NAAPO (North American AstroPhysical Observatory)

"Signals"
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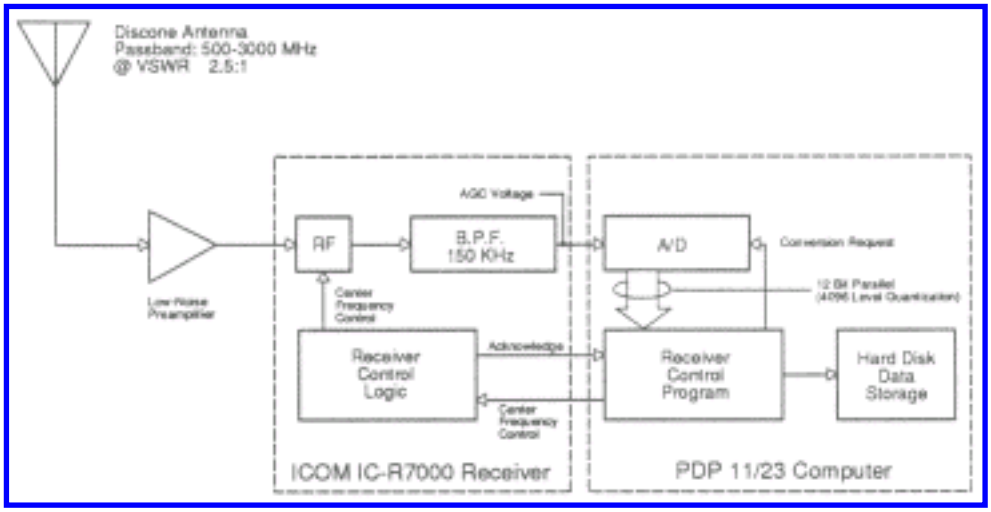
The OSURO RFI Survey

Steve Ellingson

On August 13-15, 1988 Bob Dixon, Ron Koch, and I attended the International Astronomical Union Colloquium on Light Pollution, Radio Interference, and Space Debris, held in Washington D.C. There we presented the results of a survey of radio frequency interference (RFI) at the OSURO site. The purpose of this report is to summarize our presentation and to convey some impressions of the colloquium in general.

For our purposes, any radio frequency signal which interferes with our ability to receive celestial signals (not of human origin) is considered RFI. RFI includes both deliberate signals (such as radar and satellite communications) and unintentional signals (originating from automobile electrical systems or power lines, for example). The increasing use of microwave frequencies, along with the development of areas near observing sites, has caused the RFI problem to become steadily worse. For many radio observatories, including Big Ear, RFI degrades the quality of data that can be obtained. Thus, radio astronomers have been considering ways to combat the problem.



At Big Ear, the first step in dealing with RFI has been to learn more about the problem. To do this, we built an RFI monitoring system. [See block diagram to the right. Click on that diagram to obtain a larger version.] The system consists of a custom-built omni-directional "discone" antenna, a GaAsFET low-noise amplifier, and a computer-controlled communications receiver. The discone is mounted at the focus of the telescope, and is designed such that it only detects signals which approach from near the horizon. The receiver was modified so that signal strength could be monitored by our computer, allowing data collection to be completely automated. The system continuously monitors the radio frequency spectrum between 1000 and 2000 MHz, recording any signals it detects.

The data accumulated by the system can be processed to reveal information about the RFI situation. For our presentation to the I.A.U., we monitored the spectrum continuously for two weeks and then processed the data to get an idea of what the RFI situation was at Big Ear. It should be noted that the RFI system is not as sensitive as the radio telescope, thus we do not detect all the RFI that Big Ear "hears". Despite this, we found RFI distributed over the entire spectrum. Fortunately, however, no RFI was ever detected in well over 90% of the frequencies we checked. In addition, those frequencies which we found to be "RFI-prone" were typically occupied less than 10% of the time. We also found that RFI is time-dependent: the amount of band width which was obscured by RFI as a function of time closely follows the daily cycle of human activity. One can even observe RFI "rush hours", occurring at about 8am and 5pm daily.

