



**NAAPO (North American
AstroPhysical Observatory)**

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RO Has Major Role in Future SETI Research

RO Director **Bob Dixon** attended a conference at NASA's Ames Research Center on July 25 - 27. He presented a paper on recent developments in our SETI research. While there he met with the people in charge of the NASA **SETI** program as well as others from around the country.

"This was a very encouraging experience for me, as time after time people people said how much they admire our work and the many innovations we are bringing to the field," **Dixon** commented. "We are looked upon by others in the field as being fresh and imaginative, always being able to come up with new ideas, even though we have almost no money to do it with."

The view from the outside centers upon a number of ideas and practices we have implemented that should be pursued, published and promoted. **Dixon** listed the following projects with suggested actions to be taken by the Observatory staff:

1. SETI Zoom. This technique is unique in the world. We must get it fully operational and write papers about it.
2. ARGUS Telescope. It is suggested that we send proposals for this to two different NASA branches as soon as possible. Chances for funding look good.
3. Horn Blinders. The ESL people at Ohio State (partners in using Big Ear) lead the world in this technology. Nobody else seems to have any similar capability, and other telescopes would like to use our techniques. Nancay in France is immediately interested. We must write this up with measurements and publish as soon as possible.
4. RFI Survey. Nobody else has a setup like we do to record and study RFI continuously. All we need is a talented and dedicated person to take this over and make it fly.
5. RFI-Proofing the Telescope. This can be done by adding rolled edges to the reflectors and side reflectors. Again it would be unique in the world.
6. Development of the **Karhunen-Loeve** transform. This is a new idea **Dixon** has

explored for signal processing. "We need a student with mathematical or signal processing skills to work on this, perhaps using the Cray." It would be a great paper and thesis, as nothing practical has EVER been published on this.

7. Attraction and encouragement of interesting people and ideas. Examples would be **Clive Goodall** and **Stuart Kingsley**. A paper similar to **Kingsley's** was given at the conference.

Dixon further commented that NASA will be coming out with a series of requests for proposals, asking for ways to expand the now-planned NASA-SETI program, new things to do with the data, follow-on work and work in related areas. "That is exactly where our strengths lie," he said, "and I was told to propose in those areas."

It seems the work is cut out for the Observatory personnel in the next few months. We have some very definite priority activities with which to deal.

NASA Makes up its Mind

Site of the dedicated telescope for the NASA SETI search is the 140 foot telescope of the National Radio Astronomy Observatory at Green Bank, West Virginia.

News of the selection by NASA came back from Ames Research Center with **Bob Dixon** last week. Official details will probably be forthcoming when NASA makes its announcement. Material brought back by **Dixon** outlines the basic comparisons used to make the decision. It has been known that NASA has considered three possible locations to carry out the targetted search phase of their SETI program, scheduled to get under way in 1992. These were the OSU 110 meter telescope (Big Ear) at Delaware, Ohio, the 46 meter dish at the Algonquin Radio Observatory in northern Ontario, and the 43 meter dish at NRAO.

The Algonquin site was ruled out early in the process due to its high cost and lack of adequate on-going program and infrastructure at present. Thus the competition was really between OSU and Green Bank. Comment was made that the TIW report contained many errors and that our personnel had pointed out many of these. **Dixon** has summarized the basic comparisons between the two sites. Parenthetical comments are his.

1. OSU is acknowledged to be the largest and most sensitive telescope.

2. OSU is the most available, both now and with certainty in the future. NASA plans to go on the air first in 1992 at Arecibo, Puerto Rico, then in 1994 at Green Bank. But, the Green Bank telescope will not be available to NASA until the replacement for the 300 foot telescope is fully operational, and there could be long delays in that. (NASA is worried about that possible delay. Remember, however, that the NASA SETI budget in Congress is currently zero, so NASA says without funds they will operate NO dedicated telescope, and even at reduced funds they will be delayed.)
3. OSU and Green Bank are judged equal in frequency coverage and agility.
4. Green Bank has somewhat greater sky coverage.
5. Green Bank can more quickly and extensively follow upon previous detections.
6. Green Bank is less expensive. They acknowledge that OSU operating costs are much less than the others. But they are reluctant to compare costs for the upgrades on any basis other than TIW's, since that is believed by them to be at least consistent from site to site. (I would disagree.)
7. Green Bank has less technical risk since their upgrade is not as complex as OSU.
8. Green Bank has less RFI than OSU. The primary advantage here is the Radio Quiet Zone around Green Bank. The RFI tests made by JPL showed Green Bank and Big Ear to be essentially the same. But the SERENDIP measurements by the Ames people show Green Bank to be better than OSU. They also say Big Ear has more RFI at the feed than at the office building. (NASA and I are both puzzled by these strange findings.)

