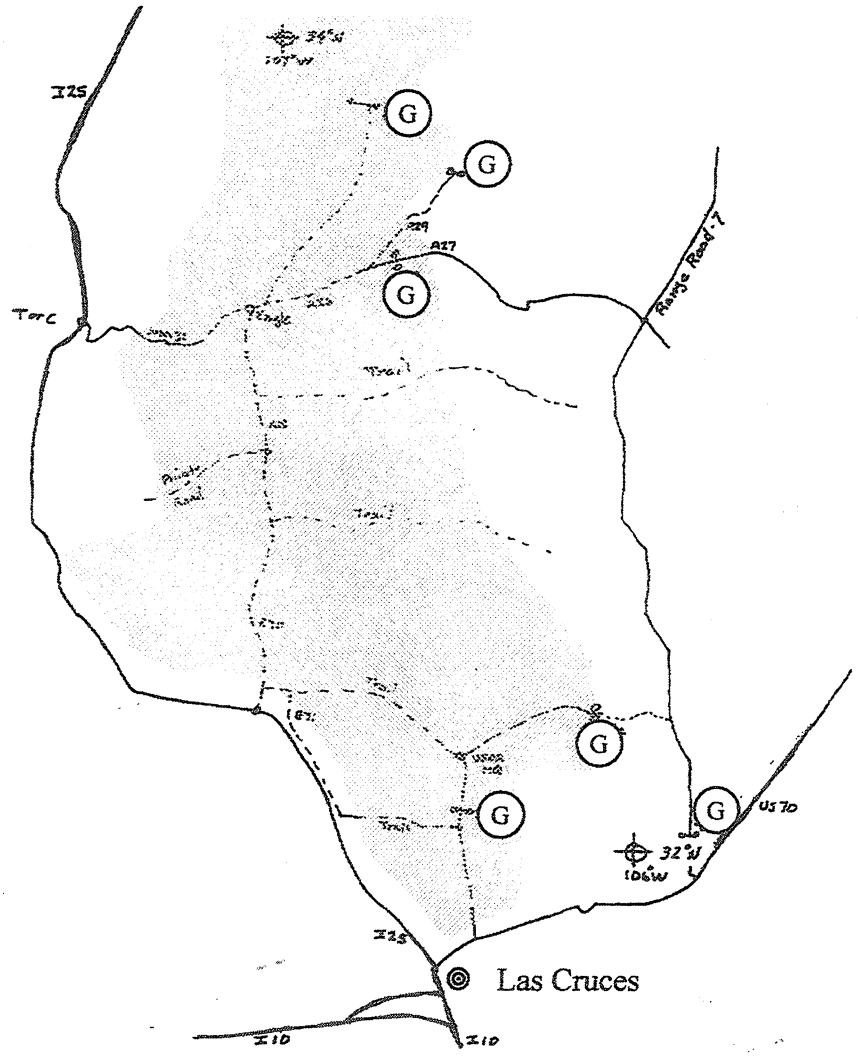


Figure 2

A map overlay showing roads that I explored in the selected area of interest. There is a very large military complex to the west of the chosen area. Note that many of the roads and trails end at locked gates ((G)).

The initial reconnaissance was time consuming. It took me over three days to scout the area shown in figures one and two. The results from the reconnaissance were then used along with the criteria listed above to identify potential locations for the monitoring site. It is sometimes necessary to reject an area if it is full of power lines, has high power radio stations, or contains many oil wells and associated plumbing.

If communications sites or other facilities with towers were observed, then a second reconnaissance trip is indicated. For each site observed, I needed to determine if the site has transmitters that could cause me problems. I used several techniques to do this. First, if I could locate the access road to the site, I would drive to it and check it out. This was sometimes difficult, as the access roads are generally not marked on publicly available maps. When I found an access road, I would either drive or walk and get as close to the facility as possible. Generally, there will be a sign posted at the gate giving a telephone contact number; name of the owner and often the FCC assigned call sign. I usually took a picture of the tower and antennas, and record in my notebook the GPS location of the site and the photo number. (Note: it is **not** a good idea to photograph military or government facilities!).

The one piece of information needed about each communications facility is the frequency

band in use. This can most easily be determined with a handheld frequency counter and can often be determined by the antenna configuration. Failing this, a search of the on-line FCC database by call sign will sometimes yield the needed information. If the call sign is not available and antenna classification fails, for non-government facilities the Fryer's Site Guide will often reveal the owner and a telephone number. Calling the listed telephone number will sometimes result in the needed information but often results in seemingly endless transfers to different people. Figure 3 shows the locations of the communications sites that I found. Note, I made additional overlays similar to Figure 3 showing transmission lines, pipelines, ranches, and airstrips.

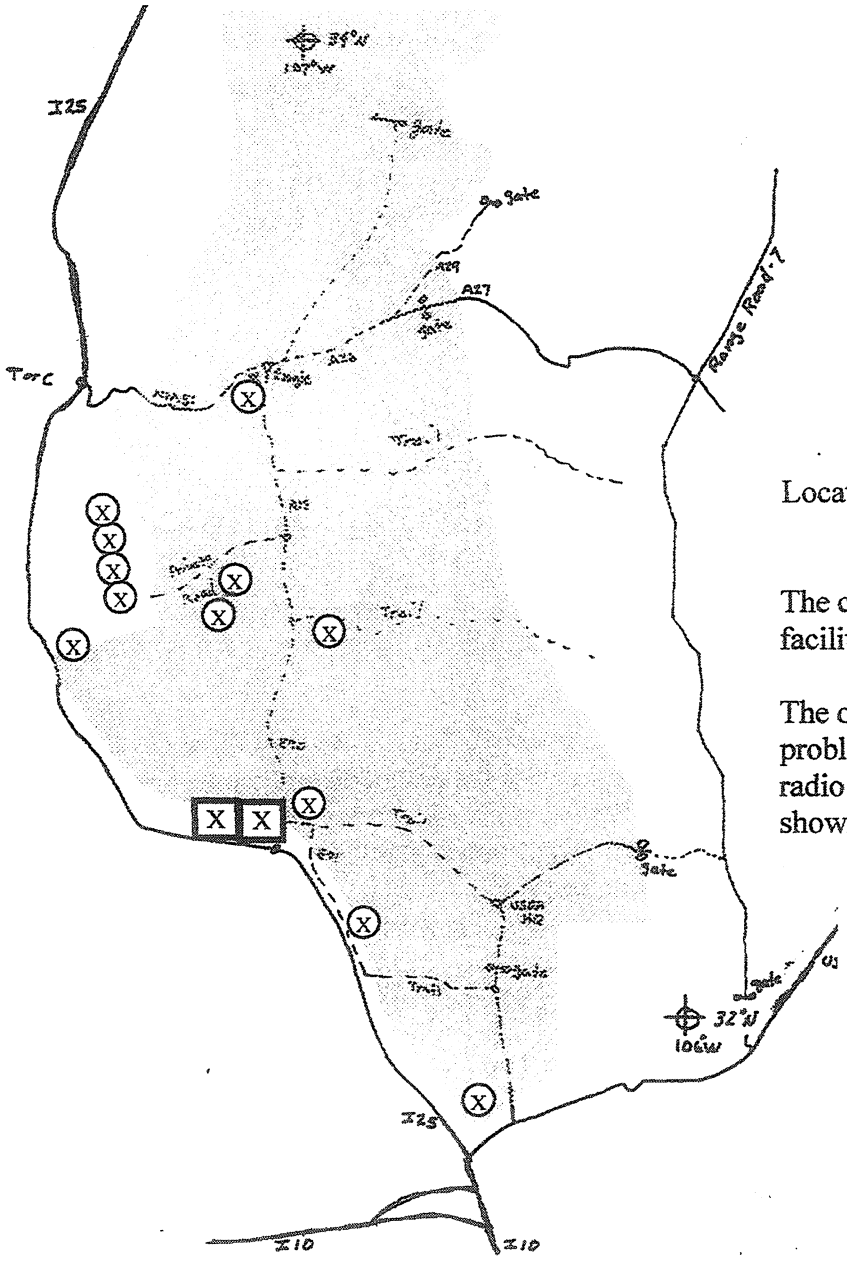


Figure-3

Locations of communications facilities.

The communications facilities are denoted with (X)

The only ones that might be a problem are the two AM radio broadcast stations shown with [X]

3. Identify Potential Sites. The next step is to identify some potential sites that meet the criteria given above. With all the above data in hand, it is possible to select a few potential sites. I selected 15 potential sites for farther evaluation. The number of sites selected was constrained by the time available to evaluate them. The potential sites should, to the extent possible, be scattered throughout the area that was scouted. Figure 4 shows the locations of the potential sites I selected.

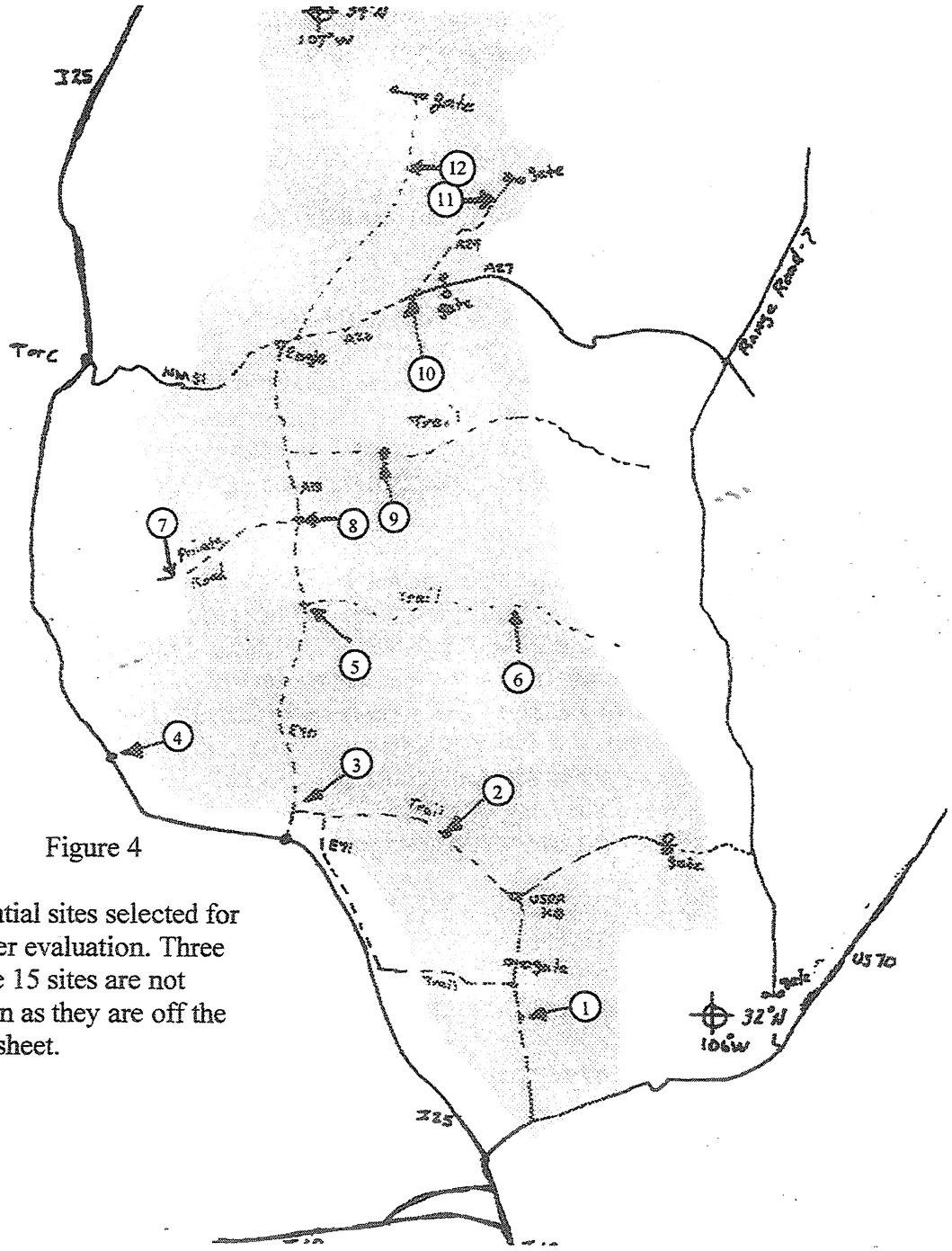


Figure 4

Potential sites selected for further evaluation. Three of the 15 sites are not shown as they are off the map sheet.

With potential sites selected, the next step was to determine the best route to get to each. This was not as simple as it seems. Often, maps will show unimproved dirt roads and trails to potential sites. At least in the local desert, I have found most of the map information to be inaccurate. The roads shown are sometimes blocked or abandoned. The desert is also filled with roads and trails not shown on the map. The best approach is to plan a route using a map and establish GPS waypoints along the roads shown on the map to the potential site. If the map is inaccurate, it will become evident when trying to drive to the GPS waypoints. Also, for personal safety, I always made sure I was properly equipped in case I had to spend the night in the desert and made sure someone knew where I was going and when I would return.

4. Sample Monitoring. When I reached each potential site, or as close as I could get to it, the first thing I did was look around the area for "no trespassing" signs and for a clear spot wide enough to park my truck and set up. If I found any "no trespassing" signs, I would immediately leave the site. If everything looked ok, I set up my natural radio receiver, WWV receiver, and recorder and made at least one 30-minute recording. I also set up a handheld frequency counter (Optoelectronics Scout) to check for nearby transmitters. I usually remained at the site for an hour or two. In additional to the natural radio recording, I observed any traffic along the access roads and looked for signs that the area is being or has been used by other people (beer and soda cans, and other trash might indicate a party site). I also looked for freshly spent gun cartridges and looked for evidence of old mining activity. In New Mexico, many old mines have not been properly closed and are a hazard.. I rejected any potential site that is posted, has evidence of party activity, has old mine shafts nearby or had more than one vehicle per hour along the access road.

5. Analysis Phase. Of the fifteen potential sites that I selected, I succeeded in collecting data at 11 of them. The others were not suitable on first examination (too difficult to get to, power line too close or access roads blocked). The data I collected at each of the 11 sites consisted of audio recording of natural radio signals, hand written log sheets with miscellaneous observations and some photos. Over about a two week period, I analyzed each audio recording using both GRAM and SpectraPlus programs. I did a quantitative assessment of the relative amplitude of 60-cycle and Loran interference and did a qualitative assessment of the general natural radio environment at each site. I found two very quiet sites with no 60-cycle interference and very weak Loran. I also selected the next two best sites that had acceptable levels of Loran and 60-cycle interference. Of course, the best site is also the most difficult one to reach. The site easiest to reach has just acceptable levels of 60-cycle interference.

Next actions. Starting in December 2004, I intend to conduct both daytime and nighttime monitoring sessions at the four northern sites and try to select two sites, a primary and an alternate, for future monitoring.

I have not completed my test monitoring of the western area and hope to do that in December/January. Hopefully, by the time of the next INSPIRE Coordinated Monitoring, I will have several good sites to choose from.

With potential sites selected, the next step was to determine the best route to get to each. This was not as simple as it seems. Often, maps will show unimproved dirt roads and trails to potential sites. At least in the local desert, I have found most of the map information to be inaccurate. The roads shown are sometimes blocked or abandoned. The desert is also filled with roads and trails not shown on the map. The best approach is to plan a route using a map and establish GPS waypoints along the roads shown on the map to the potential site. If the map is inaccurate, it will become evident when trying to drive to the GPS waypoints. Also, for personal safety, I always made sure I was properly equipped in case I had to spend the night in the desert and made sure someone knew where I was going and when I would return.

4. Sample Monitoring. When I reached each potential site, or as close as I could get to it, the first thing I did was look around the area for "no trespassing" signs and for a clear spot wide enough to park my truck and set up. If I found any "no trespassing" signs, I would immediately leave the site. If everything looked ok, I set up my natural radio receiver, WWV receiver, and recorder and made at least one 30-minute recording. I also set up a handheld frequency counter (Optoelectronics Scout) to check for nearby transmitters. I usually remained at the site for an hour or two. In additional to the natural radio recording, I observed any traffic along the access roads and looked for signs that the area is being or has been used by other people (beer and soda cans, and other trash might indicate a party site). I also looked for freshly spent gun cartridges and looked for evidence of old mining activity. In New Mexico, many old mines have not been properly closed and are a hazard.. I rejected any potential site that is posted, has evidence of party activity, has old mine shafts nearby or had more than one vehicle per hour along the access road.

5. Analysis Phase. Of the fifteen potential sites that I selected, I succeeded in collecting data at 11 of them. The others were not suitable on first examination (too difficult to get to, power line too close or access roads blocked). The data I collected at each of the 11 sites consisted of audio recording of natural radio signals, hand written log sheets with miscellaneous observations and some photos. Over about a two week period, I analyzed each audio recording using both GRAM and SpectraPlus programs. I did a quantitative assessment of the relative amplitude of 60-cycle and Loran interference and did a qualitative assessment of the general natural radio environment at each site. I found two very quiet sites with no 60-cycle interference and very weak Loran. I also selected the next two best sites that had acceptable levels of Loran and 60-cycle interference. Of course, the best site is also the most difficult one to reach. The site easiest to reach has just acceptable levels of 60-cycle interference.

Next actions. Starting in December 2004, I intend to conduct both daytime and nighttime monitoring sessions at the four northern sites and try to select two sites, a primary and an alternate, for future monitoring.

I have not completed my test monitoring of the western area and hope to do that in December/January. Hopefully, by the time of the next INSPIRE Coordinated Monitoring, I will have several good sites to choose from.

References.

The following books, reports and documents contain material relevant to site surveys and the siting of monitoring stations. I have also included some references that can aid in the identification of communications facilities. Many of these may be difficult to locate as they are not the kind of materials that most public libraries will have. The best place to find them is in the engineering section of a large university library.