Several sources of RFI were identified as a result of the survey. L-band radar, which is often used for air traffic control, appears in the survey data. We also suspect that some L-band signals may be due to reflections from aircraft. Another source of the RFI we receive includes radiotelephone-like systems. Although these devices operate at frequencies below 1000 MHz, they generate harmonics which appear as signals in the 1000-2000 MHz band and higher. Since our RFI system does not currently detect signals from more than a few degrees above the horizon, we have not considered RFI from satellites. The problem exists, however, and is of great concern to radio astronomers. Several presentations at the Colloquium addressed this problem. Although strict rules concerning use of the spectrum exist, they are difficult to enforce. For example, when a satellite's transmissions are particularly strong, its signal tends to "bleed over" into adjacent frequency bands.

Some techniques for RFI control were discussed at the Colloquium. Obviously, the best technique is to identify sources and attempt to negotiate with those responsible. When this is not productive, it is sometimes possible to salvage the corrupted data by "subtracting" the RFI signals. Unfortunately, celestial signals are much weaker than typical RFI, which makes it difficult to get reasonable results. A third approach is to physically modify the telescope to make it less susceptible to RFI. This might involve erecting metal fences to reflect signals away, or attaching rolled edges to change the receiving pattern of the antenna. At OSURO we are fortunate in that the flat reflector and the parabola act to shield against RFI from the north and south. Typical dish antennas, however, are equally vulnerable from all sides.

Our presentation at the Colloquium was well received. Ours was one of only a few presentations in which an attempt was made to measure the RFI environment, and the attendees were quite impressed at the quality of our data. This was very gratifying considering the time and financial constraints we at NAAPO work under. We plan to continue our RFI studies: currently we are working to upgrade the RFI system to allow direction-finding, which will help us locate sources. We plan to use the data to determine how best to reduce RFl effects at Big Ear: planned improvements include side shields to "seal-off" the east and west edges of the telescope, and the addition or rolled edges as mentioned above. OSURO has the potential to be one of the most "RFI-proof" radio telescopes in the world!

Future Working Session Schedule

15 October
5 November
19 November
3 December
17 December
7 January 89
21 January
4 February
18 February
4 March
18 March
1 April
15 April
6 May
20 May

(10:00-12:00 @ the RO)

RADOBS Notes

19 Jul 88 13:03:11-EDT
From: BOLINGER-J

The SIDCLK program works properly. I verified it against the old-stile [sic; "style"] sidereal time tables, when I first wrote it. It will give the correct time ONLY IF THE SYSTEM TIME IS CORRECT. When booting the system you MUST VERIFY THAT THE TIME IS CORRECT since the system sets its time against the GTSC which does drift. The thing I do every so often is to set the system time manually to the Heath time, and then run dl0:(10,4)synchro, which then sets the GTSC.

19 Jul 88 15:59:37-EDT
From: Bob Dixon

I am glad to hear that the sidclk program is correct. But if there is no clearly documented procedure for everyone to follow, the sidereal clock is always in danger of being incorrect as it is now. The Heath clock needs to be incorporated into the system, and a method of inter comparing the clocks automatically and periodically needs to be implemented.

22 Jul 88 16:33:00-EDT
From: BOLINGER-J
Subject: RO report

l. A new ribbon has been installed in the console printer.

2. The digital continuum has been rewired so that the signal from the phase detector goes directly into the a/d. There is now no way to easily adjust offset and gain of this signal. There is an offset and gain on the chart recorder, but it is at extreme position control positions at this time, and this is not quite enough, so it is likely that the chart will run off scale.

3. A differentiator with op amp isolation has been installed in the analog continuum line to the chart recorder. There is rain and thunder in the area at this time, so it is not possible to tell how well it is working.

4. Ron H. is working on mounting the discone and preamp for the RFI survey, (assuming it doesn't rain too much, he says). By the way, the discone looks real flimsy and is not waterproof. I suspect It will not last very long, particularly since the reconnection of the disc to the center conductor doesn't look too good. Isn't the disc made of stainless, in which case special care would be required in brazing?

5. The horn cart has been moved to 20ft east of center, +/- 50 miles.

6. Sidereal time has been set by using the formulas given in the Astronomical Almanac. The Almanac (1988 ed.) has been left up here on the book shelf with the proper pages marked, if anyone else wants to check the clock. I suggest calculating the time for at least 10 min. from 'present', to allow enough time to figure out the formula.

