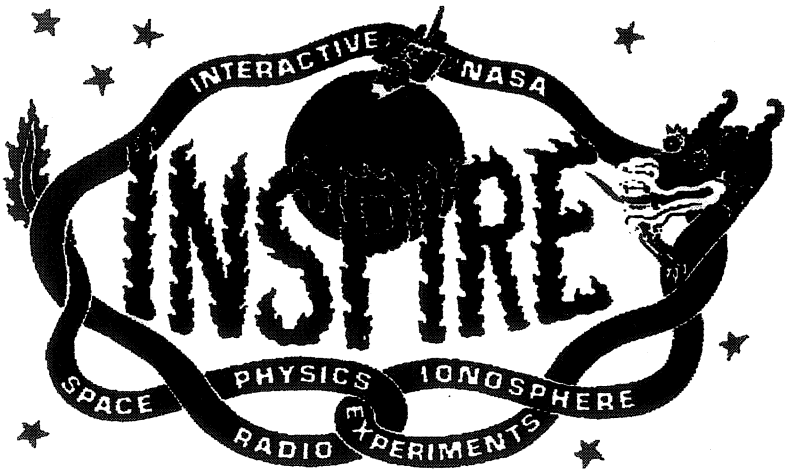

The INSPIRE Journal

Volume 12 Number 2

April 2004

North to Alaska!

INSPIRE representatives recently joined a radio production team from England to contribute to a radio documentary about the sounds related to the aurora. Bill Taylor, Shawn Korgan and Bill Pine traveled to Fairbanks, Alaska, to observe the aurora and record the related natural radio signals. See the story on Page 5 of this edition of the *Journal*.

Coordinated Observation Program Reinstated

It has been decided to reinstate (after a very brief hiatus!) the Coordinated Observation Program. See Page 4 for the details.

Antennas Compared

Veteran observer Robert Bennett of Las Cruces, New Mexico, has analyzed the performance of various VLF antennas. See his article on Page 24 for Part 1 of his analysis.

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Volume 12 Number 2
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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 1 and April 1. Submission deadlines: October 1 and March 1

Contributions to the *Journal* may be sent to:

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

email: pine@mail630.gsfc.nasa.gov

Fax: 909 931 0392

Coordinated Observation Program Resumes!

The Coordinated Observation Program has been reinstated with modifications. The new dates for Coordinated Observations are the first weekend in October and the last weekend in April. This change will put both observation periods during Daylight Savings Time which makes any morning operations closer to sunrise than during Standard Time.

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

Field Observations are Another Way to Participate!

Everyone is invited to participate in Field Observations. Field Observations offer an opportunity to record natural radio and have the results published in the *INSPIRE Journal*. Field observations may be made any time. All reports received will be included in the next *Journal*.

See Page 4 for a description of observation procedures.

Subscription Information Included on the Address Label

You can determine the status of your subscription to *The INSPIRE Journal* by looking at the address label. In the upper right corner of the label is a 2-digit number that indicates the year your subscription will expire. All subscriptions expire with the November issue. If your label showed "03" last November, then your subscription has expired. If your label shows "04", then your subscription is good through the November 2004 issue. If you have any questions or if you feel that the information shown is incorrect, please contact the editor.

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

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).

North to Alaska! INSPIRE Joins the BBC Radio in Creating a Radio Documentary Called "Songs of the Sky", The Sounds of the Aurora

By: Shawn Korgan, Gilcreat, CO
Bill Taylor, Washington, DC
Bill Pine, Ontario, CA

Around the middle of 2003, Bill Taylor, President amd Co-Founder of INSPIRE, was contacted by Kate Bissell, radio producer with All Out Productions, Manchester, England (http://www.allout.co.uk/home.aspx). Kate was researching a proposed program to be aired on BBC Radio 4 (http://www.bbc.co.uk/radio4/). The radio program was to be called "Songs of the Sky" and the topic was to be the audible sounds associated with the aurora. Kate had found the INSPIRE website and contacted Bill to find out more about natural radio signals and their possible connection to the aurora. This initial contact lead subsequently to an invitation for INSPIRE to participate in in the creation of the radio documentary. The plan was to meet in Chatanika, Alaska, north of Fairbanks in late March 2004..

INSPIRE was represented by Bill Taylor, space physicist, Shawn Korgan, amateur scientist and natural radio researcher, and Bill Pine, high school physics teacher. All Out Productions was represented by Kate Bissell, producer and recording operator, and Adam Fowler, interviewer and narrator. When we met in Alaska, we had no idea of the adventure that awaited us. The following is a compilation of the reports on the trip by Bill Taylor, Shawn Korgan, and Bill Pine.

Saturday, March 20, 2004

Bill Taylor

I had some expectations about my trip to Alaska that were grandly fulfilled: seeing the aurora and listening to its natural radio at the same time, meeting and enjoying three new, wonderful people, Shawn Korgan, Kate Bissell and Adam Fowler, and participating in the creation of a BBC radio show "Songs of the Sky", which I hope will bring many new people into the world of natural radio and INSPIRE. The unexpected experiences I will also treasure about my trip to Alaska are meeting many wild and wonderful people of Alaska and having my preconception of the audible aurora turned around.

Bill Pine, Shawn Korgan and I met on the plane in Anchorage that was to take us to Fairbanks. It was late when we got to the Chatanika Lodge, where we stayed and took just enough time to test our hand held receivers at the lodge to determine that the power line noise was too strong and we weren't able to hear anything but 60 Hz and harmonics. We went to bed, exhausted from our trips of up to 19 hours.

Shawn Korgan

It was a very memorable and worthwhile experience to be part of the group which had the privilege of flying to Fairbanks, Alaska, to study the northern lights and record the sounds of VLF (very low frequency) radio signals which occur simultaneously with the aurora borealis, the northern lights.

Saturday, 3/20/04 - This was the day that we had anticipated for several months when we would begin our journey toward the North Pole where the sounds of the northern lights are often greater in amplitude and where the aurora frequently dances across the sky.

It was great to meet in person Bill Taylor and Bill Pine, to share experiences and to prepare for recording the sounds of the northern lights. Shortly after we arrived in the late afternoon in Fairbanks, we decided to check into our rooms and rest a while after the long flight we had endured. After resting, we decided testing our receivers would be appropriate and headed out on a short walk with our receivers in hand to test VLF listening conditions in Alaska. We were surprised at the amount of AC hum we received even after walking a distance of

approximately one-quarter mile from the Chatanika Lodge (located along the Steese Highway) where we were staying.

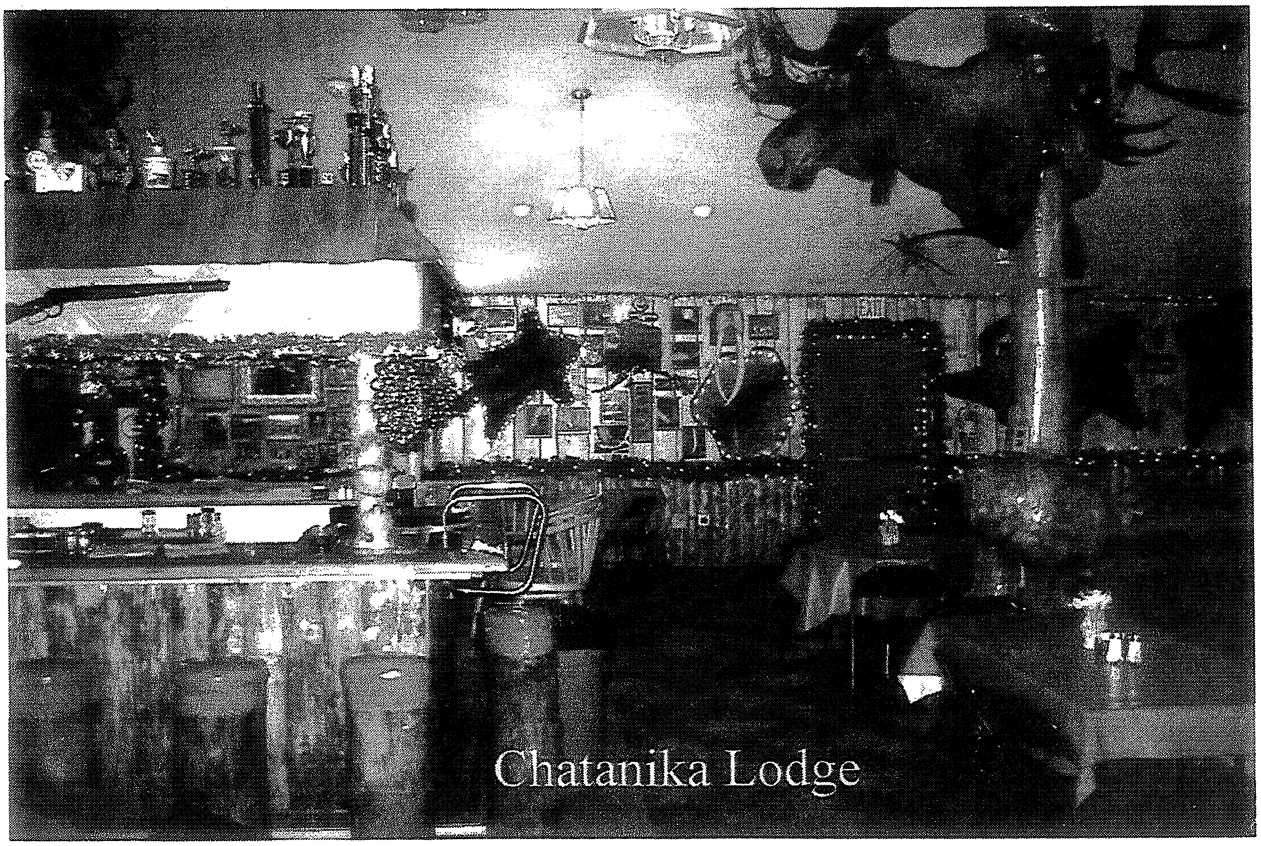
As we were walking around with our receivers, we noticed a distinct glow to our north. We questioned ourselves whether this was the northern lights or simply the last lingering light after sunset before twilight. In upcoming days, we would learn that the northern lights usually begin with a faint sky glow to the north before turning into a band across the sky or into more complex light patterns.

By the end of our walk, we all realized the next day we would have to scope out the land for a quiet listening location free of AC interference.

Sleep came slowly as I anticipated the activity in the days ahead and as I contemplated the possibility of recording all night during our stay in Alaska.

Bill Pine

After a 40 minute drive north out of Fairbanks, we arrived at Chatanika, Alaska. The front door of the Chatanika Lodge opens into a large room with a bar extending away from the door with a dining/dancing area beyond and another dining area in a room to the left. The decorating scheme is hard to describe. The walls were covered with all kinds of items from Alaska: guns, traps, mounted animals, cooking utensils, framed art, and the list goes on. The ceiling is covered with signed dollar bills left by past visitors.



There were a dozen or so people at the bar and at the tables nearby. They, of course, looked up when the door opened, looked us over, then resumed their conversations. The noise level was cheerful and these people obviously knew one another. We were looking for the "office" to check into our rooms. Turned out we were in the "office" – the reservations were kept on a spiral binder under the bar. MJ, the waitress, checked us in and directed us to park on the side of the lodge to carry our bags inside.

The lodge is described as "rustic" and that is accurate. Bathrooms are down the hall and rooms are furnished sensibly with well-used furniture. That being said, another description would be "charming". There is very little about Chatanika Lodge that resembles other places I have stayed. Many places I have stayed in my travels have been nicer and certainly more luxurious, but none has felt more like home.

Sunday, March 21, 2004

Bill Taylor

A moose a few miles up the Steese.

We were up early the next morning and drove about 40 miles NE to a summit on the Steese Highway, testing sites along the way. I heard chorus live for the first time, all morning! We found a great place about 15 miles along the highway where we observed for the rest of the trip. When we got back we had lunch and then walked to the gold dredge across the highway from the Lodge. We then relaxed and met a bunch of characters at the bar in the Lodge. There were people who had worked on the dredges and mined gold, those who were currently prospecting for gold, Ron and Shirley Franklin, who own and run the Chatanika Lodge, and several other locals.

Kate Bissell and Adam Fowler arrived in the mid afternoon. We got acquainted and briefed them on what we had done and found so far. Kate was the consummate radio producer; it seemed like she always had her microphone and minidisk recorder with her and she would whip

them out at the slightest provocation to record stories from the locals, or descriptions of why we were there. Adam was the narrator, the voice, the talent; he was always ready to ask us leading questions to get us revved up about our interests and why we were there.

In a while three old friends and a new one arrived for a planned dinner at the Lodge. The old friends were Don and Betty Carpenter from California and Vikas Sonwalkar from Fairbanks. Don is a long time (50 years!) VLF observer and scientist from Stanford University. Don and Betty were visiting Vikas and his wife, Sushma. Vikas is a VLF researcher at the Geophysical Institute of the University of Alaska at Fairbanks. I had not met Sushma before so there was the other new friend. We had a wonderful dinner while a folksinger provided the entertainment at the Lodge.

Shawn Korgan

On this day, we spent most of the morning traversing Steese highway (a highway mostly free from power lines), surveying the area for quiet VLF listening locations. By mid-day we had located a great listening spot just beyond mile marker forty-eight along the Steese Highway. This would be the spot for all our listening endeavors in the days to follow. During our drive we had great discussions regarding the VLF hobby. Bill Taylor and Bill Pine also reminisced with each other about the past.

During our stops along the Steese Highway, we heard chorus on our VLF receivers at high noon! I would rate the strength of the chorus (on a scale of 0 to 5) at about 1. At lower latitudes it would be nearly impossible to receive chorus at noon except during strong magnetic storms. No magnetic storms were in progress in Alaska during the chorus we received at noon. Also very noticeable at this time were the ALPHA navigational signals that originate from the former Soviet Union. These signals were all strong and clear!

Late Sunday afternoon Kate Bissell and Adam Fowler arrived. After we had a chance to get to know each other, we discussed our plans for the days ahead. Our schedules would be busy with late night aurora watching and VLF recording sessions to daytime interviews and visits to VLF sites of interest in the area. Also on our agenda, we planned to meet with several VLF enthusiasts interested in setting up a live VLF audio stream on the Internet from Alaska!

We were pleasantly surprised to have Professor Vikas Sonwalkar and his wife Sushma along with Professor Don Carpenter and his wife Betty join us for dinner. Professor Sonwalkar mentioned to me that I might capture auroral hiss that occurs concurrently with brightening aurora. Sure enough, I would capture several faint examples of this high latitude auroral hiss before leaving Alaska.

Bill Pine

Returning from our morning journey, we met in the dining room for a late breakfast. There were several people dining and at the bar. After a while, Kathy, who had heard a brief description of why we were there, approached us with a question about power generation. We had some thoughts on the topic and that led her to call her "old man" Mike over to hear some of our ideas. Mike's gold mining partner, Allen, also joined us and we talked for well over an hour

about gold mining, natural radio, the aurora, life in Alaska, and life off the power grid. Two things that surprised me were that there is still gold mining going on in Alaska and that Alaskans claim that you can hear the aurora under the right conditions.

Mike has been working his claims for the past several years and he makes his living by finding gold. Allen has a claim that he will start working this summer. He has been in Alaska for just nine months, but he loves it. We found out later that there is a large commercial mining operation called (appropriately) Fort Knox that takes out 1000 ounces of gold per day. Mike and Allen assured us that there is far more gold remaining in Alaska than has ever been taken out. I believe it.

