OBSERVER

SIS MICHAEL SWEATS IT OUT IN G.B.

STORY ON PAGE 2

*****

COVER STORY

Does the front cover really need an explanation? If you were in Green Bank the day this picture was taken, you would know why Sis looks this way. The lemonade (even the gallon she drank) did not cool her body temperature down past the 100 degrees she swore she registered.

We must admit, for once Green Bank had a summer day that compared with Charlottesville, Tucson, and Socorro.

Even though we know that temperatures in Green Bank will get down to -20^{o} this winter, Sis will not complain of the cold. She will only remember the long hot summer at Green Bank and say, "Pass the lemonade."

*****

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CAN RADIO SOURCES BE PRODUCED BY GALAXY COLLISIONS?

*John Stocke**

Cygnus A was one of the first extragalactic radio sources to be identified with an optical object, a distant galaxy with unusual double structure. This double structure prompted Rudolf Minkowski to propose in 1954 that bright radio sources were caused by violent collisions between galaxies. His theory did not remain in favor very long, however, because new observations failed to reveal other radio galaxies undergoing collisions. At the same time theoretical calculations showed that the energy from such a collision was nowhere near what was needed to power sources like Cygnus A.

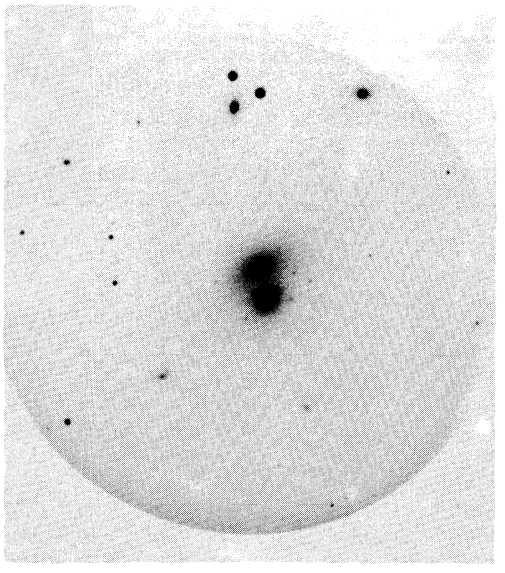

Figure 1: *A high resolution photograph of the "dumbbell" galaxy associated with the radio source 3C40. This is an image tube photograph taken through a broad band red filter using the 61 inch telescope on Mt. Lemmon, Arizona.*

Despite the demise of Minkowski's theory, many radio galaxies do show a double structure optically such as the "dumbbell" galaxy 3C40 shown in Figure 1. Moreover, rich clusters of galaxies, where densities of elliptical galaxies are high enough to expect frequent collisions, seem to be places where radio sources abound.

Feeling that this question deserved another look, I observed a large sample of isolated pairs of galaxies searching for excess radio emission from them. While these isolated pairs avoid rich clusters, the prime hunting ground for radio sources, they had the virtue of being a sample of galaxies with extremely simple properties. In this sample ellipticals like 3C40 or spirals like the pair on the outskirts of the Virgo Cluster pictured in Figure 2 can be found. These galaxies are evidently undergoing collisions (or "encounters" if you are the non-violent type) well-isolated from other galaxies in the neighborhood. Many other pairs in my sample are further apart and show no signs of

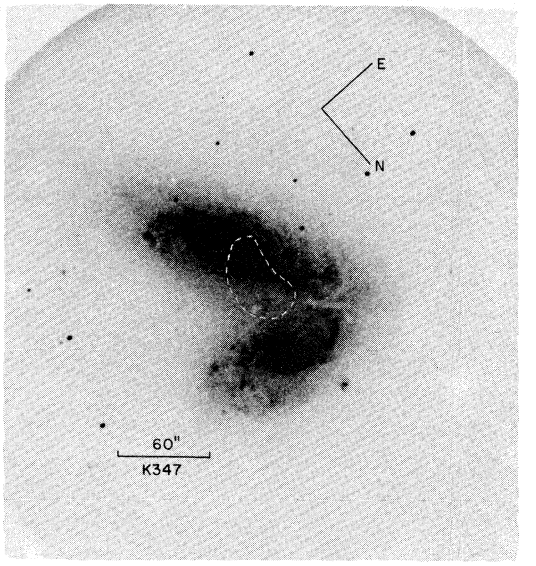

Figure 2: *Another 61 inch red plate, this time of the pair NGC 4567 and 4568. The approximate extent of the associated radio source is shown with dotted lines.*

physical interaction although their redshifts give me reason to believe they really are near to each other in space. Thus, the sample allows a continuous range of possibilities from close-interacting to well-separated galaxies.

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What I find is that the close galaxies, regardless of whether they are ellipticals or spirals, are radio sources at almost triple the rate of the more widely spaced pairs. Perhaps collisions between galaxies can account for at least some radio sources! Since my detections are several orders of magnitude weaker than Cygnus A, the theoretical arguments which killed Minkowski's theory are no longer restrictive. In fact, the approximate location of the radio source associated with the galaxies in Figure 2 indicates that it may be the direct result of a collision in progress. Since this crude outline map is based on preliminary interferometry, a more detailed study of this source is necessary before this claim can be substantiated.

In the meantime, I've returned to Green Bank to investigate a sample of extremely isolated galaxies with Mark Adams of Arizona and Eric Jensen from Rice. If the collision (or encounter, if you prefer) hypothesis is correct, then these galaxies should be deficient in radio sources since they have no neighbors at all. Only the observations will tell; maybe these ideas will be substantiated or maybe the universe will tell me, "FOOLED YOU AGAIN, DIDN'T I!"

* UCLA

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DESK TOP COMPUTERS

Rick Fisher

Your editor is getting pretty hard-up for material when he asks for articles on new test equipment. However, we did acquire a device from Hewlett-Packard which is interesting from the "look what they can cram in a little box" standpoint. I am referring to the Model 9825A desk-top calculator.

The 9825 is much closer to a minicomputer than it is to the best programmable pocket computer in capability, but it is based on the same microprocessor technology that made the HP-35 and successors possible. With a recent addition it has enough memory to store a program the equivalent of, say, a 3-inch stack of FORTRAN cards for the IBM 360 (15,000 bytes). You program it in a BASIC/FORTRAN type hybrid language. It has a built-in cassette tape drive for data and program storage, a small printer, an LED character display and several sockets for talking to other test equipment. It is the latter feature which makes it especially attractive for lab use.

Some test setups that have been built around the 9825 are a precision waveguide attenuation measurement device, an antenna reflectometer, a 6-port network analyzer, John Findlay's antenna surface inclinometer, and a time standard stability monitor. We even rigged up a special purpose radiometer backend for Sam Goldstein. With the associated X-Y plotter the data can be displayed as the measurement progresses.

The immediate production of plotted curves makes the computing calculator pleasant to use for electronics design. The 9830 at Ivy Road has been used a great deal for this purpose, and some of its programs are being translated for use in Green Bank. The newer 9825 has about 10 times the calculation speed, although it is still slow by 360 standards. A lot of antenna feed and microwave filter design has been done that otherwise would have been very time consuming even with the 360.

*****

A SLICE OF THE SOUTHWEST

Doris R. Gill

What everyone should know about attending a rodeo -- but who cares enough to ask!?!?

Magdalena Rodeo - June - Consider taking a picnic lunch and cooler of favorite beverage - concession stand may or may not be available.

Plan on going to dances held at the bars - unless you want to be surrounded by teenagers at the dance in the gym.

Check your posters next June, currently the association has disbanded, there may not be a regular rodeo in 1978.

Magdalena Old Timers Rodeo - July - Rop-

--continued, next page--

ing, roping, roping - but the extra activities mornings and evenings make this a fine community activity.

Again consider your food intake (lucked out this year and should in the future - the Mary Magdalene Fiesta now follows the Reunion. The winner of the Fiesta Queen, Prince and Princess competition is based on the proceeds raised in the candidate's name - one way to raise money is food projects at all functions.)

Out-of-towners should come equipped with campers - no use going home between Friday evening and Sunday afternoon.

Datil Rodeo - August - Arrive early so you can back your pick-up right up to the fence -- you provide your own grandstand.

Definitely bring food and drinks - only way you'll get any.

Expect a mob - but a fun-loving one - at the dance. Again a very young crowd, as this is at the community hall, not a bar.

If you retire to your vehicle often during the dance - to fill up your styrofoam cup - consider a light coat or sweater - that altitude, even in August, can be chilly evenings.

Rodeos In General - Lots of visiting - ranchers don't get together all that often not to take advantage of the occasion.

Sunburn - wear your long sleeved shirt and jeans - however, you'll only pass for a cowboy or cowgirl if you're chewing tobacco or dipping snuff.

Dust - and whatever else you want to call it.

No port-o-lets - regular old-fashioned outhouses (except at the Navajo Rodeo at the Alamo - they have NOTHING).

Delays - those barriers never seem to function continuously for even one rodeo.

Clothes - don't go too fancy - if you aren't dust-covered you'll be mud-covered.

*****

There is a vast difference
between happiness and pleasure.
Pleasure is a false face
that is more often the mask
of discontent than of happiness.

*****

"A MAN'S FILES SHOULD EXCEED HIS REACH, OR WHAT IS A LIBRARY FOR?"*

Sarah Martin

Since we have been given our "raison d' être" by the above quote, we thought perhaps an explanation of how to make one's bewildered way in the library might prove useful in some future circumstance when you find your files have exceeded your reach and you must therefore use the well-organized, easily understood library "files". Libraries contain books, which probably isn't too startling a revelation to most of you, but to a librarian, many of these books aren't just books: they're monographs, to be distinguished from serials, periodicals, and so forth. The monographs are arranged in the NRAO libraries and in most large and/or specialized collections in this country by the Library of Congress classification scheme. Contrary to popular opinion among hoi polloi, this is not a system aimed at guaranteeing job security for librarian types by ensuring that only they can find a particular book, but rather is a classed subject arrangement used so that books on a similar subject are grouped together and those on a related subject are grouped nearby. The Library of Congress classification is divided into 21 major classes from A, general works, through Z, bibliography (for you alphabet freaks, the letters I, O, W, X, and Y are not yet used). The first letter of an LC classification number indicates the general class; an additional letter, the general division of a class; and Arabic figures, in numerical sequence, its smaller subdivisions. Following the Library of Congress number is a decimal designation for the author, such as .M34, made up of the first letter of the author's last name and numbers that stand for further letters in the author's name, so that books on the same subject appear on the shelves in alphabetical order by author.