The written recommendation says the following in conclusion: "Recommend selecting NRAO for dedicated site, and finding some other way to use large (collecting area) of OSU.

NASA still has its eye on Big Ear. The dedication of many volunteers and supporters of NAAPO has allowed the on-going operation of this observatory and the maintenance of a program of high quality, innovative work. Everyone should take pride in the fact that our hard won accomplishments receive recognition and

acknowledgement from the largest potential SETI program in the world. There are yet higher goals to achieve. The time has come to close ranks and get on with the job.

COORDINATORS CORNER



Big things have happened since last issue. We have reason to cheer. We have reason to demonstrate disappointment.

We have reason to reflect. AND we have reason to increase our effort.

Marked progress is showing in our specific tasks. These are recounted in the meeting notes for 4 August. Bob brings stimulating news from NASA Ames about the future wishes of NASA SETI workers. It seems the outside world is taking note of our presence through all the smoke.

And NASA selects Green Bank's 140-foot dish for the dedicated instrument to be used in their targetted search program. On the basis of their comparisons it looks very nearly like a toss-up. So why not encourage the good Senator from the state of West Virginia. NASA needs SETI money back in the federal budget more than the higher sensitivity of a telescope. Without SETI support in Congress NO telescope will be funded for a targetted search. Perhaps NASA SETI has better plans for Big Ear than the targetted search.

The time has come to write proposals. Hopefully we can also squeeze out the writing of some of the results we will obtain in the next several months. In any case, there are exciting times ahead for Big Ear and NAAPO. I heartily congratulate all who put in so much effort these past months to place our best foot forward to NASA and any one else willing to listen.

-- peb --

Dump Clean-up Passes Milestone

Disposal of the trash from the dump site at BigEar took a volunteer turn this past month. In a massive effort to save the several thousand dollars wanted by solid waste disposal professionals, teams of volunteers from ESL and Electrical Engineering at OSU, Otterbein College and NAAPO dug in and filled a line of dumpsters with contents of the dump.

Approximately 30 man-days of labor was provided by the EE and ESL groups while an additional 6 man-days and a front loading tractor came from the NAAPO group. We note with great pride and thanks the efforts of:

Ray Feast
Mike Bruhn
John Beaver
Fred Herchline
Bill McCormick
Carl Russell
Bill Thalgott
Willie Truss
Eric Walli
Steve Brown
Walt Mitchell
Russ Childers
Clive Goodall
Dave Backus
Dick Helwig
Rick Helwig
Jon Pearson
and . . .

The Mighty Front Loading Allis Chalmers.

There seems to be about three more bags of paper to be picked. That should take a couple hours this week. All the other paper is now disposed or waiting on the observatory truck for bagging for disposal.

Congratulations on a job well done!!!

Is there intelligence in Congress?

A recent article in **The Los Angeles Times** spoke of the ups and downs of **SETI**. It points out that, besides the technical difficulties, there are other, closer to home problems.

One huge problem is the recently voted down budget for **SETI**. The government recently voted to cut all funding for **SETI** in this years **NASA** budget (see Jill Tartar's letter, reprinted in Signals volume 6 #3). They cite "proof of ETI" as the reason. What proof have they? No, it isn't little green men in hangar 13, it's supermarket tabloids, no less! Yes Virginia, there really is UFO's, and I know it, cause I read about it while standing in the checkout line at the grocery store! Some of these articles have actually been cited specifically, and as a result are now a part of our official congressional record! The absurdity of it all is that these supposedly intelligent congress-people actually believe this tripe.

If you are enraged by any of this, I am including excerpts of the congressional record that include the citings, as well as a list of the congressmen responsible for this debacle. Write, call or visit them, and let them know how you feel!

Quote from John Glenn (1981)

"I fully recognize the need for budgetary restraint in these inflationary times. But we must not be penny wise and pound foolish. We must not demonstrate our frugality by mortgaging the future."