28 Jul 88 11:14:47-EDT
From: Steve Ellingson
Subject: 11/24

The 'He-man computer moving Co.' (Huck, Ellingson, Mehr, Koch, and Bolinger) has transferred the 11/24 to Dreese. We snagged not 2 but 5 Rk07 drives. Steve Hewitt promises us more goodies soon. Thanks to Steve Hewitt and all who helped out!

1 Aug 88 22:30:29-EDT
From: Tom Van Horne
Subject: radio camera misconceptions

Perhaps I have over-inflated ideas of what an astronomical radio camera would be capable of, if so please correct me — or perhaps I merely was unclear and over-broad in what I was saying.

It is my understanding that an Arecibo sized radio camera telescope would be able (with larger integration periods due to smaller total collecting area) to 'form beams' that could duplicate (or better) the beam of the Arecibo telescope. That for any given observation period, such a beam could be formed — after the observation period was over — to examine any given area of the sky to derive the same information as if the Arecibo facility had observed it (although for a shorter period

of time). That any number of such beams and observations could be made from the same data and that these 'beams' could point at any location that was above the horizon at the time of observation. That the data derived from the telescope — as it is in digital form — could be duplicated and sent to a large number of other facilities where researchers could use other computers to 'form beams' and make other observations without the need of other 'telescopes'. That this data could be archived so that should a previously-thought-uninteresting area of the sky display interesting behavior (such as a supernova or 'pulsed Quasar'), observations of that area, as it appeared before the interesting behavior, could be carried out just as though you had pointed the Arecibo telescope that area at the time.

This was the idea I was referring to in my statement that the device would be able to record 'all the information available from the sky' which of course is overstatement.

2 Aug 88 08:18:20-EDT
From: BOLINGER-J
Subject: radio camera misconceptions

You can NEVER make 'new observations' on old data. All that you can do is reanalyze the data that is already there. It is impossible to get any 'new' information from recorded data.

This is exactly what is done with old photographs of the sky. Granted, a radio camera will be far more sophisticated in terms of collecting and storing data, but the principle is the same as the old glass plates.

Bob was talking in 'gee, wouldn't it be nice' tone. It will be a LONG time before we are able to come close to such a system as he is thinking.

2 Aug 88 11:49:10-EDT
From: Bob Dixon
Subject: Radio Camera futures

The description of possibilities by Tom is correct. While it is true that no new information, in the abstract sense, is created by "reobserving" with radio camera data, that process can produce new information not earlier known to the observer. The radio camera is a device that takes advantage of, and relies upon, future

technological developments in computing. Thus we need to think big and be aware of the future possibilities.

2 Aug 88 12:54:08-EDT
From: Tom Van Horne
Subject: Radio camera potential

If we were given unlimited funding and no technological advancement over what could be built with current technology, could we produce a system capable of operations such as I described in my 'Arecibo' speculation?

What are we going to propose as a follow up to Jim's demonstration model? Are we going to try to acquire funding for a major OSU-based project to produce a working major 'radio camera' type radio telescope? Or is this sort of application not possible at the present time.

5 Aug 88 09:16:59-EDT
From: Bob Dixon
Subject: Gamma Ray Bursts

I received a call from Los Alamos Lab. They are studying Gamma Ray bursts, and think they may be observable in the radio spectrum; nobody knows for sure. They are sending me a list of known events for us to compare with our archives. This might explain some of our events! They are very interested in the Radio Camera also, and want to collaborate with us and support our efforts to build a "real" one. They think it may be the only way to detect these events.

8 Aug 88 22:02:49-EDT
From: Bob Dixon
Subject: Dateline Baltimore

Jim and I arrived fine, and the paper went OK. We got a few people interested. Prices are quite high here, and it is HOT. Traffic bad on freeways, but downtown area is quite nice. Clean and attractive. Nice waterfront area. Wait Mitchell is here and several other OSU astronomers.