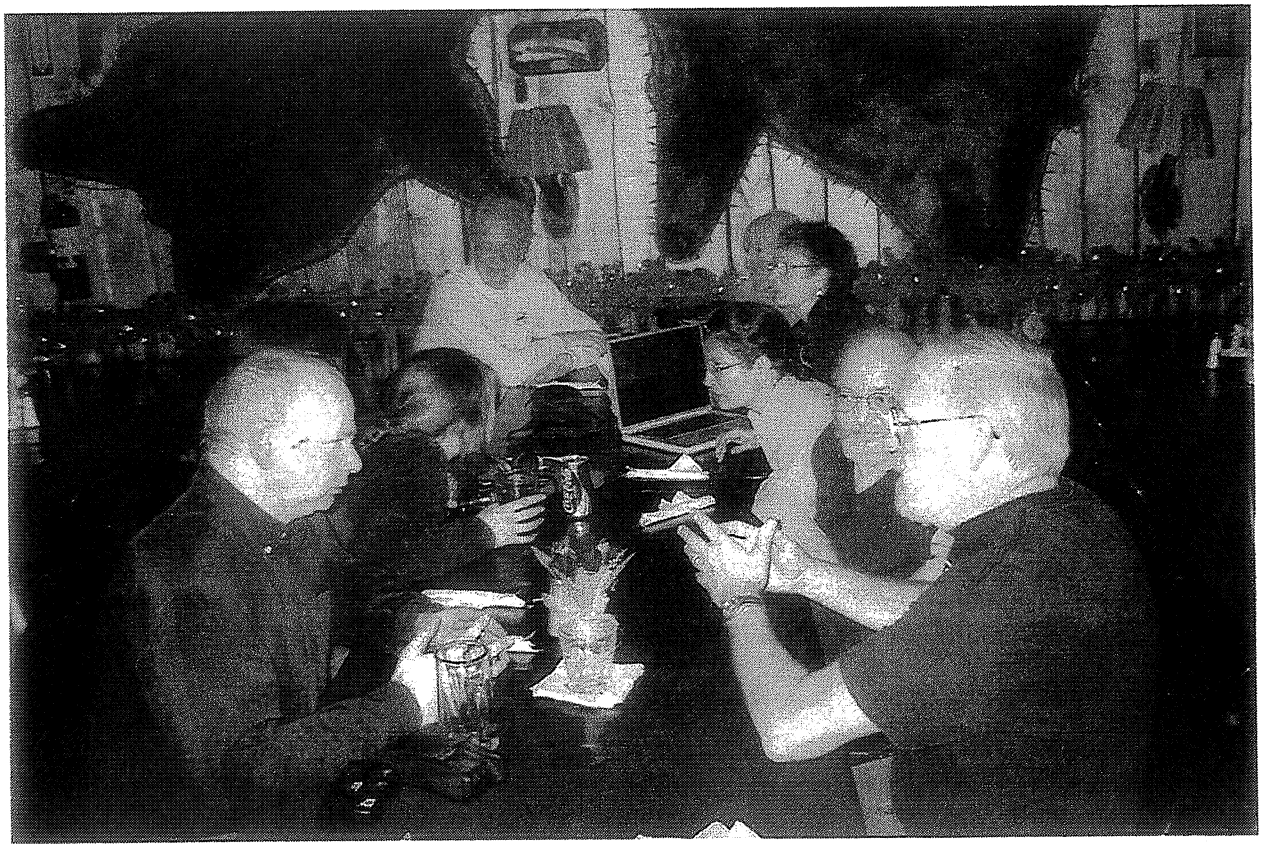
My attitude about hearing the aurora has always been that it is a myth. I can't picture any sound generating mechanism that would transport sound from the altitude of the aurora to be heard immediately on the ground. My attitude has changed. Almost without exception, the locals reported hearing sounds from the aurora under the right conditions. These conditions involve low temperatures (-50° F) and strong, dynamic aurora. The sounds reported vary from rustling sounds to popping sounds and the sounds occur as the display changes.

Kate Bissell, Bill Taylor, Adam Fowler, Bill Pine

Bill Taylor

I've seen the aurora a few times before this trip, from Poker Flat Research Range, a mile NE of Chatanika Lodge, where I flew sounding rockets over the aurora in the 70's as a post doc, and from Minnesota, where I was a post doc. The ones we saw on our trip to Alaska, north of Fairbanks about 50 miles, were the best I've seen. (Troy Birdsall, a native and experienced aurora watcher, put them at a 3 or 4 on a scale of 10 – but they were still impressive!)

When we came out of the Chatanika Lodge after dinner to head for our observing site, Bill Pine looked up and pointed and said, "There is the aurora." I said no, that's a cloud. But was I wrong! It was a very bright aurora, one that could be seen without any dark adaptation to our eyes. We were STOKED! So we ran back into the lodge to get our gear and headed north, beyond the power lines. We saw aurora and listened to and recorded chorus, hiss, tweeks and sferics until we ran out of steam, after midnight, and came back to the Lodge.



Dinner at the Chatanika Lodge

Adam Fowler, Kate Bissell, Bill Taylor,
Don Carpenter, Betty Carpenter, Sushma Sonwalkar, Vikas Sonwalkar, Bill Pine

Shawn Korgan

Sunday night, we were all surprised to hear from someone in the lodge that aurora was in progress and that it was even visible at our lodge with the outside lights turned on! A quick glance outside revealed that sure enough, aurora was in progress. This appeared to be the beginning of what could be a very interesting night of activity. At this point, we all gathered up our equipment and started on the twenty mile journey to our predetermined VLF listening spot along the Steese Highway.

As we traveled to our listening spot, the aurora was generating an impressive display. A scene similar to smoke rising from the horizon developed into an arched band of light which then proceeded to stretch across the entire sky from east to west. At times, vertical columns or rays of light would be seen shooting up into the midnight sky and on one occasion there was even faint sheets of greenish, white light rising vertically upward out of the bands of light stretching between the horizons.

With all this aurora activity, we were surprised to receive little in the way of VLF activity on our VLF receivers. At my home location in northern Colorado, whenever visible aurora have occurred it has always produced terrific VLF sounds ranging from a high rate of low frequency, low-dispersion whistlers to moderate strength chorus to strong hissbands. Why should it be any different in Alaska?

At best, we heard a faint hissband, a couple of risers and a few faint whistlers with an echo or two. This was the peak of the VLF activity during our aurora display. Spherics were constant as usual and tweeks had a slightly lower frequency ring to them in Alaska than they do in Colorado.

During this recording session, I laid a three hundred foot piece of shielded wire upon the pavement as my long wire antenna. I used the ground of our vehicle as the ground or counterpoise for the VLF receiver. Bill Taylor on the other hand had suspended a large eight foot loop antenna from several small trees. As we compared the audio from a VLF-3 receiver (tied to the long-wire antenna) and the audio from the loop receiver, it was noted that the VLF-3 receiver had the best signal. The loop receiver had slightly more white noise which masked the fainter chorus which was occurring. Approximately thirty minutes later, the loop receiver began to develop a crackling, popping sound to it and an occasional whine or screech type sound. I falsely assumed at the time that this was due to water getting into the cables as several of them were laid directly on the snow.

Within approximately an hour of the loop receiver being setup, the audio had changed from a rather decent signal to a crackling, popping and an occasional whine type sound to absolute white noise! It now appeared there was a definite problem with the loop receiver. At this point in time, the e-field receiver also began to experience a faint crackling and popping type sound. I decided to check the long wire antenna connections for any possible moisture buildup in the coax connections feeding the VLF receiver. The connections appeared clean and upon returning inside the vehicle the crackling and popping type sound had disappeared from the audio in the e-field receiver.

At this point, I personally was still under the assumption that water had somehow seeped into our wiring. What else could possibly explain the crackling, popping and occasional

whine type sound we had heard in the output of the loop receiver and then later in the output of the e-field receiver? And what could explain the sudden entire dysfunction of the loop receiver?

At this point, it might be worthy to note that faint LORAN interference was noted in the output of both my homemade SK-1 VLF receiver and also in the VLF-3 receiver.

It was getting late so we decided to make the twenty mile drive back to the lodge and get some needed rest.

Bill Pine

I had never seen the aurora and I did not know what to expect. I have, of course, seen photos, but the actual aurora has features that cannot be captured by still photography. Sometimes it looked like curtains rippling in a breeze; other times a bright region would form and move along the arc. It was fascinating and awe inspiring. It was also cold. Nighttime temperatures were about 0° F, not cold by Alaska standards, but plenty cold for this California boy! Daytime highs were around 20° F. By the end of our stay, the high temperature had climbed above freezing, announcing the arrival of spring. Fortunately, Kate and Adam had rented a motor home, so we could use that as a base to get warmed up every once in a while.

Monday March 22, 2004

Shawn Korgan

Early Monday morning, we returned to our VLF listening location for a listen to VLF conditions, to set up a better long wire antenna and also to check out the condition of the loop antenna and receiver. As there were short trees along the parking lot, we decided to hang a long piece of shielded wire (approximately three hundred feet in length) in the treetops. In an effort to achieve better success capturing the faint VLF signals, we also laid out approximately three-hundred feet of shielded wire in the opposite direction as a counterpoise which would tie to the ground of the VLF receiver.

Upon connecting the newly designed antenna to several e-field receivers, it was determined to be a success! We were instantly awarded with great sounding chorus again toward mid-day! I rated this chorus at about a strength of 2.

Next, Bill Taylor had brought along a small portable loop antenna to test the loop receiver. Upon connecting this small loop antenna, nothing was heard except static or white noise in the reception. This felt almost like deja vu from the experience with the large loop antenna the night before. We were unsure what had occurred to the loop receiver, although I remembered a question Bill had posed the night previous as to whether the e-field receiver was protected. I assumed he meant from static electricity at which point I responded yes. The VLF-3 receiver was designed to withstand accidental low voltage DC across the input and also to ground most high value AC voltages encountered in the field (excluding lightning of course). By this question, I also assumed the loop receiver must not be "protected". The large loop antenna was disassembled at this point due to the non-functioning loop receiver.

After we arrived back at the lodge, we had a chance to talk with several local residents,

including the owners of the lodge, Ron and Shirley Franklin, regarding the audible sounds people claim to have heard with their ears from the northern lights. From this point onward, Kate Bissell and Adam Fowler found a continual stream of local residents to interview who claim to have actually heard sounds caused by the northern lights with their ears. The local residents in the area and also the visitors at the lodge were extremely courteous and very willing to help in any way possible with our project.

Once again meeting up with Kate and Adam at the lodge, we decided to visit the Mt. Aurora viewing range and lodge. Mt. Aurora is an ideal location to view the aurora with its elevation above the surrounding terrain. This also makes it a prime location to receive radio signals generated by the northern lights. Troy and Stephen Birdsall currently operate a live web camera (www.aurorawebcam.com) upon which the aurora occurring north of Fairbanks, Alaska can be viewed online during the aurora season. It just so happened that Troy had recently researched into the possibility of streaming live audio from the northern lights onto the Internet simultaneous with the live video stream already in operation! If this were to develop, it would be a one of a kind operation and the first of its nature in existence that I am aware of. After we tested several possible locations for a VLF receiver, it appeared likely that a live VLF audio stream from Mt. Aurora would be a possibility although some processing of power line interference would have to be performed to eliminate unwanted interference.

Monday night, we once again leave the comfortable surroundings of the lodge to head out into the dark, cold Alaska night to do more aurora watching and VLF recording. Aurora was once again in progress and similar in appearance to the night before.

Late this night, I planned to stay up and record VLF audio and watch the aurora the entire night! I figured this was a worthwhile endeavor after making the long journey from Colorado. Due to lack of activity, I had recorded relatively little VLF activity so far. I could not imagine arriving back home with little if any VLF audio from Alaska! After I spoke with everyone else, it was agreed that I would stay and record the sounds of VLF during the night while the rest of the group would take the second vehicle back to the lodge.

During the night, I would capture some of the best VLF audio since we had arrived in Alaska. This would include whistlers, sudden short increases in hissband which corresponded to brightening aurora and also low frequency chorus. The aurora became particularly active during the night with a curtain stretching upward into the sky for over fifteen minutes at one point. Rays of light were constantly shooting upward into the sky which had a similar appearance to a car's headlights or to a very bright spotlight shining upward into the sky. On several occasions whistlers would occur just previous to these rays of light suddenly appearing.

During this particular night, HAARP was conducting air glow experiments. They were attempting to create patches of light by heating various portions of the earth's atmosphere. The VLF modulated HF transmissions were inducing VLF radio signals in the VLF band. These transmissions were distinctly audible on the VLF receiver and included various steady tones and frequency ramps (rising tonal emissions).

Bill Pine

Monday evening at the Lodge, things were quieter. I met Butch, a pipeline veteran of 22

years who is now retired. He had many interesting tales of working on "The Slope". It was a tough environment with temperatures as low as –70° F with a wind chill on top of that. I was surprised to learn that work on the slope happens mostly in the winter when the frozen ground gives good support. I also met Neva, who works at the nearby Poker Flat Rocket Range. Neva lives at Mile 42 on the Steese, past the end of the power grid. She agreed to arrange a tour of Poker Flat the following morning.

About 10 PM we headed up the highway to our observing site. I had been having problems every session with my VLF3 receiver. When I first turned it on, it worked fine. After about a half hour, the signal strength would fade and in a few minute it would quit altogether. Between sessions I would change the receiver and check out the one that had failed. The "failed" receiver checked out just fine every time. It was a mystery.

Bill and Shawn were having some equipment problems, too. This was no surprise since experience has shown that Murphy accompanies all field trips so that he can impose his law! Bill and Shawn were able to troubleshoot their equipment and keep it running. Their receivers were inside the motor home while mine was outside stuck in a snow bank. It occurred to me that maybe my problems arose from the cold temperature that the receiver and tape recorder were experiencing.

Tuesday, March 23, 2004

Bill Pine

Tuesday morning we headed for Poker Flat Rocket Range. We were late leaving the Lodge due to many conversations that had to be concluded. Neva let us in the gate and, when we arrived at the Science Center, she called Brian, the staff scientist, to show us around. Brian is from New Zealand and his job at Poker Flat is to provide coordination between the equipment of the sounding rockets and the interfaces at Poker Flat. The tour was great. Brian was quiet at first, but soon warmed up and provided a wealth of information. We found out later that most tour groups only ask things like "How cold does it get here?". Our questions were better than that and I think Brian enjoyed showing us around.

Bill Taylor

Tuesday afternoon we visited North Pole High School, just outside of Fairbanks, and met Curt Szuberla, a physics and math teacher there, who is an INSPIRE participant. He is also a PhD space physicist and is planning to install a VLF-3 near the high school and stream its output onto the Internet. We are looking forward to our first high-latitude streaming site! But Curt has some competition for the first high latitude VLF stream – Troy Birdsall. Troy runs an aurora webcam from his family's property near Mt. Aurora, a few miles south of Chatanika Lodge. See his website, http://www.aurorawebcam.com He also plans to put a VLF-3 on the property and stream VLF simultaneously with the aurora images.

Adam and Kate also interviewed several people who have heard the aurora with their ears. Most of them haven't talked about it much because they think that others will think they are

crazy! As I mentioned, I was skeptical, but after hearing very similar reports from them, I've become a believer. I've also done a little Googling on the topic and am even more convinced that it is real. Really tough to record, but real. The anecdotes go like this: It's a very cold night, -40 degrees or below, the aurora is very strong, and synchronized with its dancing is a hissing sound and sometimes crackling.

A possible theory for audible aurora is that the aurora creates a vertical electric field in the atmosphere to over 10 kV/m, up from the 100 V/m fair weather field that exists world wide all the time. The electric field of the VLF waves from the aurora adds to this electric field. The total electric field is high enough to cause coronal or brush discharges from points, such as pine needles, snow or even human hair, perhaps in ears. Coronal discharges are audible and the VLF waves will modulate the discharge. There are even reports of recordings of sounds from aurora, but I have not seen scientific reports of the recordings.

Bill Pine

While talking to Curt, he showed us his field setup that his students take out for observations. He carries the receiver and recorder in an ice chest. Next time I go to Alaska, I will carry my equipment in an ice chest – to keep it warm!