Two Letters from Bill Mook

Letter to Phil Barnhart

9124 Leith Drive
Dublin, OH 43017

July 23, 1990

Dr. Philip E. Barnhart
Signals - The NAAPO Newsletter
Otterbein College
Westerville, OH 43081

Phil,

I ran across some interesting information in a recent issue of a magazine called The Planetary Report. This magazine reports on recent data from space craft and interesting planetary phenomenon. It was reported from both Voyager spacecraft that interesting radio emissions were beginning to be detected. It is thought that these emissions may be caused by the collision of solar wind particles (protons) with interstellar material at the heliopause. What may make them interesting to SETI researchers is that these emissions;

- i) surround the Sun in all directions and are nearby (less than $6E12$ meters distant).
- ii) are non-thermal and on occasion may even be narrow band.
- iii) may excite the hydrogen line and other bands in the 'water hole' preferentially since they involve interaction with solar atmosphere nuclei.

The easiest way to imagine what is going on is to imagine the charged solar wind particles as a laminar flow near the sun, but becoming turbulent when they encounter the heliopause. There they circle in a magnetic field of their own making. For those who still remember such things, envision cigarette smoke rising smoothly from an ashtray. When the flow slows sufficiently the smooth flow become turbulent. The solar wind, which is made up of charged particles, would radiate non-thermal EM waves when their flow becomes turbulent after moving across the solar system in a non-turbulent manner.

A back of the envelope calculation indicates that with a velocity of 450 km/s, available kinetic energy in each proton would be;

$$E = .5 \cdot 1.65E-27 \text{ kg} \cdot (450E3 \text{ m/s})^2 = 1.67E-16 \text{ J} \quad (1)$$

Assuming proton density equals 10 protons per cubic centimeter at this distance from the sun, then computing the number of protons slowing per second per square meter;

$$450000 \text{ m/sec} \cdot 10\text{p/cc} \cdot 100^3 \text{ cc/m}^3 = 4.5E12 \text{ p/sec m}^2 \quad (2)$$

and multiplying it by the energy available for each proton yields the power in Watts radiated per square meter;

$$1.67\text{E-}16 \text{ J/p} * 4.5\text{E}12 \text{ p/sec m}^2 = 75.178 \text{ Watts/m}^2 \quad (3)$$

We're assuming here that we are looking through a thickness for each square meter sufficient to stop the protons.

The power available at Earth from each square meter would be at most;

$$75.178 / (4 * \text{PI} * (6\text{E}12)^2) = 1.66\text{E-}25 \text{ Watts/m}^2 \quad (4)$$

Which may be detectable if radiating in bands we are using for SETI surveys. This may be an explanation of many of the non-thermal, deep space emissions detected on our narrow band survey. While actual power levels may be orders of magnitude lower than this, it may be interesting to pursue further. A few tests based on the following may be possible;

- i) Turbulent flow is likely to be dominated by the solar magnetic field. Thus polarization of any emissions from this source would likely be different along the solar magnetic equator (plane) versus the solar magnetic poles (circular).
- ii) Power levels may fluctuate with solar activity. We might review periods of peak narrow band anomaly production and compare them with solar activity.
- iii) Given the well defined kinetics of solar wind emissions, it should be a simple matter to compute likely frequency distribution and look for emissions at those frequencies. This requires Voyager data.
- iv) one could receive data from the same locations as the Vovager spacecraft and compare data.

In any case, this may serve as a factor in any interstellar communications scheme, and deserves further study. I know that JPL is working very hard to determine the impact of radio emissions from this source on the proposed Voyager Interstellar Mission going on now until 2015 AD.

Sincerely,

William H. Mook, Jr.

[Signature deleted.]

LETTER to Machtley

9124 Leith Drive
Dublin, OH 43017

July 23, 1990

The Honorable
Ron Machtley
U.S. House of Representatives
1123 Longworth House Office Building
Washington, DC 20515

Dear Mr. Machtley,

Your recent comments regarding SETI research as appeared in the Congressional Record for Thursday June, 28th 1990 is in grave error. While as a Republican I applaud any effort to reduce wasteful spending by the House, there is no excuse for misinformed and faulty decision making.