Since 93% of the monograph collection in the NRAO libraries fall into the LC classes Q and T and their subdivisions, we give you herewith a brief outline of these:

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Q	- Science (general)
QA	- Mathematics (including computer science)
QB	- Astronomy
QB 475	- Radio astronomy
QB 477	- Radio astronomy - popular works
QB 479.3	- Radio interferometers
QC	- Physics
T	- Technology (general)
TA	- Engineering (general)
TJ	- Mechanical engineering and machinery
TK	- Electrical engineering, electronics

Keeping this brief outline in mind, you should be able to look at the number QB 477 .H47 and without even thinking about it know that would be the call number for a popular book on radio astronomy by someone whose last name begins with H. A little investigation in the card catalog or on the shelves would produce the answer that it's The Radio Universe by J. S. Hey.

Most of the classification numbers we use are those assigned by the staff of the Library of Congress in Washington. Since they catalog and classify more than 100,000 titles each year, a few errors may occasionally creep in, but for the most part, the numbers they assign are fairly reliable. (We give little credence to the story that LC classified Jastrow's Red Giants, White Dwarfs in with physiological abnormalities and the assigning of the subject heading HORN (MUSICAL INSTRUMENT) to the IEEE book Electromagnetic Horn Antennas was quickly corrected.

Of course, one should always use the card catalog--whether the regular card catalogs available in the CV-Edgemont and GB libraries, or the computer printouts available in CV-Ivy, Tucson, and Socorro--when one knows the specific book one is after or if one wants to know most specifically what is available on a particular subject, since the best books on a subject will possibly be checked out at the time you're scanning the shelves. However, if you just want to look around in a certain subject area, you should be able to with just knowing generally which sections which subjects are classed in. Of course, you can always ask the librarian for help, but librarians are usually so busy coming up with new ways to confuse and confound you, they may not wish to be disturbed .....

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* It should be pointed out that the title of this article is a quote from one of our (ahem) distinguished staff members so that readers will not assume that such a sexist remark originated with the author.

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GROTE REBER

Grote Reber was at NRAO-GB on July 24, 25, and 26 shooting part of a TV show for ABC-TV (Australia). The show, titled "The Wildcat Astronomer", is about Reber's early and present efforts as a pioneering amateur radio astronomer.

Sequences shot at NRAO included a cafeteria colloquium with NRAO staff, a 300-foot control room sequence with Ed Burke, and a lot of footage with Reber at the historical Reber radio telescope. While these were the main sequences, much other footage was shot of telescopes, electronics, and the site.

Grote Reber during a shooting break.

*****

FOOD FOR THOUGHT

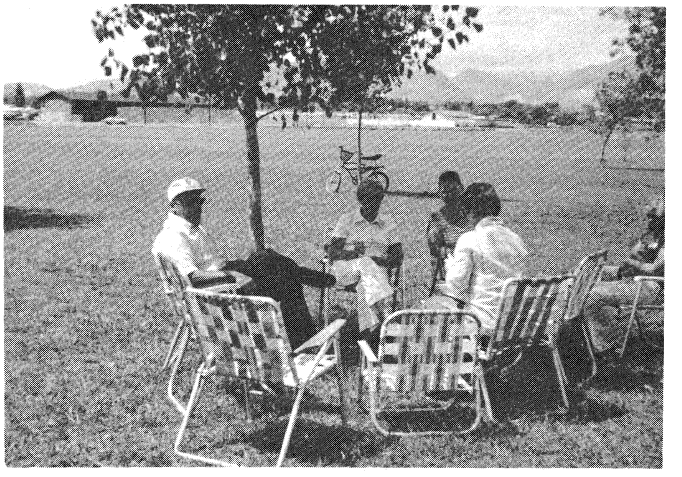
The greatest sin.....Fear
The best day.....Today
The biggest fool.....The boy who will not go to school
The best town.....Where you succeed
The most agreeable companion.....One who would not have you any different than what you are
The great bore.....One who will not come to the point
The still greater bore.....One who keeps on talking after he has made his point
The greatest deceiver.....One who deceives himself
The greatest secret of production.....War
The best work.....What you like
The best play.....Work
The greatest comfort.....The knowledge that you have done your work well
The greatest mistake.....Giving up
The most expensive indulgence.....Hate
The cheapest, stupidest and easiest thing.....Finding fault
The greatest trouble maker.....One who talks too much
The greatest stumbling block.....Egotism
The most ridiculous asset.....Pride
The worst bankrupt.....The soul that has lost its enthusiasm
The cleverest man.....One who always does what he thinks is right
The most dangerous person.....The liar
The most disagreeable person.....The complainer
The best teacher.....One who makes you want to learn
The meanest feeling of which any human being is capable.....Feeling bad at another's success
The greatest need.....Common Sense
The greatest puzzle.....Life
The greatest mystery.....Death
The greatest thought.....God
The greatest thing, bar none, in all the world.....LOVE

* * * * *

SECOND ANNUAL VLAPRA PICNIC

(photos by Dave Coombs)

The annual VLA Employees Picnic, August 13, was again a big success. A beautiful day, tremendous food (in spite of the cooks)

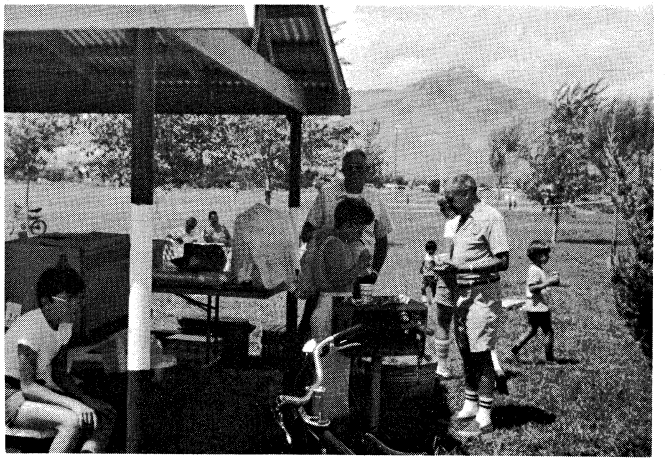


Lots of visiting, especially in the comfortable shade

There was beer in the sun....

beer in the shade....

beer with the family....



beer? camouflaged in a cup????

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They ran.....

they jumped.....

they fell.....

* * * * *

If you are alive and happy today,
that is enough.
Tomorrow never comes until it is today.
There's no reason
why each succeeding day
should not be as happy,
or happier, than your yesterdays
if you mentally picture
a continuation of this happiness
in your future.

--Harold Sherman

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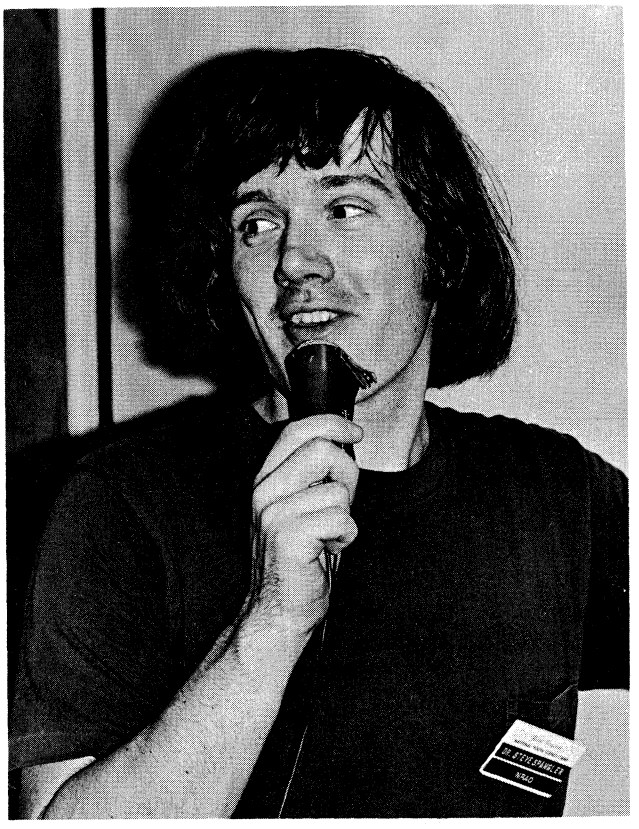
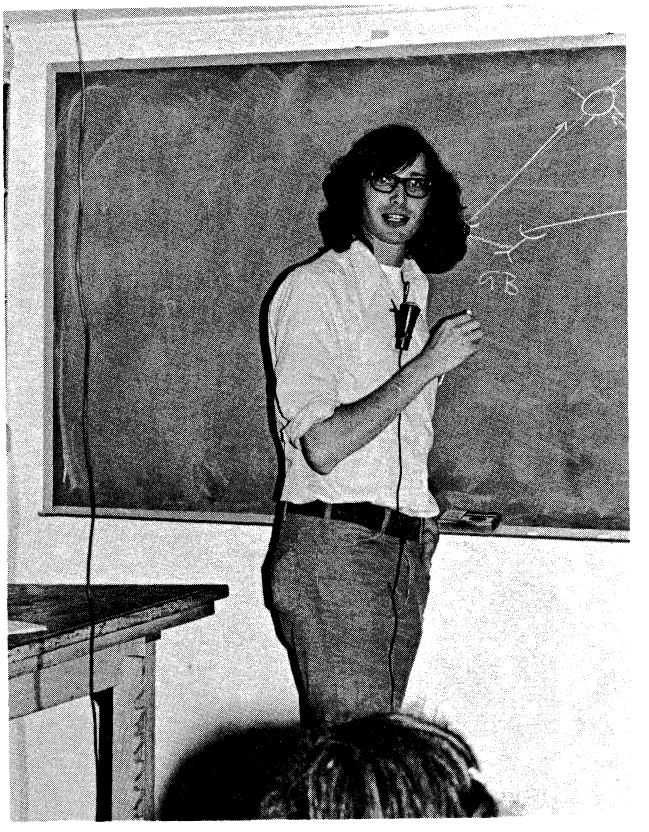
1977 NYSC LECTURES





Steve Spangler and Barry Geldzahler -
Lecturers at the 1977 National Youth Science Camp

Steve Spangler (CV) and Barry Geldzahler (GB) were featured lecturers this summer at the 1977 National Youth Science Camp, held at the Pocahontas County 4-H Camp near Thornwood. The camp, founded in 1963 and sponsored by the State of West Virginia, hosts the two top recently graduated high school science students from each state for three weeks of lectures by prominent speakers and rigorous outdoor activities. Steve spoke to the camp on "Radio Astronomy and Inter-planetary Scintillation", while Barry's topic was "Very Long Baseline Interferometry and the Galactic Center".

The National Radio Astronomy Observatory is a long-time supporter of the science camp and annually sponsors a tour of its facilities for the young scientists.

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FOR SALE

Heating stove: Warm Morning with jacket. Stove pad included. This stove has been used very little. Price: $225.00. Contact Berdeen O'Brien - 456-4542 - after 5:00 p.m.