10 Aug 88 07:42:15-EDT

From: Bob Dixon
Subject: Dateline Baltimore #2

Have had many helpful conversations with other SETI people here. Visited a few tourist places yesterday. Jim flies back today. Our RFI data will be very valuable; have already discussed it with some of the people here. In addition to the new data, we badly need a graph made some time ago. It shows data from the SETI program, intensity of all signals vs frequency of occurrence. Marc Abel made the original. It may be on my desk in Dreese or at home in the office there (ask my wife and go there to look). Others have made such graphs and remarkably they all look very similar, even from very different systems. Also, we must have absolute signal strength known, and be able to explain it. Others will be doing that. It is also good to show percentage of clear bands, etc. as Steve suggested, on separate graphs.

14 Aug 88 10:24:37-EDT
From: Bob Dixon
Subject: Dateline Washington #N

Steve Ellingson has arrived. He was accosted by the police last night for stealing his own stereo out of his van.

Ron and Steve are seeing the sights in DC this morning, while I am slaving away in the motel room getting our paper ready. Steve has done a super job of getting illustrations made, etc. Also, the photos of the equipment and antenna are great (I don't know who made them).

Good News - I was approached by one of the well-known scientists here who has been in the RFI field for some years. He says it is great that we are doing this survey, because essentially nobody does this. He need our data over the long term as ammunition to get FCC help, etc at the federal level. He might even want us to make measurements at other places (?). We must plan to run the RFI survey forever, as a new type of observation which is valuable in its own right.

Yesterday we heard all about light pollution. It is very bad, because most people who install lights do not know what they are doing. In most cases, money can be SAVED with better lighting which causes less sky illumination. Ron especially liked the paper about the effect of night lights on moths. Ron and I both learned a

lot about lighting, and it is very interesting.

Today we hear about space debris. There is a plan for a junk-collecting satellite that will cruise around and collect the debris and throw it down to burn up in the atmosphere. It is getting that serious. The space shuttle had to have its window replaced earlier because a tiny speck of space debris nearly punctured it on an earlier flight.

Last night we went to a party at the Naval Observatory. Saw the primary clocks for the USA, and looked at Saturn through one of the telescopes.

Tomorrow are the RFI papers including ours.

The heat and humidity are so bad here that people are not walking around outside much at all. Everyone stays inside. This must be depressing business for the stores, etc. It gets DOWN to about 85 early in the morning, and then approaches 100 every day.

15 Aug 88 20:54:03-EDT
From: Bob Dixon
Subject: Washington Final

Our presentation was a great success. Many good questions and comments. People are quite impressed with our work. Our data was more detailed than anyone else had. It is incredible what a volunteer group can do! Arecibo and Holland want details on our equipment, especially how to use and program the Icom.

We were late to the meeting today because they reversed the direction of a freeway during rush hour. The heat reached its peek this eve, but then it rained at last. We have never seen such a lightening display as has been going on here now.

Steve and I got invited to go to Arecibo for a mutual exchange of info. But there are strings that make it impractical. Ron says he had to beat the job offers off with a club. Steve and I have great ideas on RFI-proofing the Big Ear. It could be the best antenna in the world for RFI rejection.

18 Aug 88 08:19:46-EDT
From: Bob Dixon

Subject: Research Grant

We have received $2500 from the VP for Research, to be used for urgent needs as outlined in the proposal by Steve Janis.

18 Aug 88 08:25:47-EDT
From: Bob Dixon
Subject: RFI proofing

NASA feels all telescopes will be RFI limited for their SETI program. This may be a more important concern than anything else, based on various experiments they have conducted so far. The OSU telescope is inherently low RFI-susceptible, and can be made much more so. The biggest step is side shields. I suggest using telephone poles along both sides, and hanging crude mesh from them. The power company is now replacing all the poles along my street. I talked with them and we may be able to get the old ones for free. They are perfectly good. We would need a way to transport them to the RO, and later a way to install them. Any ideas on how to transport them? They are about 30 feet long. We need around 20 or more. They could be stored at the RO until we have a way to install them. Maybe the power company could be talked into transporting and installing them, as a charitable contribution, if the right approach were made to the right people. They have the stuff to do it easily and quickly.

18 Aug 88 09:46:01-EDT
From: Bob Dixon
Subject: RFI Proofing

The side fences are only part of what is needed. Shields on the horns (sides and top) plus rolled edges on all reflectors and fences are needed. No permission from the golf people is needed, as there is nothing in the lease that says anything about telescope changes. However, perhaps we could make a deal with them to pay for the fences (to keep out the golf balls), in exchange for letting them come closer to the telescope.