A case might be made for reduced funding of basic scientific research by the Federal government (including SETI), but the characterization of SETI research as some sort of tabloid science is unwarranted. Nobel laureates such as Enrico Fermi and Phillip Morrison have published papers and have performed research in this area. Other reputable scientists have pointed out that just as the activities of NASA should not be confused with 'the backs of cereal boxes', SETI research too is valid science and should not be identified with UFO's and other tabloid popularizations. To do so blemishes the scientists who work, in this field and reflects poorly on your education and knowledge. For your information I include the basic facts currently accepted by most of the scientific community regarding SETI as a scientific enterprise:

It is clear that the same processes that have lead to the evolutionary development of life and intelligence on Earth, operate throughout the universe. One can show that there exists a distinct probability that life and intelligence exists elsewhere in the cosmos. Dr. Frank Drake of Harvard has computed this probability to be:

$$n = R^* f_p f_l f_i f_t L \quad (1)$$

where;

n - the number of extraterrestrial civilizations

R^* - the average rate of star formation

f_p - fraction of stars with planets

f_l - fraction of planets harboring life

f_i - fraction of ecologies harboring intelligence

f_t - fraction of intelligences with technology

L - lifetime of technical capability

Now this wouldn't be of much interest to scientists unless we could perform some measurement or test to verify or disprove this relation. Fortunately, within the past decade we have achieved the technical means to perform such a test, and to do so at modest cost.

Modern radio telescopes, useful for a wide variety of things as well as SETI, equipped with powerful digital filters, again useful for other things in addition to SETI, have the capacity to detect modest artificially generated signals anywhere in our galaxy of 100 billion planetary systems. How can we tell an artificial from a natural radio source? Simple, natural radio sources are thermal, artificial sources, independent of content or method of modulation are not.

If it weren't for these facts; a) that artificial sources can be identified automatically independent of content, and b) very low power artificial sources can be easily separated from high power natural radio emissions I would agree that searching for ET would be a boondoggle, but such is not the case.

Finally, I hear a lot from congress regarding HDTV and how it leads to basic improvements in digital technology. I just want to note that the digital signal

processing technology developed for HDTV and electronic countermeasures are very similar to the digital signal processing technology used in SETI. That means there is a very definite positive spin off from SETI into our domestic electronics and defense industries, apart from the value of n which would be determined for Eq. 1 above. This is one reason Dr. Bernard Oliver, Director of Research and Development for Hewlett-Packard, is active in SETI research.

Again, as a republican I find it distasteful to write to any representative to demand higher spending as I believe that the 25.3% of GNP spent last year exceeds sustainable levels of spending, but I do not mind in the least in pointing out that SETI should not be singled out for special treatment merely because of an unfortunate link in many uninformed minds with tabloid headlines. Forty years ago space satellites were featured in tabloid headlines. It took Sputnik to jar us out of our complacency. If signals from an extraterrestrial civilization are detected, do we really want to play catch up with other nations? I think not, and I believe you should reconsider the positions you have taken in light of the these facts.

Thank you for your time and consideration.

Most Respectfully Yours,
William H. Mook, Jr.

Seen In The *Columbus Dispatch*

[Caption on photo:
Dispatch file photo
John D. Kraus monitors output
from Big Ear radio telescope]

[Click on photo for a larger version.]

Space search strapped for funds

By George Embrey
Chief, Dispatch Washington Bureau

WASHINGTON - John D. Kraus of Delaware, Ohio, has been waiting two decades for his "Big Ear" radio telescope to detect evidence of intelligent life in outer space.

But while Kraus has been waiting, Congress has been moving to unplug the line.

Kraus, professor emeritus of engineering at The Ohio State University, has been hearing scary static on Capitol Hill about the government's Search for ExtraTerrestrial Intelligence program.