Shawn Korgan

By morning, low frequency chorus was in progress as the rest of the group pulled up from a refreshing night of sleep. In the sky overhead appeared a bright sundog on the west side of the sun and a fainter sundog on the east side of the sun. The snow glistened brightly in the crisp morning air. After we had monitored the chorus on our VLF receiver for about an hour and after we had viewed the scene, we decided to head back to the lodge. This would turn out to be the last time we would attempt to record sounds from the northern lights. I was glad I had opted to stay up an entire night to record VLF activity!

Later this day, we visited the North Pole High School a second time after confirming a good time to meet with Curt Szuberla. Meeting up with Curt Szuberla, we discussed the possibilities of setting up an online VLF audio stream from the North Pole High School. We hiked at least one-half mile to a location we thought might make a good location for a VLF receiver. It turns out that a location close to the school was actually a better location for a VLF receiver due to less power line interference and due to the possibilities of simpler equipment installation. As with the case of Mt. Aurora, some type of processing of the audio signal would be necessary to eliminate unwanted power line interference before streaming the audio onto the Internet.

We also had a chance to tour the Poker Flat missile range where many experiments are performed annually on the aurora.

This evening we said our goodbyes to Bill Pine who had to leave a day earlier than Bill Taylor and myself. To end this evening, we viewed faint aurora from the top of Mt. Aurora before turning in for the night.

Bill Pine

Tuesday night I stayed at Pike's Waterfront Lodge on the Chena River in Fairbanks. Pike's is a beautiful new hotel and I wished I was at the Chatanika Lodge. Wednesday morning meant another day of travel back to reality.

Wednesday, March 24, 2004

Shawn Korgan

On this morning, Kate Bissell and Adam Fowler would interview me for the final time before we packed up our luggage in preparation to leave the lodge. We said our goodbyes to the lodge owners on the way out.

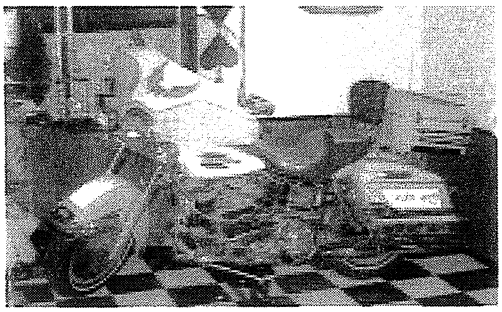
As Kate and Adam had several private interviews to perform, Bill and I had a chance to stop by the University of Alaska Museum. Later this evening, we would eat our final meal together. Bill and I said our goodbyes to Kate and Adam. It is always hard to say goodbye to new friends who live halfway across the world! Kate and Adam will continue onward to Galena, Alaska, to speak with Alaskan natives regarding myths and legends on the northern lights while Bill and I have early morning flights back home.

After arriving home, it was hard to return to work. It was as if going back to work would undo the experience of our expedition to Alaska.

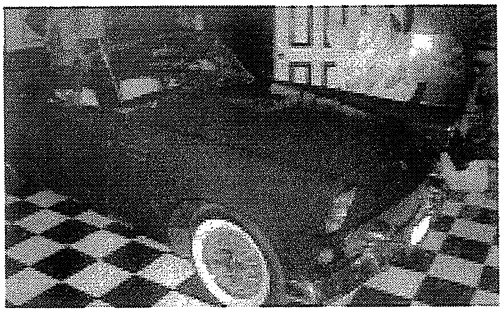
Over the course of the next several days, I pondered over the unusual problems we had experienced in Alaska with our VLF receivers.

Bill Taylor

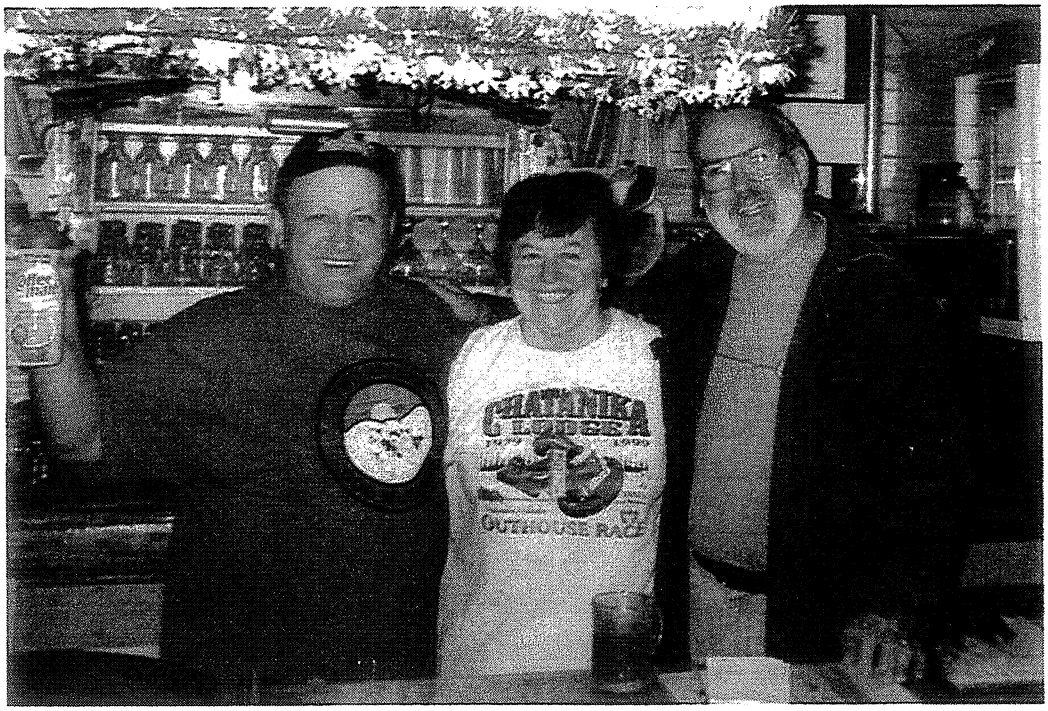
The trip was a magical experience for me, on many levels, and I will treasure it always.



Ron's 1979 Harley Dresser Touring Bike



Ron's 1955 T-bird Convertible



Our Hosts at the Chatanika Lodge
Ron and Shirley Franklin

On behalf of The INSPIRE Project, Inc. and All Out Productions, we would like to thank our hosts at the Chatanika Lodge and all of the wonderful people of Alaska for their warmth and hospitality. We will return.

Kate, Adam, Bill T., Shawn, Bill P.

We Heard The Lights!

By Shawn Korgan
Gilcrest, CO

Unfortunately, I would not realize the full significance of what I am about to discuss until returning home from Alaska. This experience began on Sunday, March 21st when we arrived at our VLF listening location along the Steese Highway, just past mile marker forty-eight, and began monitoring the audio from our VLF receivers. Aurora was already in progress when we arrived. We excitedly hooked up our equipment as we watched the aurora over our shoulders!

As previously noted, I had laid out a long stretch of shielded wire (approximately 300 feet in length) on the pavement as my e-field antenna and had already begun monitoring the sounds of VLF. There was a constant crash of spherics heard on the output of the receiver along with some very faint chorus. At this point in time, the e-field receiver worked fine and was not experiencing any unusual symptoms. While I monitored in the RV, Bill Taylor and the rest of the group were busy setting up a large eight foot loop antenna in some nearby trees. I monitored for a short time longer and then decided to check on the progress of the loop antenna setup. They had nearly finished the setup.

Soon afterward, the loop receiver was hooked up and running. When we first listened to the audio from the output of the loop receiver it sounded great! The constant crash of spherics was heard along with the faint chorus. The loop receiver did have slightly more white noise in the reception although it was working fine. Once again, we listened to the audio from the e-field receiver. The audio from the e-field receiver still sounded normal at this point in time. After a short time, we again listened to the audio from the loop receiver. At this point in time, the loop receiver started to experience some type of crackling, hissing and an occasional whine type sound.

I remarked that it sounded as if water had somehow seeped into the wiring of the loop receiver. Adam Fowler, the narrator for the BBC documentary, remarked at how I was able to identify the strange sounds we were hearing in our receiver so quickly. In return I replied that I had previously experienced sounds similar to this when water had seeped into connections of audio amplifier equipment.

Again, we listened to the audio from the e-field receiver. At this point, the e-field receiver was also beginning to experience the same hissing, crackling and popping sounds although much fainter in amplitude! After a short time, we once again attempted to listen to the audio from the loop receiver and at this point nothing but white noise was capable of being heard! I was shocked that within the space of one hour the audio on the loop receiver had gone from a clean audio output to a strange crackling, popping type sound (with an occasional whine) to nothing but static or white noise! What could have possibly have happened to the loop antenna or receiver?

Once again, we listened to the audio from the e-field receiver. At this point, the crackling, popping sound was a little louder in the e-field receiver. I wondered whether the e-field receiver would be the next piece of equipment to stop working? At this point, I remarked that I was going to check the connections for the e-field antenna to make sure no water had gotten into these wires. As I walked out to check the wires, I noted that I had left the e-field receiver turned on and that my every footstep was making a corresponding loud footstep inside the RV. Mysteriously, after I checked the long wire connections (which were dry), the noise on

the e-field receiver entirely cleared up. I wondered at the time what was going on with our equipment, although I was simply glad the problem had at least temporarily disappeared. The temperature this night was below the freezing point.

On the very next morning, Monday morning, after arriving back to our listening location, we once again tried the loop receiver. As previously noted, we connected the loop receiver to a small portable loop antenna and again nothing was received except white noise. There was not even so much as a single spheric audible in the output over the noise. A handheld e-field receiver on the other hand revealed constant spherics and moderate strength chorus.

This morning, we had stretched a length of approximately 300 feet of shielded wire through the tops of small trees at our quiet listening location. This would serve as our antenna Monday night. At the same time, we had also laid out approximately 300 feet of shielded wire in the opposite direction to act as a counterpoise to pull in the weak VLF signals. The ends of these two shielded pieces of wire were over 700 feet apart! I felt confident that no moisture could possibly get between these two distant connections and interfere with our recordings on Monday night!

On Monday night, we hooked up the e-field receiver and monitored the audio. Once again, aurora was in progress. No problems were noted in the receiver as had occurred the night previous. We had fixed the problem! Or, so we thought!

This was the evening I decided to personally stay up and record the sounds of VLF during the entire night as we had not yet captured much of interest on our VLF receivers while in Alaska. This evening, I would record in the 4x4 truck instead of the RV where we had experienced problems the night before. The battery for the truck had to be disconnected as the vehicle was generating computer related electrical interference on the VLF receiver.

This evening, I eliminated the short length of coax I had used the night previous. Eliminating the coax cable was my perfect plan to eliminate any possibility of moisture buildup between the input and the ground of the VLF e-field receiver. It was at this connection (where the end of the coax cable tied into the long wire antenna) that I had assumed moisture might have somehow intruded and created noise in the e-field receiver the night previous. You can only imagine my surprise and frustration when the noise once again surfaced even after I had removed the coax cable and as I realized the individual ends of shielded wire were over 700 feet apart from each other! There I sat attempting to record some of the best VLF audio of the entire expedition when the crackling and popping type sounds once again began to surface! What could I do? What was the source of this noise?

At 12:02 UT, the receiver began to experience more than simply a crackling, popping type sound but also began to experience an occasional whine or screech type sound as had occurred the night before in the audio of the loop receiver before it mysteriously stopped working. At this point, I began to experiment with the receiver to figure out where the source of the noise was coming from. I noticed that the noise almost entirely disappeared when the counterpoise line was disconnected from the receiver. Even disconnected from the e-field receiver, this single-shielded length of wire (laying atop the snow) was still producing noise loud enough to be picked up by the nearby e-field receiver! I had to actually throw this line completely outside of the vehicle to prevent the noise originating from this line from disrupting my attempts at recording the aurora!

I then proceeded to lay out a new counterpoise line on the pavement. This counterpoise did not have near the amount of noise the counterpoise line on the snow had although there was still an occasional crackling and popping type sound shortly after I hooked up the new

counterpoise line. Shortly thereafter, the noise disappeared. I did not record much in the way of the crackling, popping, whining type sounds as I figured it was useless noise disturbing my aurora recordings. Looking back, I wish I had recorded further examples of this noise. The reasons will be noted in the remainder of this article.

Here are the facts. Our VLF receivers in Alaska were prone to some type of electrical charge which was particularly noticeable from wires which had been laid along the top of the snow as opposed to upon the pavement. The effects of this charge were noticeable upon both a long wire e-field receiver and upon a large loop receiver. The effects of this mysterious charge were not immediately noticeable upon connecting our antenna lines to our VLF receivers. Our receivers would function normally for a short amount of time before beginning to experience the abnormal crackling, popping, hissing and finally whining and screeching type sounds.

Continuing, aurora was visible each time we experienced these problems with our equipment although the problems were not experienced throughout the entire duration of the aurora. Both a loop receiver and a e-field receiver began to experience this noise at the same time on the first evening we attempted to record the northern lights. First the noise developed in the loop receiver and then shortly thereafter it was noticeable in both receivers. (It is also interesting to note that Bill Pine had experienced problems the day previous with his handheld VLF-3 receiver not functioning for a short time.) Moisture between input connections as the source of the noise was ruled out on Monday night when I eliminated all coax lines and simply connected the two insulated wires feeding in opposite directions (over 700 feet apart from each other) directly to the inputs of the e-field receiver. Both a VLF-3 receiver and the SK-1 receiver revealed the same noise.

It is also interesting to note that I have used long wire antennas (up to 1000 feet in length) for over five years on Trail Ridge Road in the Rocky Mountains (at an elevation of over 12,000 feet) and have never experienced the problems we experienced while in Alaska (the popping, crackling and whining type sounds characteristic of electrostatic charge buildup upon electronic equipment).

After arriving home, it was discovered that the front-end chip in the loop receiver had indeed been damaged. I hooked the small loop antenna to the receiver and still, nothing but white noise was noticeable in the receiver's output. The receiver was perfectly dry both inside and outside. Replacing the unprotected front-end IC chip with a new one fixed the receiver! This was proof positive in my mind that the front-end chip of the loop receiver had been damaged by some type of static electricity. But what on earth had created such a large buildup of electrostatic charge on a lonely road over twenty miles from power lines? For the answer, I believe one has only to look upward into the sky during a display of the northern lights!

It was at this point that it began to dawn on me that we had actually recorded audio examples of the sounds of coronal discharge, the leading explanation for the audible sound generation mechanism of the northern lights!

Could the source of this charge be the DC "voltage" counterpart to the high "current" produced by the aurora? Is the electrostatic charge we experienced upon our VLF receivers the source of the audible sounds people claim to hear from the aurora? These are questions which remain to be entirely answered.

The intriguing part is that the "noise" we experienced on our VLF receivers is identical to nearly all of the testimonies regarding the audible sounds heard during auroral displays, a crackling, popping, hiss or screeching type sound, etc.

After arriving back home and re-reading personal testimonies from people who claim to

have actually heard sounds during auroral displays (refer to www.members.tripod.com/~auroralsounds/aslist.html), I came across the following amazing similarity to our own experience while in Alaska.

Colin Graham, Inuvik, N.W.T (observer #93 on the above web page) reports audibly hearing crackling and popping type sounds in conjunction with a bright auroral display! The most intriguing part of this testimony is that this group heard "similar" noises coming from their audio amplifier as they had audibly heard from the aurora with their ears! By the way, what are VLF radios? Audio amplifiers! Here is another group (other than ourselves) which experienced audio amplifier interference during the northern lights. Remarking upon the incident, he mentions that the noises in their audio equipment "repeatedly had a similar sound [to what they had heard with their ears from the northern lights] transmit through our equipment and it was not any of our instruments." Continuing, "it was intermittent and sometimes 'burst' through the sound system and then we would stop playing and turn off all the stage gear and you could still hear the sound in the main sound system. After complete diagnostic of the system we determined it was not our equipment, lighting or sound system; it was a mystery sound."