1. Spectrum Monitoring Handbook, International Telecommunications Union (ITU), Geneva, 1995.

2. Spectrum Monitoring and Utilization, CCIR, ITU, Geneva, 1986

3. Radio Science Observing, Volume 1, Carr, Prompt Publications, 1998.

4. Site Survey Guide, NSA Technical Manual, US Department of Defense, 1958.

5. Naval Shore Electronics Criteria for Communications Station Design, NAVELEX 0101-102, US Navy, 1973.

6. Naval Shore Electronics Criteria for VLF, LF and HF Communications Systems, NAVELEX 0101-103, US Navy, 1972.

7. Radio Frequency Interference Handbook, NASA SP-3067, NASA Goddard Space Flight Center, 1971.

8. Fryers Tower Site Guide, NM, AZ, TX, and CO edition, 2001, Fryers Inc.

9. Manual of Regulations & Procedures for Federal Radio Frequency Management, NTIA, US Dept of Commerce, 2002. (Lists the frequency bands used by the federal government).

10. Federal Communications Commission WEB Site, HTTP://wireless.fcc.gov/uls

11. THE LOWDOWN, journal of the Long Wave Club of America (LWCA), and their WEB Site- HTTP://www.lwca.com

12. The VLF Group, WEB Site http://groups.yahoo.com/group/VLF_Group/

10 Years of Scientific Research of the Hessdalen Phenomena

Assistant Professor Bjørn Gitle Hauge
bjorn.g.hauge@hiof.no
Østfold University College Norway

"Convengo dedicato a Le Ricerca Italiana nella Valle di Hessdalen, Norwegia"
Citta di Cecina, Italy Marzo 2004

1. Abstract

The author has for the last decade been a member of the Hessdalen project research team, and participated in the development of the Hessdalen Interactive Observatory, also called "Blue Box". The author has a master's degree in electronics and specializes in electromagnetic transmission. The author has long experience with radar and radio transmission from the Royal Norwegian Navy. Assistant Professor Erling Strand, the founder of the Hessdalen Project, conducted together with the author the first international congress of the Hessdalen phenomena in 1994. This congress attracted scientists from all over the world and boosted the scientific research in Hessdalen. Statements from the congress indicated that explanation of the phenomena could lead to new concepts in physics. This congress also started the collaboration between Østfold University College in Norway and CNR in Italy. Together with Dr. Stelio Montebugnoli, the author started the EMBLA project with the purpose of studying the electromagnetic radiation and behavior of the Hessdalen phenomena in 1999. The author has participated in a number of investigations in Hessdalen, and last in the CIPH winter mission

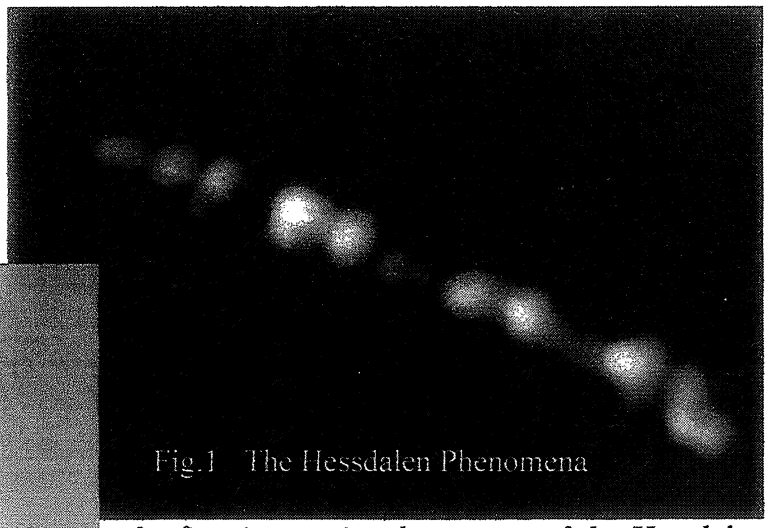


Fig.1 The Hessdalen Phenomena

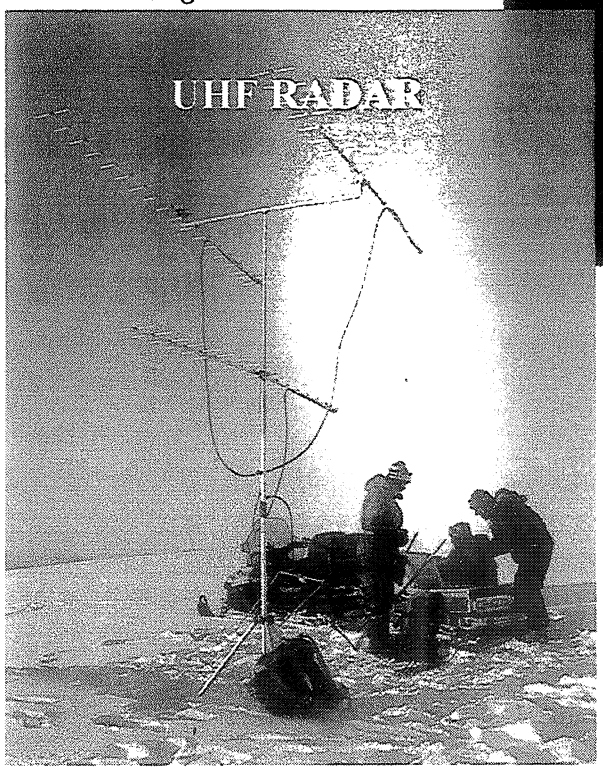


Fig.2 CIPH winter mission 2004

in Hessdalen 2004. Several students from Italy and Norway have also been involved. Since 1998, automatic surveillance of the valley has been done by the "Hessdalen Interactive Observatory". Despite the 24 hour surveillance and well manned and equipped research campaigns in the EMBLA project, no mayor breakthrough has been made. Spectacular pictures and video recordings have been obtained, but correlation with other scientific measurements is hard to find. No "fingerprint" of electromagnetic radiation from the phenomena has been obtained which can identify an unknown light source as the real Hessdalen phenomena. The research has so far demonstrated that the Hessdalen phenomena is difficult to investigate and explanations hard to find. Despite this, the EMBLA/CIPH team has gained significant experience in this kind of scientific study and is possibly the most competent team to carry out such expeditions in the world. The key to the solution lies in scientific knowledge and economic resources and this solution may show us the way to a new storage mechanism for energy.

2. *The Hessdalen Project 1984*

Mysterious lights have been seen flying around in the Hessdalen valley for over 100 years. The intensity of their appearance made a peak in the period of 1982-1985. Lights were seen daily in this period, and the Hessdalen lights became a world known tourist attraction. No scientific investigation was done until Dr. Erling Strand and his team created "Project Hessdalen" in 1983. During a four week long winter mission in 1984, important data was obtained. Results from this campaign were significant: 53 observations were classified as the Hessdalen phenomena, HP. The phenomena were also seen on radar while invisible, indicating that it was going through different phases and releasing energy. The HP was also observed standing still in the middle of the valley for nearly two hours. No other campaign has managed to come even close to the amount of data. The next campaign, Phase 2, was carried out in the winter of 1985 by the same crew, with more instrumentation and better infrastructure. No results were obtained due to heavy winter storms. One research team had to be rescued down from the Rogne Mountain; winter times are dangerous. Scientific reports from Phase 1 were published, and Dr. Erling Strand held numerous speeches around the world for the next 10 years. In 1994, the first international scientific congress was held in Hessdalen. This started a new era of scientific investigation in Hessdalen.

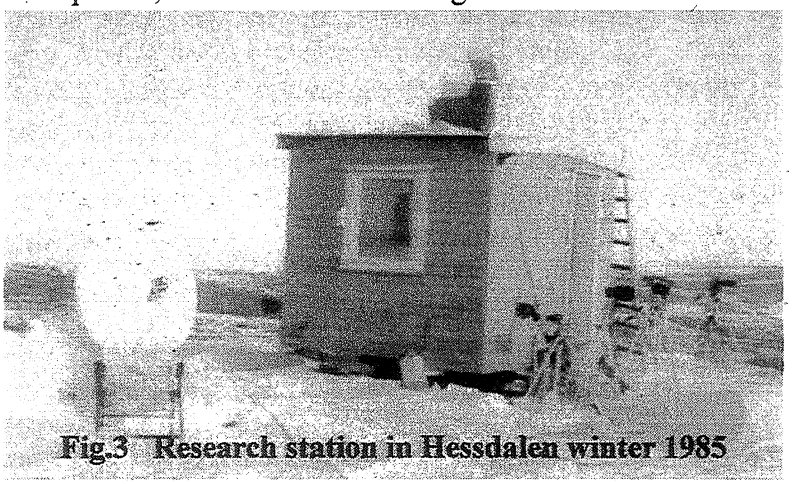


Fig.3 Research station in Hessdalen winter 1985

3. *The First International Scientific Congress 1994*

In the winter of 1994, 28 researchers from all over the world met in Hessdalen for the first scientific congress about the Hessdalen phenomena. Professor Boris Smirnov, nominee for the Nobel price, and Dr. David Fryberger from Stanford Linear Accelerator Center, SLAC, were of the opinion that the Hessdalen phenomena cannot be explained by today's mainstream physics and that further

investigation of the phenomena could lead to new concepts in physics. Several papers and speeches were presented at the congress, but no one was able to explain all of the artifacts with the phenomena (see Table 1). Among the most interesting theories discussed was the "self-contained electromagnetic field theory", "ball lightning model & fractal structure theory" and "rotating plasma theory". The congress urged that investigation of the HP must be intensified and that permanent instrumentation should be installed in the valley. The congress was not able to advise about what kind of instrumentation should be used in the hunt for the phenomena. The congress was given high attention in the media and focused upon scientific investigation. This congress helped move the scientific investigation out of "dead water". Speculation in the media and rumors of supernatural beings and flying saucers had since 1985 halted scientific investigation. No researcher dared to risk his reputation entering this field of investigation. The congress "opened" Hessdalen for scientific research. Attending this congress was astrophysicist Dr..Massimo Teodorani. His publications and connections in Italy would later give birth to Project EMBLA and his work was vital for development of the Hessdalen project.

Fig.4 First international congress of the Hessdalen phenomena

Theory	Speaker	Country
Ball lightning process/fractal structure	Prof. Boris Smirnow	Russia
Self restricted EM field	Dr. Gert H. Arnhof	Austria
EM standing waves	Dr. E.T. Protasevitch	Russia
EM impulse	Ass.prof. Erling Strand	Norway
Tectonic stress	Researcher P. Devereux	England
Rotating plasma	Prof. Y.S Zou	China
Plasma formation process	Prof. Edward Manykin	Russia
Vorton driven ionized gas	Dr. David Fryberger	USA

Table 1. Theories presented at the 1994 Congress in Hessdalen

4. *The Medicina Congress*

Shortly after the congress, Dr. Stelio Montebugnoli was informed about the congress in Hessdalen by Dr. Massimo Teodorani. Dr. Stelio Montebugnoli invited Assistant Professor Erling Strand and Assistant Professor Bjørn Gitle Hauge to visit the CNR radio telescope, located in the small village of Medicina outside Bologna, Italy. Dr. Montebugnoli organized two conferences about the Hessdalen phenomena, one at the telescope in Medicina, and one at the CNR facility in Bologna. At these two congresses topics about how to extract data from the

Hessdalen phenomena were discussed in detail. The support from Dr. Montebugnoli and the competence at the Medicina radio telescope was crucial for the further development of the research in Hessdalen. Their competence in developing instruments for detecting electromagnetic radiation from faint stars and galaxies made this place ideal to discuss how to extract information from the Hessdalen Phenomena. For people used to looking for mysterious light and radio sources, like quasars far out in the galaxy, the Hessdalen phenomena was not so impressive and mysterious. In the author's experience, astronomers are more used to dealing with unexplainable phenomena than many other researchers. Some of the objects in astronomy have similarities with the Hessdalen phenomena, like the pulsar, the rotating neutron star. Discussions have also been raised about "mini black holes" and whether this also could explain the power source of the Hessdalen phenomena. At these meetings Assistant Professor Erling Strand and the author learned the basics of radio astronomy research, and the author also spent six weeks at the radio telescope to learn more about techniques and instrumentation. The hospitality and help given by the Italian researcher were tremendous and extremely valuable for the later implementation of the "Hessdalen Interactive Observatory", the Blue Box. In the period from 1996 until now, several instruments for observing the Hessdalen phenomena have been developed by Italian researchers, instruments of great importance for the research.

Fig.5 1995 Author and Dr. Stelio Montebugnoli

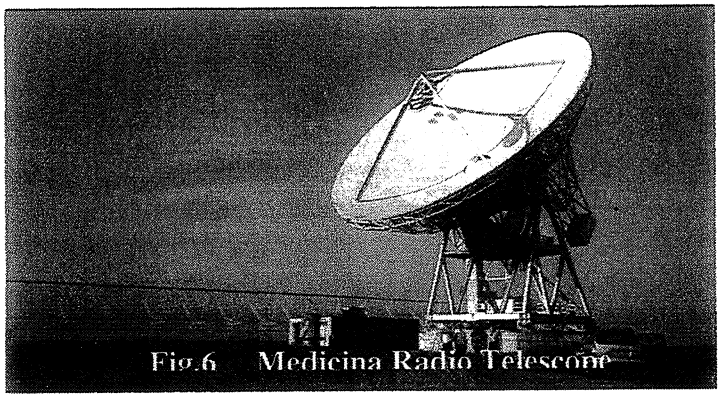


Fig.6 Medicina Radio Telescope

5. *Blue Box*

Back in Norway, Dr. Erling Strand and the author started to work on instruments which could be used to detect optical and electromagnetic radiation from the Hessdalen phenomena. In 1994 a student group made their thesis work on this subject under the guidance of Assistant Professor Erling Strand, Dr Montebugnoli and Dr. Teodorani. The group advised a combination of optical and radio detection systems to be developed. In 1997 this work was carried on when a Norwegian thesis group developed the POSIG radio frequency detection system, Fig.7, under the author's supervision. The system could detect signal frequency, signal level and signal bearing in 360^0 degrees, over a bandwidth of 400 MHz. Field tests were carried out with no significant results; more sensitivity and visibility had to be added. At this point, the system had to be installed in a house with a power

supply and limited visibility. In the Norwegian mountains, all of the houses with power supply are in the bottom of the valleys. A research station had to be built up on the mountain side if any results were to be obtained. The solution had to be a transportable 10x10 foot steel container, with sufficient insulation and temperature control to be able to cope with Norwegian winter conditions. A container was acquired, and work started out to rebuild it for the necessary specifications. In parallel with this, work was started by Assistant Professor Erling Strand to develop an automatic video detection system which was able to filter out all manmade optical lights and to only record light sources which could be the Hessdalen phenomena. This system was connected to the internet, and every time a mysterious light showed up a video recorder started and a picture was displayed on the Hessdalen internet page. This system was coupled together with a magnetometer, also able to send its data to the internet page. The installed equipment was a combined optical and electromagnetic registration system. In the autumn of 1998, the container and the equipment were transported 500 kilometers from the Østfold University College to the Hessdalen valley and installed on the mountainside. This installation had not been possible without the help of the landowner, Mr. Bjarne Lillevold. Power lines were built up to the container and, from 7 August 1998, the systems in the container were up and running. The instruments in the container were totally autonomous and data was sent to Østfold University College over the internet; all of it displayed on www.hessdalen.org. This system was in the beginning called "The Hessdalen Interactive Observatory", later changed to "Hessdalen AMS" (automatic measuring station). Since the container was colored blue, it was nicknamed the "Blue Box".