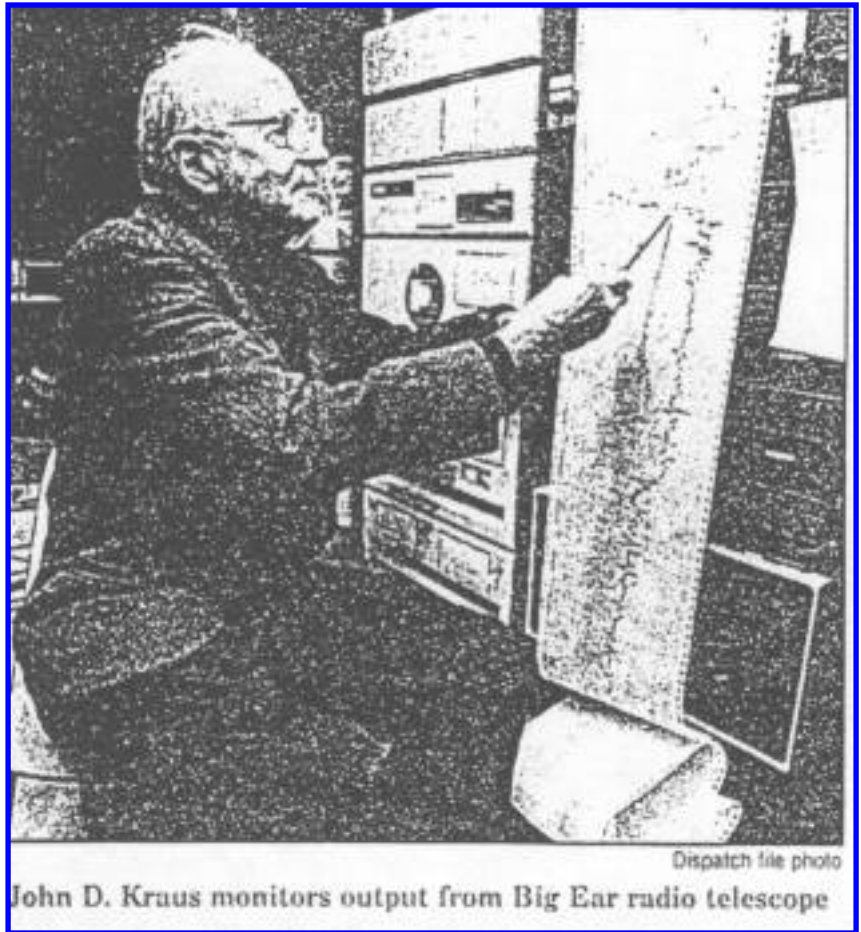
The glitch is a Rhode Island congressman who won a surprise House vote recently to wipe out all of the \$6.1 million that the National Aeronautics and Space Administration had requested for the program for next year.

The vote came after Rep. Ronald K. Machtley, R-R.I., said, "Does any congressman think for a second that he can explain to any reasonable person how important it is to spend \$6.1 million to see if E.T. really exists?"

Rep. Silvio O. Conte, R-Mass., who helped Machtley get permission for a floor vote on the killer amendment, disparaged the program as a search for "little green men with big foreheads."

Kraus, director of Big Ear, the OSU Radio Observatory in Delaware, Ohio, refuses to answer in kind.

Acknowledging Congress' budget crunch, he said he thought Machtley "was trying



to find ways of conserving funds. This recent action shows that this project is extremely vulnerable."

At 79, Kraus is a patient man. He built the stadium-sized radio telescope in the 1960s. In 1973 he dedicated Big Ear to the full-time search for intelligent radio signals from space, making it the first machine in the world dedicated to such a task.

Hearing the likes of Machtley whack away with the ax of fiscal austerity is nothing new to Kraus.

"This isn't the first time this has happened in Congress," he said. "It was cut to zero ... some 10 years ago. Senator Garn came to the rescue last year."

Sen. Jake Garn, R-Utah, is the top-ranking GOP member of the Senate Appropriations Subcommittee on Veterans Affairs, Housing and Urban Development and Independent Agencies. That subcommittee passes on NASA budget items such as the intelligence program.

Jeff Vincent of the NASA legislation office had not heard of any pending attempt to cut the program in the Senate. He assumes the Senate will keep the 1991 budget intact and will prevail when the Senate and House bargain over different NASA budget plans.

But late last month, there were signals the program might face a fresh snag in the Senate. Subcommittee Chairman Barbara A. Mikulski, D-Md., had planned to get the NASA budget through the full Senate Appropriations Committee and, possibly, to a Senate vote.

But she had to delay NASA budget matters because of special hearing into the problems surrounding the Hubble orbiting telescope and the manned space-flight program. That probably means Kraus and the other scientists pushing the extraterrestrial intelligence program will have to wait until September, after Congress' summer break, for Senate action.

"There are so many other things going on," Kraus said. "This is very small by comparison."

"This has been in a kind of holding pattern, circling to land for years and years. Every year, hopefully, something is going to happen next year."