Could electrostatic discharge or coronal discharge (also referred to as brush discharge) actually explain the sounds heard during displays of the northern lights?

"Professor Chant's theory was enthusiastically embraced by two American researchers, S. M. Silverman and T. F. Tuan, who in 1973 wrote a comprehensive 110-page paper on the subject. It is a mine of information. The brush discharge theory is supported to some extent by D.E. Olsen, who measured a jump in the geoelectric field from the fair-weather value of around 100 volt per metre to over 10,000 volt per metre during an intense aurora. This is approaching the electric field strength needed to excite an audible brush discharge under suitable conditions...." http://users.hunterlink.net.au/~ddcsk/aurora1.htm

Add to this the fact that during a bright aurora display in Colorado on October 29, 2003, I felt a profound static charge in the air. During the peak of this auroral display, there were two bright red patches to both my East and West while directly in front of me were bright white and green curtains rising to almost directly overhead. What a sight! Patches of light were moving very slowly from one side of the aurora to the other. This was the best auroral display I have ever experienced with what I recently witnessed in Alaska being second best.

During this Colorado aurora the air gained some type of static charge to it as suddenly every breath I took made my nostrils feel like they were full of static electricity! This charge was also felt slightly upon the hairs within my ears! This was very annoying to me at the time although I did not recognize the significance of the experience. I should note that I was sitting in my car when this static type charge began to be experienced. I would assume the vehicle should have shielded me from any type of change in the charge of the air but this was not the case. It was as if my body suddenly had a different charge from my surroundings.

Recognizing this was a very bright auroral display and that many people claim to have heard sounds from the northern lights, I stepped out of the car for a while during part of the brightest display in an attempt to "hear" the northern lights with my ears. Unfortunately, I did not hear anything even though it was absolutely quiet. The static charge I felt began suddenly as the aurora became very brilliant and began stretching to what appeared to be almost directly overhead. The charge dissipated and became unnoticeable as the aurora faded away.

On the VLF group e-mail reflector (http://groups.yahoo.com/group/VLF_Group), I had the following comments to make upon this experience at the time. "On October 29th [2003] when the brightest auroras I have ever seen were occurring in Colorado, I very distinctly felt a

static charge on my body (or in the air). This lasted between fifteen minutes to half an hour during the duration of the brightest portion of the aurora. I especially noticed [sensed] the static electricity feeling by the tiny hairs within my nose and ears.... I've never heard of anyone experiencing anything similar to this but thought I would pass it along." VLF reflector group message 2750.

Our experience with coronal discharge upon our VLF receivers in Alaska along with the feeling of static electricity during the brightest aurora display I have ever seen leads me to highly believe that coronal discharge is indeed responsible for the sounds of the northern lights! Could there be any more convincing evidence?

While we were in Alaska, Ron Franklin (the owner of the Chatanika Lodge we were staying at) mentioned that he occasionally hears more than the standard popping, crackling and rustling type sounds from the aurora. He has also heard the aurora occasionally screech like a bobcat which he said can make a person's hair stand on end! This type of sound would occur during higher amounts of coronal discharge. Coronal discharge produces a popping, crackling type sound during slower discharge rates. This popping, crackling sound can be steady in rate/speed or it can vary in rate/speed creating a type of rustling sound. During slightly higher discharge rates the popping, crackling sound turns into hiss, frying and hum type sounds. And finally, during high discharge rates sizzling, screeching, squeaking and squealing type sounds are heard. Again, these sounds can vary in speed, pitch or duration corresponding to the discharge rate. If the discharge rate varies widely, a mixture of the above sounds might be heard. Add to this the fact that Ron has smelled ozone (or something very similar to it) in the air as audible sounds of the aurora are occurring. Ozone is generated during coronal discharge!

Coronal discharge, as I basically understand it, occurs as electrical charge upon an object is released into the surrounding air generating ozone and frequently noise as it does so.

After adding up all the facts, it is easy to come to the conclusion that the noise we experienced in Alaska upon our VLF receivers was coronal discharge! This alone could explain what burned out the front-end IC chip in the loop receiver while only aurora was visible overhead.

In closing, I believe good hearing is a requirement to hear audible sounds from the aurora as coronal discharge is often a soft, subtle type sound. I believe we actually obtained more on this expedition than we bargained for and we did not even realize it at the time. It's science! You have to love it!

The upcoming thirty minute radio documentary entitled "Songs of the Sky" will focus on the sounds heard using simple VLF receivers from the northern lights and upon reports that sounds from the northern lights can also be heard audibly without the aid of a radio receiver including personal testimonies and a brief mention of possible explanations for this unusual and as yet unexplained phenomena. Another twist in the documentary will focus on legends and myths from Alaskan natives regarding the northern lights.

Kate Bissell is the producer of this radio documentary which is tentatively scheduled to air on BBC Radio 4 stations across the United Kingdom May 31st at 8:30 p.m. BST (British Summer Time GMT +1 / UTC+1).

You will want to tune into this fascinating broadcast live on the internet May 31st at www.bbc.co.uk/radio4/. Simply click on the "Listen Live" button to hear the broadcast. If you miss the broadcast click on the "Programme Finder" to locate the broadcast.

Thanks to Bill Taylor and Bill Pine from the INSPIRE project and to Kate Bissell from the All Out Production Company for making this expedition possible!

SOME ANTENNA OBSERVATIONS
Part 1

Robert Bennett
Las Cruces, NM

For almost a year, the author has been collecting data to determine the performance of various antennas for use with the VLF-3 INSPIRE Receiver. The goal is to determine which antenna is "best" for my particular location and noise environment, (*these results may not generalize to other locations and environments*). This paper is divided into two parts. In Part 1, results relating to about half the antennas tested will be presented. The rest will be presented in Part 2.

Antennas Considered. The antennas considered for use generally have to meet three criteria.

First, the materials to construct the antennas have to be readily available and the design must not require professional machine shop work.

The second restriction is that the antenna materials have to be inexpensive. I set a limit of $50 per antenna, although most of the prototypes were quiet a bit less than this.

The third restriction is that a single person must be able to assemble and erect the antenna. Also, the antenna has to fit in the bed of my truck. This means that each piece of the antenna can be no longer than 6-feet.

Given the above constraints, I ended up evaluating the following antennas. A detailed description, including sketches and photographs, is in the appendix.

a. Vertical monopole (whip), 6-Feet in length, mounted on a wood support that elevates the base of the antenna about 3-Feet above ground level. The antenna has two feeder connection points, one for an open wire line and one for a coax cable.

b. Sloping Long Wire Antenna, 120-Feet in length. A 20-foot telescoping mast supports the taller end. The lower end is 3-Feet above ground. The antenna is made of 14-guage stranded, insulated, electrical cord.

c. Vertical Monopole, 4-Feet in length and mounted atop a 20-foot PVC pipe mast. The antenna is fed with RG-59 Coax cable. I used a 50-Foot length of coax so that the antenna can be located well away from the monitoring position.

d. 500-Foot Long Wire Antenna. Made of insulated wire and supported above ground by throwing on top of low bushes.

e. 1000-Foot Long Wire Antenna, same as above except longer.

f. Ferrite Loop Antenna.
g. Box loop antenna.
h. "Tree" antenna.
i. "Wet Sand" antenna. The tree and wet sand antennas were the subjects of extensive discussion on the VLF Group (VLF_Group@yahoogroups.com).

Evaluation Technique. The 6-foot vertical whip was selected as the reference antenna. The general technique was to first connect the reference antenna to the VLF-3 receiver and record from 15 to 30 Minutes of natural radio signals. The VLF-3 was adjusted for maximum gain and the recorder gain adjusted so that its level meter was in the green zone and slightly below the red line (recorder saturation). Next, the reference antenna was replaced with the antenna to be evaluated and an additional 15 to 30 minutes of natural radio recorded. All recorder and VLF-3 settings were held constant.

Usually a second "run" with the same antennas but with the VLF-3 antenna attenuator in the "in" position was made.

Most of the experiments were conducted at night, between the hours of 2000 and 0100 local time. However, some of the experiments were repeated to obtain data during the daytime. The daytime periods varied but usually occurred between 0800-1000 and 1500-1700 local time.

Spectrum analysis programs (SpectraPlus and Gram) were used to analyze the data on the tapes.

RESULTS

The following charts show the results. Figure 1 is the performance of the reference antenna with the VLF-3 antenna attenuator "out" then "in". This figure clearly shows the presence of Loran when the antenna attenuator is out. The Loran signal appears as peaks in the spectrum at multiples of 1 kHz. The Loran signal is completely eliminated by placing the attenuator in the "in" position. However, the penalty one pays for eliminating Loran is a 6-10 dB decrease in signal level at all frequencies.

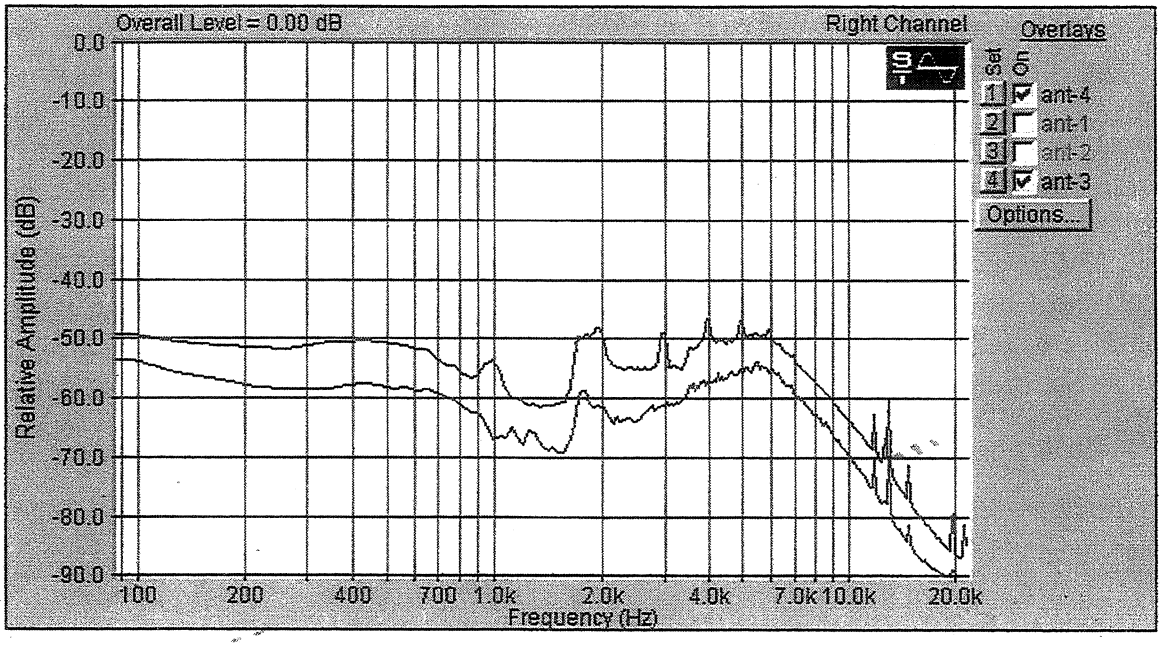


Figure 1 Reference Antenna. Top trace is with VLF-3 Attenuator "out". Bottom trace is with attenuator "in".

Figure 2 shows the results obtained using the 120 Foot long wire antenna. These results are interesting and were unexpected. The figure shows that the long wire provides about 10 dB more signal across the band than did the reference antenna. Loran is present when the VLF-3 attenuator is "out" and not present when the attenuator is "in". However, note in figure 2 that the level differences with the attenuator "in" versus "out" are not significant in the bands of interest for natural radio, 1 to 10 kHz. This result was not expected!

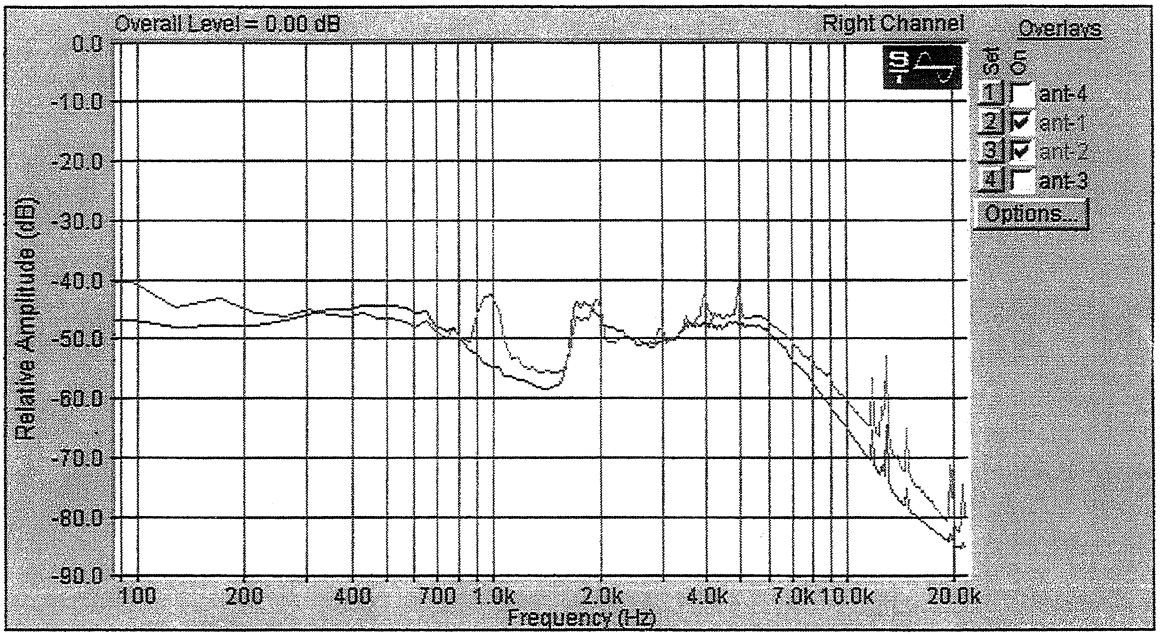


Figure 2 Comparison of 120 Foot Long wire antenna with VLF-3 attenuator "out" (top trace) and "in" (bottom trace)

Figures 3 and 4 show plots of the reference antenna and the 120 Foot Long Wire on the same chart. The difference between the signal pick up by the two antennas is very clear in figure-3 but less pronounced in Figure 4. Figure 4 clearly shows Loran pick up by both antennas and the long wire provides several dB more Loran signal than does the reference antenna.

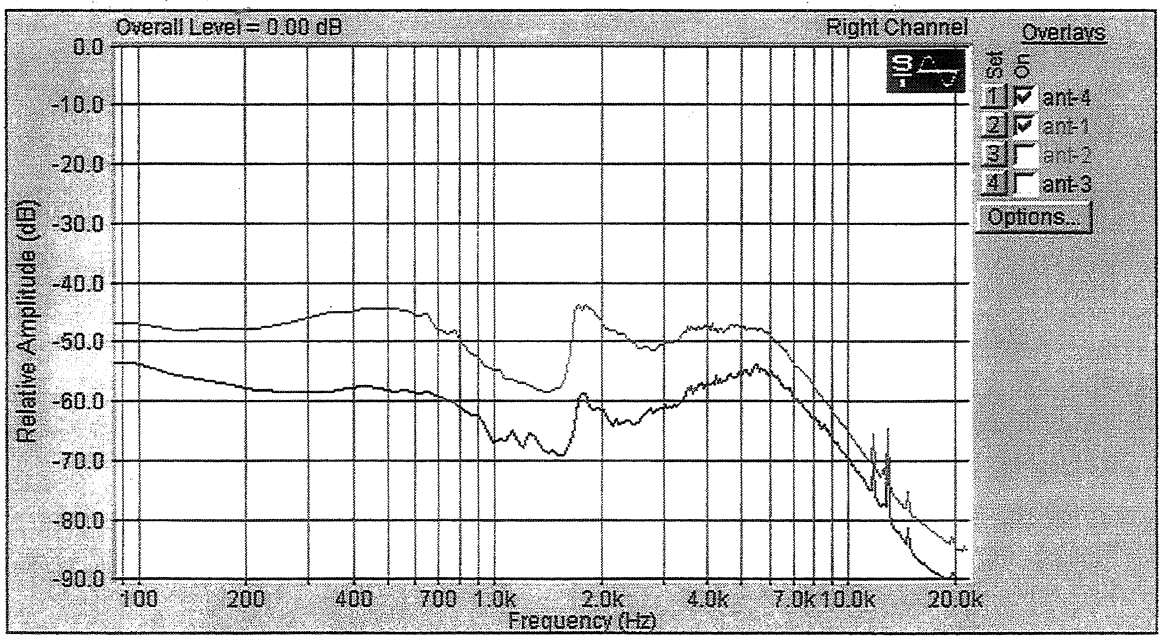


Figure 3 Comparison of 120-foot long wire (top trace) with 6-Foot Vertical reference (bottom Trace) with VLF-3 attenuator "in".