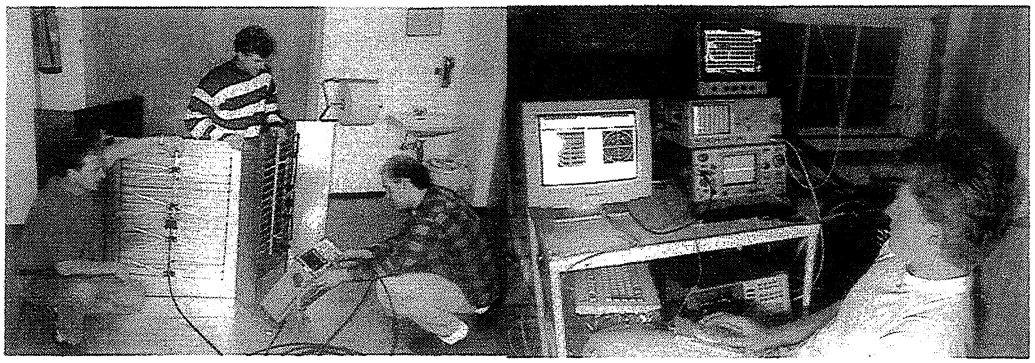


Fig.7 POSIG antenna & receiver

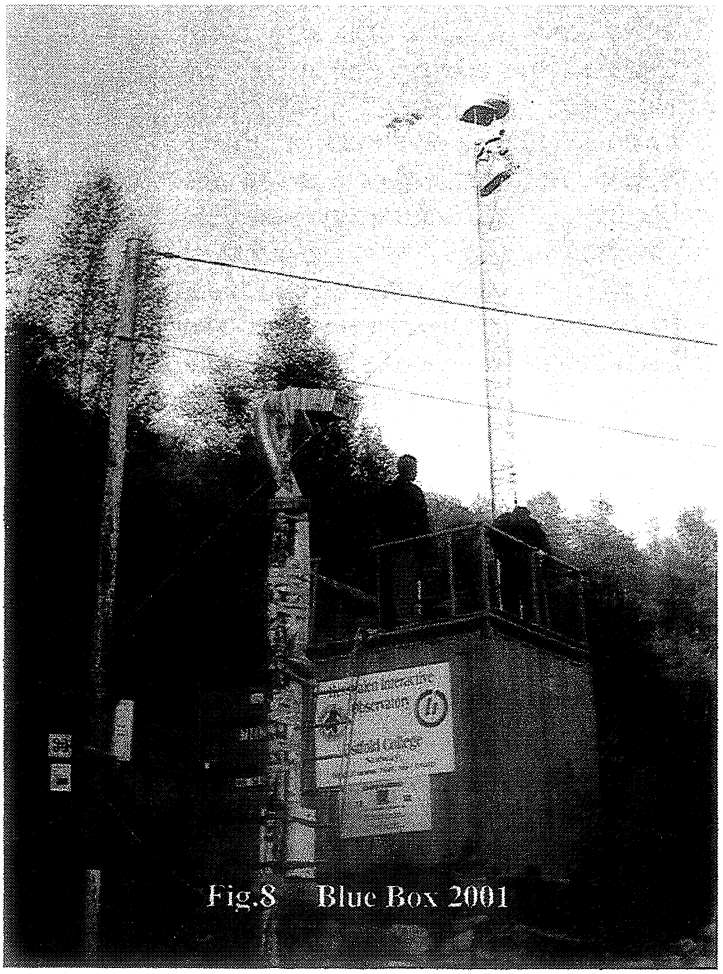


Fig.8 Blue Box 2001

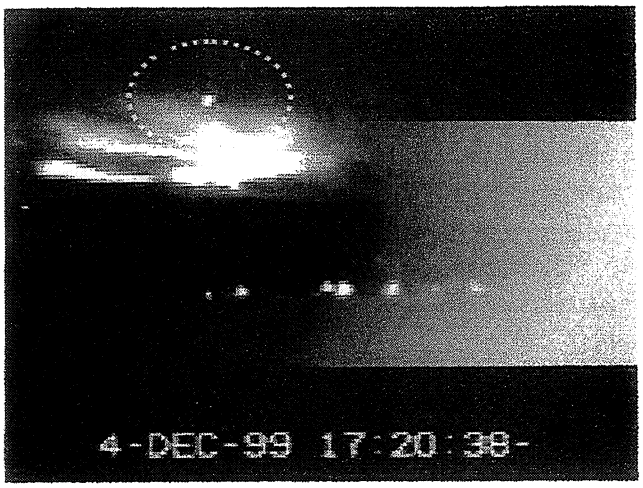


Fig.9 HP detected by Blue Box

The installation was a success and no major problems showed up during the first pilot test in the winter. From 1999 the container was ready to accommodate more scientific equipment to study the Hessdalen Phenomena. Table 2 shows a list of the instruments installed in Hessdalen from 1998-2004.

Instrument	Installation	Supplier
B&W CCD Automatic video recording system	1998	Norway
Fluxgate magnetometer	1998	Norway
POSIG radio signal detection system (dismantled)	1998	Norway
ELFO extremely low frequency observer (0.1-20KHz)	2000	Italy
Sentinel 1 spectrometer (1.42GHz)	2000	Italy
INSPIRE NASA VLF receiver (100-22000Hz) E-field	2000	Italy
Raytheon Radar	2001	Norway
Color CCD Stereo Automatic video rec. system	2001	Norway
Weather station	2002	Norway
VHF & UHF spectrum analyzer	2003	Italy
UHF Radar	2004	Italy

Table 2. Instruments installed permanently in Hessdalen

6. *Student Exchange & Thesis Work*

Fig.10 Norwegian students Maria Eriing and Hermann Fjelberg at the radio telescope in Medicina Italy

A key to the development of the Hessdalen Interactive Observatory, Blue Box, is the work done by Italian and Norwegian students in their thesis work. Already in 1996 the Italian engineering student Christiano Miani made his thesis work on an FFT analyser for Hessdalen under the supervision of Dr. Stelio Montebugnoli. Several Italian and Norwegian engineering students have made their thesis work on developing instruments for detecting optical and electromagnetic radiation from the Hessdalen phenomena. Over 70 students from both countries have participated in the project from 1994 until 2004. Students are motivated by the unexplained mystery and the possibility to make a scientific breakthrough. Persons able to supply data that can explain the physics behind the Hessdalen phenomena will receive world wide publicity. In 1998 talks started between the author and

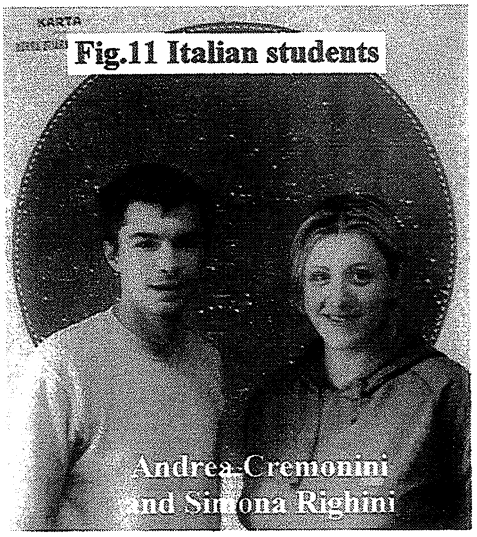


Fig.11 Italian students

Dr. Stelio Montebugnoli about the possibility to exchange students between Norway and Italy. Students coming from Norway to Italy were to work with Italian scientists and students at the Medicina radio telescope developing instrumentation for Hessdalen. Students from Italy were to take part in the development in Italy and then go to Hessdalen in Norway for installing the instruments and to take part in a scientific research mission. The first two Norwegian students to participate in this exchange program were Petter Norli and Cecilie T. Langvik, (Fig.12) in 1999. Both were majoring in electronic engineering. Their thesis report is available at the www.hessdalen.org (English version). Their task was to make a plan for a scientific program for studying the Hessdalen phenomena. This plan was called: "A preliminary study of EMBLA 2000". Embla 2000 was the name of the international research project between Italy and Norway. The task of the project was to study the electromagnetic signature and behaviour of the unexplained Hessdalen phenomena.

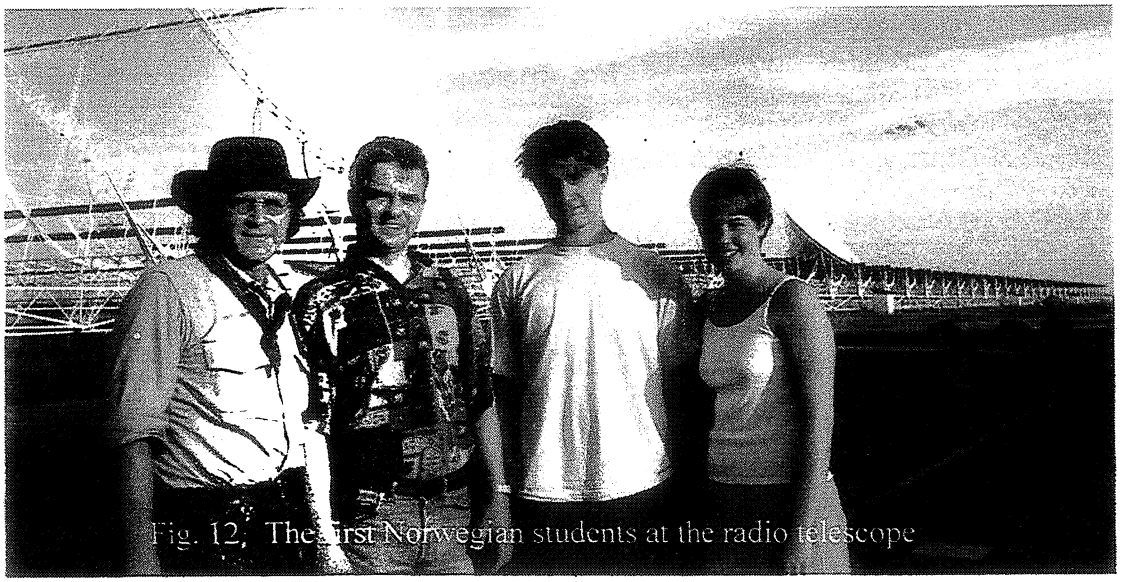


Fig. 12, The first Norwegian students at the radio telescope

7. *Project Embla*

The plan for Project Embla was worked out by Dr. Stelio Montebugnoli and the author. This plan was presented and adopted by IRA (Institute for Radio Astronomy) in Bologna, Italy, and the ØUC (Østfold University College) in Sarpsborg, Norway. Dean Tor Langvik Hansen ØUC and Director Lucia Padrielli IRA authorized and signed the plan 16/4-1999. The main objective for the Embla 2000 plan was:

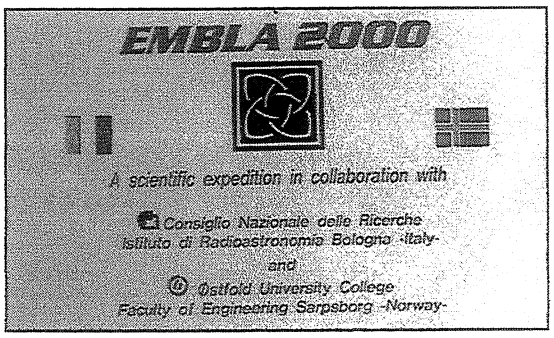


Fig.13 Container signboard

To undertake a 3-month long research period in the Hessdalen valley in the summer of 2000 aimed at extracting new data from the Hessdalen phenomena (radio frequency field) through the use of spectrum analyzer used in radioastronomy, in radio frequency monitoring systems and in Seti program. In previous observations carried out in the past from ØUC, a weak pattern has been observed in the 0,1 - 1,5 GHz range in concomitance of the phenomena breakthrough.
The project will be carried out as cooperation between Østfold College and the Instituto di Radioastronomica, Italy. The project will involve students and researchers from both countries.
As the Hessdalen phenomena generates light which, according to data gathered, indicates that it affects the earths magnetic field, the aim of the project will be to map out radio pattern from the Hessdalen phenomena and thereby try to determine whether Hydrogen is a part of the phenomena (radio emission at 1.42 GHz). This will give new and unique knowledge of the Hessdalen phenomena, which could be of significant international interest.

During the spring of 1999 the two Norwegian engineering students, Petter Norli and Cecilie T. Langvik, had been working out a preliminary instrumentation development and study for the Embla 2000 campaign, together with Italian researchers at the Medicina radiotelescope (Bologna, Italy) under the supervision of Dr. Stelio Montebugnoli and MsC. Jader Monari. The main objective of this work was to purchase, build and measure a front end receiver with antenna and preamplifier, for analyzing electromagnetic radiation from the Hessdalen phenomena. They also investigated and proposed a spectrometer for analyzing the signals. This report gave a theoretical background for studying electromagnetic radiation from the Hessdalen phenomena and made a basis for the Norwegian researchers to prepare for the Embla 2000 campaign next year. During the spring of 2000 Dr. Stelio Montebugnoli and his crew developed several new instruments to be used in Hessdalen and a special receiver for ultra low electromagnetic radiation was developed, the ULFO system (ultra low frequency observer). This system was able to detect the magnetic field in the low frequency range of 100 – 20000 Hz. This was a very sophisticated system with two magnetic field antennas, preamplifiers and correlation receiver made to avoid the 1/f-noise, which is a problem in the low frequency band. Another system, the Sentinel I system for detecting radiation from ionized hydrogen at 1.42 GHz was made ready with an omnidirectional antenna, able to detect electric fields. On suggestion from Flavio Gori, European manager for the NASA INSPIRE program, another ultra low frequency receiver named INSPIRE, Interactive NASA Space Physics

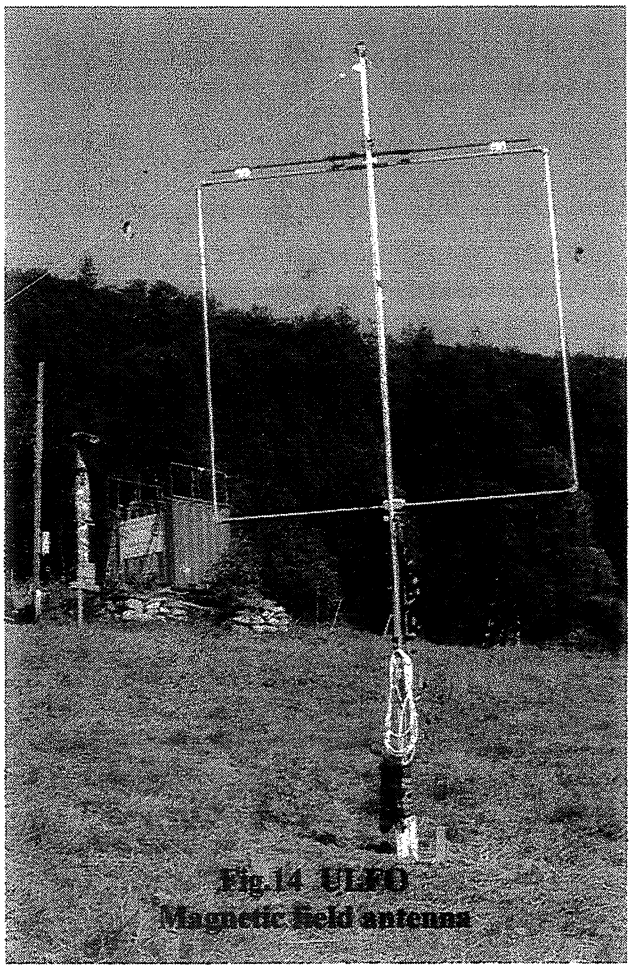


Fig.14 ULFO Magnetic field antenna

Ionosphere Radio Experiments, was developed for the EMBLA 2000 campaign. This receiver was coupled to a 100 m long dipole electrical field antenna and the post processing FFT software was GRAM. This last system has later been further developed and refined by Norwegian students into a "stereo" system where both electric and magnetic fields can be detected and analysed instantly. This INSPIRE-stereo system has been used with success in several campaigns in Hessdalen after 2000. In August 2000 Dr. Stelio Montebugnoli, MsC. Jader Monari, Dr. Massimo Teodorani and 4 other researchers left Italy and drove to Hessdalen by car and truck to install the instruments in the "Blue Box" in Hessdalen. The Italian Embla crew worked together with Assistant Professor Erling Strand, the author and three other Norwegian colleagues to install instruments and antenna systems during the first week of operation. This kind of instrumentation had never been used in Hessdalen before, and the attention from media was huge. The operations combined optical observations with monitoring the spectrometers mounted in the container. Spectrometers were programmed to store interesting signals when detected. But what was an interesting signal? No one had ever detected electromagnetic signals from the Hessdalen phenomena with 100% certainty that the signals were radiated by the phenomena. To obtain sufficient data, the Embla team had to store a huge amount of data to be sure that they were able to detect the correct signals. The amount of data from the receivers, ULFO – SENTINEL I – INSPIRE, that had later to be analysed was large. Instruments were collecting data for 25 days, and slowly they started to give new information. This information raised new questions and gave no hope to a quick solution. In the technical report from the EMBLA 2000 mission, report available at: www.itacomm.net/PH/ Dr. Stelio Montebugnoli, Dr. Massimo Teodorani & MsC Jader Monari wrote:

Fig.15 Embla 2000 Crew

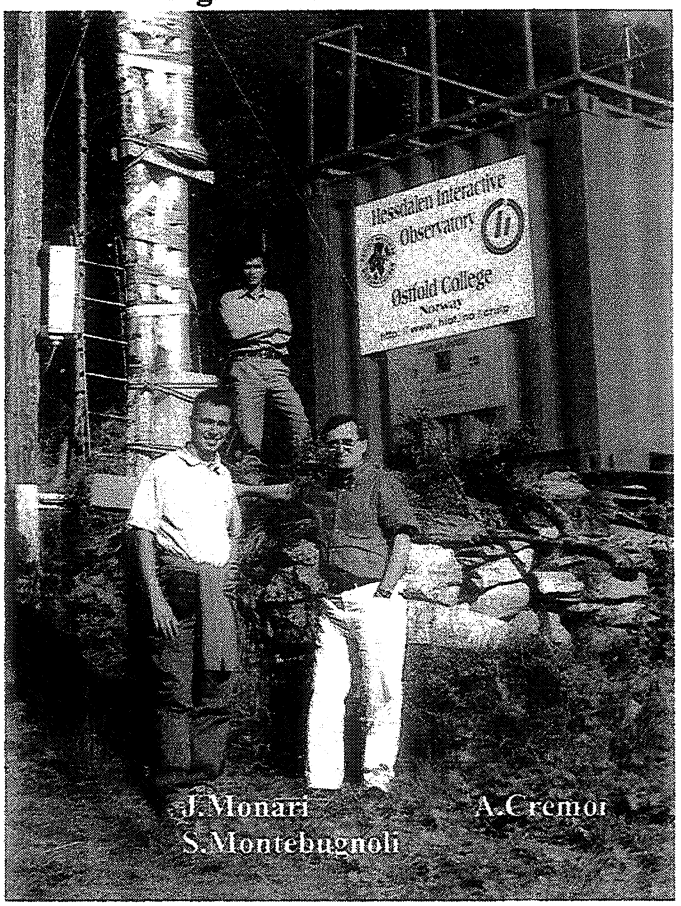


Fig.16 Spectrum Analyzers SENTINEL 1 – INSPIRE – ULFO Student A. Cremonini

The Embla project employed radio spectrum analyzers which where automatically in function for 25 days, and

discovered highly anomalous signals which were characterized by a spike-like and a doppler like morphology. Moreover during the many planned skywatching sessions, it was possible to sight repeatedly luminous atmospheric phenomena in various points of the Hessdalen.

The results of the Embla 2000 campaign are described in detail in the report available at the CIPH web pages. The Italian researchers had brought with them the "firepower" of radioastronomy equipment into a new scientific field and a huge amount of post processing had to be done. To be able to extract signals which were radiated from the phenomena, scientists needed to know which signals were radiated from other natural and manmade sources in the valley. This called for more monitoring of the electromagnetic radiation in Hessdalen and told the Embla crew that the campaign in 2000 was just the first one of many to come.