Garn's subcommittee assistant, Stephan Kohashi, said last week that part of the problem is that a small program suddenly tried to double in size and attracted the House budget cutters' attention.

The extraterrestrial intelligence program has been operating on about \$6 million to \$8 million a year, but NASA asked for \$12 million for 1991.

NASA scientists have been trying since the late 1970s to get money to design and build a central, computerized device that could enlist numerous radio telescopes to scan some 14 million radio frequencies.

If the search equipment is ready, NASA hoped in 1992 to launch a \$100 million, six-year search for alien signals.

"The program is hitting this blip because it's going to hardware, and that's what attracted the attention," Kohashi said.

Kraus said Ohio State has not been getting much out of NASA for its share of the program's work anyway — about \$15,000 a year.

"It has not been able to accomplish much, although it has served to give some training to a number of graduate students," he said.

Big Ear, however, is one of three radio telescopes in the United States and Canada that NASA is considering upgrading under a new program. The mission, which could require a \$3 million modernization of the telescope, would be a search of nearby stars that may have planetary systems.

However, any such modernization is now captive to the congressional debate.

"We'll just be waiting it out now as we have for 80 years," Kraus said.

Non-Detection of Pulsar in SN1987A

When the progenitor star that resulted in SN1987A went supernova, astronomers eagerly awaited proof of their theory that pulsars are created in supernova events. They thought they had such evidence when they detected a rapidly pulsing signal in 1988. The only problem was, that if the source was indeed the pulsar in SN1987A it was rotating too fast for current theories regarding pulsars. Theorists quickly came up with physically logical reasons why the pulsar was not spinning itself to shreds.

As it turns out, the data were nothing more than a spurious source of noise caused by a faulty piece of detecting equipment. A camera was introducing the faulty reading, which was discovered by the team that reported the pulsar in the first place. The incorrect reading was discovered when the detecting equipment was pointed at a portion of the sky known to harbor no pulsars. The pulses were still detected, leading astronomers to assume that the equipment was at fault.

Meeting Notes

21 July 1990

-- EP --

The meeting began at roughly 10 am. Those in attendance included Mitchell, Barnhart, Hanson, Phillips, Brown, Backus, Schumacher, Goodall, and Childers.

Brown reports that there have been crews from both the ESL and the EE departments of OSU on site to aid in the removal of articles from the dump. There has been arranged some dumpsters for the purpose of removing the rest of the unsightly mess. There is still much to be taken out, and it is requested that as many as possible remain after the meeting today to assist in this chore. Brown also reports that he has the synthesizer hooked back up as of last week, and is now running under computer control.

Phillips reports that he is in need of volunteers to assist in the repair of the broken fence post, as well as the completion of the paint job to the interior of the RO office building.

Childers reports that the SETI software is now running, and that it now detects the signal squinter. He was asked to document a complete description of what he has

done to automate the horn cart, for possible submittal to the IEEE journal, or at least for NAAPO pre-prints.

Schumacher volunteered to work on the PDP 11/23 + to get it up and running.

The meeting adjourned at roughly 11 am, with all going off to the dump area to assist in the removal of as much of the trash there as possible. At least one dumpster was filled, with another partially filled. All the trash easily visible has been removed, though there is still some yet to be removed that is behind the brush.

4 August 1990

-- EP --

The meeting began at roughly 10 am. Those in attendance were; Barnhart, Dixon, Phillips, Brown, Huck, Mitchell, Ferryman, Janis, Goodall, Childers, and 2 of Barnhart's guests, Don Nelson and Bob Bates.

Barnhart reports that he got a call from an Otterbein graduate currently with **Battelle Institute**, offering for donation a **Lindgren Screen**. We are very much interested in this donation, as it is felt that if it were erected in the focus room around the computers, that it would effectively cut down on much of the system-generated RFI. Barnhart also received a letter from Dr. John Kraus, stating that it is necessary to remove the paper from the dump area. He feels that if that were removed, we would have the dump situation under control in his eyes.