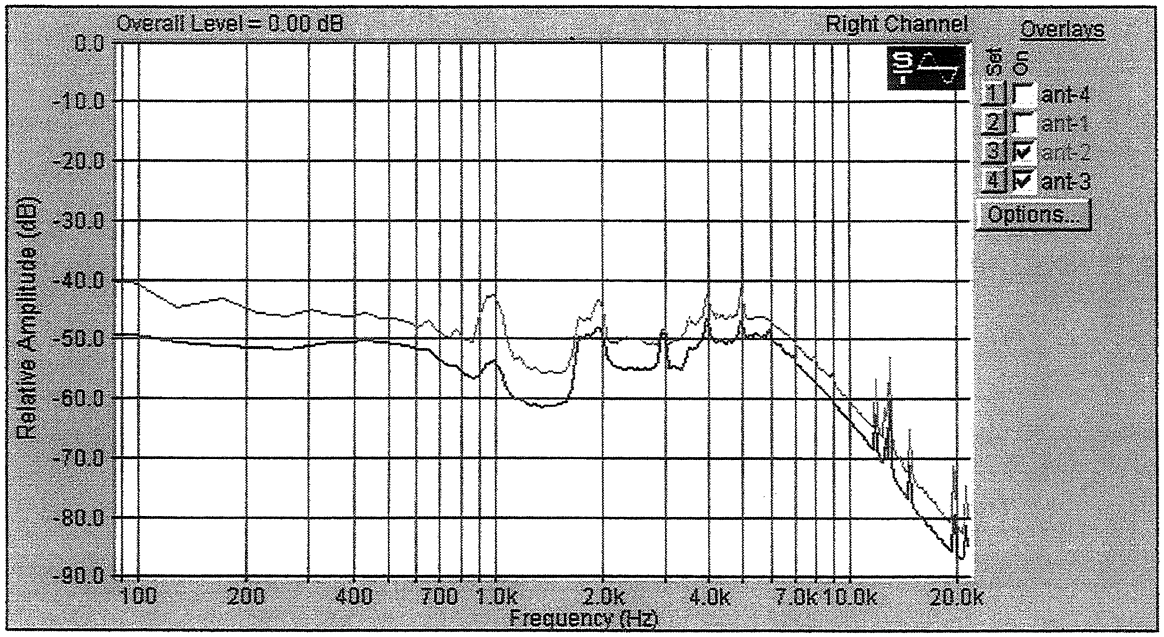


Figure 4 120-Foot long wire (Top trace) versus
6-Foot Whip (bottom Trace) with VLF-3 attenuator "out".

The 120 foot long wire antenna also picked up more 60~ power line interference than the 6 foot whip. Figures 5 and 6 show this effect. Figure 5 is for the long wire and clearly shown stronger 60~ harmonic interference than the 6 foot whip in Figure 6. The interference appears as horizontal lines in the charts.

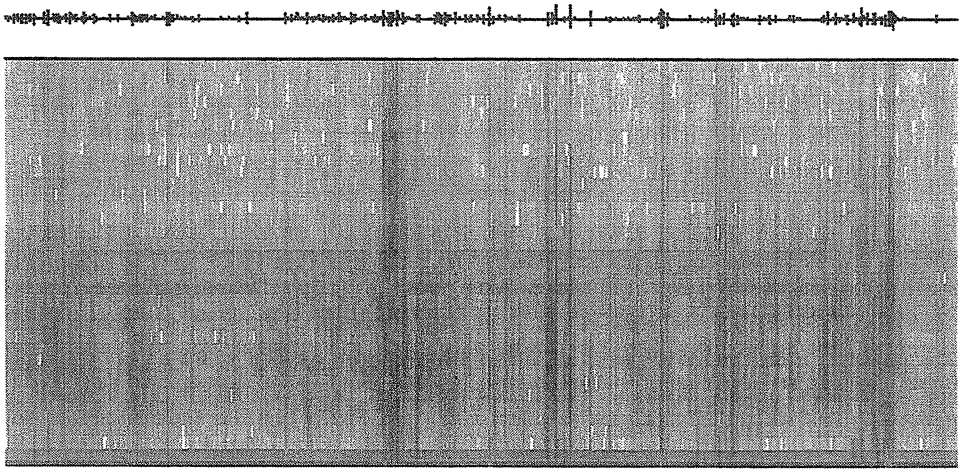


Figure 5 120- Foot Long wire. GRAM spectra of the 0 to 1 kHz portion of spectrum.

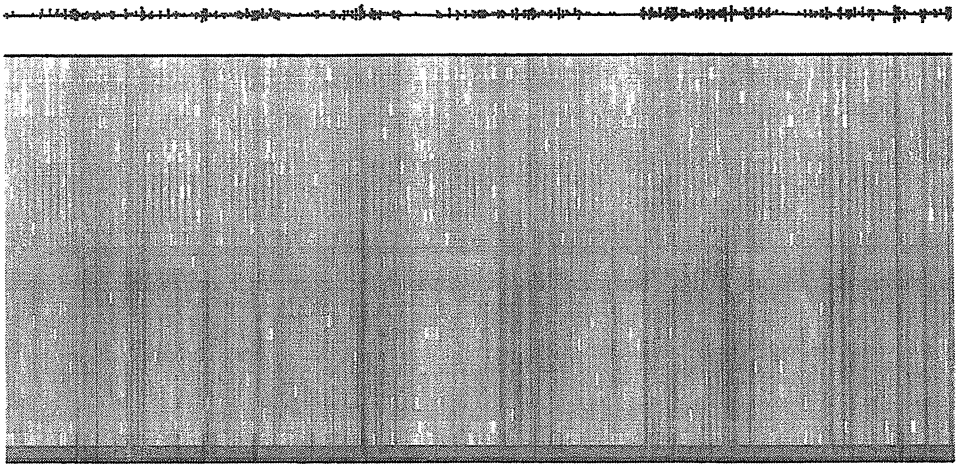


Figure 6 Reference antenna. Gram plot of 0 to 1 kHz portion of spectra.

The next antenna considered was the elevated 4-foot whip using a coax feed line. Figure 7 shows a comparison of the elevated whip with the reference antenna. In this experiment, the VLF-3 antenna attenuator was "out". Two things stand out in this chart. First, the natural radio signal levels are about the same for both antennas. Second, the elevated whip using a coax feed effectively removed the Loran signal, which is very clear in the trace for the reference antenna. The shunt capacitance of the coax is probably sufficient to attenuate the Loran signal without significantly affecting the natural radio signals.

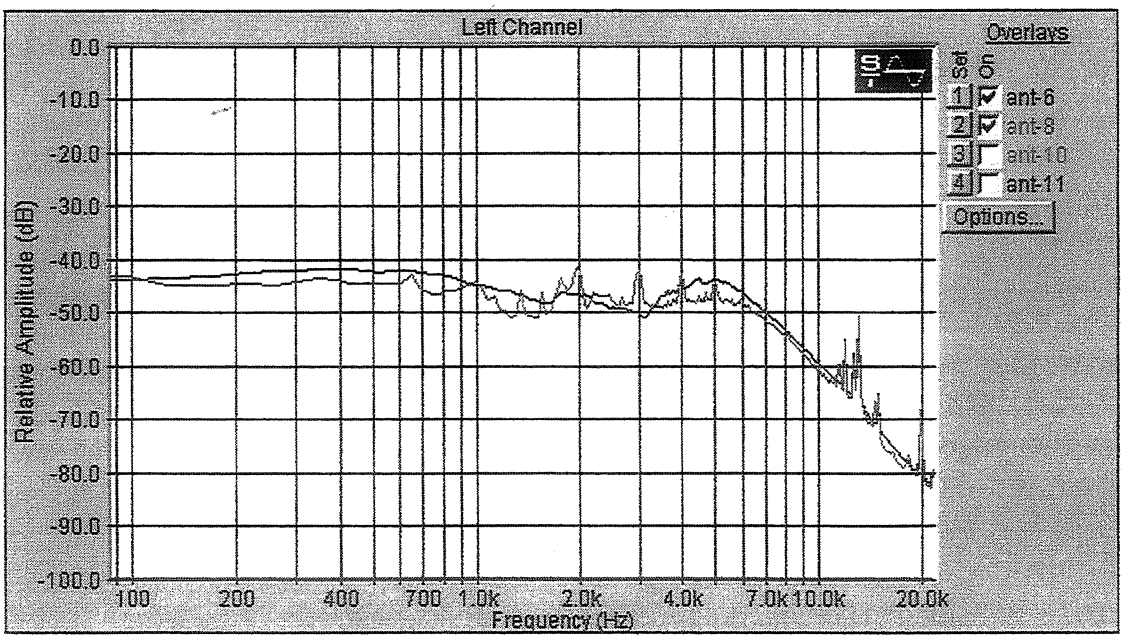


Figure 7 Comparison of reference antenna (bottom trace) with elevated whip fed with coax (upper trace). VLF-3 attenuator "off".

Figure 8 shows the effect of placing the VLF-3 attenuator "in". Note that the reference antenna curve does not show any trace of Loran. The elevated antenna trace remains free of Loran. However, note the differences in signal levels in the 10-20 kHz region. It seems that the VLF-3 attenuator in combination with the shunt capacitance of the coax is forming a low pass filter that has its cutoff point at about 6 kHz.

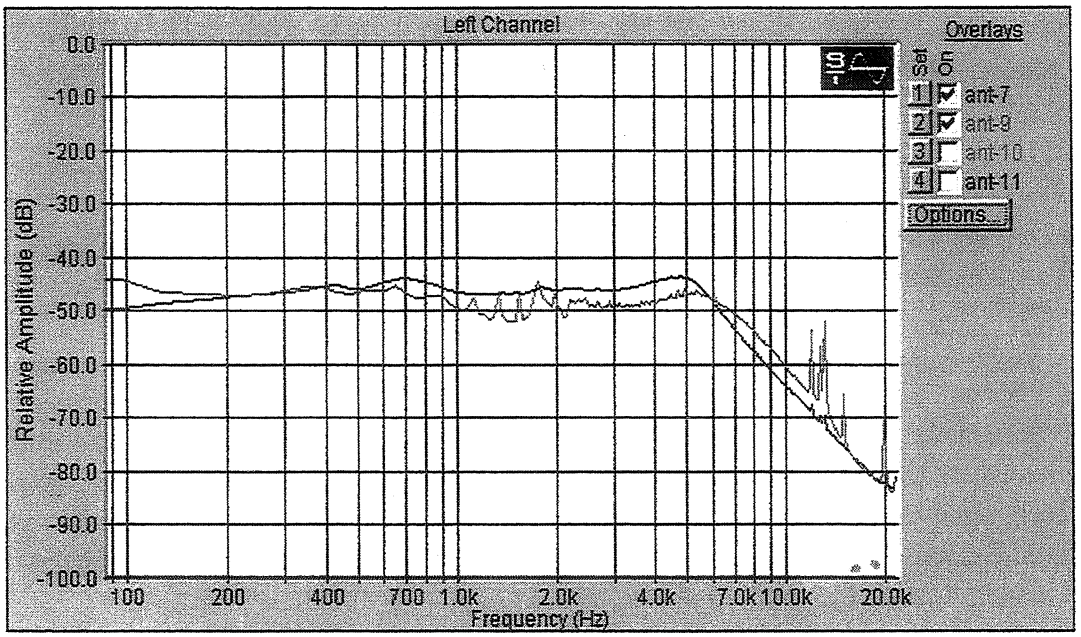


Figure 8 Reference Antenna (lower trace) and elevated whip (upper trace) with the VLF-3 attenuator "on".

Day versus night. Figure 9 is one example of the differences between daytime signal levels and nighttime levels. All the other experiments reveal the same trends so for the sake of brevity; only this example will be discussed. The data shows that nighttime natural radio levels (tweeks, sferics, whistlers, etc) are generally stronger than daytime levels but the differences are not constant. During some experiments the difference was only a dB or so and in others like the one presented, the levels differ by 10-12 dB. The manmade signals (Loran, plus communications and navigation signals between 10 and 20 kHz) are usually much stronger in the daytime than at night. Also, the daytime spectra usually shows stronger 60~ power line interference, normally odd harmonics. Note the spike in the daytime spectra at 660 HZ (11^{th} harmonic).

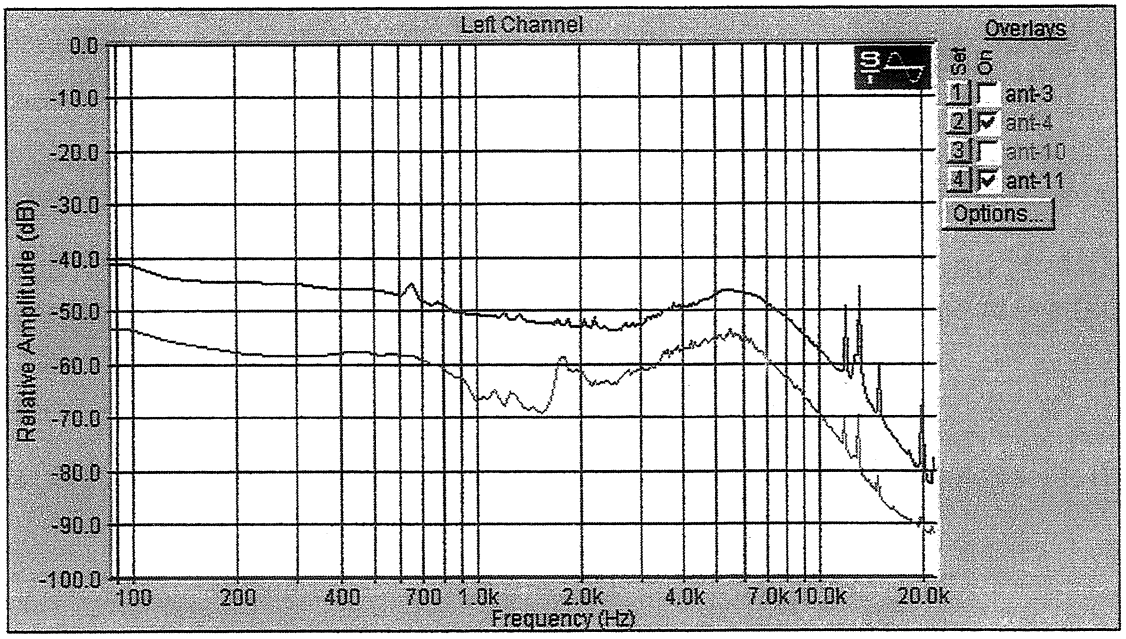


Figure 9 Day (top trace) versus Night (Bottom trace) signal levels using the reference antenna with VLF-3 attenuator "on".