8. *Embla 2001-2002-2003*

The Embla 2000 campaign had generated a huge amount of data that needed post processing and no clue was given regards to which signal frequency to search for. No beacon or "radio station" in the frequency band was found which could be directly connected to radiation from the Hessdalen phenomena. In the spring of 2001, Norwegian students Maria Erring and Hermann Fjelberg, worked together with Italian students Andrea Cremonini and Simona Righini, to post

Fig.17 Embla 2001 Congress

process data from the Embla 2000 campaign, develop new instrumentation, and prepare for the new Embla 2001 campaign. In May 2001 a congress about the new Embla 2001 campaign was held at the Medicina radiotelescope, where researchers, students and representatives from both countries met to present papers and discuss the forthcoming campaign in Hessdalen. This congress, conducted by Dr. Stelio Montebugnoli, was an important meeting for researchers working on this kind of phenomena. All kinds of different instrumentation were discussed and the need for a RADAR system in Hessdalen was addressed. Some believed that the phenomena had an optical invisible high-energy state, rotating/moving in a self contained field. If something disturbed this self contained field, it would start to radiate energy and that the optical appearance, when the colour changed from white to yellow and red, indicated that the phenomena was dying. It was also necessary to raise the detection rate to correlate the optical signal with

electromagnetic radiation received at the different spectrum analyzers. Discussions were based on the use of RADAR in the 1984 Hessdalen project, when Assistant Professor Erling Strand showed that it was possible to detect the Hessdalen phenomena with RADAR. During these registrations it was discovered that the phenomena also had an optical invisible state, but visible on radar. Dr. Massimo Teodorani also addressed the importance of detecting the optical spectrum radiated by the phenomena and thereby be able to identify absorption and emission lines. The detection of these lines could enable the researchers to find out what kind of chemical elements the phenomena was composed of. The Embla crew decided to equip the 2001 campaign with an optical spectrometer supplied by Italy and a RADAR system from NORWAY. A portable ultrasound detector, Geiger counter, electric and magnetic field detectors were also to be used for reconnaissance of different areas in the valley. Nine Italian and five Norwegian researchers and students participated in a 4 week long campaign in Hessdalen in the autumn of 2001. The radar system and a new stereo video detection system were mounted in the Blue Box by the Norwegian team before the start of the campaign. No scientific expedition in Hessdalen had been so well equipped and manned as the Embla 2001 mission. Work done in this campaign demonstrated the elusiveness of the phenomena and the problem of correlating registrations on different instruments with the real Hessdalen phenomena. It also showed that the use of high frequency radar had to be done from the highest points in the valley because of false echoes, clutter and noise problems. Low frequency radar had to be developed for use down in the valley. The 2001 campaign was well equipped and a lot of lessons were learned. One was the Radar problem, another was the need for better optical spectrometric instruments and more money. In the technical report from the optical 2001 mission, www.itacomm.net/PH/ , astrophysicist Simona Righini wrote:

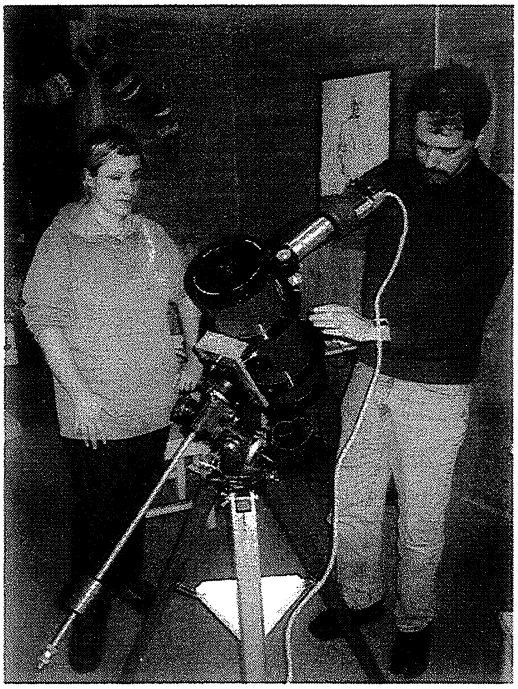


Fig.18 Embla 2001 Telescope & Spectroscope S.Righine M.Teodorani

Fig.19 Night Watch 2002

During the 2001 campaign a lot of photographs and video material have been collected, providing evidence about the phenomenology of the light events .However, a definitive set of quantitative data hasn't been achieved yet.

The 2001 campaign had added more data and new knowledge was acquired about how to study the phenomena and which types of instruments to use. In 2002 another campaign was carried out in Hessdalen with a new UHF radar system developed by Dr. Stelio Montebugnoli and MsC Jader Monari. This radar system showed interesting results and indicated that the phenomena had an

invisible state. More optical data was also acquired. In this same period the Østfold University College conducted a 2 week long science camp in Hessdalen for pupils in primary school. In this campaign, base camps at the mountains Rogne and Finså were established. These base camps and techniques developed to establish them, gave important knowledge that later should be used in the 2004 winter campaign in Hessdalen. In 2003 another mission was carried out, mainly to prepare for the winter mission in 2004. The winter mission carried out in February was successful in testing out equipment in near arctic conditions and observations were done from the base camp established at Rogne mountain, where the UHF radar and MPS system were tested out. The MPS system is a transportable TV transmitter and an INSPIRE receiver and transmitter. The system is in a small box supplied with batteries and can be left alone on a mountain top for 12 hours. Signals from the video camera and the INSPIRE receiver are received down in the valley at the research base. Transport is easy in winter time, and the great visibility makes the probability for observing the phenomena high.

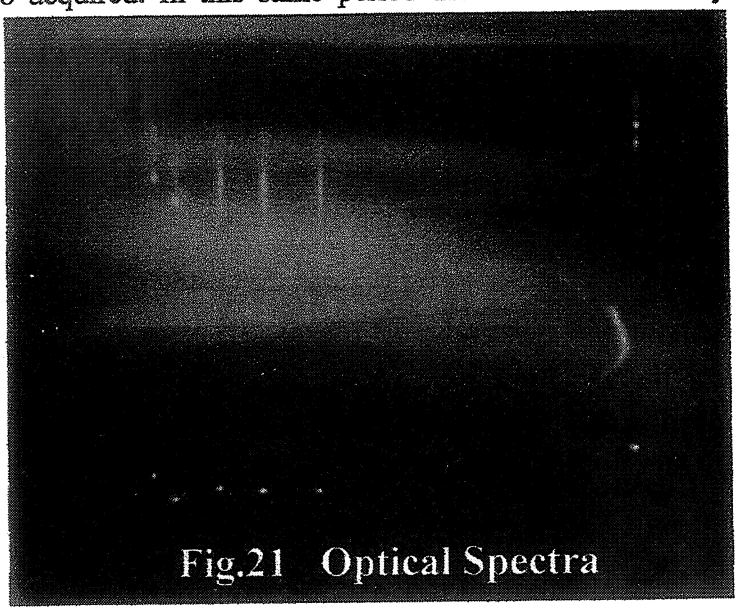


Fig.21 Optical Spectra

So far the campaigns from 2000 until 2004 have given the EMBLA crew unique experience in this kind of field investigations. Papers published on the CIPH internet pages have created healthy debate and will increase the knowledge and quality of data. This will give new expeditions significant information and increase the quality of data recording. The Embla project is a great example of collaboration between Italy and Norway and has given students from both countries outstanding knowledge and unique international experience.

9. *Conclusion*

Until 10 years ago in 1994, the Hessdalen phenomenon was regarded as a pure hoax created by some disturbed minds dreaming about flying saucers. Hessdalen was an isolated small valley in Norway, unknown to the world. Hessdalen is now the most famous valley in Norway due to the unexplainable flying light phenomena which is the target for the scientific research campaign named Project EMBLA. This project ended once and for all the speculative debate about whether the phenomena existed or not. The phenomena has been identified by the Embla crew as a flying luminous object with certain characteristics that make it unique to science. These characteristics are so special that they can lead scientists to understand new concepts in science. The four year long EMBLA campaign has shown the researchers that the phenomena is more elusive than anticipated, and that it may be more than just one phenomenon. The phenomena may be made up of several smaller pieces which can break out from the main body and fly away. The body seems also able to collect fractal pieces of energy/plasma from the ground while flying by. The phenomena must radiate energy because it changes color, but no electromagnetic radiation can

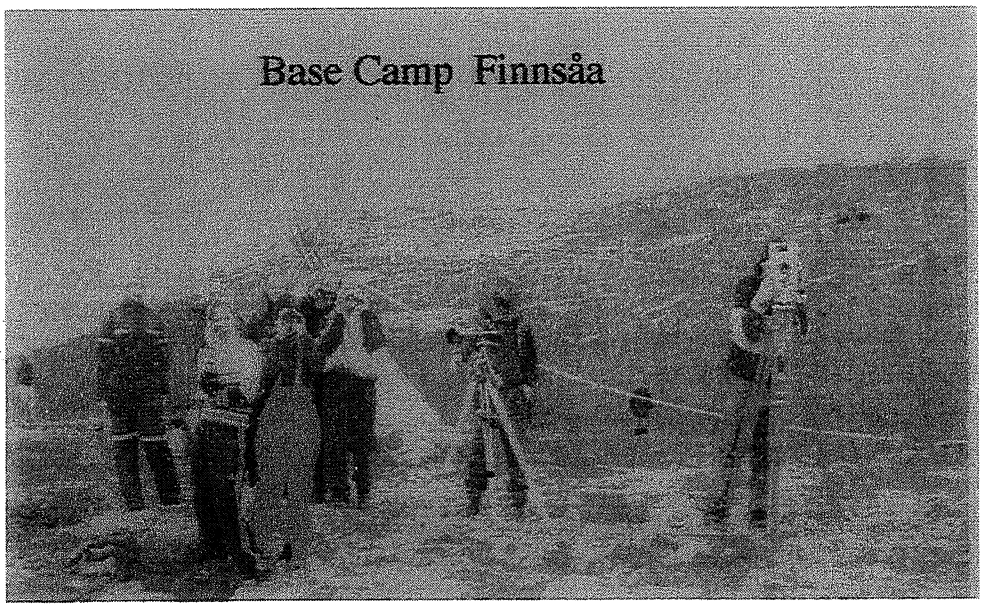
be 100% connected to it at this time. Many interesting spectra in optical and radio frequencies have been obtained, but more data is needed to correlate the radiation to the phenomena. The Embla crew has gained unique experience in obtaining data from such phenomena and is possibly the best equipped and skilled scientific team in the world which is working to solve this kind of mystery. The scientific papers published in the CIPH web pages creates professional debate and helps to develop theories and knowledge. Over 70 students from Italy and Norway have been involved in the program and gained unique experience and built relationships between the two countries. The work done by Dr. Stelio Montebugnoli and his Italian team has been of the highest importance for making the Hessdalen phenomena known to the world as a scientific challenge. Without the support, friendship and hospitality given by Dr. Montebugnoli and his researchers, there would be no Blue Box, no research campaigns would have taken place, and Hessdalen would still be an isolated unknown valley with no scientific possibilities. The Hessdalen valley has been opened for scientific research by the Italian/Norwegian Embla crew and the CIPH organization. The Embla crew is in the frontline of this important international research and will have the best possibilities to solve the mystery.

Fig. 22 Winter Mission 2004

Science Camp

What is Science Camp?
Why is it organized?
Where is it held?

Leif Lervik
Counsellor
Østfold University College
Faculty of Engineering and Natural Sciences
Østfold, Norway



Science Camp is a program for the pupils of two junior high schools in the county of Østfold in Norway. It is arranged by the Faculty of Engineering at Østfold University College.

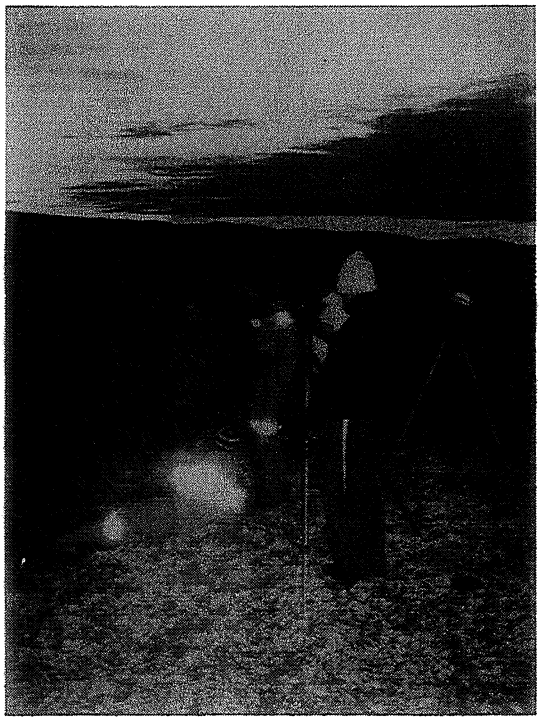
The pupils from the junior high schools went to Hessdalen Valley in Trøndelag, not far from the city of Trondheim, in the central part of Norway. Some of our professors and students went with them also. There, at our research station where we investigate the phenomena occurring in the Hessdalen Valley, the group stayed for a week investigating the light phenomena in the atmosphere of Hessdalen, THE HESSDALSPHENOMENA.

Testing the telescope

As a praparation for the expedition, Østfold students visited the two junior high schools during the spring of 2002. They brought with them different instruments and taught the pupils how to operate them.

During the week in Hessdalen, the pupils were divided into different groups, which had specific purposes. One group measured the radioactivity in the air, others made weather reports, created a journal from the camp supported by video and photographs, edited the WEB site, made spectrum analyses, did surveying, and one group was responsible for the radio communication between the groups and headquarters.

Every night two groups of the young people went to the base camps at the two hills called Rognefjell and Finnsåa. There they spent the night waiting to observe the light phenomena and then make the necessary documentation of it such as video, the distance to the light and its speed.



Searching for the light phenomena

Then, one can ask the question: Why do we make all this effort and arrange Science Camp?

The answer is easy. In Norway we are short of engineers and students of mathematics and physics, as they are also in all of western Europe. The number of engineers is decreasing in Norway. At our university college we wanted to do something about this situation. We want to improve the situation and increase the number of students.

We spent a lot of time and money to market our engineering studies. We arranged fairs at the college, advertised in the newspapers and visited every high school in the area and also across the border to Sweden.

However, we thought that we had to do something special to succeed in our efforts.

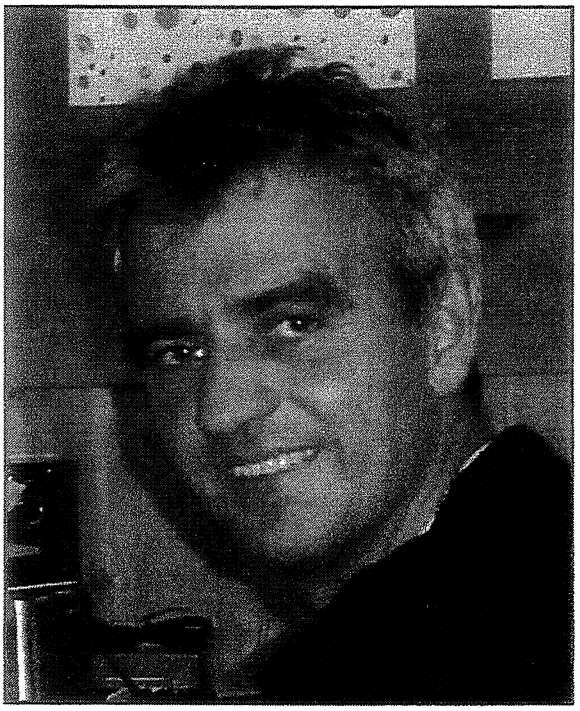
We know that young people are curious and they are interested in new cases and mysteries. We wanted to make the most of that fact so we launched the principle of MUMI (or, in English, MAMI):

- Mystery
- Astonishment
- Motivation
- Interest

The meteorological group

Our intention was to use this principle and build good relations with the young people. Working on this, suddenly one of our professors, Bjørn Gitle Hauge ("The Bear" in English), threw this great idea out to our group: "Let's go to Hessdalen!"

In Hessdalen there is an old school where we can stay, but, more important, there is our research station, the "Blue Box". There we have instruments tracing the light phenomena and sending the results to our university college. At this place in Hessdalen the researchers from our faculty, and our opposite members and good friends from Italy are researching the light phenomena in the atmosphere of Hessdalen. We thought that this phenomena should be interesting also to the pupils from the junior high school.



"Let's go to Hessdalen!"

The mission was prepared during winter and spring of 2002. The following autumn we set out for Hessdalen with two classes. Every class stayed there for one week. In total there were 55 pupils at the camp.

Based on the reports from the participants, the camp was a success, and we are already preparing for a new Science Camp in autumn 2005. The camp might also be interesting for students of natural science in Italy.

What do you think of that?

Will we see you in Hessdalen?

Coordinated Observations 10/2004

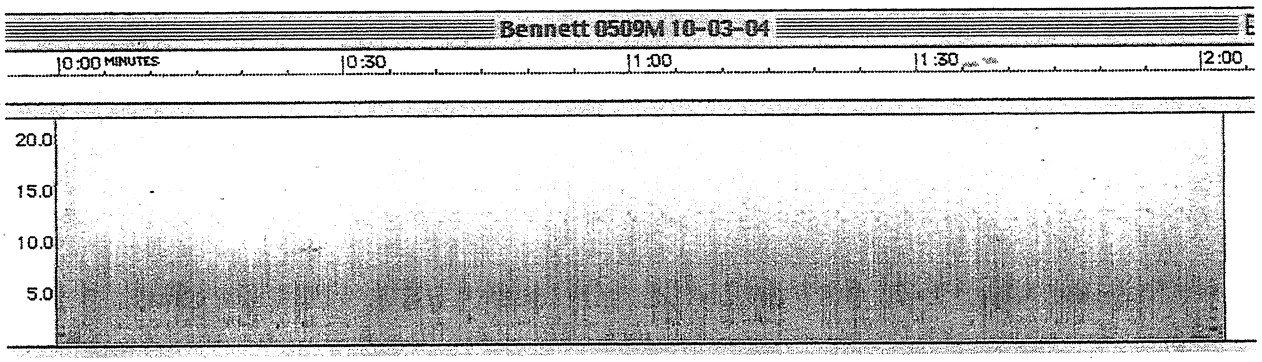
By Bill Pine
Ontario, California

All INSPIRE participants are encouraged to make observations and send their data tapes and logs in for analysis. The *Journal* would like this report to reflect the activities of all observers. Any data is good data! Please send data tapes regardless of how "successful" the session turned out to be. See Page 4 of the Journal for formats and procedures.