Dixon reported on the **NASA** decision regarding our use as a dedicated **SETI** instrument. We did not get the bid, though we did come in second to the **Green Bank** facility. There is generally a feeling of the **OSURT's** use at **NASA** however, as they recommended several possible ways that they may utilize our large collecting area. Dixon stated that he felt that the decision was not politically motivated, as many people, including **Dr. Carl Sagan**, made it a special point to assure him of this. Many people expressed to Dixon our ability to come up with unique ideas and implement them, especially with little or no funding. Dixon then read a list of projects that require completion. All these projects require volunteer effort to complete, and your assistance is sorely needed. If you would like to get more active in the effort, please contact Dr. Dixon to determine if there is any area

that could utilize your particular talents. This is still a pivotal period to the **RO**, and your help will be greatly appreciated.

Brown reports that Russ and he have been experimenting with the signal squirter, and that it works fine. The big problem, however, is that it is much too powerful, and swamps the system. Discussion ensued regarding possible ways to "crank down" the power, and make it more useful.

Childers reports that he and Rodney have been working on the SETI software. He reports that there is a problem with the algorithm, and that it is not yet possible to detect a signal. More work will be performed to correct this situation.

Mitchell brought an article from the quarterly journal of the **Royal Astronomical Society** regarding cosmology and ET; specifically the **Fermi-Hart** paradox. Anyone interested in copies may contact Dr. Mitchell.

Goodall reports that he has possibly gotten the **BBC** interested in doing a "mini series" on SETI, featuring the **OSURT**. He will be getting back in contact with them regarding this, and promises to keep us informed.

The meeting broke up at roughly 11:50 am, with most going off to their respective tasks, mainly the unloading of Barnhart's truck of the Foster inventory, plus the RO's truck of garbage.

For RO STAFF, with dictionary, who missed the point. . .

feck-less (fek'lis), *adj.* 1. Ineffective; incompetent; feeble: *feckless attempts to repair the plumbing.* 2. without worth, spirit, or value; indifferent; lazy: *a feckless young man.* [late ME *fek* (var. of *fect*, for EFFECT) + -LESS] —**feck'-less-ly**, *adv.* —**feck'less-ness**, *n.*

"WE NEED MORE FECK AROUND HERE!"

PEB

Hubble, Hubble, Toil and Trouble

After delays of many years, and much extra cost in the way of storage time and personnel, the **Hubble Space Telescope** was finally launched by the shuttle **Discovery** in April, 1990. After an initial shakedown period, the **HST** was to begin sending back scientifically interesting data.

Unfortunately, a figuring error in one of the mirrors will jeopardize some of its optical use for a couple years. The scope suffers **spherical aberration**, which does not allow all the light from all points of the mirror to come to a focus at one point. The light now focuses on an area roughly 2 arcseconds in diameter. Until the problem is resolved, the **HST's** use as a visual scope is not as good as most amateur scopes here on the ground.

A solution to the problem has already been put forth; a corrector lens can be built which makes up for the focusing errors in any mirror. The mirrors on the **HST** will have to be "mapped" to ascertain exactly where the figuring errors are before the corrector lens can be built. Then, it will have to be brought up to the scope and replaced in orbit, as the **HST** cannot be brought back to earth. Doing so would result in more damage from reentry, plus there is the possibility of contamination. Though there has been planned a replacement of the **Wide Field Planetary Camera**, which will house the corrector lens, that replacement is not scheduled until 1993. Until then, astronomers will concentrate on getting all the science they can out of the three instruments that are unaffected by the problem. There are 2 spectrographs and a photometer that do not rely on the main mirror's focusing ability.

It is indeed unfortunate that the problem had to occur in the visual aspect of the scope, just the aspect that the general public was most interested in.

A congressional investigation is currently looking into the question of responsibility regarding the error. Any findings will be reported on here in **Signals**.

Quote from Cocconi & Morrison (1959)

"The probability of success is difficult to estimate, but if we never search the chance of success is zero."

Massive Cosmic Structure Found

Astronomers have discovered the most massive structure in space to date, dubbing it "**The Great Attractor**". The Great Attractor is roughly 150 million light-years from the Solar System, and is composed of galaxies and other matter.

This structure is exerting gravitational pull on the Milky Way, along with millions of other galaxies. Astronomers say that galaxies within this superstructure are not being pulled away from one another, but rather falling in on a region believed to be hundreds of millions of light years wide.

The structure has been overlooked to date due to its sheer size. Astronomers usually study small portions of the sky, but the Great Attractor covers so much area, "it was a case of not being able to see the forest for the trees", to quote **Dr. Alan Dressler**, of the **Carnegie Institute of Washington**.

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Designed by Jerry Ehman

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