19 Aug 88 10:29:02-EDT
From: Tom Van Horne
Subject: radio camera applications

UFOs interfere with electrical devices. Anybody who's seen 'Close Encounters' knows that. Furthermore UFOs glow. That's how people see them at night. It is surely a reasonable extrapolation to suggest that UFOs may well have a detectable radio signature. The radio camera, as an all-sky passive monitoring device that records the radio status of the sky and detects changes such as local interference sources would be one of the most effective devices ever created (only device ever created?) for the scientific study of UFOs. 'Why are you guys spending millions searching the stars for aliens when the ET's are visiting us', you ask? Why, the radio camera does BOTH!

The radio camera would be an incredible device for passive intelligence gathering. Sites distributed around the Soviet Union would be able to form beams to tightly focus on specific emission sites. A system in orbit would be able to resolve individual vehicles, buildings, or telephone lines. Jim, these nice men from the NSA and those nice men in uniform over there and that group of nice men with the funny foreign accents in the back have all been waiting to see you.

I imagine the radio camera's processing is too slow, but what a ground station design. To heck with all that clumsy support framework and giant dishes. Just lay out these antennas in your parking lot and tune in on any satellite above the horizon!

26 Aug 88 14:45:01-EDT
From: Bob Dixon
Subject: Telephone Poles

So far things are looking good for getting the telephone poles to build side shields on the telescope. The Helwigs have a trailer that can haul them and know how to drill the holes for them. We can use the crane to put them into the holes. I am still negotiating with the power company. One question — how do we get them onto the trailer? They weigh about 600 pounds each. They are about 30 feet long. We could have 15 people all lifting 40 pounds each. Is that practical?

30 Aug 88 08:32:41-EDT
From: Bob Dixon
Subject: The Argus Timed Array

My new tasks as Acting Director at the computer center seem to leave me in a state

of collapse when I go home at night, but my mind continues to whirl along even after the collapse. While lying in such a stupor last night, I derived the following results and had these ideas, about what we have been calling the Radio Camera. Now we need Jim's keen mathematical abilities to show convincingly that this is correct.

The name Radio Camera is correct, but not sufficiently descriptive. We intend this for all-sky coverage, and a camera rarely has hemispheric coverage. Tom Van Horne says that Argus a mythical being that looks everywhere. This sounds more attention-getting. I would like to read a reference that describes the mythical Argus.

The term phased array is typically used for any array, but is incorrect for our case. To achieve wide band width, you must use time delay, not phase delay. Hence we will call it a timed array. Even in the case of the mark I where we split the band width into small segments first.

The sensitivity of an array of N elements and a total collecting area A is the same as a single dish having the same area and the same type of receiver. But this is only true for the instantaneous sensitivity in a given direction. If one wishes to search the whole sky, or to calculate the average sensitivity over the whole sky, then the array is more sensitive than the dish by the factor sqrt M, where M is the number of beams the dish needs to fill the sky. For a filled array, N is approximately the same as M, and M is proportional to A. Therefore to obtain the same all-sky sensitivity, an Argus array need only have the square root of the area of the equivalent dish. There has been the claim that interferometers have greater RFI immunity than dishes. I have an article on that. I believe the idea is that as the earth turns, the synthesized main beam is kept fixed on the sky. This causes RFI sources to drift through various side lobes (and adjacent side lobes have opposite phase), and hence it tends to cancel. If we operate the Argus array with beams fixed to the sky, rather than the earth, we will have exactly this advantage over a single dish. We win in all ways and in all cases over a single dish.

I hope Jim's calculations verify this.

30 Aug 88 13:13:48-EDT
From: Tom Van Horne
Subject: ARGUS

It turns out that there is an excellent reference to ARGUS easily available. The conclusion of Arthur C. Clarke's IMPERIAL EARTH deals with the building of an advanced deep space system for exploring ultra long wave radiation for signs of extra-terrestrial intelligence This project is secretly planned by the 'ARGUS' committee. It is planned as a follow up to project Cyclops which has been unsuccessful after 200 years. Named ARGUS, it would look in all directions simultaneously. From the novel's Acknowledgments and Notes section — 'Indignant antenna designers who feel that Argus would not work as specified are invited to contemplate ABM radars and Think Big.' This written in 1975 followed acknowledgments and thanks to Robert Forward, Grote Reber, and Barnard Oliver.