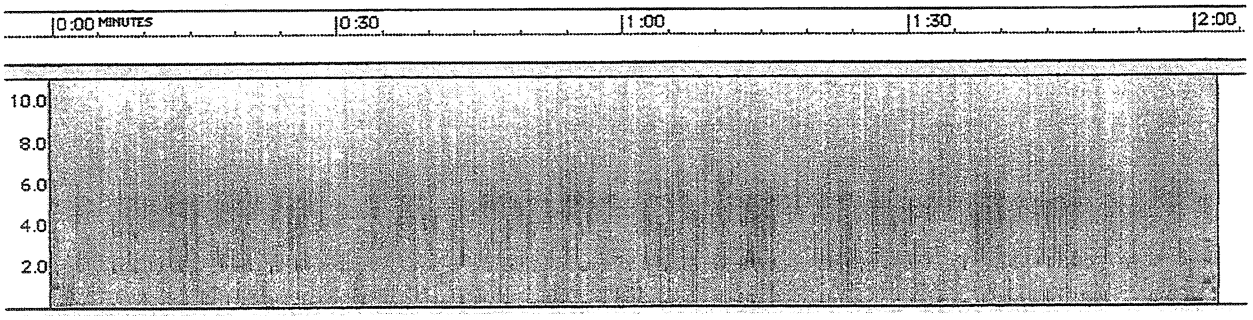
Coordinated observations were made on Saturday, October 3, 2004, by Robert Bennett in New Mexico and Shawn Korgan in Colorado. Bob and Shawn are probably the most faithful and experienced INSPIRE participants

1100 UT (5 AM MDT)

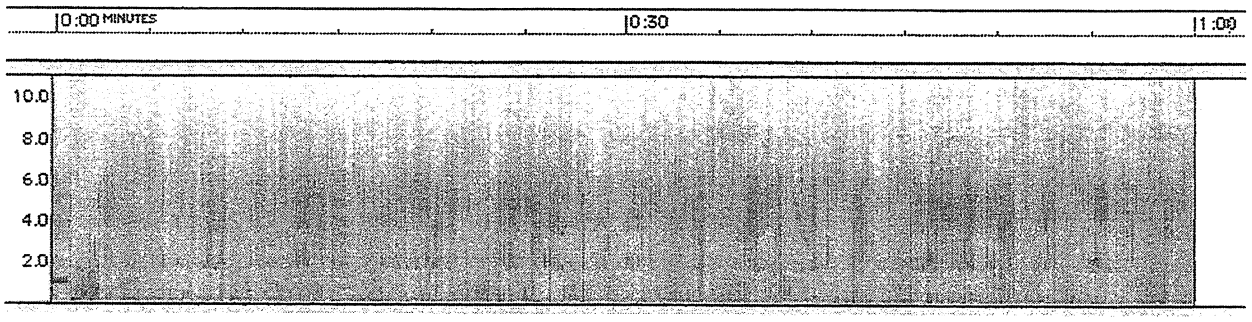
Robert Bennett Las Cruces, NM



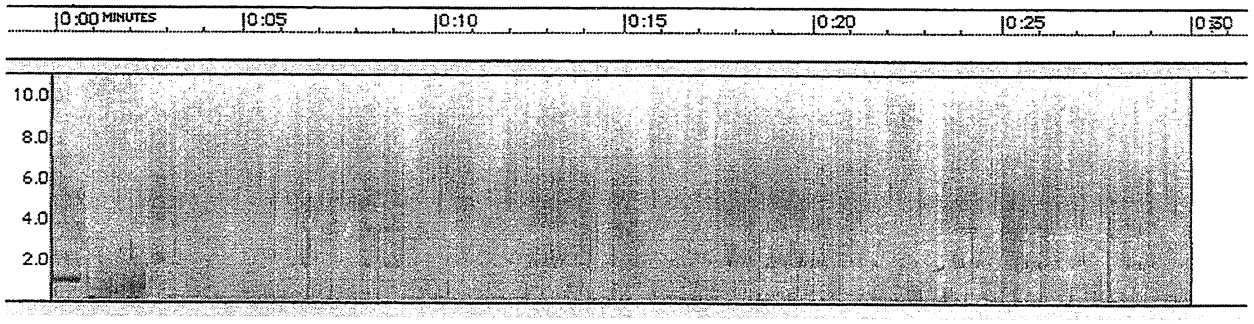
Robert reported the presence of a thunderstorm about 30 miles to the southeast of his observing site. Local lightning (lightning within a few hundred kilometers) shows up on the spectrogram as closely spaced vertical lines and sounds on the audio like many sharp pops.



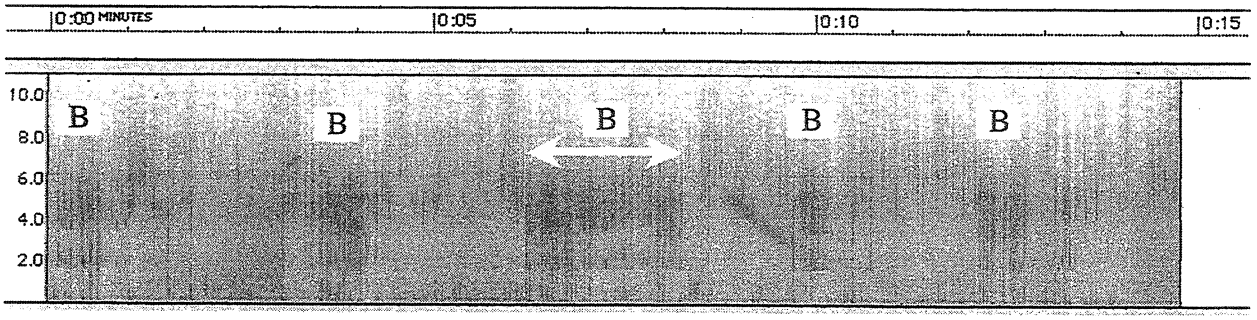
0-11 kHz frequency range.



First minute.



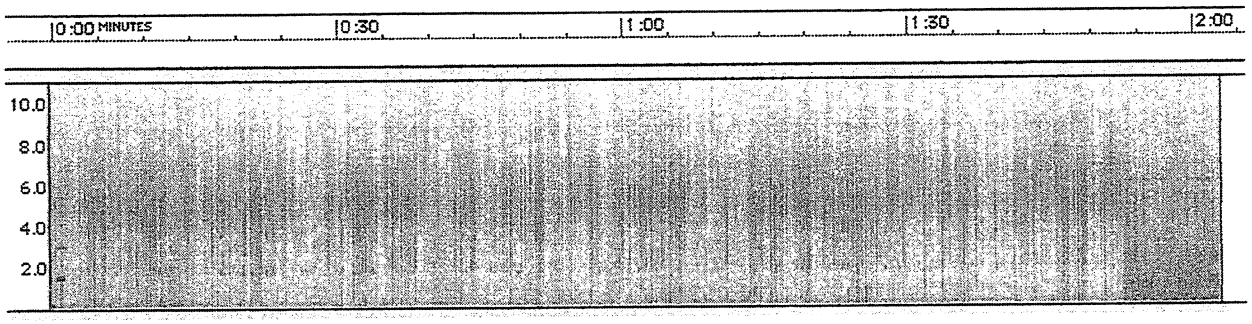
First 30 seconds.



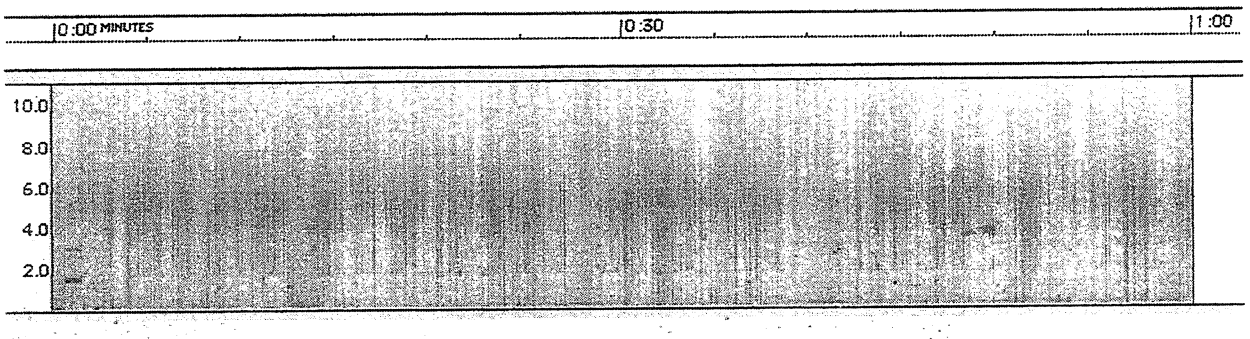
Fifteen seconds starting at :30 seconds. A whistler appears at :39 seconds. Tweeks appear in bursts (labeled B).

1200 UT (6 AM MDT)

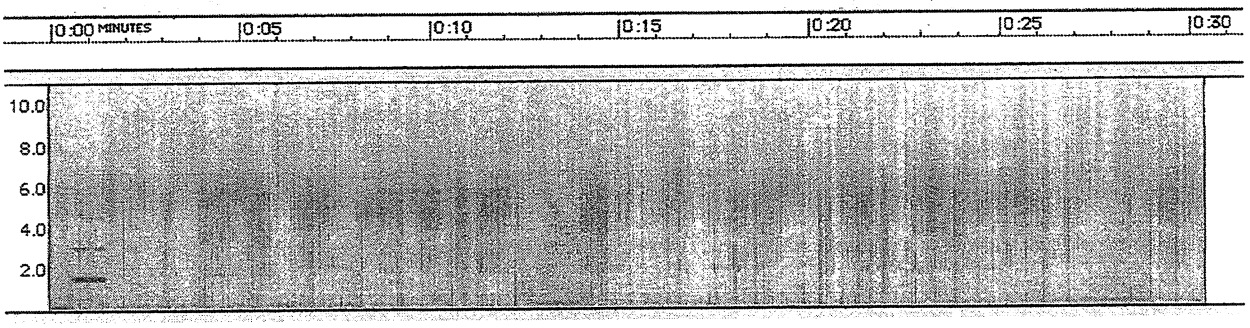
Robert Bennett — Las Cruces, NM

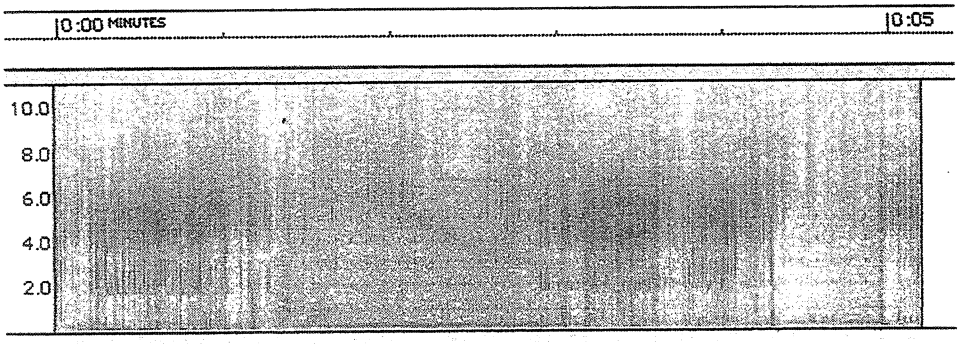


At 6 AM the sferics are still dense and so are the whistlers. LORAN is present.



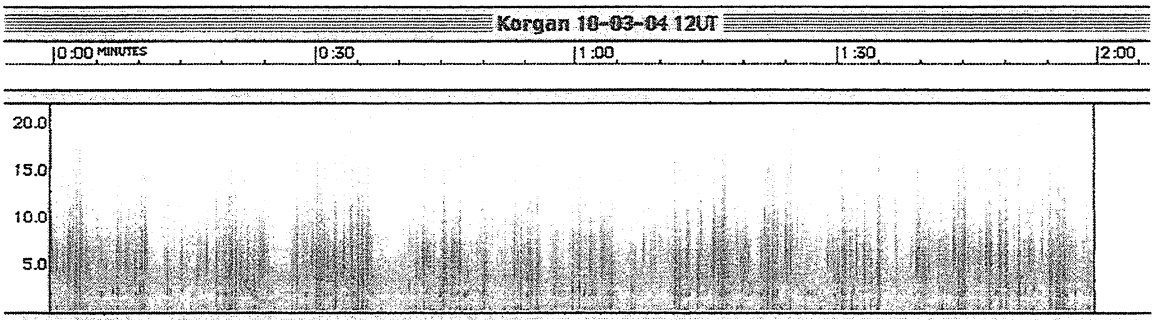
The horizontal dashes at the beginning are from the WWV tone and its harmonics.



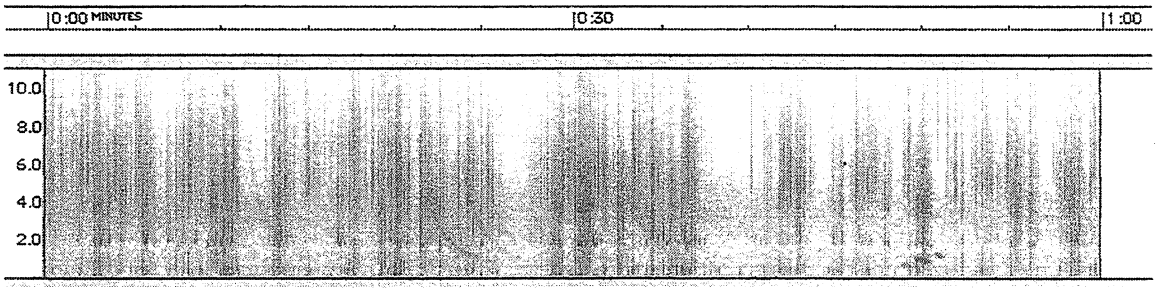


A whistler is seen at 12:01:13 UT. Tweeks in bursts appear as closely spaced vertical lines with the tweek "hook" at about 2 kHz.

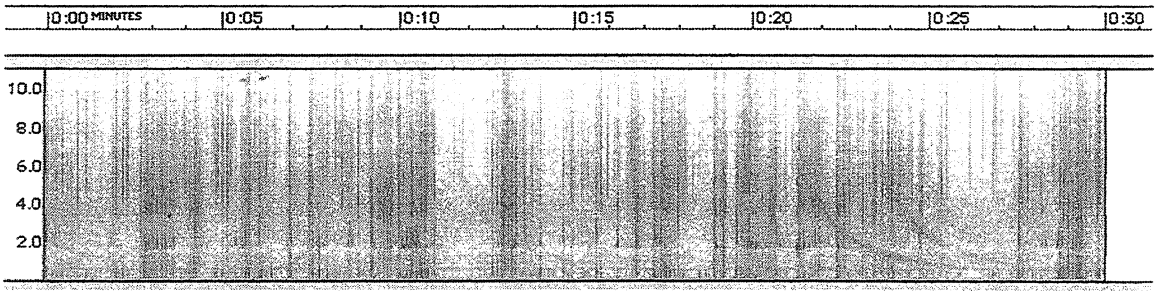
Shawn Korgan Gilcrest, CO



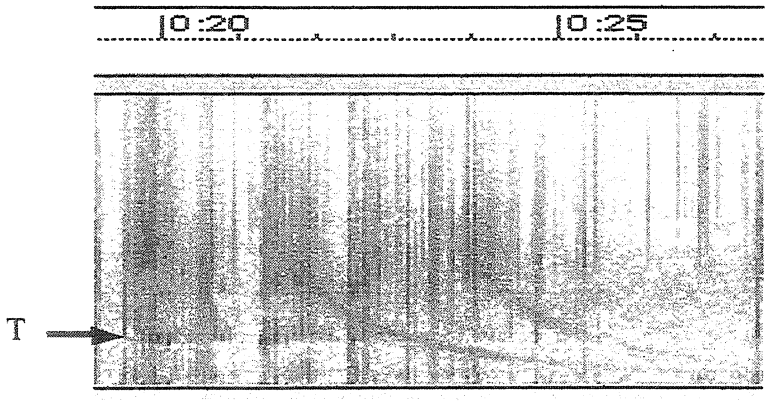
In Colorado, Shawn is getting even more whistlers with less sferic intensity in the background. The thunderstorm is well east and south of Shawn's location.



Individual whistlers are apparent in this one-minute specrogram.