* * * * *

NRAO ROUNDUP

Reprinted from the NRAO Quarterly Report for April 1, 1977 - June 30, 1977

RESEARCH PROGRAMS

140-Foot Telescope	Hours
Scheduled observing	1385.25
Scheduled maintenance and equipment changes	705.50
Scheduled tests and calibration	74.50
Time lost due to:	
equipment failure	36.50
power	7.00
weather	0.00
interference	0.00

Interferometer	Hours
Scheduled observing	1829.75
Scheduled maintenance and equipment changes	136.00
Scheduled tests and calibration	163.25
Time lost due to:	
equipment failure	38.75
power	0.00
weather	4.75
interference	0.25

300-Foot Telescope	Hours
Scheduled observing	2023.75
Scheduled maintenance and equipment changes	150.50
Scheduled tests and calibration	0.00
Time lost due to:	
equipment failure	14.50
power	7.50
weather	1.00
interference	0.00

36-Foot Telescope	Hours
Scheduled observing	1972.25
Scheduled maintenance and equipment changes	157.00
Scheduled tests and calibration	54.75
Time lost due to:	
equipment failure	38.25
weather	39.50
power	7.75
interference	0.00

ELECTRONICS DIVISION

Charlottesville

The VLB Mark III system development is progressing, and a request is being submitted to schedule an experiment between Green Bank and Haystack during September 1977. Six video channels (twelve recorder tracks) should be available for this experiment. NRAO has recently received the Honeywell 28-track head and is expecting delivery of a Spin Physics 28-track head in July.

Development of Model IV autocorrelator has run into a problem resulting from a National Semiconductor decision to withdraw their Super Pace Computer from the market. A Varian V77-400 computer has been ordered as a replacement and is due to be delivered in August 1977. This will result in some delay; it is now expected that the correlator will be ready for observing during November 1978.

During this quarter NRAO has built several 2-mm mixer mounts similar to the A. R. Kerr (NASA) design. These have to be whiskered and will be used in the new Tucson 2-mm (130-170 GHz) receiver.

Progress on the 1-mm (230 GHz) mixer has been delayed by other projects. However, we expect to complete the mixer and make measurements in the near future.

Green Bank

The 140-foot telescope was out of operation most of the month of May for the installation of a ModComp II computer for on-line data handling. This computer is now interfaced to all of the 140-foot observing equipment and is in full operation. During this shutdown reflection tests were made from the prime focus at 9 cm to study the spectral-line baseline ripple problem. All of the major reflections were identified and some corrective modifications to the telescope are being designed.

The first 18-25 GHz maser built in Green Bank became operational in May. Considerable improvements have been made to the bandpass

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shape near the ends of the tuning range, and further development continued. Members of the Tucson electronics staff arrived in Green Bank at the end of June to begin integrating this maser into a downconverter system for Kitt Peak. A frequency/phase locked LO system has been developed for the 140-foot maser system which can frequency switch over 500 MHz in less than 10 milliseconds.

An inexpensive servo motor for the 140-foot deformable subreflector has been acquired and tested. An on-line VLB data quality analyzer has been built and tested. Cooled FET amplifiers and different feed designs are being investigated in an effort to improve the low-frequency receivers.

Tucson

During this quarter the PDP 11 computer was delivered and installed in the downtown laboratory. A 256-channel integrator/multiplexer has been completed and interfaced to the computer. This has been tested, and the multiplexer may now be used to troubleshoot filter banks downtown.

All the equipment necessary for the whiskering of diodes has been acquired, and during the next few months we hope to be able to relieve Charlottesville of this task.

Work is continuing on the 130-170 GHz receiver, and we expect to complete this by the end of the year.

Work has started on the varactor downconverter system using the 18-26 GHz maser as an IF amplifier. A prototype LO injection system has been designed and will be completed in the next few weeks along with the modified dewar vessels and radiation shields. We hope to have the system working in the laboratory before the end of the year with receiver temperatures of around 100° K at 115 GHz.

ENGINEERING DIVISION

Design and field supervision continued for modifications and additions to equipment and structure on the 140-foot telescope. Drawings and specifications for the deformable subreflector and mounting frame for the 140-foot were completed and orders were placed for their fabrication. Design and research continued on a deforming system. Research and conceptual design continued for a future 25-m millimeter wavelength telescope and astrodome. Design was completed and fabrication started for modifications and additions to the 36-foot telescope. Assistance was provided in the research and development of a surface measuring instrument. Inspection assistance was provided the VLA project. Routine engineering assistance was provided operations and maintenance at Charlottesville, Green Bank, and Tucson.

COMPUTER DIVISION

140-Foot Telescope

Control System - The 140-foot control computer has been installed, replacing the original Honeywell DDP116. The physical separation of the telescope control and off-line data analysis function has been kept. The new control system is implemented in FORTRAN running under the manufacturer's operating system and enables the telescope operator to define and automate fairly complex control procedures. Flexible automated card control of the telescope is now possible; observing efficiency has been significantly increased.

Manuals describing the system in some detail are in preparation.

Off-Line Data Analysis Manual - A manual describing the use of the 140-foot off-line ModComp TPOWER/SPOWER system is available. The manual "On-Site Spectral Line Data Reduction" by Kathy L. Harper and Thomas R. Cram may be obtained by writing the Computer Division secretary and requesting NRAO Users Manual Report No. 28.

VLBI - The on-line program has been modified to allow processing of data recorded with only one head.

Processor hardware and software are undergoing modification to allow the use of additional information recorded at the time of observation, such as system temperature, source name, and a "good data" flag.

VLA Post-Processing - A set of programs has been developed which process VLA data, starting with calibrated output from the DEC-10 system. With the exception of calibration operations, the programs provide capabilities

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similar to those of the older Green Bank interferometer package.

VERY LARGE ARRAY PROGRAM

Antenna No. 10 was accepted on April 22, 1977, Antenna No. 11 accepted June 9, 1977, and Antenna No. 12 was undergoing acceptance tests the last of June, 1977. Fringes were obtained with Antenna No. 7 on May 10 and with Antenna No. 8 on June 23, 1977.

During the observing run on May 22-25, the fixed head disk between the synchronous and asynchronous computers and the real time filler program were activated, providing direct communication between the two computers.

Most of the electronic design modifications which were required to bring the performance of the prototype system within specifications have now been completed. The prototype batch of the VLA-2 custom integrated circuits was under test and the preliminary results have been very satisfactory.

Approximately 850 hours were scheduled for tests, calibrations, and observations with arrays of up to seven antennas. The sixteen observing programs run mainly involved studies of point sources, and were chosen primarily to provide measurements of the instrumental characteristics.

SUMMER STUDENT PROGRAM

In November 1976, more than 125 colleges and universities received announcements of our 1977 summer student program. From the more than 150 applications received, 21 students were selected to participate in the program as research assistants to the scientific staff and in the electronics and computer divisions. Eleven students are working in Charlottesville, six in Green Bank, and four in Socorro.

Lectures, 22 in number, will be given by the staff on various topics in radio astronomy and instrumentation. Students are encouraged to attend the regular NRAO colloquia and seminars. They will also assist as tour guides in the public education program in Green Bank.

Since its beginning in 1959, 444 students have participated in the summer program. We have had several students return as thesis students, and some have returned as full-time employees.

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GREEN BANK BOWLING

Dick Hiner

The Green Bank bowling season is here again. The season began on 6 September for the Tuesday night-6:30 league and will last thirty-six weeks. Howard Brown, Ed Burke, Harold Crist, Jim Gibb, Bruce McKean, Larry Miller, Bob Vance, and ? are bowling the first half.

Richard Hiner, Don Hovatter, Wendell Monk, Russ Poling, Bill Vrable, ?, ?, and ? are bowling the second half.

Note one ? bowling the first half. We need someone to fill that slot right away. How about you? The start of the second half of the season is way off, but we still need to fill three spots (?, ?, and ?). If you are interested in bowling either the first or second half, or both, please contact Jim Gibb, extension GB-264, or CB-Scottie Dog.

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AND THAT'S THE WAY IT WAS..... PART II

Doris R. Gill

The Graphic smelter, built at Magdalena in 1896, operated intermittently until 1902. From 1894 to 1902 the Kelly and Graphic mines, the chief properties, were worked with fair regularity.

Although the first recorded production of zinc in New Mexico was in Grant County in the early 1890's mining in quantity did not begin until the realization in 1903 and 1904 that massive deposits of zinc carbonate, an oxidized zinc ore found in Magdalena, were valuable for use in paint manufacture. For

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many years prior to 1900 the mines in the Magdalena area had been important producers of gold, silver, and lead, and large quantities of zinc carbonate, whether recognized or not, had been removed as waste and thrown over the dump. In 1903, a discovery was made of especially rich zinc carbonate ore bodies as replacements in limestone. An attempt followed to find a market for the ore and samples were taken to the Joplin, Missouri smelter; it was determined that the material was suitable for the manufacture of zinc pigment, and large bodies of zinc carbonate ore began to be worked in the two important mines of the Magdalena area, the Kelly and the Graphic mines. The Graphic mine was purchased by the Ozark Smelting and Mining Company, a subsidiary of the Sherwin Williams Paint Company, and the Kelly and Nitt mines were acquired by the Tri-Bullion Mining and Development Company. Zinc carbonate ores constituted most of the production of the district from 1903 to 1906. The Graphic and the Waldo mines were major producers of zinc ore in the area until June 1949. From 1907 to 1920 the chief production came from zinc-lead sulphide ores which were milled in the district or shipped to smelters outside the state. During this period the Nitt mine of the Tri-Bullion Mining and Development Company produced a moderate amount of sulphide ore. The Kelly mine was purchased by the Empire Zinc Company in 1913. Mining operations were greatly curtailed following the world war but a moderate production, largely of carbonate ores, was maintained from 1922 to 1928. The Ozark Smelting and Mining Company mined and milled a considerable tonnage of sulphide ores in 1926 and 1927.

In the earlier years the zinc carbonate, smithsonite, constituted most of the production. Pure smithsonite, a zinc carbonate, is colorless and uninteresting with no gem stone value. However, when small amounts of zinc are replaced by copper it becomes a translucent apple-green to dark-green to blue semiprecious gem stone known as herrerite. In 1907 large quantities of a new green gem variety of smithsonite were found in various mines in the Magdalena district (No. 26) in Socorro County (Sterrett, 1908, p. 795). The most productive deposit was at the Kelly mine in a zinc vein in a cavity several feet wide and about 25 feet long. Here the green smithsonite lined the cavity in layers up to 2 inches thick yielding hundreds of pounds of excellent material that was cut and sold as cabachons (Sinkankas, 1959, p. 531). According to Northrop (1959, p. 475) collectors have so thoroughly combed the dumps in the district that extremely little herrerite of good color can be found today. Handsome specimens of herrerite from the Magdalena district are displayed in nearly every museum collection in the United States.