When John and I came across the Argus reference in Greek mythology (I had been looking for a reference to a hundred-eyed titan, I knew they were a feature of Greek myth) neither of us remembered Clarke's reference in *Imperial Earth*. I have long accepted the fact that throughout my life, as I think of original ideas, I will constantly find reference to these very ideas as I re-read long neglected writings by ACC, who has shaped my thinking and philosophy more than any other author.

From the dictionary, Argus, a giant with a hundred eyes, ordered by Hera to watch Io: after he was killed by Hermes his eyes were put into the tail of the peacock. 2. any alert watchman. There is also an entry for Argus-eyed - vigilant.

The only area where I see Argus as having less capability than a dish is in the study of individual burst signals where the larger integration period will make it less sensitive. Unfortunately that's mostly what we're seeing at this point.

30 Aug 88 18:13:42-EDT
From: Richard Helwig
Subject: POLE MOVEMENT AIDS

One of the ways which the telephone poles could be moved is with several pairs of log carriers. I would think that we would need 3 or 4 pair. The problem is that I don't know where we might get these. Does anyone out there have a pair or an idea as to where we might get some. Log carriers are the same thing as railroad tie carriers. Does anyone have an in with a local railroad? Give it some thought.

The Editor's Notebook

John Ayotte

The September 26th *U.S. News & World Report* contains a good article outlining the four major programs being considered by NASA in the wake of our renewed presence in space. I have always been a supporter of manned space missions (although I do understand the planetary scientists who would rather see the funds spent on robotic probes), and I'm excited by the possibilities outlined in the four NASA scenarios.

The first program outlined is a major manned mission to Mars. This mission would begin around the year 2006, with the launch of a fuel freighter carrying the liquid oxygen and hydrogen needed for the eventual return of the manned ship, About a year later, the manned mission, with an eight man crew, would depart on a six month journey. The mission to the surface of Mars would last ten to twenty days. The article makes the point that that the $300 billion budget (over a 25 year period), while huge, represents a smaller percentage of today's gross national product than the Apollo program did in its day.

The second mission discussed is a landing on Phobos, rather than on Mars proper. This program calls for a four man landing by 2003, and is technically and economically less ambitious.

Plan number three calls for the establishment of a major observatory on the far side of the moon. This option is the simplest of those being considered by NASA and is considered to be clearly within the grasp of readily available technology. The planned observatory would consist of both radio and optical telescopes, and would not be permanently manned. The construction is scheduled for the year 2004 (since the program depends on the construction of the space station and the establishment of a communications satellite in a halo orbit about one of the Earth-Moon libration points to relay the data to receivers on the Earth.)

The last plan is for a permanent lunar colony. The lunar base offers the prospect of a future space program that could be sustained with controlled annual budgets. The plans cover the time period from 2001 to 2016, and it is felt that the Lunar colony could lead to a Martian outpost as soon as 2014. The main reason that I mention

these programs here is a strong feeling that the work we are doing on the Argus Timed Array concept represents on ideal design for the Radio Telescope element of the lunar observatory. The multi-element array would be easy to assemble on the surface of the moon. The whole sky coverage would enable scientists to extract the maximum amount of information from the data generated by on unmanned instrument. I suspect that the scientific return on the financial investment in this program is potentially greater than any of the others, even if it is the least glamorous.

The Atlantic Monthly for August carried on article, "Are We Alone?" by Gregg Easterbrook that devoted some fourteen pages to a reasonably thorough and balanced discussion of the search for extraterrestrial intelligence. Bob Dixon is quoted several times. Easterbrook implies that Bob is shy, and shuns publicity, but we all know that he is a willing and capable speaker. Much of the publicity that the Radio Observatory has had over the years would never have been possible without Bob's dedication.