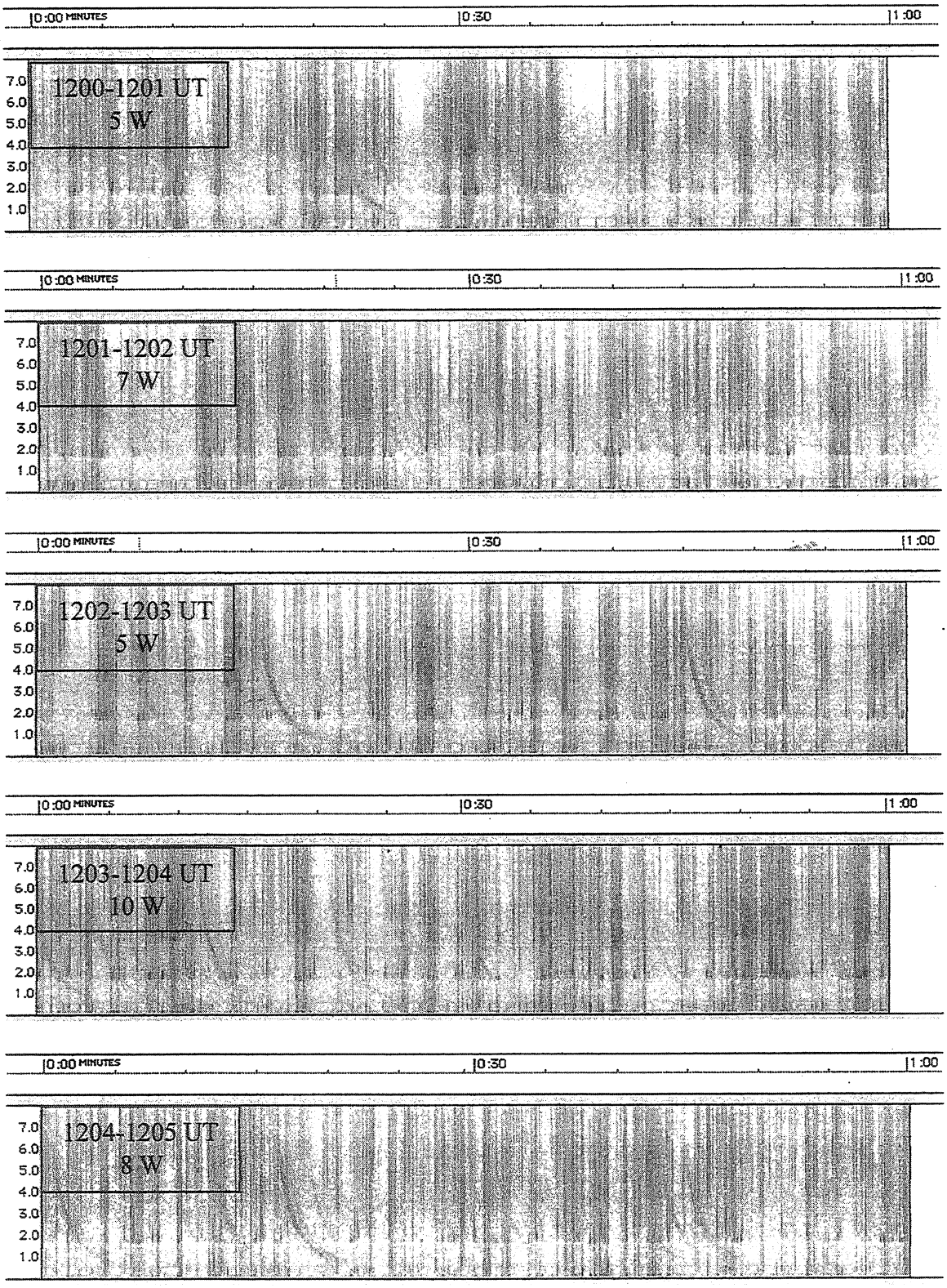


Individual tweeks with their hooks show up on this 30-second spectrogram.



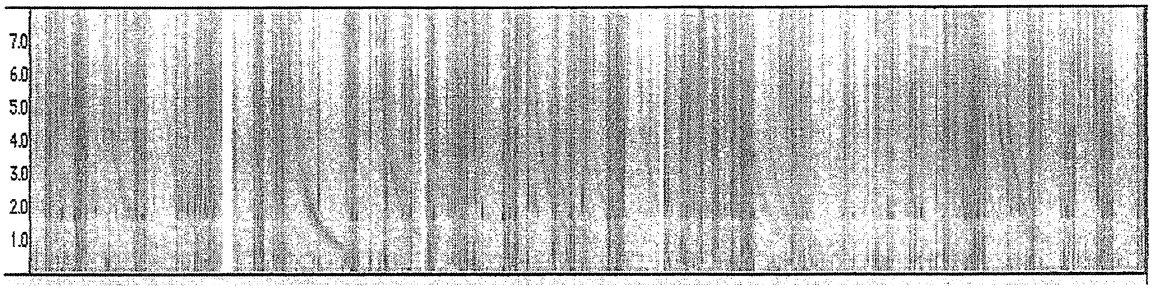
The whistlers shown at :20 - :25 seconds from above. The tweek hooks are shown by a T at about 2 kHz.

If a frequency range of 0-8 kHz is used, whistlers are very easy to spot and count. The following spectrograms show a minute-by-minute display from 1200UT to 1205UT. In the boxes, the time interval is shown and the number of strong whistlers is shown.

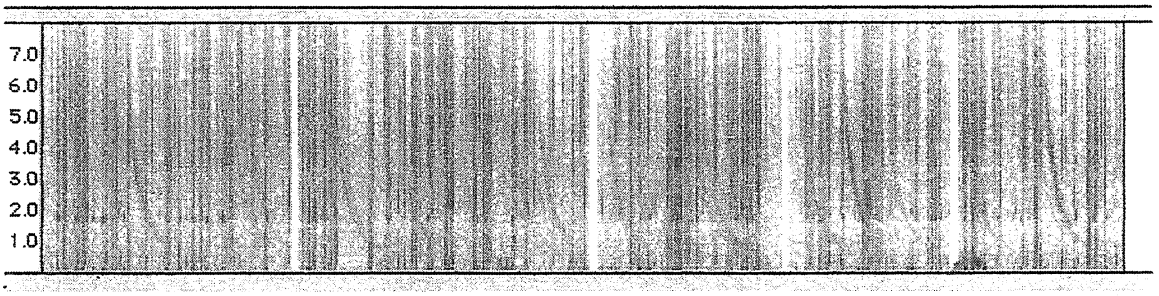


The following are spectrograms of whistlers that were captured by Shawn in the next 25 minutes.

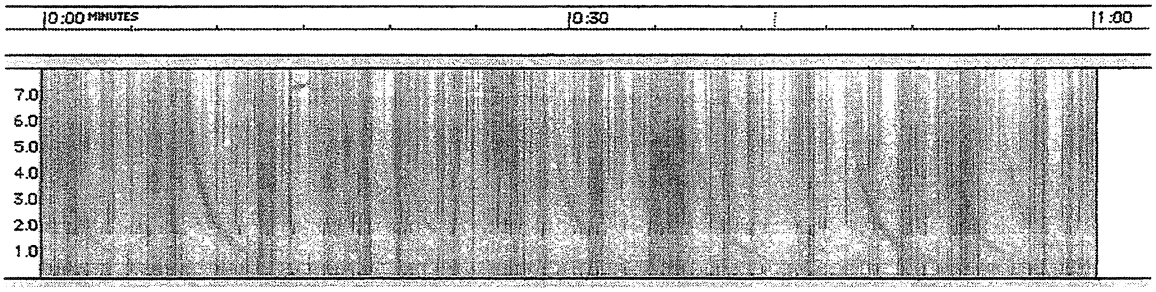
Whistlers (l to r). Numbers indicate the minute.



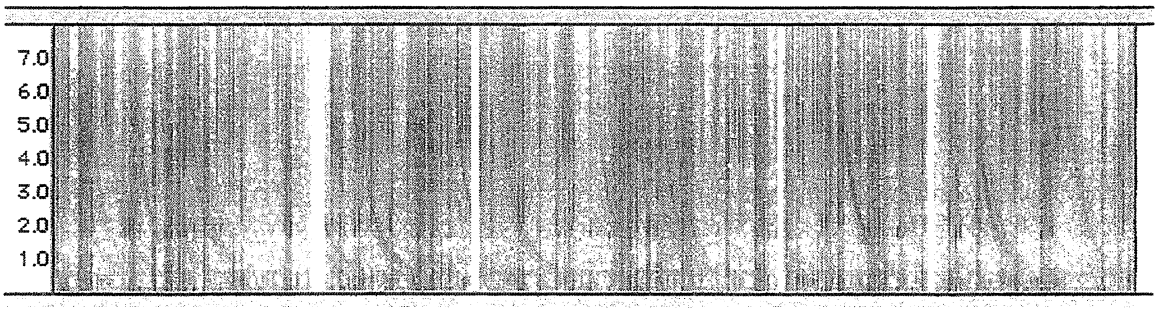
05, 07, 09, 10 triple, 12 quad



(l to r) 16 w + 4w, 17 double, 17 3w, 20 triple, 20 group



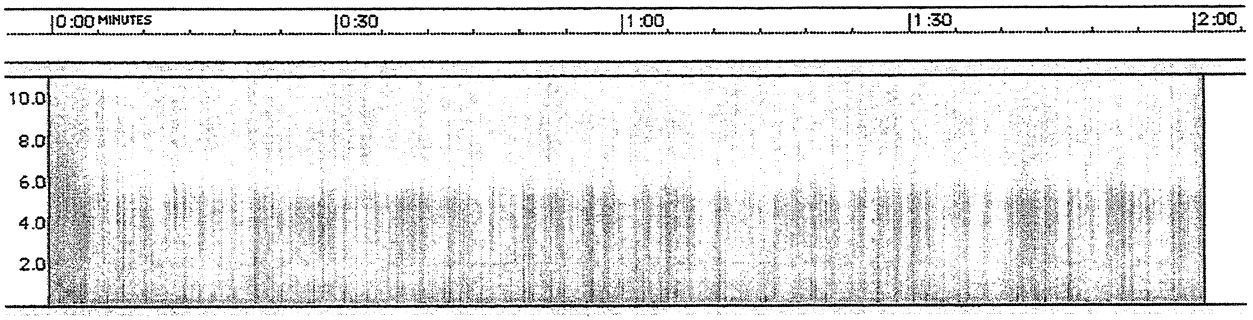
Minute 22: 12 W logged!



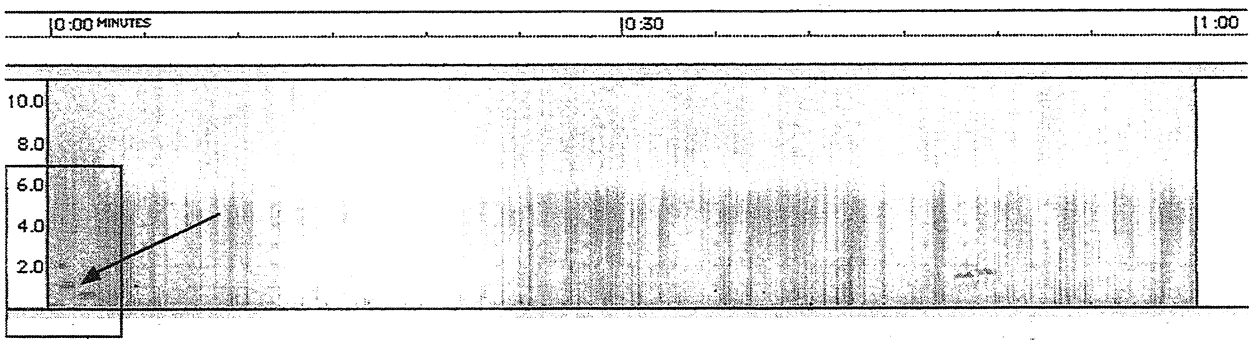
(l to r) 24 lots, 25, 26 cluster, 28, 29

1300 UT (7 AM MDT)

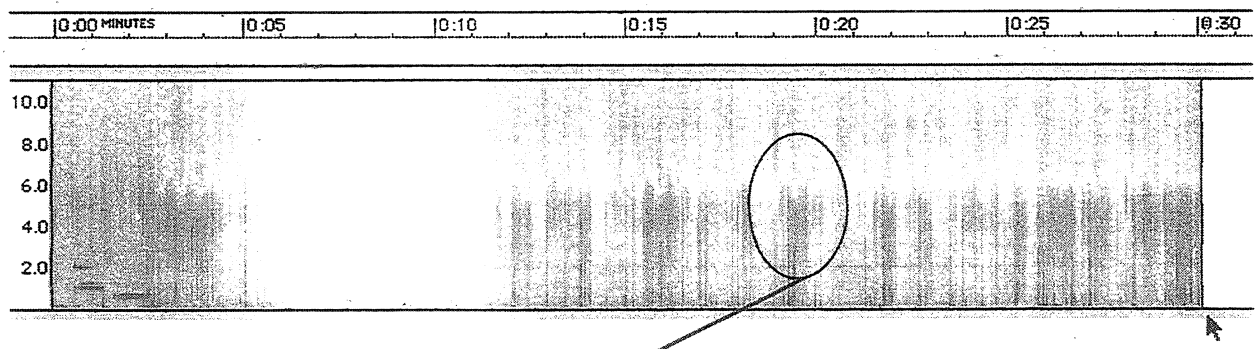
Robert Bennett — Las Cruces, NM



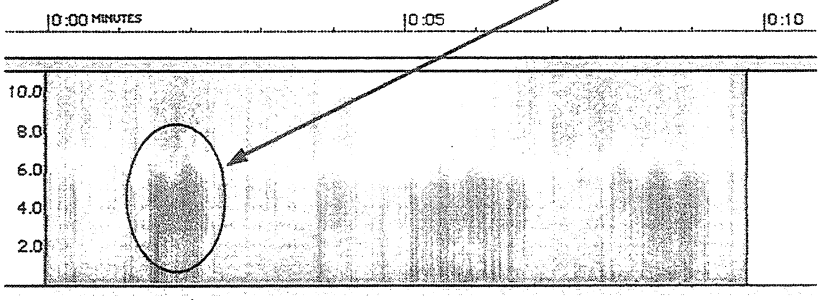
This session actually started at 1301 UT. Sferics still dense, whistlers getting fainter.



WWV tones at 1301 shown in frame. The arrow points to the 1 kHz minute tone.

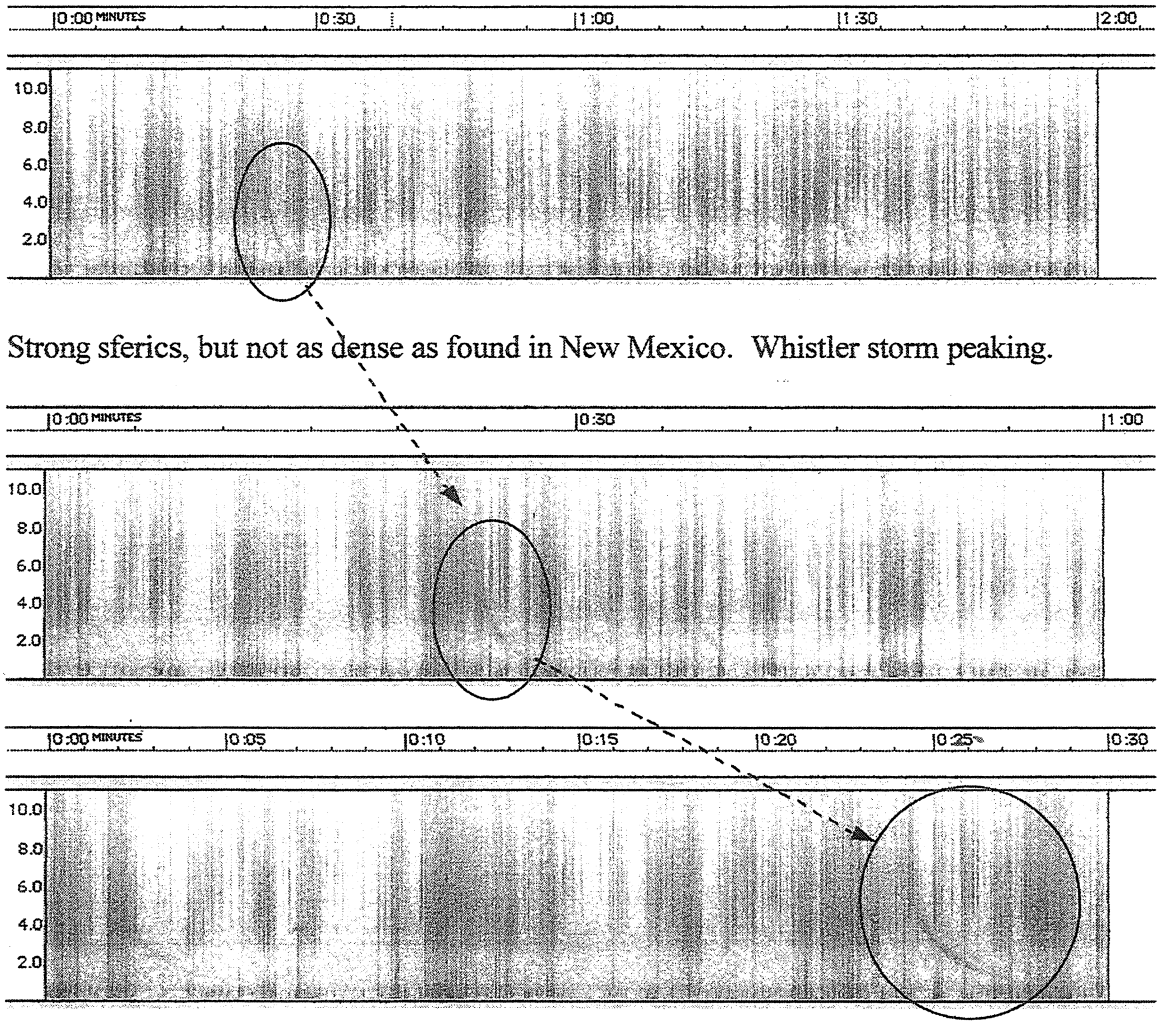


Note the rhythmic pattern in signal at about 6 kHz.