The Magdalena district was the principal zinc producer in New Mexico for many years, and 46 percent of the zinc output of the state from 1904 to 1928 came from this district. For the same period it accounted for 34 per cent of the lead production of the state. The value of the production from 1904 to 1928 was $21,835,712, in zinc, lead, copper, silver and gold. The value of the entire production from the discovery of the district to 1928 was about $28,400,000. Since 1930 zinc mining in the Magdalena area has followed the pattern of other zinc camps in the West; production fluctuates with the prices. The total production of the area is estimated at 325 million pounds.

--ORE DEPOSITS OF SOCORRO COUNTY, New Mexico Bureau of Mines & Mineral Resources, Bulletin 8, 1932.
--MINERAL AND WATER RESOURCES OF NEW MEXICO, United States Geological Survey, 1965.

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CREF UNIT VALUES - 1977	
January	$40.28
February	39.30
March	38.73
April	38.73
May	37.96
June	39.91
July	39.34
August	38.56

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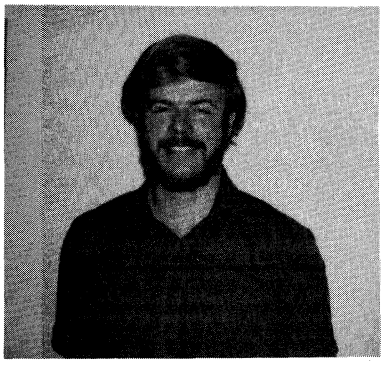
PERSONNEL UPDATE

NEW EMPLOYEES



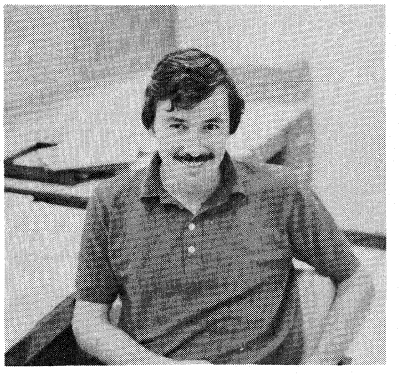
John Archer
Electronics Engineer
VLA - New Mexico

Photo Not Available

Beverly L. Bibb
Clerk
VLA - CV

Barbara A. Coerper
Jr. Technician
Electronics - CV

Ina W. Cole
Prog./Secretary/Librarian
VLA - New Mexico

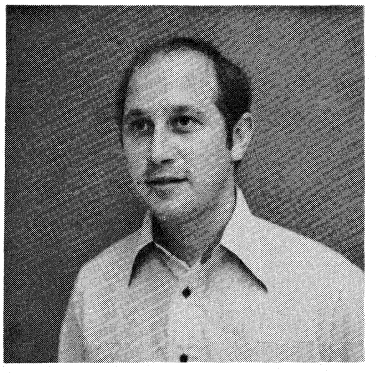


Francis J. Hart
Technical Specialist
VLA - New Mexico

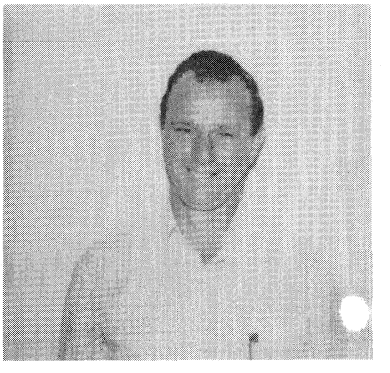
Jerry D. Long
Sr. Technician
VLA - New Mexico

Photo Not Available

Carolyn H. O'Brien
Typist
Director's Office - CV



Mark J. Reid
Assistant Scientist
Basic Research - CV



Malcolm W. Sinclair
Electronics Engineer
VLA - New Mexico

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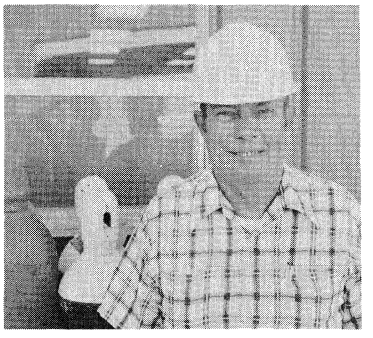
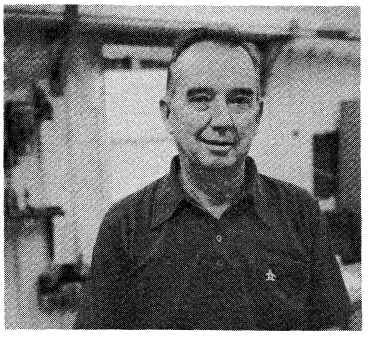
NEW EMPLOYEES (continued)



Orrin G. Sumner
Technical Specialist
VLA - New Mexico



Alfred M. Zerwas
Staff Shop Technician
VLA - New Mexico

REHIRES

James J. Condon	Visiting Assistant Scientist	Basic Research - CV
C. Thomas Wilkes	Research Assistant (Co-op)	Scientific Services - CV

LEAVES OF ABSENCE

James L. Dolan	Electronics Engineer	VLA - New Mexico
J. Marvin Wimer	Staff Shop Technician	Plant Maintenance - GB

RETIREES

Charlie Puffenbarger	Heavy Equipment Operator	Plant Maintenance - GB
Bearyl McLaughlin	Maintenance Electrician	Plant Maintenance - GB

TERMINATIONS

Neil P. Albaugh
Bruce Balick
Francis F. Bocchino, Jr.
Gregory Brubaker
Frank O. Clark
Mike Collins
George Conant
Nathalie Dolan

John Faulkner
Valerie Jackson
Feliz M. Landavazo
Alan P. Marscher
Judith A. Myers
Daniel J. McGuire
Theodore E. Neubauer

Richard Porcas
Eugen Preuss
D. Dawn Reiche
Craig L. Sarazin
Gary Steigman
Victor Torres
Rick Wooddell
Matthew R. Wordeman

* * * * *

THE LAW OF HUMANTICS

1. The Law of Maximum Unhappiness

   Unhappiness always tends toward a maximum.

   Corollary I: If anything can go wrong, it will.

   Corollary II: Any time things appear to be going well, you have overlooked something.

   The above law stated in mathematical form is

   $$1 + 1 \neq 2$$

   where the symbol $\neq$ signifies "hardly ever equals".

2. The Laws of Mathematics

   a. In any given miscalculation, the fault will never be placed if more than one person is involved.
   b. Any error that can creep in, will. It will be in the direction that will do the most damage to the calculation.
   c. All constants are variables.
   d. A decimal will always be misplaced.
   e. In a complex calculation, one factor from the numerator will always move into the denominator.
   f. In any given computation, the figure that is most obviously correct will be the source of error.

   Corollary 1: No one to whom you go for help will see it either, but everyone who stops by your desk with unsought advice will see it immediately.

3. The Harvard Law of Animal Behavior

   Under carefully controlled laboratory conditions, organisms tend to do as they darn well please.

4. The Law of Selective Gravitation

   A dropped tool will land where it can do the most damage.

5. The Law of Thermomydamics

   First Law: You can't win.

   Second Law: You can't even break even.

   Third Law: You can't get out of the game.

   Corollary I: Things will get worse before they get better.

   Corollary II: Who told you things would get better?

6. Parkinson's Law

   Work always multiplies to fill up the available time.

7. Maeir's Law

   If facts do not conform to the theory they must be disposed of.

8. Horner's Law

   Scientific experience varies directly with the amount of equipment ruined.

9. The Basis of the Law of Errors

   Everybody believes in the Exponential Law of Errors, the experimenters because they think it has been proved mathematically, and the mathematicians because they think it has been established experimentally.

Maxims and Principles

Meyer's Maxim: To err is human, but to really foul-up you need a computer.

Gellman's Principle: In physics anything which is not forbidden is compulsory.

Rules For Experimenters

1. First draw the curve, then plot the points.
2. A record of the data is mandatory, it shows you have been working.
3. Experiments must be reproducible, they should all fail in the same manner.

--continued, next page--

4. Do not just believe in miracles, rely on them.
5. Never repeat a successful experiment.

The Scientist's Creed

SCIENCE IS TRUTH. DO NOT BE MISLED BY FACTS.

--Compiled by J. Beck
ORAU-STD
March 1976

*****

THE VLA ANNOUNCES

THE "BIG EVENT"

The Final Contract For

ANTENNA 29

The Mating of the LANKY COMPUTER PEDESTAL

with the GORGEOUS OPERATIONAL DISH

Occurred at 2100 Hrs. U.T. on

August 13 at the Home Plant in

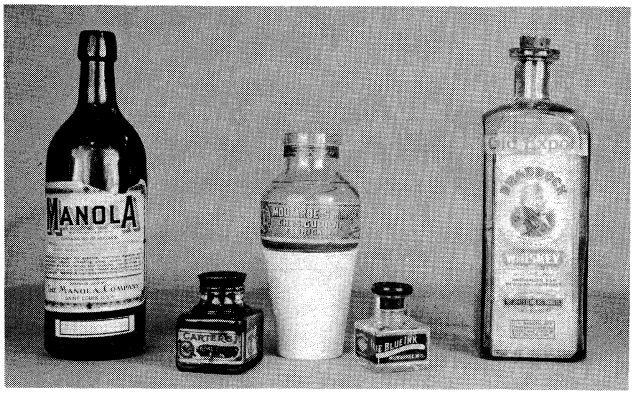
Salem, Oregon.

C O N G R A T U L A T I O N S

Ken and Linda

*****

BOTTLES



Pictured are five really old bottles found with their labels intact: from left to right they are identified as a tonic bottle, an ink bottle, a mustard bottle, an ink bottle, and a whiskey bottle. These superbly preserved old bottles were found by one of our employees while remodeling his 70+ year old home.

All the bottles were found together when flooring was torn up to remove a flue. Finding the tonic (18% alcohol) and whiskey together isn't strange, but how did the mustard and ink come to be with the other two? One wit's suggestion: Sometime in the past a fluemaker had tired blood and drank the tonic for a pick up. One bottle of tonic later, Fluemaker found he wasn't feeling any better so he got something stronger--a quart of whiskey. Apparently Fluemaker ate while drinking fluids and he particularly liked mustard sandwiches. How about the ink? The ink was used up writing letters to his mother about the flue he was making.

Why the fluemaker(?) drank the tonic and whiskey for his health is obvious if you read their labels. For your enjoyment, we are printing the front and back labels of the Manola bottle and the front label of the whiskey bottle.

--continued, next page--

(Front Label)

MANOLA

Trade Mark Reg. U. S. Pat. Office

Contains 18% of Alcohol.

A POWERFUL RECONSTRUCTIVE-TONIC AND ALTERNATIVE BLOOD MAKER AND TISSUE BUILDER

MANOLA.--Increases the appetite, improves digestion and assimilation, induces refreshing sleep, makes good blood, strengthens the heart, nerves and muscles, rapidly builds up debilitated tissues and exhausted nerves and restores health and strength. MANOLA improves every function of the body.