If you wanted to explain the major issues confronting the SETI community to someone, this article could serve you very well. You really should track down a copy for your own information and as a resource. Much of the article is devoted to questions about the probability of intelligent life in the universe and the probability that such life would eventually colonize the galaxy. These are valid issues, and something that I would like to see more of in the pages of *Signals*.

Another article I'd like to mention (unfortunately it is too long to reprint) was sent to me by Herb Johnson from Colorado Springs. (Herb was a volunteer with the Observatory in the early 80's). "A Self-Organizing Pattern Retrieval System and its Applications" was a paper by Robert A. Levinson presented at an conference on Artificial Intelligence in Denver. The paper describes the research on the design and application of a non-traditional database storing complex data structures that analyzes patterns in the database to improve retrieval efficiency. A version of the self-organizing database system is being developed to support the identification and characterization of signals in an RF environment. The primary application of this system is the guidance and control of *NASA's SETI Microwave Observing Project*. I have one copy of the article for anyone who would like to read it. Unfortunately, there is no indication on the copy of where it was originally printed (though I suspect it was the conference proceedings). Levinson is at the Department of

Computer and Information Sciences, 227 Applied Sciences, University of California, Santa Cruz, CA 95064 if anyone wishes to get in touch with him directly.

If you are looking for an unusual vacation spot you might check this out. It came to me in a newspaper clipping from Phil Barnhart. It seems that the Star Hill Inn (call 425-5605 for information) has opened about 10 miles north of Las Vegas offering electric-powered telescope pads, personal observatories, and rental telescopes and accessories at a good dark sky site.

1 October Working Session

Those Present: Barnhart, Dixon, Bolinger Mitchell, van Horne, Koch, Ayotte, Janis

DIXON and VAN HORNE reported their plans to attend the Toronto meeting of the Planetary Society. A video presentation and slides have been prepared.

DIXON shared information sent from the IAU Colloquium No. 112 on RFI and Light Pollution. This was the Washington meeting he and ELLINGSON attended in August.

Reports of Working Groups:

SOFTWARE GROUP

DIXON reports little progress in getting the SETI program operational. His administrative duties at the Computer Center are taxing and leaves him with little mental energy to carry out necessary tasks. He stresses the value of seeking a FORTRAN programmer to carry on the tasks under his direction. Such a volunteer would only need to gain an understanding of the program, then carry out the tasks as outlined by DIXON.

Incidentally to the software needs, DIXON reports there are about 60 power poles we will have access to, providing we do not allow locals to pick them up for firewood. Cable TV ineptitude has meant that many of them have been sawed off near the tops, making them somewhat shorter than we like. Pole hauling crews should monitor the bulletin board to move as quickly as possible when the time is

ripe.

CHIEF ENGINEER

BOLINGER reports the cart has been moved back to the position about 30 minutes east of the meridian to catch the 'mystery signal'. It did not show up at the scheduled time but was there at very strong level the following night. It is still very mysterious.

A set of rail car wheel and two lengths of track would be desirable for the horn cart. Anyone with such a resource should get in touch with us as soon as possible. All ink recorders are spreading more ink on operators than on chart paper. This is Corollary 172 of Murphy's Law.

The Heath clock is nearly back in working function. There still seems to be lost bits or bytes (or maybe even words) on the way into the 11/23.

PUBLICATIONS GROUP

In addition to SIGNALS, AYOTTE reports he has been producing projection materials for the Toronto meeting. The slides look great.

AYOTTE and BARNHART will meet soon to hammer out a flashy brochure for public relations purposes.

CHIEF OBSERVER

Van HORNE has promised to post a schedule for the 'mystery signal' in the focus room ASAP He admits to letting this and other things slide while doing the production work on the video segment for Toronto and other places.

He has delegated the SUSAN LEACH group project to BARNHART. His gratitude will be amply demonstrated in the future by the willingness with which he will extend himself to further impossible tasks.

HEADQUARTERS GROUP

BARNHART has taken the donation of a number of terminals from Oberlin

College. He will pick them up on Monday.

A brief summary of the Halifax adventure was presented. A more thorough report will be carried in the late October issue of SIGNALS.

Within the week it is expected that the Gould thermal recorder will be in hand and the problem of ink flow will be behind us.

The meeting adjourned at 11:30. Next working session will be 15 October.

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