The last experiment to be discussed is the 500-foot long wire antenna. The antenna was oriented generally in an East-West direction and supported by placing it in the tops of dormant creosote and mesquite bushes. The height above ground varied between 1 foot and 3 feet and care was taken to prevent the insulated wire from contacting the ground. Previous experimentation showed that if the wire is allowed to contact the Earth for any appreciable distance, then the levels of power line interference increase greatly. Figure 10 shows the results. This experiment was performed in the daytime and the VLF-3 attenuator is "in". Two things are immediately evident. First, the long wire provides more signal pick-up at frequencies below about 2 kHz than does the reference antenna. From 2-10 kHz, the antennas are about the same and above 10 kHz, the reference antenna is better. Second, the 500-foot long wire picks up substantially more 60~ interference than does the reference antenna. Note the strong 60~ odd harmonics at 300, 660, 780, 1500 and 2100 Hz.

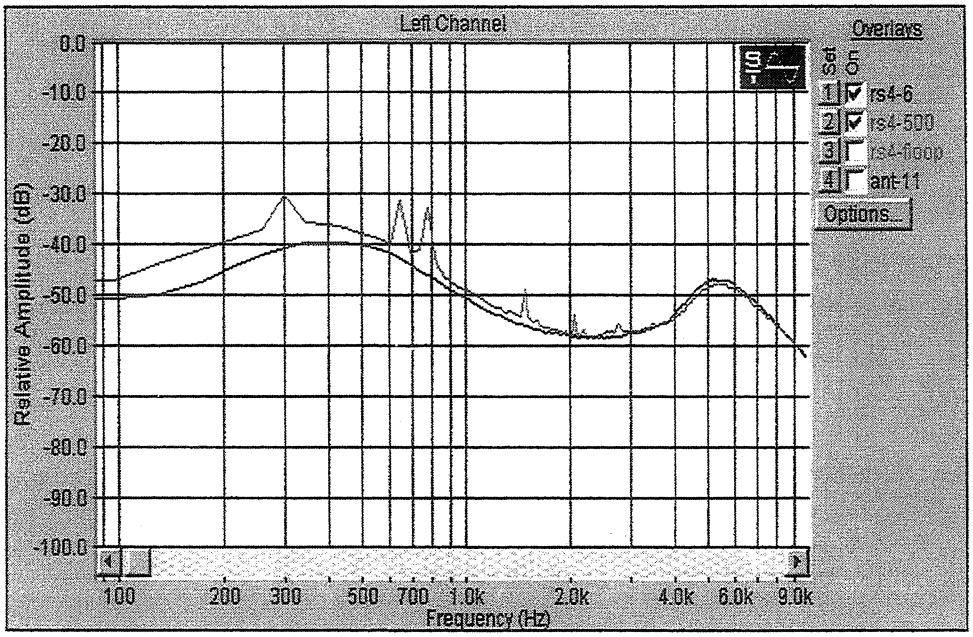


Figure 10 Comparison of a 500-foot long wire antenna (top trace) with the reference antenna (bottom trace).

CONCLUSIONS

From the information presented, the following conclusions can be drawn:

a. The antenna attenuator on the VLF-3 receiver will effectively eliminate Loran interference when using any of the experimental antennas.

b. Use of the VLF-3 attenuator is not without penalty. Its use can result in up to a 10-dB loss in receiver sensitivity.

c. The long wire antennas provide additional signal pick up but at the expense of increased 60~ interference.

d. An elevated whip antenna connected to the VLF-3 receiver (attenuator "out") with a coax cable feed provides about the same performance as the ground mounted 6-foot whip reference antenna with the VLF-3 attenuator "in". The appeal of the coax cable feed is that it can be used to attenuate Loran without using the VLF-3 antenna attenuator.

e. So far, the author has not found a compelling performance reason to replace the simple ground mounted 6-foot whip reference antenna with a more complex antenna.

f. The use of coax cable to eliminate Loran interference is attractive and can easily be applied to the reference antenna. This will be further investigated in the future.

Report on Field Observations 10/2003-4/2004

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.

The guidelines for observations are:

1. Fill out a log cover sheet and data sheets for each observation.
2. Place a voice introduction on each tape indicating name, date and start time.
3. Insert a time mark every two minutes during the observations.
4. Submit the data to:

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

The observations in this report will be given in chronological order. The convention for naming files is the following:

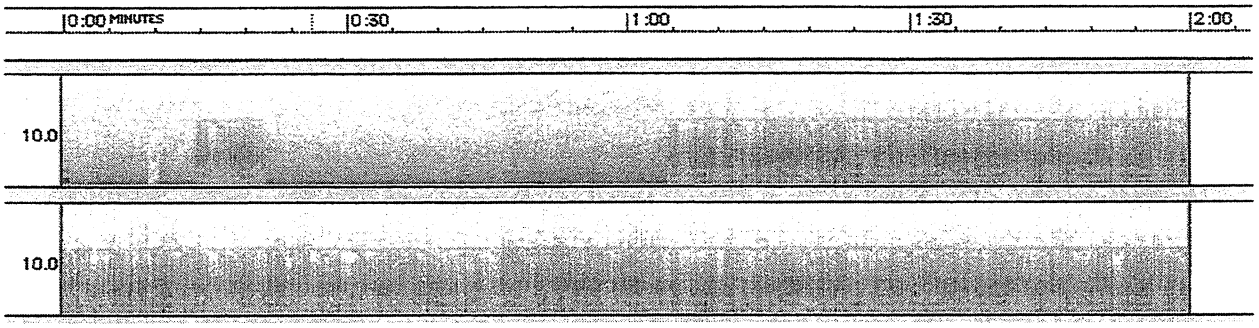
Name 4-26-04 13UT 06CST

Observer Name Date Start Time UT. Start Time Local

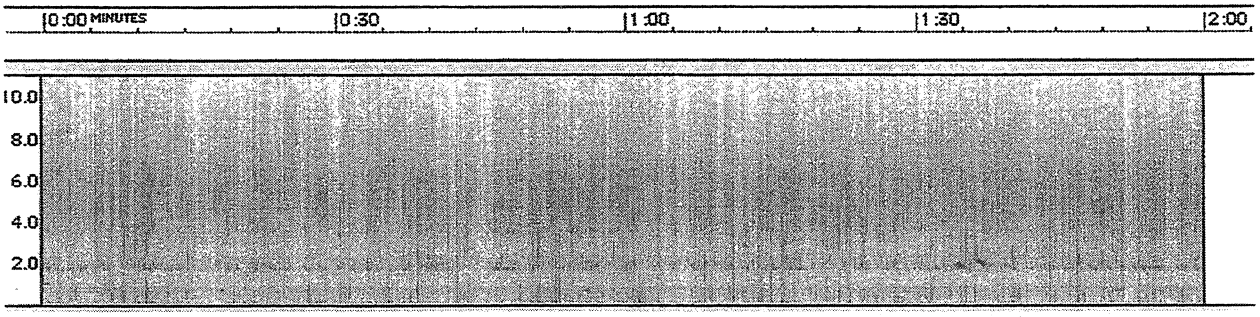
Spectrograms made for data analysis include the first 2 minutes 0-22 kHz range; the first 2 minutes 0-11 kHz range; the first minute 0-11 kHz range and the first 30 seconds 0-11 kHz range. When circumstances dictate, other formats for spectrographic analysis may be used. Spectrograms are also made of any portions of the tape requested by the observer.

On all spectrograms, the frequency range appears at the left of the spectrogram and the time interval appears at the top of the display. The time scale always starts with "0", rather from the actual time. An arrow on a spectrogram indicates the time interval shown on the following display.

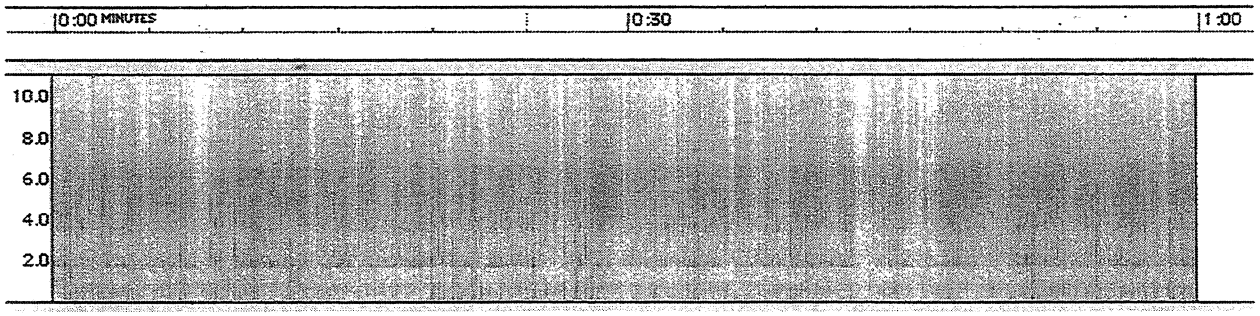
11-20-03 Robert Bennett Las Cruces, NM



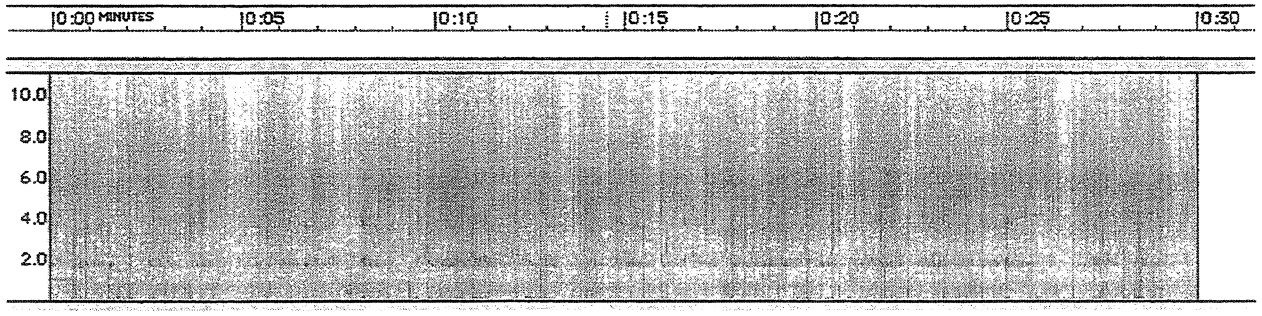
0346 UT 2046 MST WWV on top track with sections of data switched in occasionally. Data from a VLF3 receiver on the bottom track. Dense sferics and tweeks.



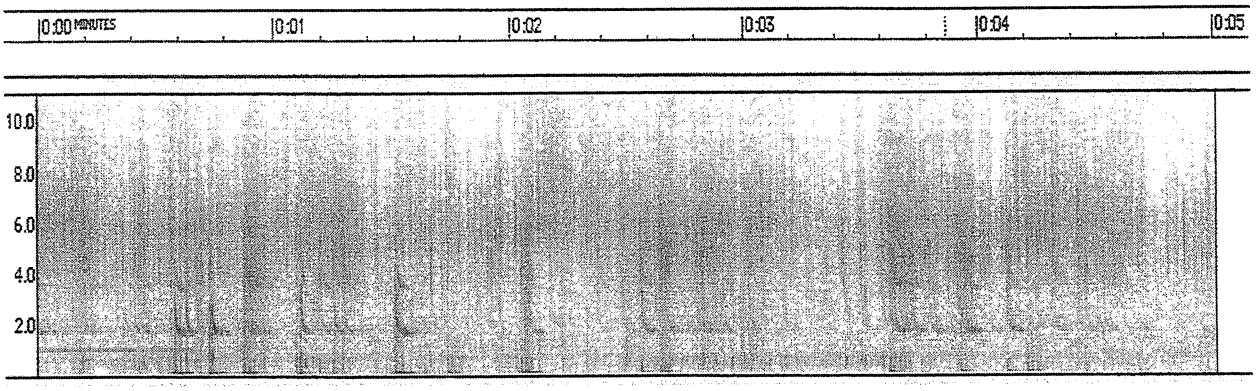
Data track using 0-11 kHz frequency range.



First minute.



First 30 seconds.

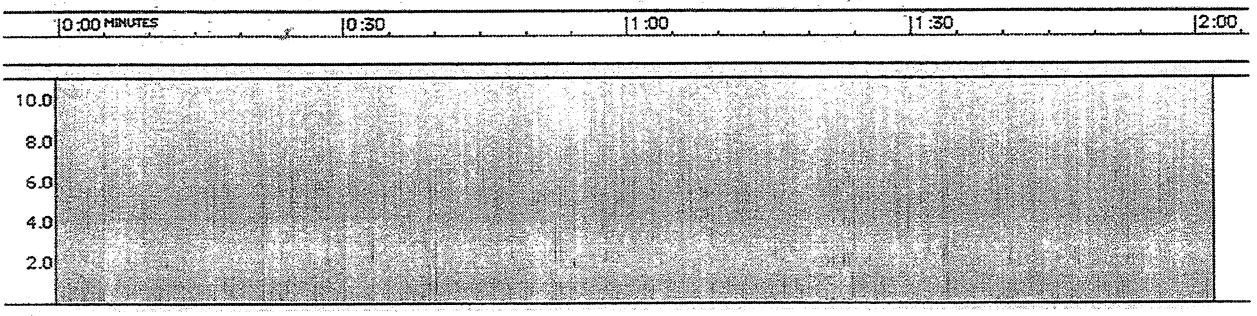


The first 5 seconds showing many individual tweeks.

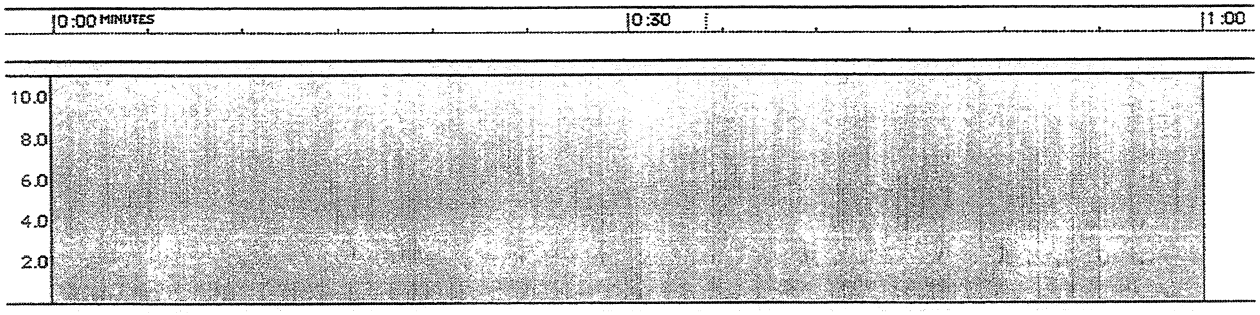
Robert reports:

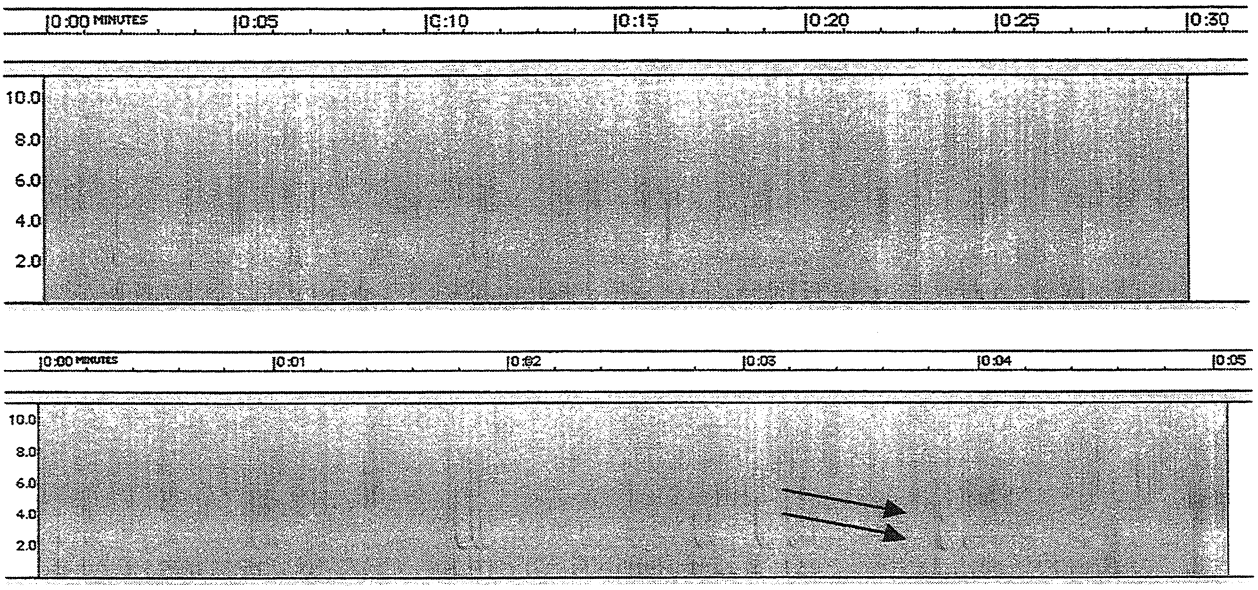
On 20 Nov, I monitored overnight. I started monitoring at about 8:00 PM Mountain Time. I made recordings during the 2040-2115 and 2120-2150 MST periods. I continued observing until 0200 MST on 21 Nov after which I went to sleep. I did not make any more recordings on 20/21 Nov. In general, I found the sferic and tweek levels and frequency to be very high when I started and slowly decreased in the early morning hours. The levels were so high that I could not hear the normally loud Loran signal. The monitoring conditions were otherwise excellent; the temperature at 2000 MST was 45 degrees F and slowly dropped to 36 degrees by sunup on the 21st. There was no moon and no wind and it was very dry in the desert. I experimented with both a 6-foot vertical whip (E-Field Probe) and a 120 foot long wire antenna. The Natural Radio signal levels were very high on both antennas but when using the whip, I did not hear any traces of either Loran or 60~ power line noise. However, using the long wire, I heard both Loran and some 60~ pick up. For some reason, the natural radio signal slowly decreased in amplitude and by 0200 on 21 Nov, I could clearly hear Loran on the 6-foot whip.