Prepared Only By

THE MANOLA COMPANY

Saint Louis, U.S.A.

DOSE.--For children, one-half to one teaspoonful; for adults, two teaspoonfuls to a tablespoonful after meals.

(Back Label)

On account of its powerful Reconstructive-Tonic action, MANOLA is of permanent value in Anemia, Nervous Exhaustion, Loss of Weight, Consumption, La Grippe, Chronic Coughs, Pneumonia, Senile Debility, Malaria, Malnutrition, Deficient Development of Children, during Convalescence from Wasting Diseases, in fact wherever there is Weakness and Emaciation from ANY cause.

Each tablespoonful (½ ounce) of MANOLA contains the following medicinal ingredients: 1 M. each of Tr. Echinacea; Tr. Cinchona, and Phos. Acid Dilute, U. S. P., and ½ M. each of Fowler's Solution and Tr. Nux Vom., U. S. P.; and also the tissue phosphates of Calcium, Potassium, Sodium, Ferrum and Magnesium, prepared according to the prescription originated by Dr. W. H. Schuessler, of Oldenburg, Germany, in the relative proportion in which these vital constituents are contained in the cells of the human body. In addition to the ingredients given above, MANOLA contains only aromatics, the whole combined in perfect solution with a nutritious, palatable base.

DOSE.--For children, one-half to one teaspoonful; for adults, two teaspoonfuls to a tablespoonful after meals.

No. 634. Guaranteed by the manufacturer under the Food and Drugs Act, June 30, 1906.

* * * * *

VLA: FIRST IMAGES

Bruce Balick

The VLA has been used for various scientific projects for about a year. However, because of the limited number of antennas and various growing pains, the VLA has not been utilized for one of its major functions until just recently. This function is to form images, or radio pictures, of objects in the sky with a clarity somewhat better than the best optical photographs and a sensitivity well in excess of most other radio telescopes.

This past summer Bob Hjellming, Carl Bignell, and I were involved in a pilot program to make the first detailed images on the VLA. We chose to observe a certain class of objects known as planetary nebulae for which earlier radio pictures (made on the Green Bank, Westerbork, and Cambridge interferometers) were available. These earlier pictures had not been able to resolve to fine details as well as the VLA images. Compared to the VLA images, these others appear as if they are out of focus. Nonetheless, the earlier radio pictures served as important checks of the gross properties of these first, and potentially unreliable, images from the VLA.

The planetary nebulae were chosen for study because they are small, bright, and have relatively simple structure compared to most other types of radio sources. Moreover, they have one very advantageous property insofar as our observations are concerned. For theoretical reasons they are expected to appear almost exactly the same at radio and optical wavelengths. Hence we could use optical photographs of these objects as the fundamental reference against which we test the accuracy of these first VLA images.

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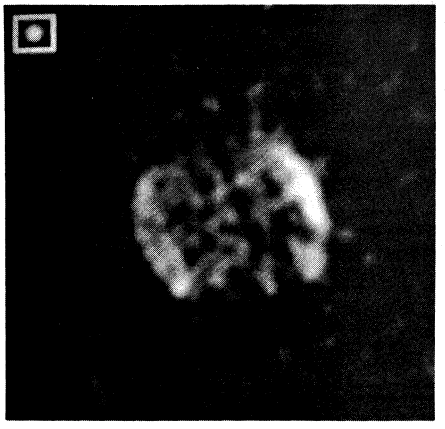
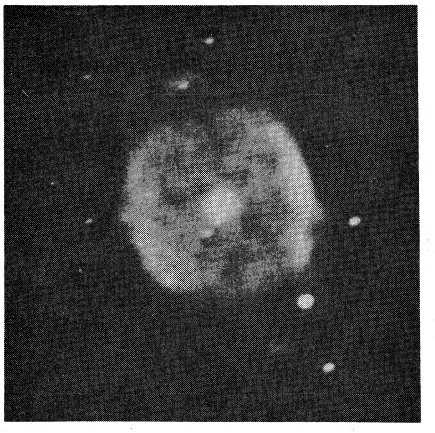
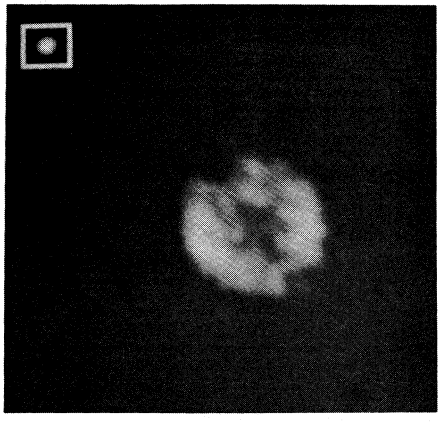


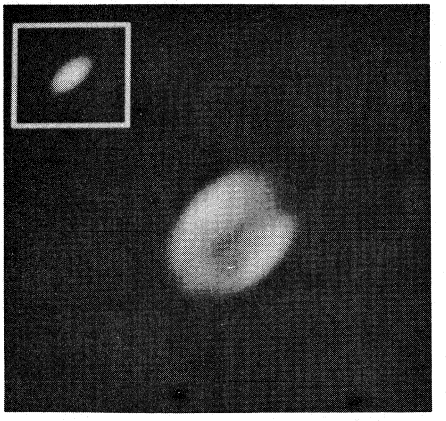


VLA Radio Image
(Response to unresolved or "stellar" object shown in the insert.)

Optical Picture
(Dots are foreground stars which are not yet detectable at radio wavelengths.)

Figure 1





NGC 7354

NGC 7027

Figure 2

In the first figure are shown two images. One of these is the VLA radio image and the other an old optical photograph of the planetary nebula NGC 40.

It is readily seen that the most prominent features correspond nearly exactly. Fainter features in the radio image are not real. These features are dominated by noise in the radio observations. The noise results because NGC 40 is extremely faint and difficult to detect. The details seen in the radio and optical pictures, or "resolution", is about 1½ arc seconds, or about the apparent size of a penny held at a distance of a mile.

Shown in the second figure are two additional VLA images. The objects studied are brighter than NGC 40 and no noise appears in these reproductions. One of these, NGC 7354, also looks exactly like its optical picture.

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The other, NGC 7027, cannot be seen optically in its entirety because most of the nebula is hidden behind a very dense cloud of dust. The radio waves easily penetrate the dust cloud whereas most of the optical light is absorbed. This illustrates one of the many important reasons for building the VLA.

As the VLA grows, so too will its ability to discern finer details and to become a more sensitive probe of the radio sky. Our first maps are only a step along the exciting path certain to be blazed by this instrument.

*****

FROM CHICKEN LITTLE TO FRED HOYLE

Lee J Rickard

Things keep falling out of the sky - onto Madagascar, this time. The early reports from the Malagasy Republic told of a spectacular fireball on July 30, accompanied by loud noises and seismic activity near Tananarive, the capitol city. Several days after the event, rumors about the details had taken epic dimensions: not one fireball but two, each striking the ground and producing the largest impact craters in modern history (240 and 75 meters, to be compared with 40 meters for the Sikhote-Alin event of 1947). The subsequent reports have been, shall we say, non-confirming. One of the seismic events was apparently an unrelated natural tremor. And if there is a crater associated with the other, then it must be rather smaller than the record, for it has yet to be found, despite a week of helicopter searches over the area of impact.

Such is the confrontation of man with meteor. The not-so-subtle suggestion of a divinity in the interaction leads to exaggerated responses. Ancient records of meteors - in China, India, and Japan - are positively enthusiastic in attributing them to heavenly interventions. The Temple of Diana at Ephesus uses a meteorite for a foundation stone, and a shrine in Mecca features a sacred meteorite. Swords forged from meteoric iron were favored by kings as representing celestial support; Attila is reputed to have carried one. (Indeed, the first implements of the Iron Age may have been made from meteoric, rather than terrestrial, iron. The Sumerian, Hittite, Egyptian, and Hebrew names for iron have often been translated as "metal from heaven".)

At the opposite extreme, the Western attitude about meteorites was for a long time quite negative about the possibility of their celestial connections. This was apparently due to Aristotle, who considered meteors to be purely atmospheric phenomena, like rainbows and aurorae. In fact, D. G. King-Hele points out that the Greek word meteora means "things suspended in air", derived (he notes with ill-concealed relish) from a phrase meaning "the space between hanging nooses". The atmospheric connotation remains today in the word meteorology, and in certain medical terms pertaining to flatulence. Even modern scientists distinguish meteors, the bright streaks in the sky, from meteorites, the rocks that occasionally reach the ground. King-Hele suggests that the adoption of Aristotle's classification for meteors actually kept people from connecting them with their solid debris. After all, the idea of rocks congealing from the air is fairly nonsensical.

This sentiment persisted for hundreds of years, and the infrequent eyewitness reports of meteorite falls were dismissed as fancy. But serious questions arose in the 18th century with Edmond Halley's studies of the heights and speeds of meteors. At the end of the century, the German physicist (and lawyer) E. F. F. Chladni proposed that meteors occurred when fragments of a broken planet fell to Earth, and that some left identifiable remnants. This hypothesis was widely accepted after a careful study of the 1803 L'Aigle meteorite fall by Jean-Baptiste Biot. Some skeptics remained, though. Thomas Jefferson is said to have dismissed a meteorite report from Yale by saying: "It is easier to believe that two Yankee professors would lie, than that stones would fall from heaven."

Of course, the skeptical attitude is not difficult to adopt, considering the very strange things that people have claimed to see falling from the sky. You can find a sampling of such claims in Charles Fort's Lo!. Fort collected, from various newspaper

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and magazine stories, hundreds of reports of rains of peculiar objects. A shower of frogs in Nevada. A shower of eels in Alabama. A rain of brown worms in Indiana and, ten days later, a rain of red worms in Massachusetts. A shower of snails in Cornwall, a rain of blood in California, deluges of nails in Texas and of periwinkles in Worcester. The Yankee professors' story of a stone falling from heaven may not have been harder to swallow than these, but neither was it any easier.

Incidentally, Fort's personal story was itself curious. Supported by a modest inheritance, he spent the last 26 years of his life reading old newspapers and magazines in the British Museum and the New York Public Library. He culled reports of peculiar phenomena, and formulated outlandish hypotheses to explain them. (For example, the mysterious rainfalls were debris from some vast Sargasso Sea of space.) His purpose was mainly to be humorous, to tweak the noses of what he felt were the humorless, dogmatic priests of science. It is likely that he never took his own speculations seriously, but he did attract some serious followers - the most important being the novelists Theodore Dreiser and Tiffany Thayer. They encouraged the publication of his books, and formed a Fortean Society. After Fort's death in 1932, the Forteans became themselves earnest and humorless, devoted to publishing Fort's old notes and reporting new Fortean phenomena. The Fortean best known to us today would probably be Kenneth Arnold, whose 1947 UFO sighting kicked off the modern flying saucer craze.