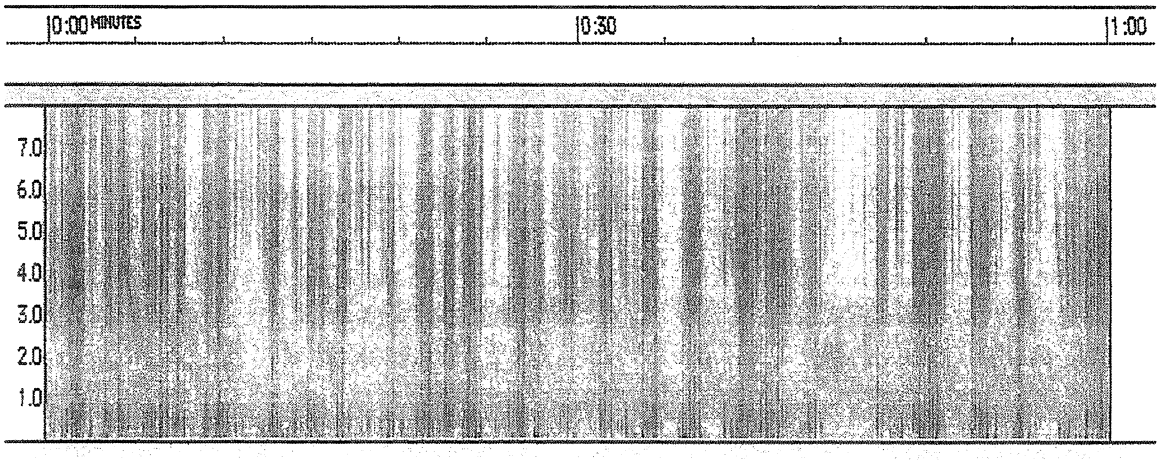
Whistler at 13:01:50 UT

Shawn Korgan **Gilcrest, CO**



Strong sferics, but not as dense as found in New Mexico. Whistler storm peaking.

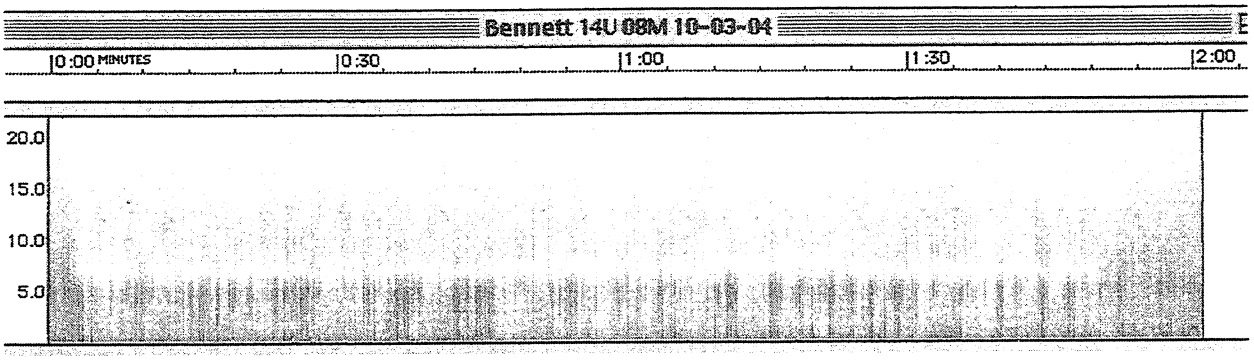
1328-1329



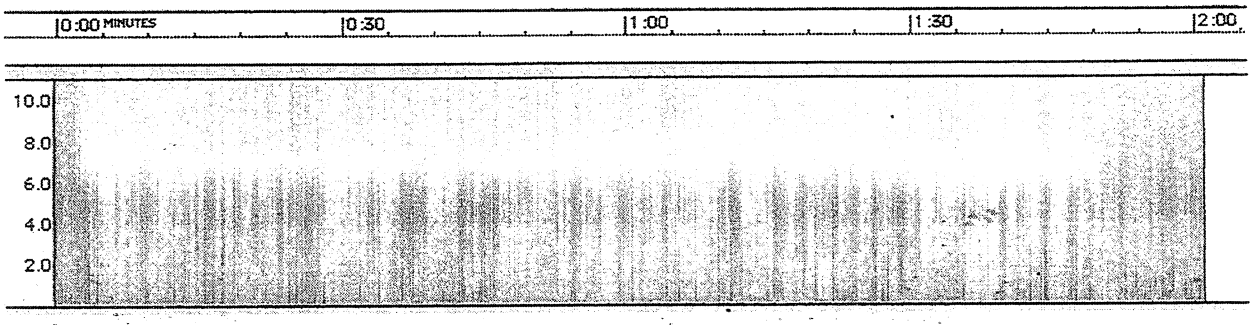
Hundreds of faint whistlers – a whistler shower (and chorus).

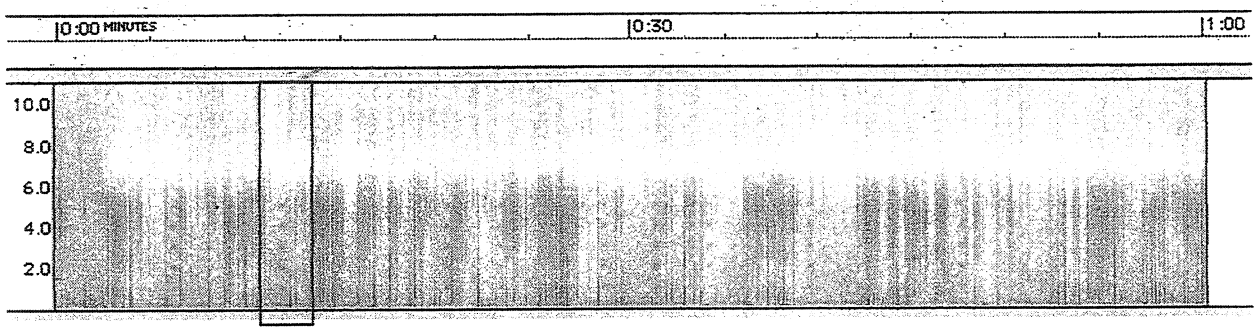
1400 UT (8 AM MDT)

Robert Bennett — Las Cruces, NM

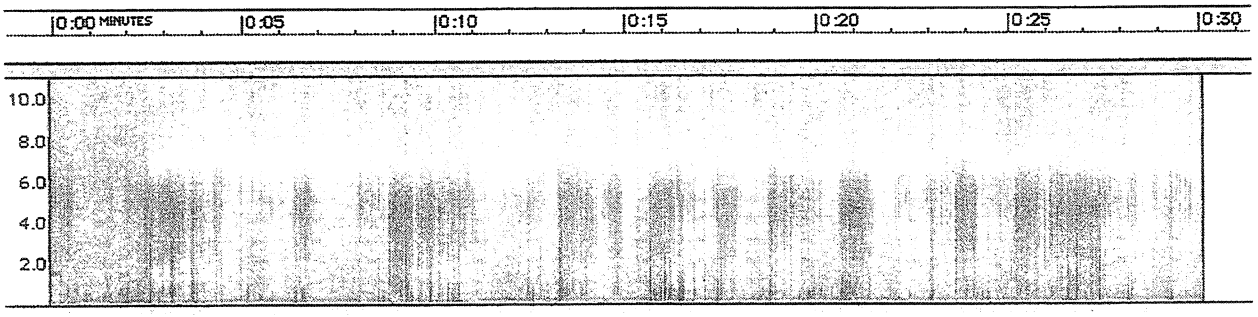


Whistlers decreasing in intensity (strength) and density (number per minute).

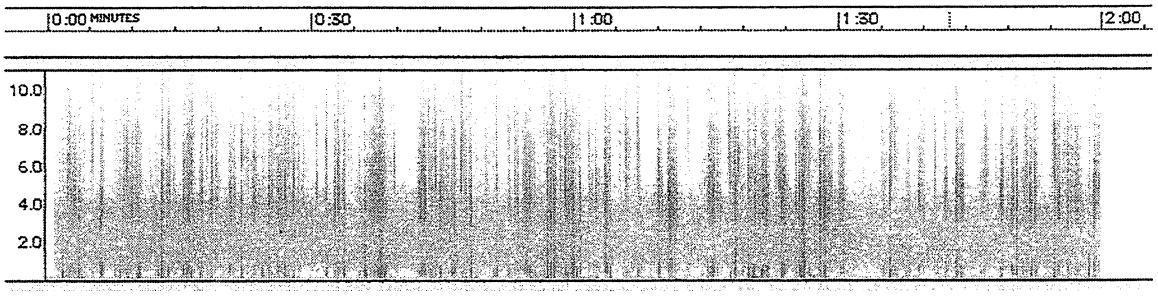




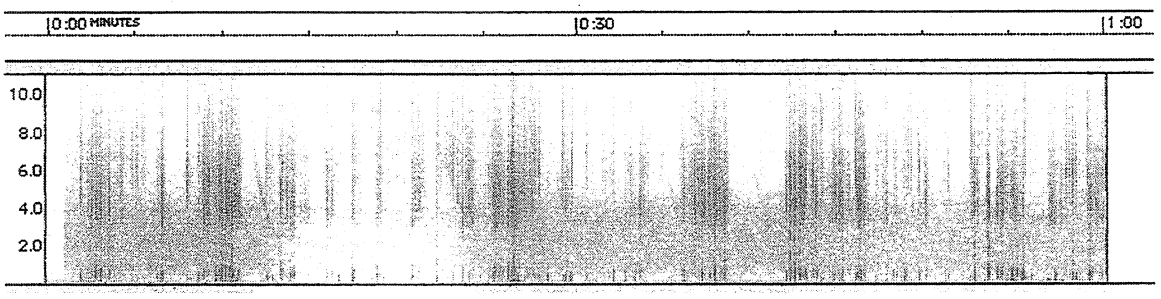
In the box is a vertical series of dashes from a LORAN transmitter. This sounds like a clicking sound on the audio.



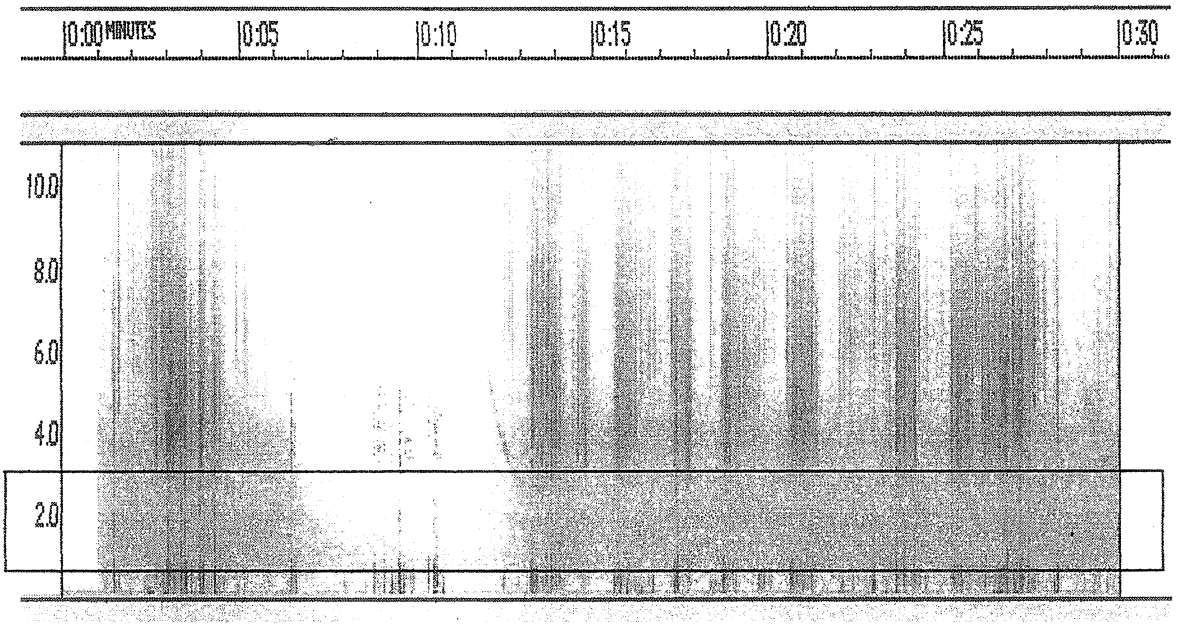
Shawn Korgan **Gilcrest, CO**



The whistler storm has subsided and a hiss band has formed. Strong whistlers are still observed.



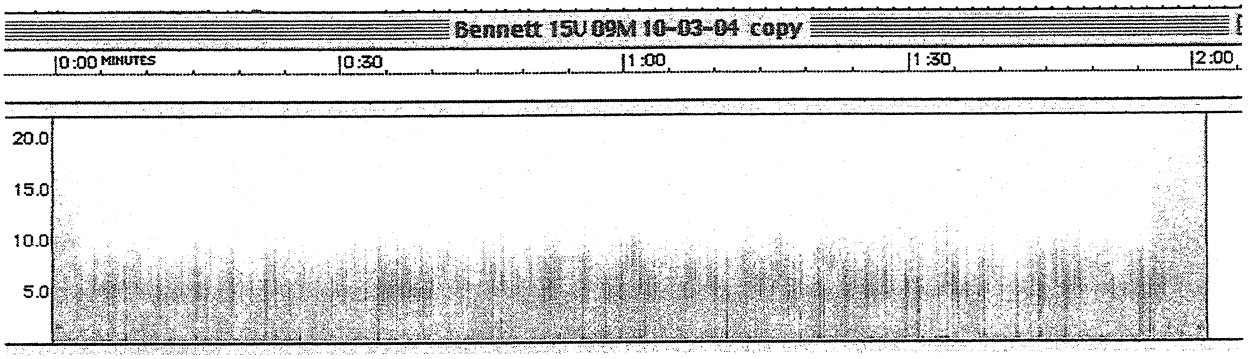
One change in conditions is indicated by the absence of LORAN signals.



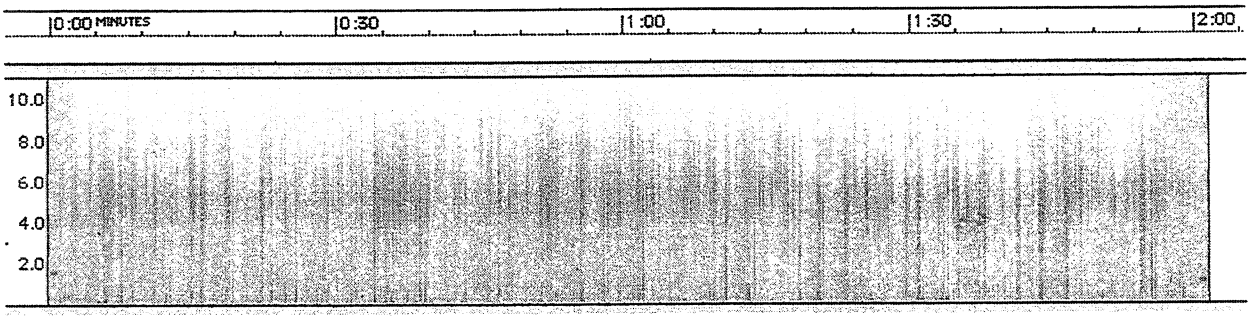
The hiss band is shown in the box.

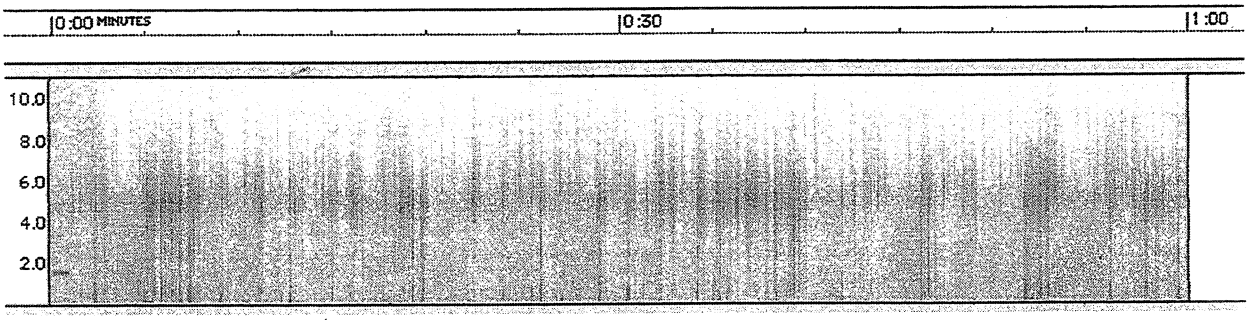
1400 UT (8 AM MDT)

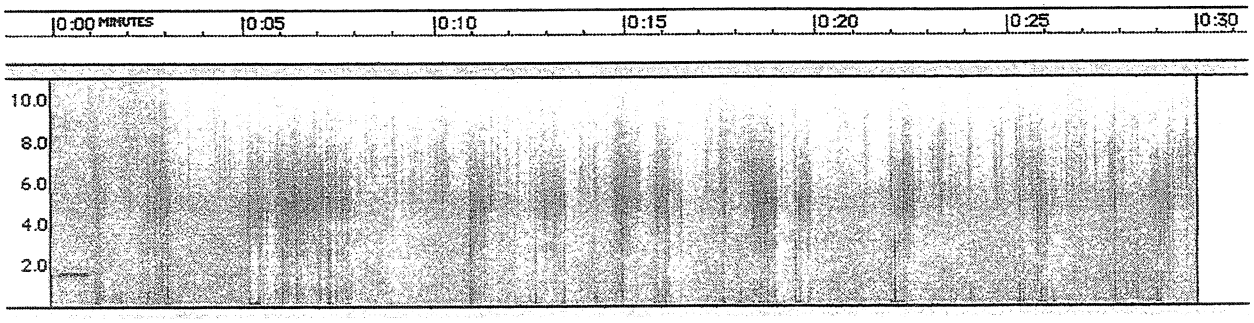
Robert Bennett Las Cruces, NM



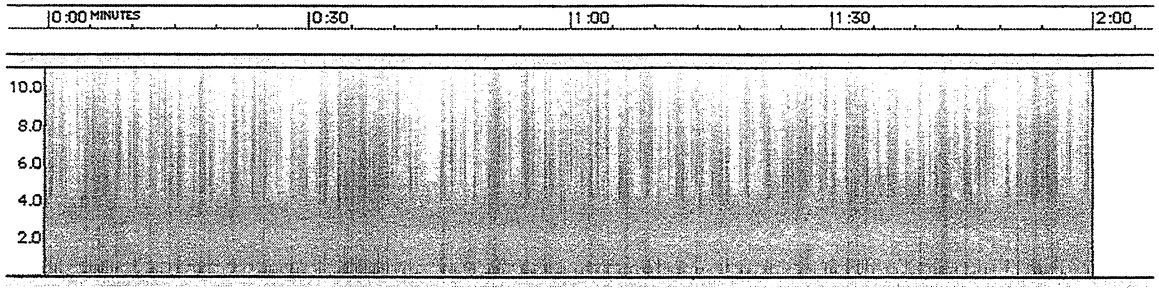
The last hour of observing in New Mexico shows a declining local thunderstorm.