11-22-03 Robert Bennett **Las Cruces, NM**

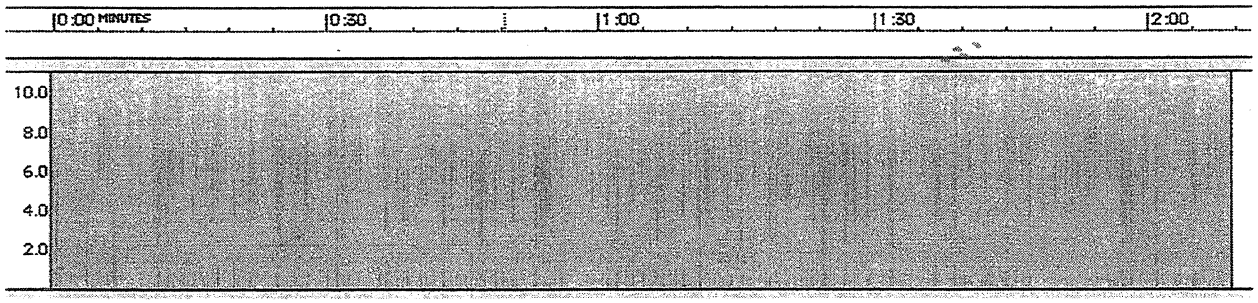


1217 UT Dense sferics and tweeks.

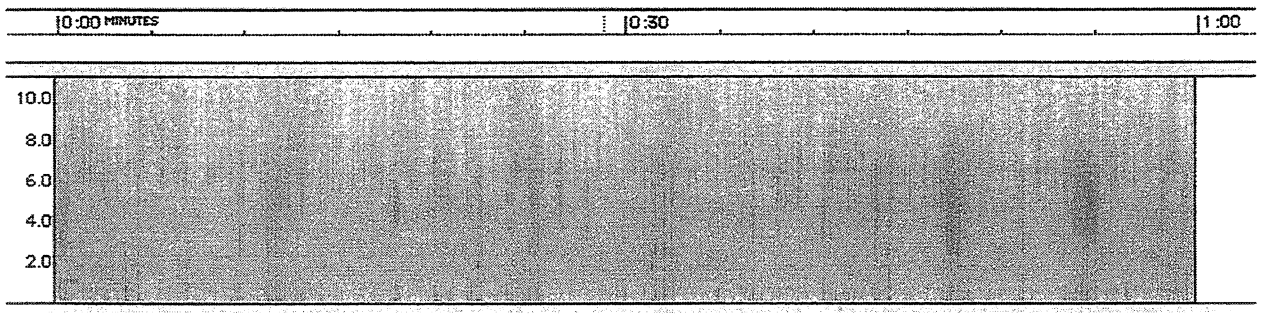


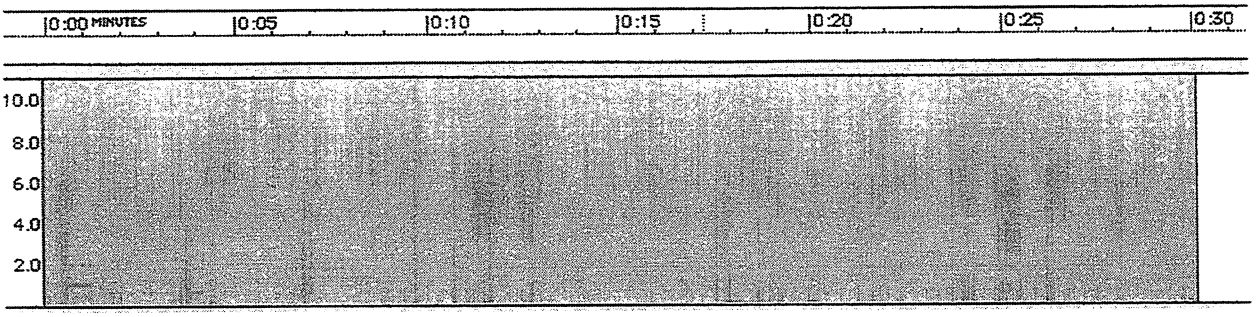


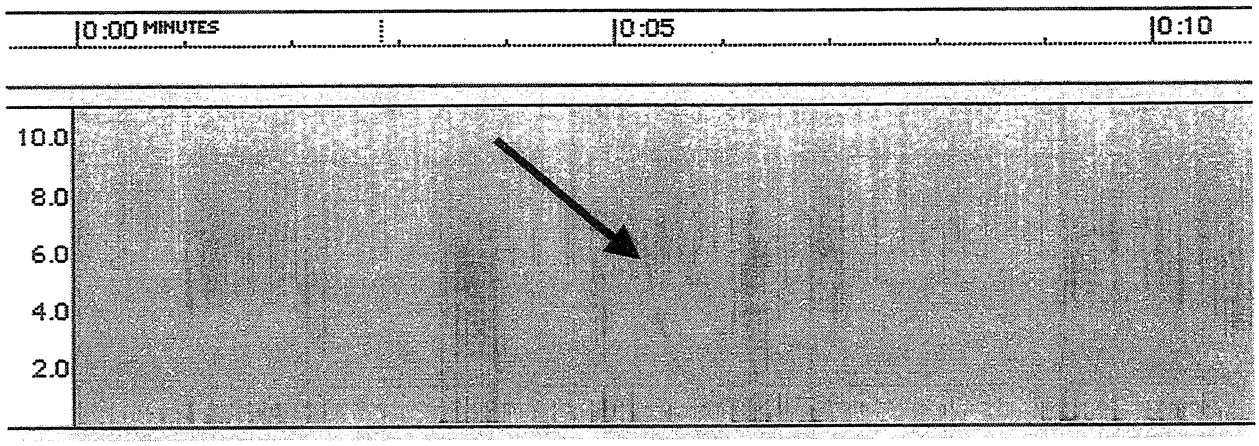
Note the tweek at 3.8 seconds with a harmonic of the tweek "hook" at about 4 kHz. This indicates a strong tweek.



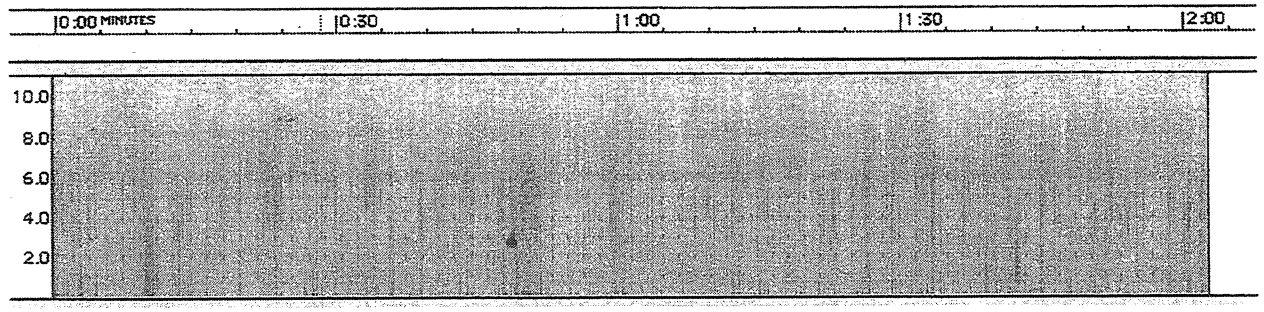
1305 UT Dense sferics, tweeks are rare.



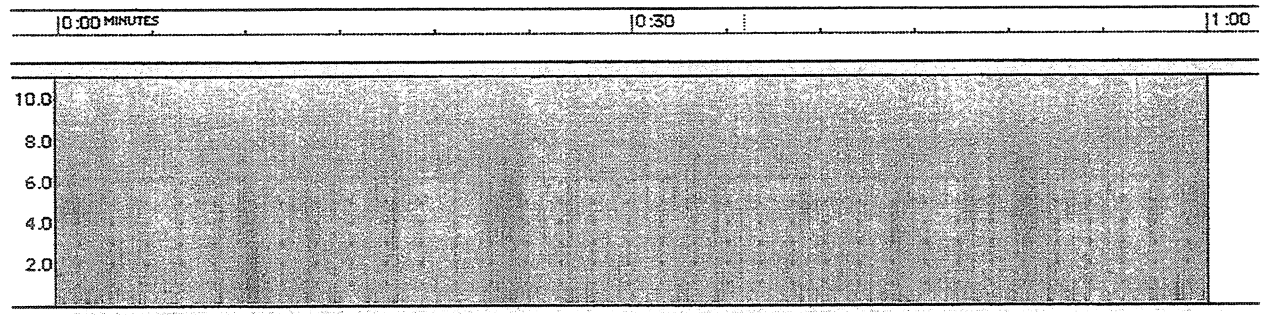


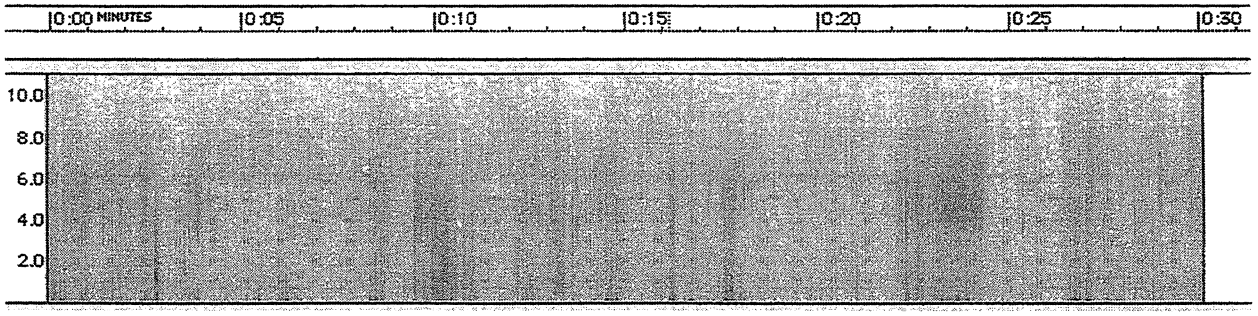


Segment starting at 1 minute showing a whistler at 1306:05 UT.

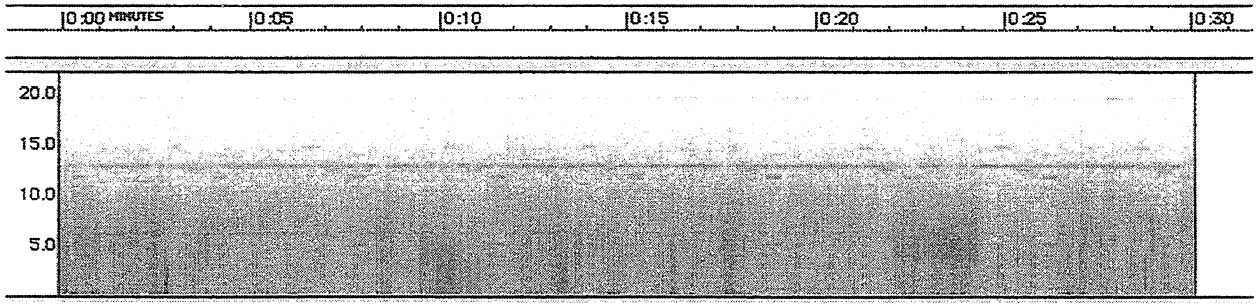


1400 UT 0700 MST Dense sferics, strong Loran



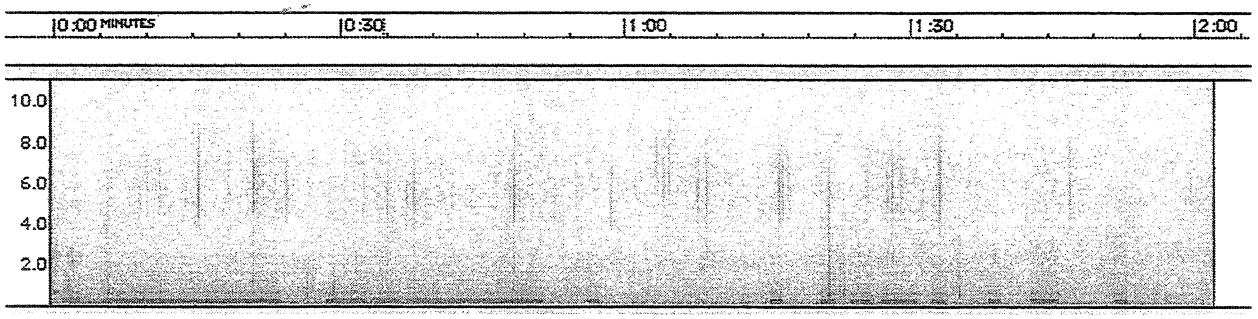


The vertical sets of dots are Loran.