The Bible includes descriptions of one fall of meteorites (Joshua 10:11) and a number of Fortean phenomena (e.g., the plagues of Egypt). Exodus, in particular, has prompted one of the most notorious pseudoscientific works on terrestrial-celestial encounters. In Worlds in Collision, Immanuel Velikovskii, a Russian-born psychologist, reviewed the Biblical story in the light of the mythologies of several other cultures (often using, it turns out, poor translations and secondary sources). He interpreted it as evidence of a near-collision between the Earth and a comet - a comet that had been expelled from Jupiter, and that later settled down to form the planet Venus. Thus the rain of flies over Egypt consisted of Jovian flies brought by the comet. (As Carl Sagan points out, Velikovskii neglected the problems of parallel evolution of flies on Jupiter, and of fly ablation during entry into the atmosphere.) The rain of manna over Sinai was, according to Velikovskii, a deposit of cometary hydrocarbons. Whilst ricocheting between Earth and Mars, the comet is also supposed to have parted the Red Sea, stopped the Earth's rotation (coincident with Joshua's request for same), and supplied Saudi Arabia with oil. Psychologist, heal thyself.

(Curiously, there does seem to be evidence for at least one catastrophic encounter between the Earth and a comet: the 1908 fireball over the Tungus region in Siberia. This blinding-bright bolide ignited a forest fire and felled trees over a 400 square-mile area, but it left no impact crater. Apparently, the incoming solid body disintegrated before impact, while the shock wave it had made in the atmosphere reached the ground, with devastating results. From analyses of the required motion through the atmosphere, G. I. Petrov has shown that the object must have had a low density, about 0.01 gm/cm^3. This supports the proposal, made by F. J. W. Whipple and I. S. Astapovich in the 1930s, that the Tunguska object was the head of a small comet. The comet wasn't seen before impact because it was small - about one-tenth the size of the smallest observed comets - and lost in the glare of the morning sun. Comet statistics suggest that such events aren't altogether rare; we can expect a Tunguska-sized collision about once every 2000 years.)

One of the most intriguing speculations about living things falling to earth from space is the panspermia hypothesis. Its philosophical roots can be traced at least to Anaxagoras (circa 450 B.C.). Its modern form was first proposed by H. Richter in 1865 (and expanded by S. Arrhenius just before World War I) in order to avoid the problem of the origin of terrestrial life from nonliving matter. The basic idea is that the Earth may have been seeded by spores from other worlds, spores that drift through interstellar space, propelled by

--*continued, next page*--

the pressure of starlight. The question of the ultimate origin of the spores is thrown into infinite regression - not a very satisfying solution philosophically, but adequate for those times because it was believed that the universe has an infinite past. Of course, the origin problem cannot be ignored in the finite universe, as we now understand it. In addition, we can now make more restrictive arguments about the hazards of interstellar travel, and the times required to travel from source to Earth. These theoretical difficulties are discussed in detail by Shklovskii and Sagan, in Intelligent Life in the Universe.

The panspermia hypothesis can also be studied experimentally. For example, if there were such spores at the time of the formation of the solar system, they may have been incorporated into carbonaceous chondrites - meteorites that are presently thought to be congealed chunks of the protoplanetary nebula. The first search for such spores was made by Pasteur, with the Orgeuil meteorite of 1864 (with negative results). A study by B. Nagy and G. Claus in the early 1960s revealed "highly structured forms", about 10 microns in diameter, in several chondrites. It was an exciting discovery, because these forms appeared to be the remnants of living organisms. They were. E. Anders and F. Fitch identified them as ragweed pollen. Unfortunately, carbonaceous chondrites are porous; their contamination by terrestrial microorganisms begins upon entry into the atmosphere.

Another test was proposed by A. I. Oparin, one of the first biochemists to make a serious study of the origin of life. He noted that the concentrations of the chemical elements in a proto-organism ought to be, in a crude approximation, proportional to the concentrations of those elements in the organism's environment. A comparison of the elemental concentrations in present organisms (particularly those of the trace elements that are not strongly influenced by the chemistry of the living organism) with the elemental concentrations in the earliest terrestrial biological environment (seawater, we think) would thus be a direct test of panspermia. D. M. Gualtieri has reviewed this information in Icarus, and finds that the evidence favors an oceanic genesis of terrestrial life over any extraterrestrial origin.

Of course, one could push the panspermia hypothesis back to earlier times - before the formation of the oceans, perhaps 4 billion years ago - and more primitive organic forms. In some recent letters to Nature, F. Hoyle and N. C. Wickramasinghe are attempting just that. They have determined (to their own satisfaction) that certain spectral signatures of the interstellar dust grains must be due to polysaccharides. These are rather large organic molecules, polymers built up from formaldehyde, whose commonest terrestrial forms are cellulose and starch. Such polymer coatings on dust in the protoplanetary nebula would have enabled the dust grains to stick together, like clumps of overcooked rice. Within the clumps, Hoyle and Wiskramasinghe can imagine the formation of more complex prebiotic molecules, some of which would survive accretion onto the forming Earth, where they would serve as the beginning of terrestrial biological activity. (This is not a new idea for Sir Fred. He first considered the possibility of life developing within an isolated interstellar dust cloud in his 1957 science-fiction novel, The Black Cloud.)

The trouble with the Hoyle and Wickramasinghe scenario begins at step one; alternative identifications of the grain spectral features (as arising from silicates, ice, and graphite) are considered much more likely. In addition, there are problems with their assumptions about the physical conditions and histories of interstellar clouds, and with the details of forming complex molecules and having them survive accretion. It is perhaps not surprising that, among the many things that fall from the sky, there are also the castles that theoreticians build there.

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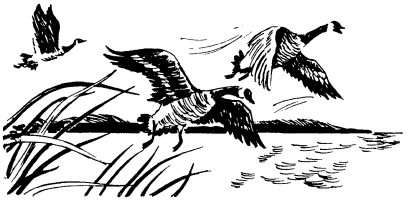


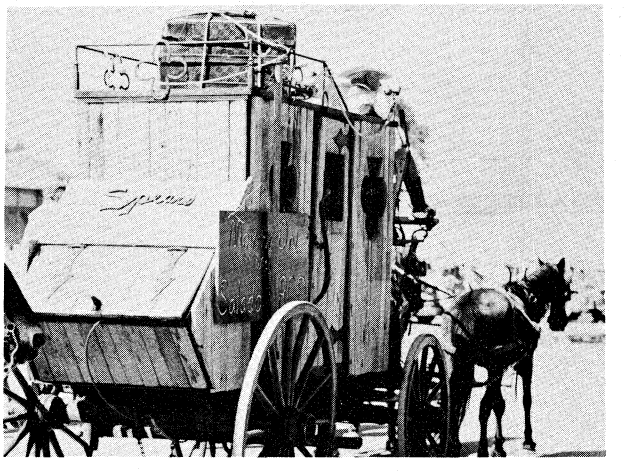
MAGDALENA OLD TIMERS REUNION PARADE - 1977

(photos by Dave Rosenbush)

Queen Margaret and her court of past queens (must be 65 or older to be eligible for competition).

Navajo's resplendent in native costume.....

A bank holdup.....



What a way to travel.....

Fiddlin' & pickin'.....

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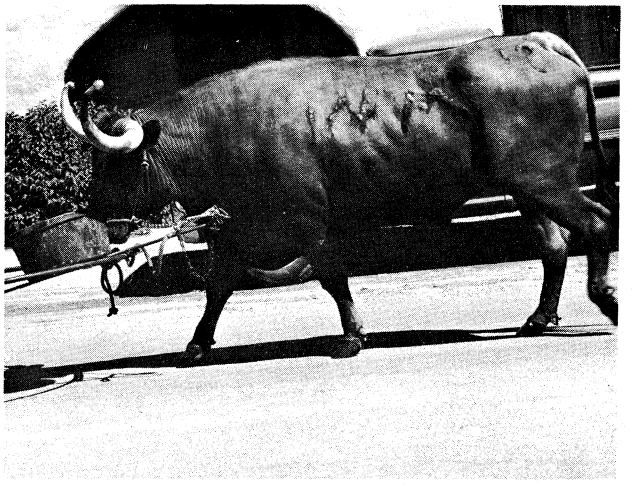
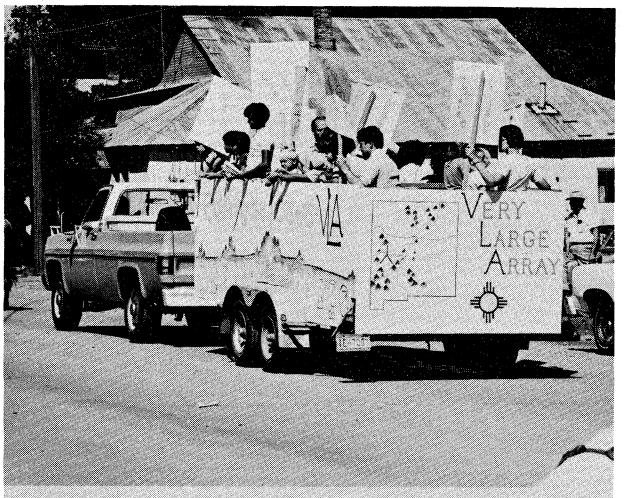
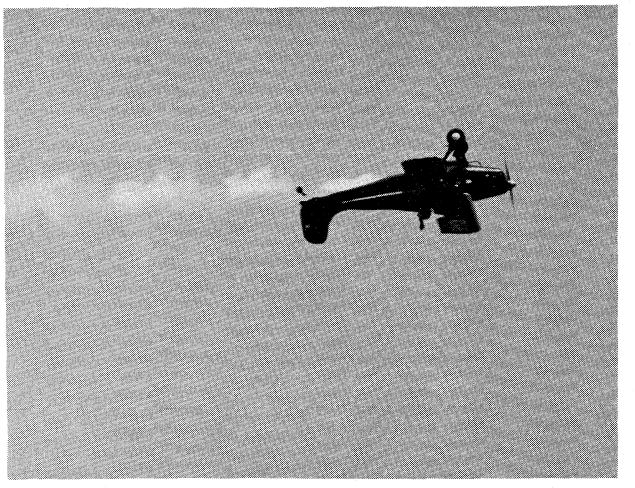
Looking for a gentle pet?





A TROPHY WINNER



Following the parade there was a spectacular air show. Quite legal - the airplane vintage, 1936 - the pilot, over 55.

The weekend included a street dance Friday evening, a free Bar-B-Que at noon on Saturday, an afternoon rodeo open to old timers 55 or older, a fiddling contest open to all ages and a dance Saturday evening, a free breakfast Sunday morning, and the rodeo again Sunday afternoon.