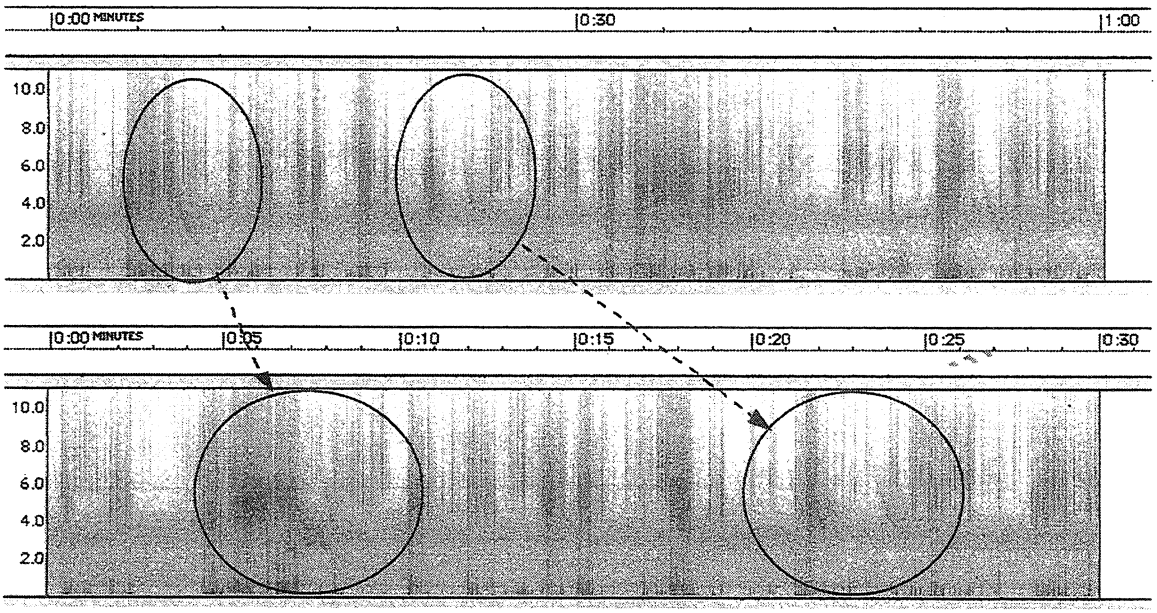




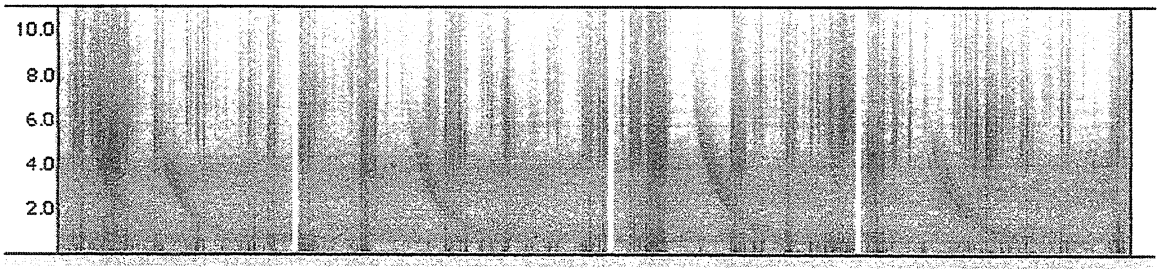
Shawn Korgan Gilcrest, CO



In Colorado, sferic density has not changed much. Strong whistlers pass through the hiss band.



We end this report with some "neat" whistlers logged by Shawn between 1512 UT and 1530 UT.



1512 UT, 1515 UT, 1519 UT, 1529 UT

Report on Field Observations 4/2003-11/2004

By Bill Pine
Ontario, California

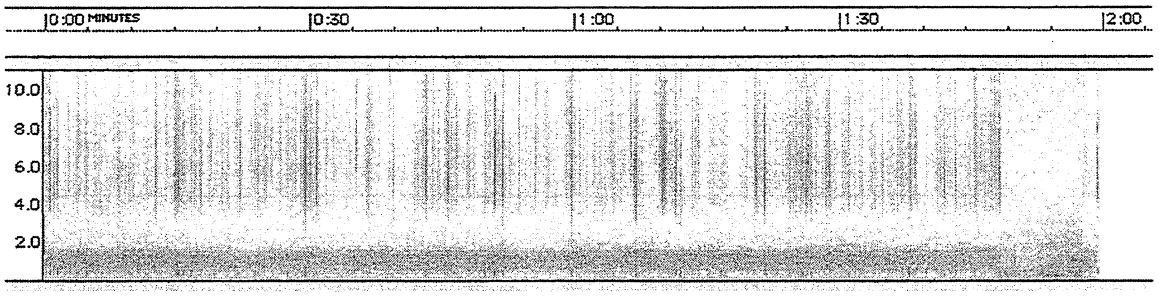
Please refer to Pages 4-5 of the *Journal* for formats and procedures for Field Observations.

Returning to INSPIRE observations after a brief interval are Linden Lundback and Brian Cowan in Saskatchewan, CANADA. Linden wrote:

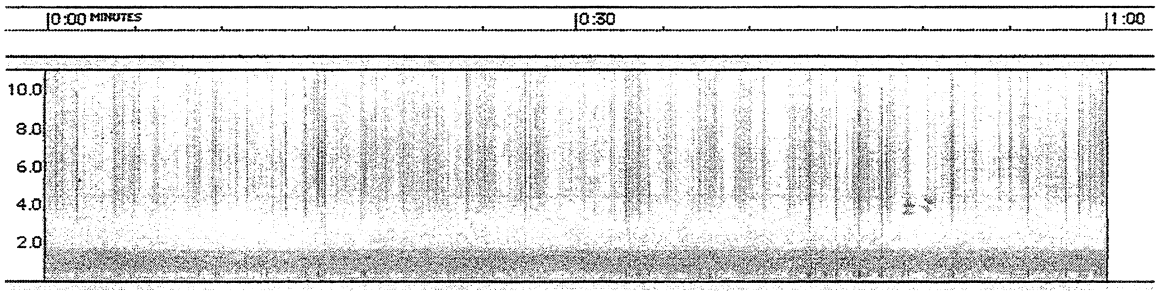
> I am sending a CD with a couple of WAV files on it that represent Team I-2's most recent VLF observations.
>
> We have been rather inactive the past year or so as I (Linden Lundback) have moved to a different part of the province and have been occupied with adjusting to a new job and location. Another reason was our deteriorating recording quality from the Radio Shack tape deck we used for oserving. We have been looking for a good used Marantz or comparable deck for the past few years but haven't found one up here as yet. This session we tried direct recording to a laptop which seemed to work ok (after spending a few hours to get everything working to a acceptable level).
>
> The data you will receive is two .wav files on a CD...it's set up as a music CD...don't know if that's ok. *(Editor's note: music files are fine.)* Let me know if this mode is not acceptable and I will try to resend the info. to your requirements.
>
> It was gratifying to again participate in these observations and of course getting the direct computer recording to work. We both enjoy working with INSPIRE and Radio Jove and having the opportunity to participate in a small way with these two research areas.
>
> One frustration in this session was that our borrowed computer didn't have a very good battery and it 'gave up the ghost' in the latter part of only our second observation. That resulted in us having to abandon observations after two sessions. We are now looking at a used laptop that we can dedicate to these and Radio Jove observations and build a power adapter to the car for longer session recording.
>
> I will be mailing our data in a day or two.
>
> Linden Lundback for Team I-2

Linden Lundback and Brian Cowan Watrous, Saskatchewan, CANADA

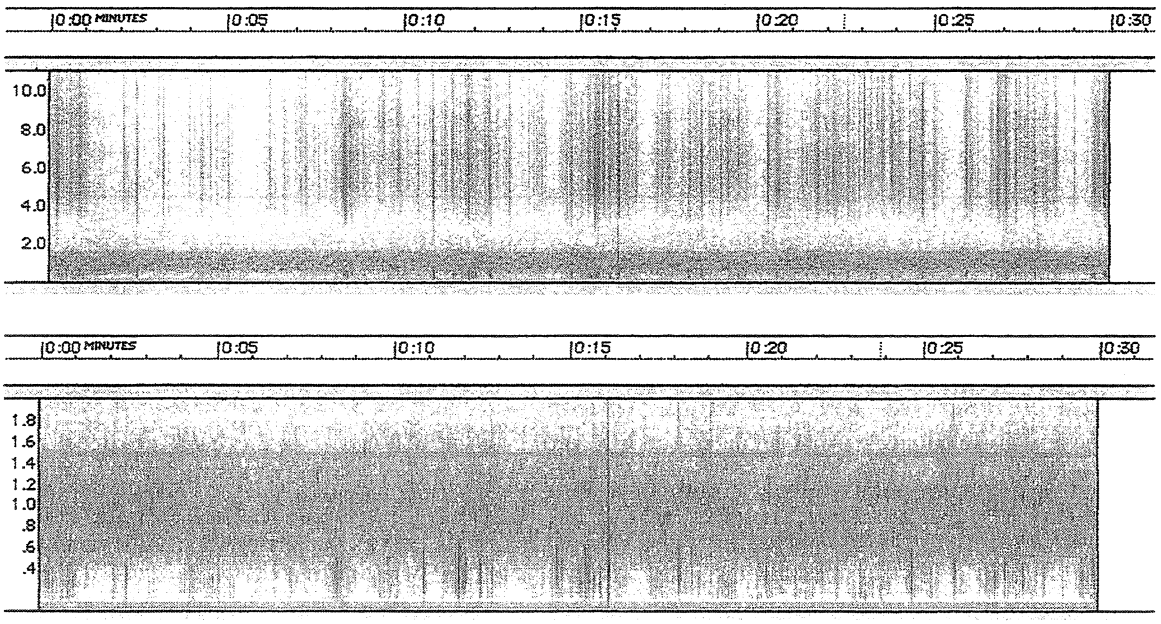
May 1, 2004 1238 UT 0638 Local



Strong sferics are present. The dark band below 2 kHz is chorus.

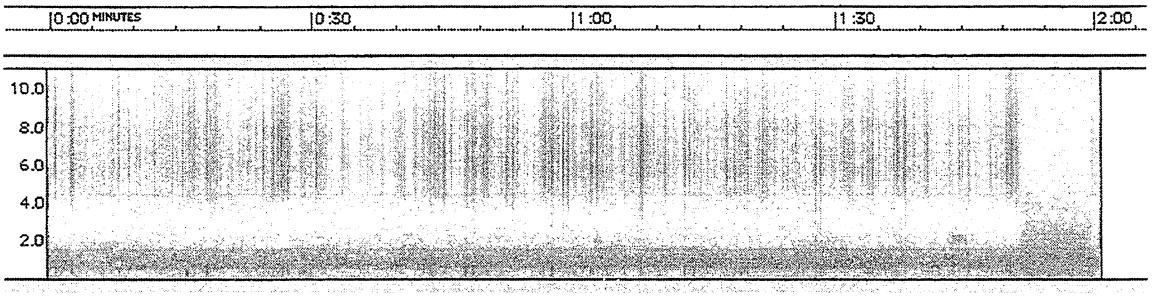


First minute.

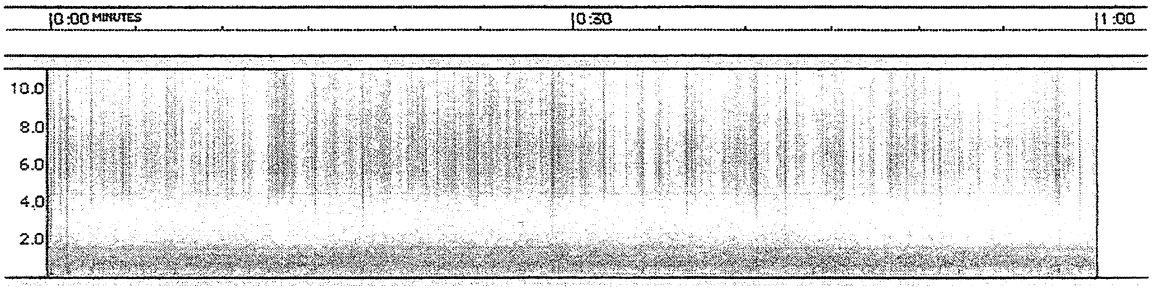


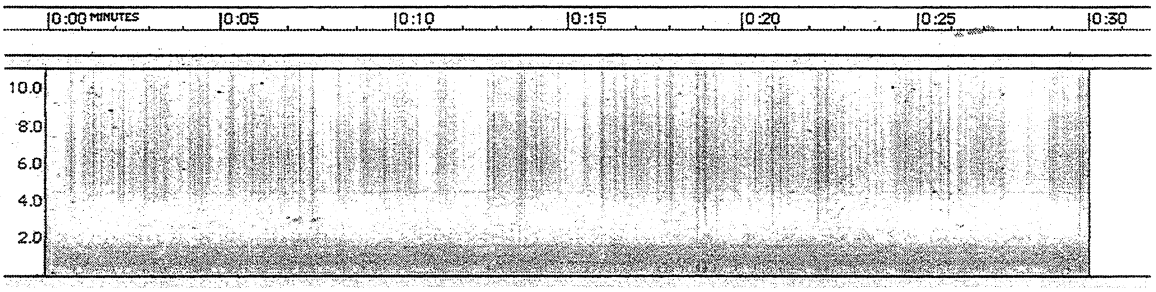
Using a 0-2 kHz frequency range, chorus can be examined.

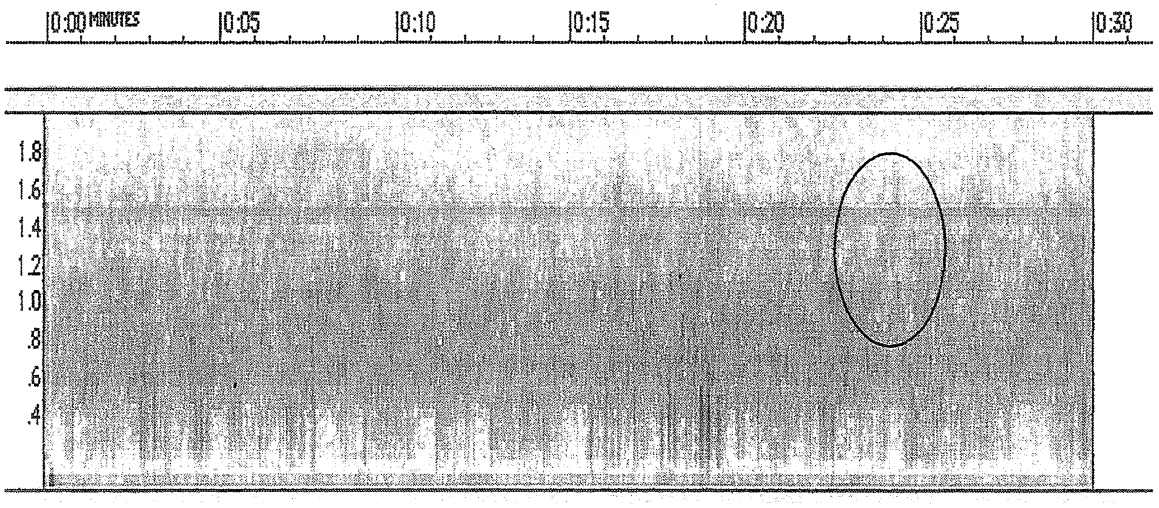
May 1, 2004 1300 UT 0700 Local



Just 20 minutes latger, chorus is stronger.







Chorus consists of rising tones (oval) that periodically appear above the low frequency noise.

Data Log Cover Sheet (copy as needed)

INSPIRE Observer Team _____ Team Number: ____

Equipment: Receiver _____

Recorder _____

Antenna _____

WWV radio _____

Site description: _____

Longitude: _____° _____ ' W Latitude: _____° _____' N

Personnel: _____ _____ _____

_____ _____ _____

Team Leader address: Name _____

Street _____

_____

City, State, Zip, Country _____

email: _____

Local Time to UT Conversion Table

EST + 5 = UT	EDT + 4 = UT
CST + 6 = UT	CDT + 5 = UT
MST + 7 = UT	MDT + 6 = UT
PST + 8 = UT	PDT + 7 = UT

INSPIRE Data (copy as needed)

INSPIRE Observer Team ______________________ Team Number: ____

Coordinated Observation Date: __________ Receiver ________

Tape Start Time (UT) __________ Tape Start Time (Local) __________

Local weather: ____

Code: M - Mark (WWV or Voice) S - sferics T - tweek W - whistler A - Alpha C – chorus
Sferic Density: D: ___ Scale of 1-5 (1 – Very Low, 3 – Medium, 5 – Very High)

Time (UT)	Entry		Observer
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________
________	M-WWV M-V S T C W____________________	D: ___	__________