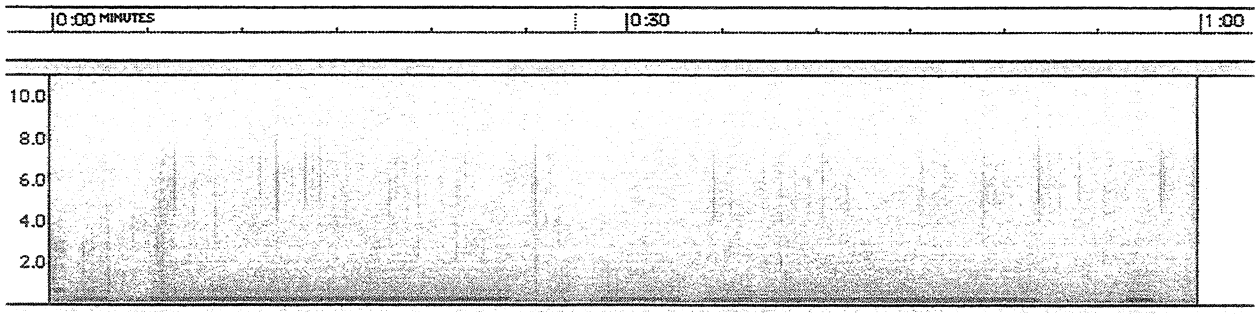


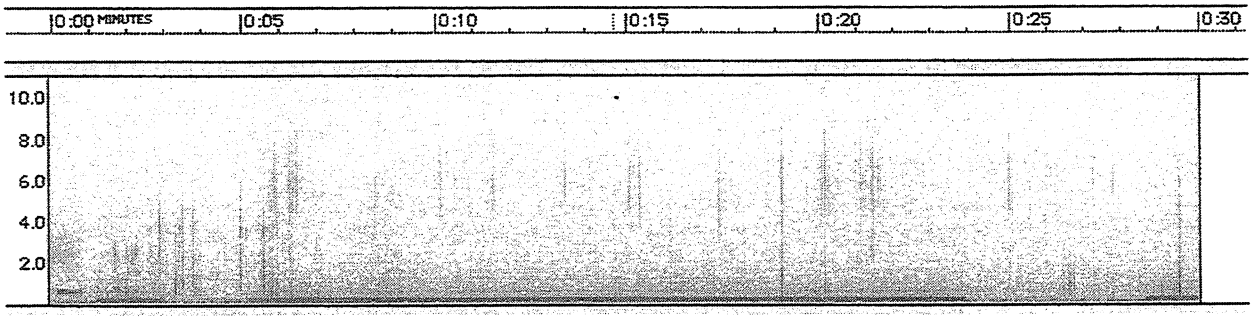
The first 30 seconds using a 0-22 kHz frequency range. Russian Alpha navigation dashes are clearly visible (and audible on the tape) between 12 and 15 kHz. A steady carrier also appears at about 13 kHz. Robert reported rising wind and deteriorating observing conditions.

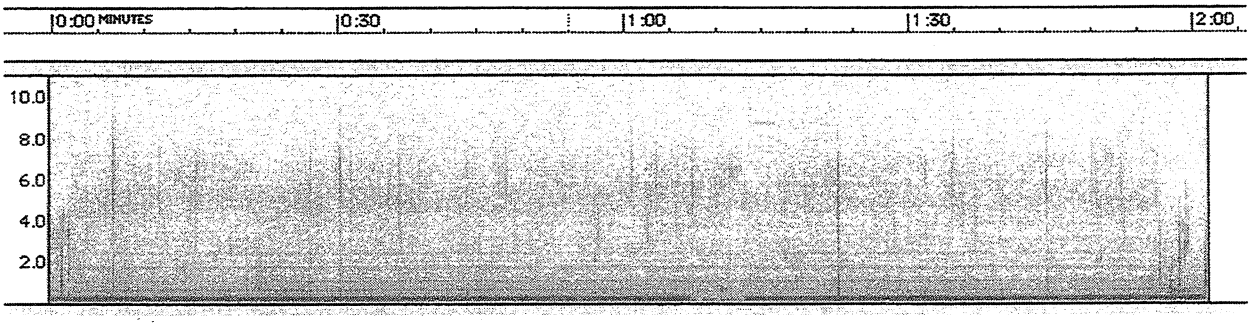
12-16-03 Chaffey High School Ontario, CA



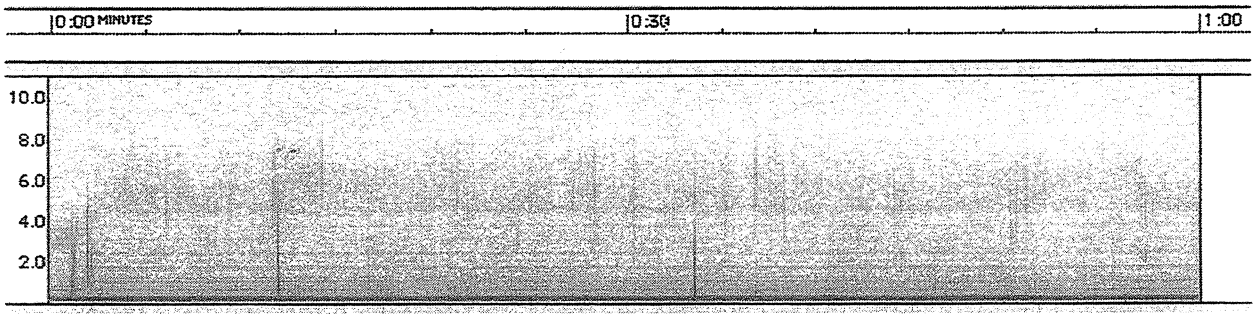
12/16/03 0102 UT Dearzy Martinez, Tiffany Steele Some sferics and tweeks.

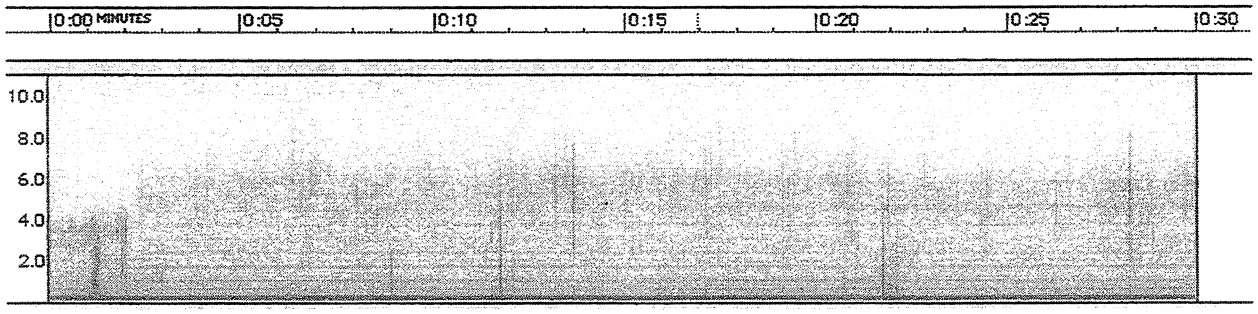






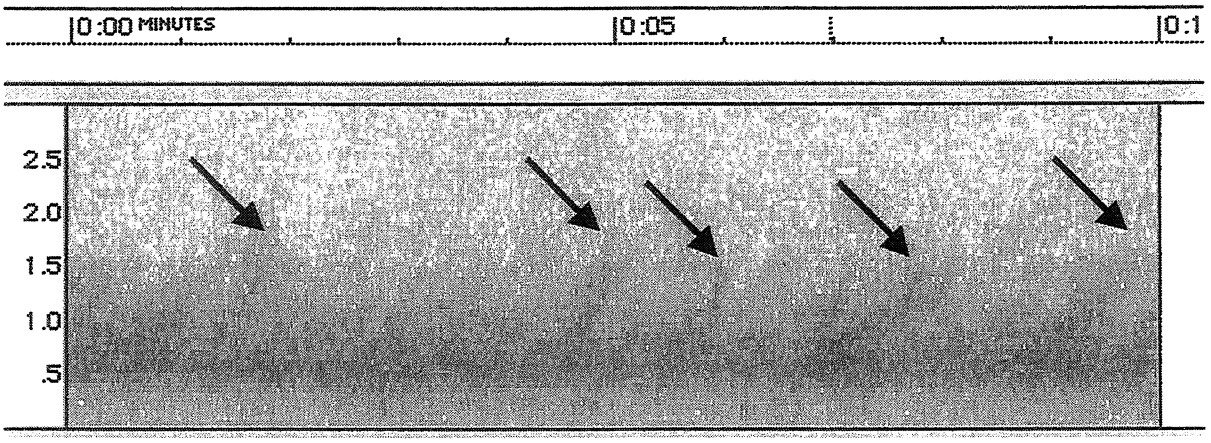
12/16/03 0129 UT Joelle Brown, Ana Guzman Some sferics and tweeks.



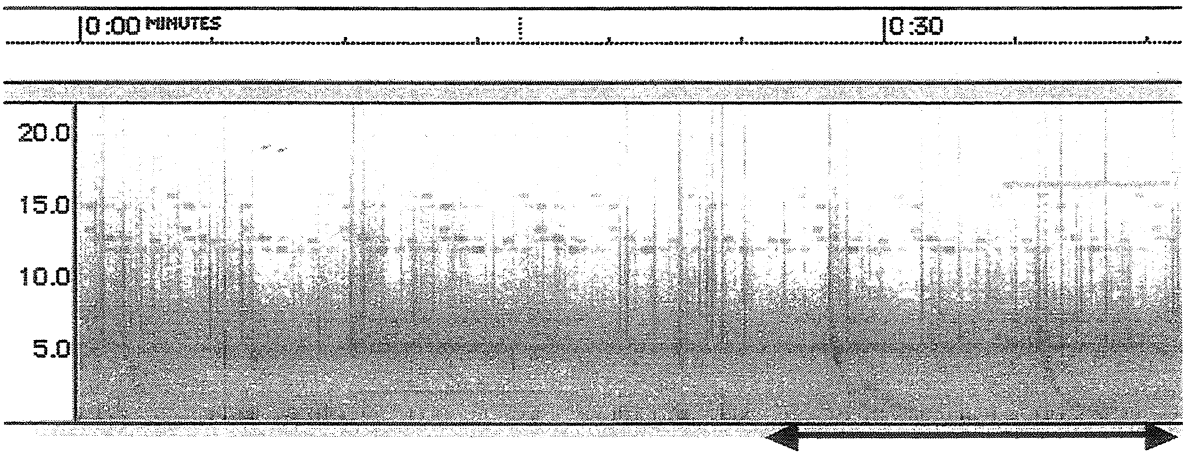


12-16-03 Shawn Korgan Gilcrest, CO
Recorded North of Fairbanks, Alaska

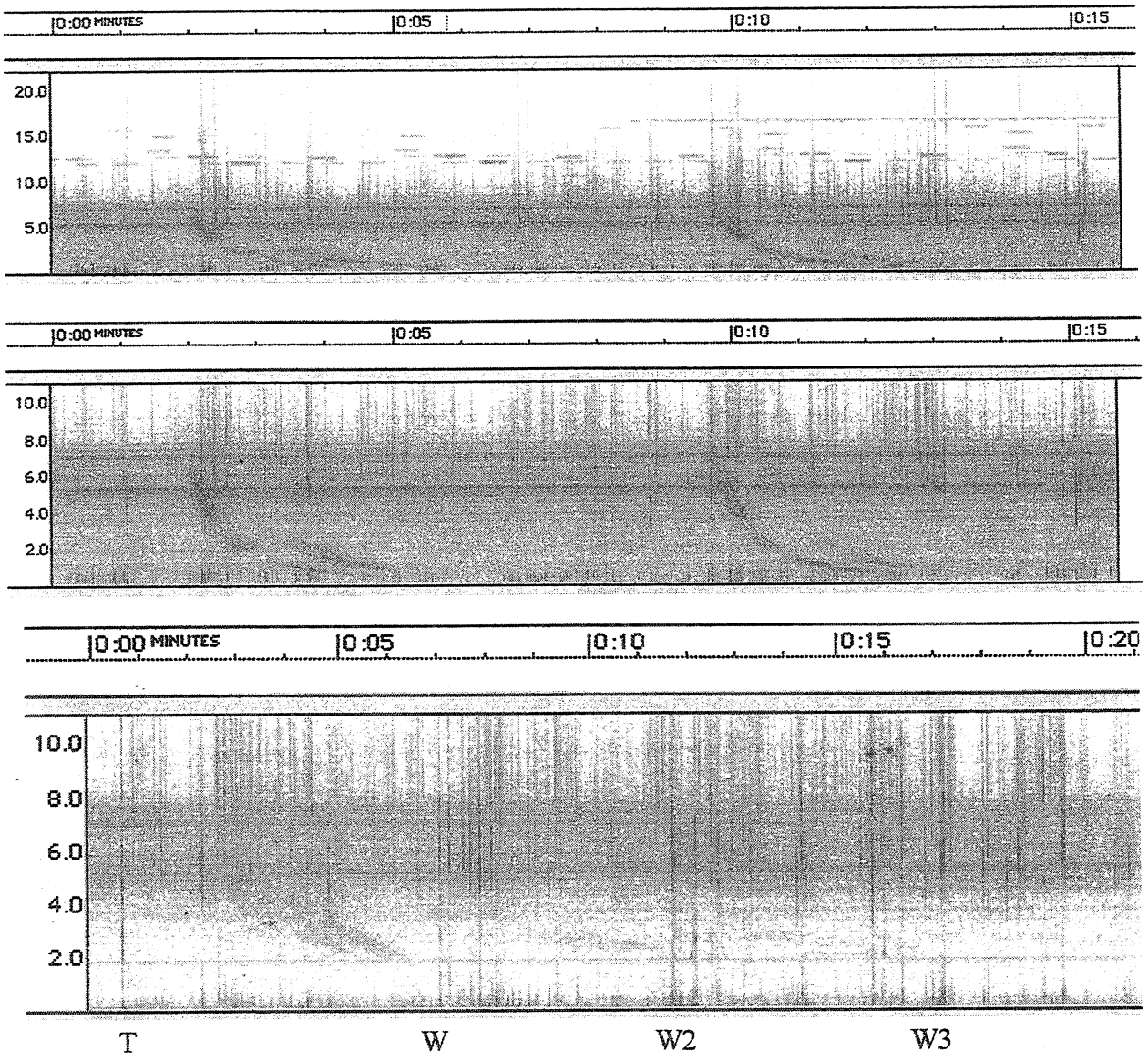
The following are some brief spectrograms of natural radio signals recorded by Shawn Korgan during the recent trip to Chatanika, Alaska.



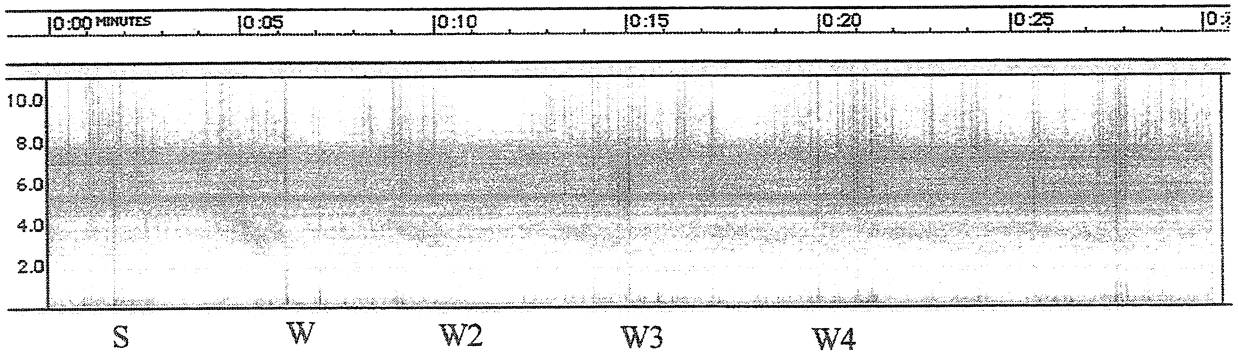
3-22-04 1200 Alaska Time (AT) Chorus sounds like birds chirping. On the spectrogram, chorus shows up as a series of rising tones. The arrows show the tops of the most prominent risers.



3/23/04 Whistler collection. This view, using a 0-22 kHz frequency range, shows Russian Alpha navigation signals as series of dashes between 12 and 15 kHz. The arrow indicates the segment enlarged below.



A whisler from later in the session. This sounds like a two-hop whistler originating with the strong tweek (T) followed by the whistler (W) and at least two echoes (W2 and W3).



Still later, a whistler (W) following a strong sferic (S). Several echoes follow the whistler.

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: ___	__________