All this in "SLEEPY MAGDALENA".....come join us next year, July 8 and 9.

MICROWAVE THERMOGRAPHY--AN UPDATE

Phil Myers

OBSERVER readers may remember that about two years ago in these pages, Alan Barrett described a new application of microwave radiometry to diagnostic medicine, under development at M.I.T. Since then, we have taken a good deal of clinical test data on the detection of breast cancer with this technique. It seems appropriate to update *OBSERVER* readers on our progress, since (1) this is a true "spin-off" of radio astronomy, with potential practical benefit; (2) we now have some interesting results; and (3) Pat Crane and Wally Oref cornered me one day in the Jansky Lab and were very persuasive.

Background. Microwave radiometers can detect microwave radiation of very low intensity. In radio astronomy, this radiation may consist of photons emitted millions of years ago by gas clouds in distant galaxies. A small fraction of them make their way to earth, bounce off the reflectors of the 140-foot telescope, and enter the radiometer feed horn. In microwave thermography, this radiation consists of photons emitted one ten-billionth of a second ago, by a few cubic inches of human tissue, into a tiny waveguide antenna no bigger than a stethoscope. In either case, if enough photons enter a sensitive radiometer each second, their power can be detected and measured. The microwave power emitted by human tissue is due to thermal radiation. This is the electromagnetic radiation given off by all matter as electrical charges jiggle back and forth in their normal thermal motions. The hotter an object is, the more intense is its emission. When we see the red glow of embers, we are seeing thermal radiation. Our bodies are not hot enough to glow visibly, but they still emit thermal radiation, mostly at infrared wavelengths. This infrared emission is the basis of the infrared "sniper-scope", which can detect camouflaged soldiers, and of infrared thermography, which can detect thermal patterns in the skin as an aid to medical diagnosis.

At microwave wavelengths (roughly 1 cm to 1 m) the thermal radiation power given off by human tissue is only about ten-billionths of the power given off at infrared wavelengths. Yet the marvelous sensitivity of microwave radiometers, developed largely for radio astronomy, enables them to detect this emission. Furthermore, microwave radiometers can detect local variations in the body's emission. These can correspond to changes in local temperature as small as a tenth of a degree Celsius. There are many instances where the local body temperature is hotter than nearby body temperature by a few tenths of a degree to a few degrees C: inflammations, healing bones, and areas of rapid growth such as a fetus or a cancerous tumor. Cooler regions can also be present, in areas downstream from blocked blood vessels, and in areas which have been burned or frostbitten.

Infrared thermography has been applied to detection of all of these conditions, particularly to detection of breast cancer. However, its success has been limited, partly because it is sensitive only to radiation emitted from a shallow layer within about 0.1 mm of the skin surface. Infrared photons emitted from deeper tissue get absorbed in the overlying tissue and never make it to the skin surface. In contrast, body tissue is more nearly transparent at microwave wavelengths. Microwave photons can escape to the skin surface from depths of several cm, depending on tissue type and frequency. Therefore in the late 1960's, Al Barrett figured that if one applies the techniques of microwave radiometry to the medical diagnostic problems of infrared thermography, one may do as well, or better, because one can "see" deeper. As with infrared thermography, and in contrast to mammography (x-ray exams), there is absolutely no risk to the patient. On the other hand, the long wavelengths involved in microwave thermography require that its resolution be coarse, a few cm^2 instead of the mm^2 of infrared thermography or mammography. If our maps were made into optical photographs they would be very fuzzy, with little detail. But is there enough detail to be useful diagnostically? That is what we set out to learn five years ago.

Results. We began our clinical work 2½ years ago. We have been fortunate to

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have a grant from the N.I.H., the collaboration of Dr. Norm Sadowsky and Ms. Jeannie King at Faulkner Hospital, Boston, the engineering skills of Jack Barrett and Cosmo Papa, and the hard work of many students. We have examined over 3000 women, including over 60 with breast cancer confirmed by biopsy, in a room set aside for our equipment at Faulkner Hospital. Our 3.3 GHz radiometer was the first built for this purpose. The great need for a safe method of detecting early breast cancer put this study first on our list of clinical work. The women we examine come to the hospital to get clinical, x-ray, and infrared breast exams. Then they agree to take the microwave exam, which lasts about 10 minutes. A medical technician places a small waveguide antenna on each of nine points on each breast, and records the resulting temperature reading. A picture of a typical exam appeared in Time, June 20, 1977, on page 80. We have found that the best criterion of detection depends on the difference between the average microwave temperature of the right and left breasts. If this difference exceeds about 0.3 °C, our criterion says "cancer"; otherwise, it says "normal". With this criterion, we correctly identify about 70% of the actual cancers as cancer, and we incorrectly identify about 30% of the normals as cancer ("false alarms").

How does this compare with the infrared and x-ray results? The infrared detection rates are almost exactly the same, while the x-ray method finds about 90% of the cancers with about 15% false alarms. Thus the microwave and infrared methods perform about equally well, while the x-ray performs better than either. But the x-ray method, or mammography, is believed to have a very slight risk of causing cancer due to its ionizing radiation. Many radiologists now want to apply mammography less for screening of normal women, and more for followup of "high risk" women (those with a family history of cancer, or with a lump in the breast). More emphasis is now being placed on absolutely safe detection techniques. The microwave and infrared methods each find about 70% of the cancers, but each method finds some that the other misses. If both methods are used together, then they detect 90% of the cancers--they do as well as the x-ray but with no risk. If x-ray is used for followup only, this combination exposes only about half the incoming women to x-rays, finds 90% of their cancers, and has a false alarm rate of 15%. In short, microwave thermography may be useful in detecting breast cancer--not as a replacement of the x-ray, but as a supplement, which helps to detect as well as the x-ray does, while reducing the risk of exposure to x-rays.

Therefore the answer to the question which began this research is a solid "maybe". Our results look promising enough to the N.I.H. to continue our funding for three more years. But there is much more to be done: measurement at other frequencies, development of finer-resolution antennas, automatic scanning, and better detection criteria; and extension to other disease areas. We plan to explore the potential of microwave thermography as fully as we can.

Since we began to publish in this area, we have found that it attracts much more attention than our continuing research into the molecular spectra of interstellar gas clouds. It seems that many people have ideas about how microwave thermography can or should be used. One gentleman assured us that we have a way to detect the "carrier" of ESP and mental telepathy. Another believes that we should detect hot potatoes: if we can pick out invisible potato bruises by their extra heat, we will save the potato industry "millions of dollars". Perhaps the most amusing incident arose during the photography session which we arranged for the Time magazine story. We asked a local model agency to provide a woman about 40 years of age, so that we could simulate a typical exam for the Time photographer. But the agency dispatcher forgot to tell the model that she would have to disrobe to the waist. When she arrived at the hospital I explained the situation to her. She refused to be photographed with bare breasts, saying "my Sunday school students might recognize me if they see the picture". I never found out which part of her she expected them to recognize! In any case, Time published a picture of a different model we had taken six months earlier.

*****

Sand.

Round and square and sharp

And smooth and rough and tan.

Sand.

Two pointed peaks piled upon my palms.

Sand canyons growing, eating into the mountains.

Streams of sand falling,

Dust blowing away,

Into forever.

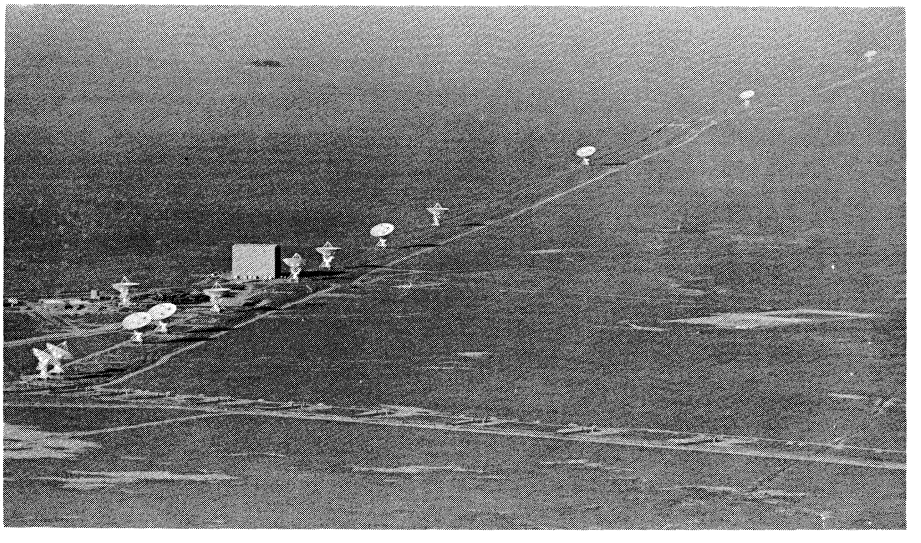
Like the sand, you slipped through my fingers,

and were gone.

* * * * *

VLA - PHOTO UPDATE

photo by Dave Rosenbush



Viewed left to right -- Antennas 5 and 3 (sub-array 2) tracking 3C84;
Antennas 7, 1, 4, 6, 2, 8 tracking DA267;
Antennas 9 (in testing stage), 10, 13, 12 grouped around the assembly building with 11 stowed on CW9.
The oasis in the left background is the Jack Bruton ranch headquarters complex.

* * * * *

WHAT'S COOKING?

Country-Style Spare Ribs

from the kitchen of
Dave Shaffer

2-3 lbs. of country-style spare ribs (the more meat, the better)
1 cup ketchup
1 cup red wine (burgandy is good)
1 cup cut-up onions
1 cup brown sugar
1 tablespoon hot mustard (i.e., Guldens)
1 tablespoon Worcestershire sauce
1 can (16 oz.) pineapple chunks (drained)

Bake spare-ribs in shallow pan in 350° oven for ½ hour. While the ribs are baking, combine all the other ingredients in a saucepan over low heat until the brown sugar is dissolved and everything is well blended. Take the ribs out of the oven and trim off as much fat as can be done easily. Return the ribs to the pan and pour the sauce over them. Bake for an additional 45 to 60 minutes, turning the ribs once so they are well-cooked in the sauce. Remove from the oven, place ribs on a serving plate and drain sauce into a bowl. Serve with brown rice, putting sauce on meat and rice. Serves 4 or so (depending on how hungry you are). Some more burgandy goes well with dinner. You could add cut-up green pepper to the sauce if so inclined.

Potato Chip Cookies

from the kitchen of
Dick Hiner

1 lb. butter
1 cup sugar
3½ cups flour
1 tablespoon vanilla
1 cup crushed potato chips
1 cup chopped nuts

Blend butter and sugar. Add vanilla. Add dry ingredients and mix well. Drop on greased cookie sheet. Bake in preheated 350° oven for 10 to 12 minutes. Sprinkle with powdered sugar.

Waffles

from the kitchen of
Wally Oref

3 cups flour
4 teaspoons baking powder
1 teaspoon salt
2 teaspoons sugar
2/3 cup melted margarine
2 cups milk
4 eggs (separated)

Sift flour, baking powder, salt, and sugar together.

Beat egg whites until stiff. Set aside. Beat egg yolks well and add milk and yolks to dry ingredients. Add slightly cooled melted margarine and mix thoroughly. Fold in beaten egg whites. Bake on pre-heated waffle iron.

Serves 6-8 people.

Lasagna

from the kitchen of
Barry Geldzahler

Cook: 3/4 box of Lasagna Noodles (broken in half)

Brown: 1 lb. ground beef and ½ lb. sweet sausage (season to taste with oregano)

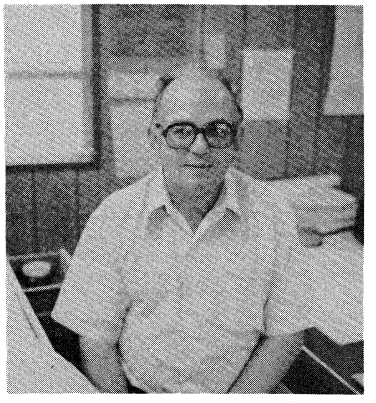
Coat the bottom and sides of a casserole dish with a little (not too much) spaghetti sauce to prevent scorching and sticking.

Build up the lasagna with layers of noodles, ricotta cheese, ground beef and sausage, and Mozzarella cheese. Top off with more spaghetti sauce and a final topping of Parmesan cheese.

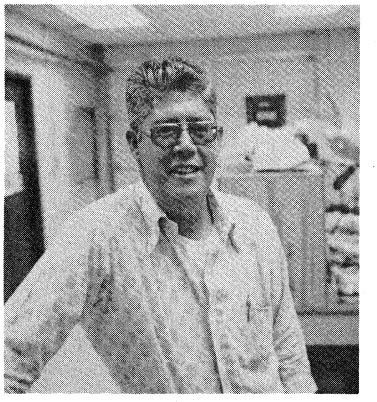
Cook about 30 minutes in a 375° oven.

VLA - NEW MEXICO-BASED EMPLOYEES

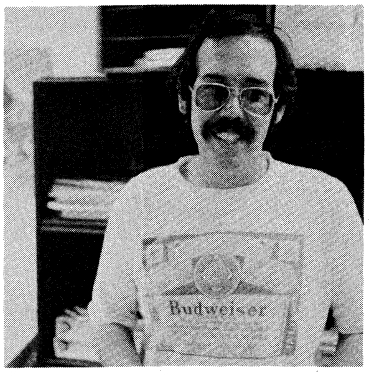
Rosalina G. Armijo



Larry Carlisle



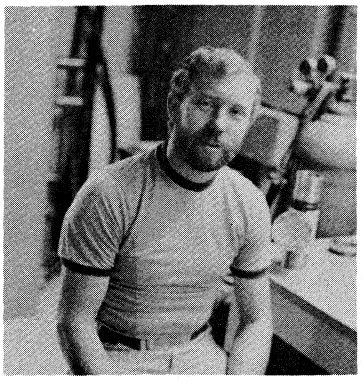
Martin Chavez



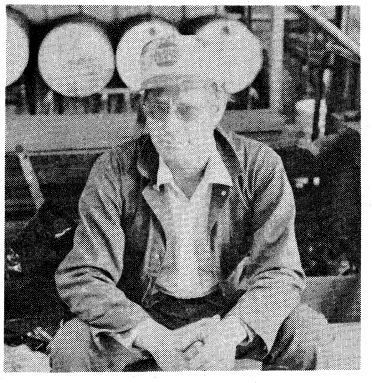
Tom Cote

Michael E. Fusco

Doris R. Gill



James Guin



George D. Harris

Adrian Herzog

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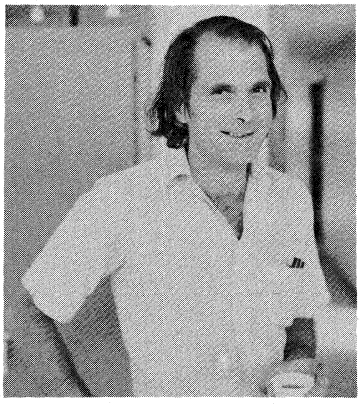
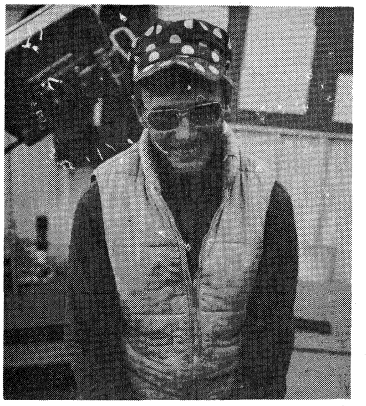
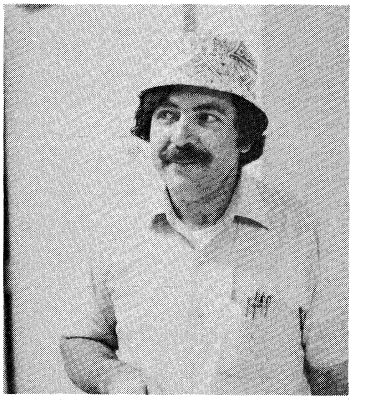
VLA - NEW MEXICO-BASED EMPLOYEES (continued)



Bruce Hillhouse

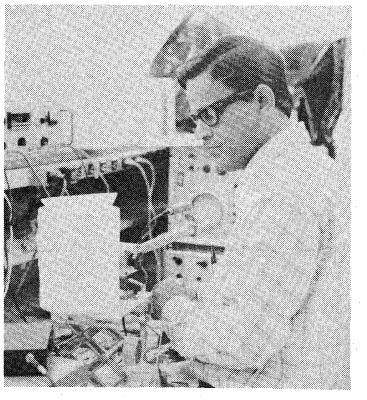


Jerry Kaber

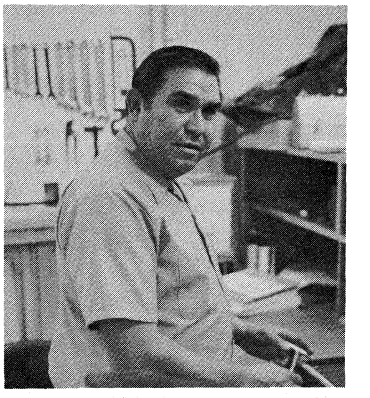


Pat Lewis

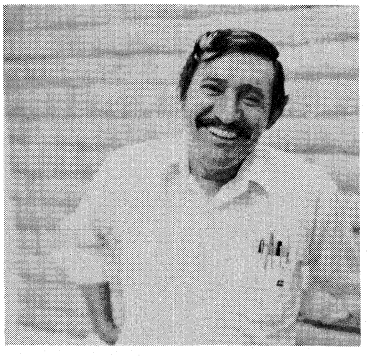
Alvah E. Miller



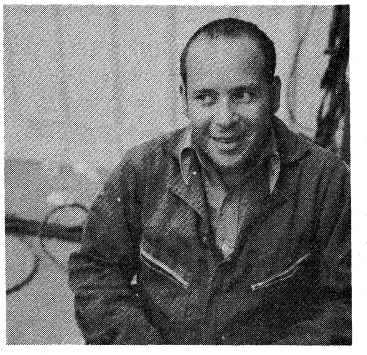
Gopalkrishma G. Nadkarn:



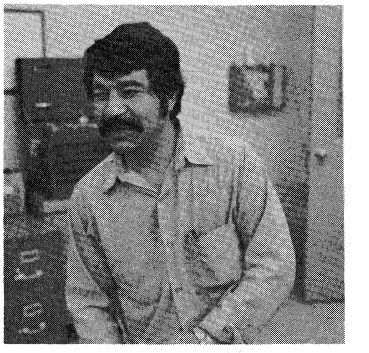
Joe Ortiz



Nat Pargas



Nick Montoya



Lewis Serna

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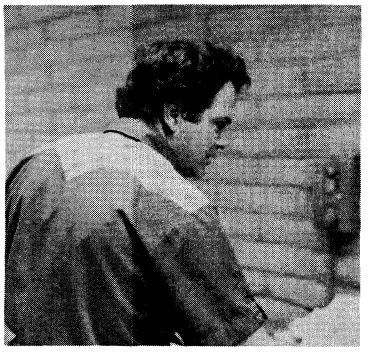
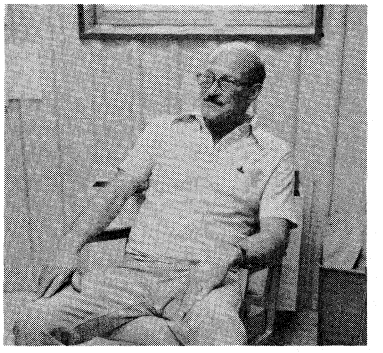
VLA - NEW MEXICO-BASED EMPLOYEES (continued)

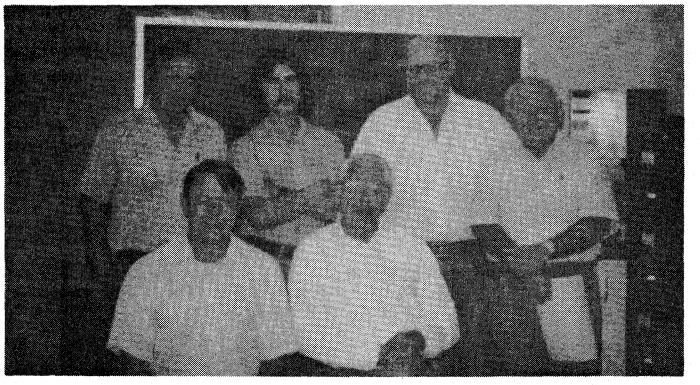


Eugene Spaulding



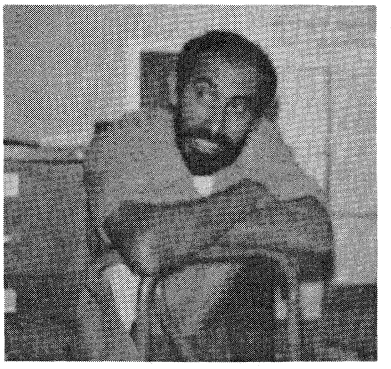
Robert Stidstone

Les Temple



Standing: Don Swann, Skip Lagoyda, Bob Dorr, and Bob Mitchell
Sitting: Joe Lee and Ted Jorgensen

Marion Gallagher
Millie Lopez
Florence Foster



Emilio Vallez

Mike Keyes
Emily Mathieu
Linda Martinic

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