The OBSERVER

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Story on Page 7.

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FASTER THAN LIGHT? YES...WELL, NOT REALLY

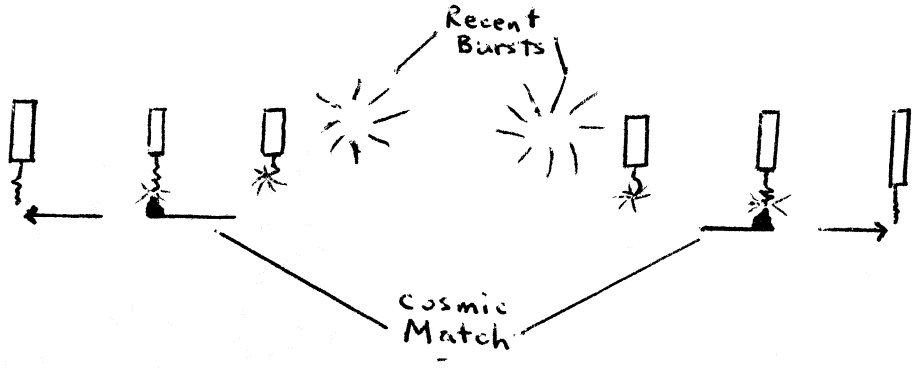
Al Marscher

It's been four years now since Ken Kellermann reported in the *OBSERVER* about a strange phenomenon which he and his collaborators from around the world thought they had detected. Now he and Dave Shaffer confirm what had been strongly suspected four years ago: that there exist in the distant regions of the universe some radio-emitting objects which appear to be moving at velocities faster than the speed of light. Now, you may ask, "If superman can fly 'faster than a speeding bullet', why can't a radio source move faster than light?" If you were to pose that question to the late, great Albert Einstein, his response would probably be, "Nichts kann schneller als das Licht fahren!" (Translated: "Nothing can travel faster than light!")

So there it is. Kellermann and Shaffer claim that radio sources travel faster than light and Einstein says that they shouldn't. Ken and Dave base their claims on several years worth of observations of very compact regions of radio emission using very long baseline interferometers (VLBI). A VLBI system refers to several telescopes (usually the 140-foot in Green Bank, one in Germany, one in California, and possibly a few others in between) which work in unison to explore the most compact objects in distant galaxies and quasars. What the VLBI types "see" in these objects are two regions of radio emission ("components") which are moving away from each other at super-light speeds.

Now everyone who has attempted to put down Einstein's theory of relativity so far has fallen flat on his or her posterior. So, ever since Kellermann and friends announced that this startling phenomenon was actually occurring, we theoretical types (that is, the kinds of scientists who push their pencils and punch their calculators ten hours every day so that they can tell guys like Ken and Dave what they should be seeing) have busily been trying to satisfy both the VLBI people and Einstein at the same time. It hasn't been easy.

But we have been imaginative. Several scientists have proposed that the object which emits the radio signals is not really moving at all. Actually, they say, the source is just like a Christmas tree with blinking lights. The "light bulbs" are imagined to blink in such a way that the points that one sees lit up on the "Christmas tree" move around very quickly. Actually, the VLBI people now say that the lit-up areas all lie on a straight line, so that the simple "Christmas tree" analogy doesn't work. But several enterprising theorists have cooked up a similar theory which might explain the behavior of these objects. In this model, we imagine a row of cosmic firecrackers lined up in space. Let's further imagine a pair of "matches", each going in opposite directions, igniting the fuses on the firecrackers (see the figure). We mainly see the light (or radio signals) from the firecrackers which most recently exploded, since they are the brightest. Now, if the fuses on the different firecrackers are of just the right lengths, then we can show through fairly complicated mathematics that the bright spots of the object can move faster than the speed of light. Note that it's not the firecrackers themselves or the matches that are moving



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that fast. It's just that when the next firecracker explodes, the bright spot moves very rapidly from the previously exploded firecracker to the one that's just bursting. So Einstein's laws are not disobeyed, since no tangible object is moving faster than light.

Another theory deals with a sort of optical illusion. We imagine two objects (in this case the two radio components) which are speeding almost directly toward us at nearly (but less than) the speed of light. Now the radio components are moving almost as fast as the radio signals which they emit (radio waves travel at the speed of light). This leads to an interesting effect (which again requires rather complicated math to work out): the radio components appear to move faster than the speed of light. The only problem is, how does one explain how the two objects got themselves shot out of the center of the galaxy or quasar in the first place? This is a question which the author and several other scientists have spent a while trying to answer. We all agree that the whole phenomenon most likely stems from catastrophic explosions at the nuclei of galaxies and quasars, but we don't really know what causes these explosions or exactly what happens to the debris.

There are other theories, too, which have been proposed to explain the types of things that the VLBI astronomers observe. For example, if the quasars and radio galaxies are not as far away as we think they are, then the observed motions do not exceed the cosmic speed limit. This interpretation leads to more problems than it solves, though, and it would be just as well if I did not go into them here.

In any case, in this article I have shown that there are several ways to make radio sources appear to travel faster than light without breaking Einstein's laws. So that means we theorists know all there is to know about super-light motions, right? Wrong, Intergalactic Breath! The problem is that Ken and Dave keep coming up with new observations that shoot down our cute little theories. What's a poor, downtrodden theorist to do? Well, why not go make up a new theory so that Kellermann and Shaffer can disprove that one too? After all, that's how we make a living.

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A FOND FAREWELL AS DICK SKAGGS RETIRES

A smiling Dick Skaggs stepped out of the NRAO lobby door on April 29, 1977 saying, "I'll miss all of you!", but we really had the feeling he was saying, "Gee, it will be nice not to have to go to work Monday." Yep, after fifteen years of faithful service, the long-time employee of the Electronics Division decided to strike out to find the enjoyment of retirement life.

Dick always left his work bench neat and clean, but didn't say one word on the morning of the 29th when he found it cluttered with a giant tool box (from his co-workers). Someone said he did mutter something when he opened the tool box to show some of the female employees and inside there was on display a centerfold from Playboy.

In the afternoon co-workers gathered around a table of good eats and drinks to bid fond adieu. Rick Fisher presented Dick with an autographed photo of all Green Bank employees, and Dick expressed his appreciation for the gifts, party, and good wishes.

Dick Skaggs at Retirement Party with autographed photo.

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Guess what? The following Monday morning Dick was down at the highway waving to the NRAO employees as they trudged to work. He was laughing as he yelled to them, "Have a happy day!" In all sincerity Dick, many happy days to you!

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MORE ABOUT MASERS

Craig Moore

In a recent issue of the *OBSERVER* we talked about masers and likened their operation to ping-pong balls on a set of stairs. The stairs, we said, were constructed in the ruby by applying a magnetic field. In this issue I would like to discuss the magnet that generates this field.

This magnet is an electro-magnet of about 1000 turns which operates in the range of 7 to 10 amperes. However, it is not an ordinary magnet, in that it does not need a voltage source to keep this current flowing. This form of apparent perpetual motion is achieved with superconductivity -- a property of certain elements and alloys of elements, which at low temperatures (say -450 ^{o}F) exhibit no electrical resistance.

Our maser magnet is wound with Niobium-Titanium wire which has been copper plated and insulated with varnish. The copper carries off heat during cool down and also carries the current in case of an unexpected warm-up, when the magnet is said to dump. When cold the Nb_3Ti core of the wire is superconducting and one can charge the magnet from a low voltage, high current DC power supply. When charged, a superconducting shunt is placed across the power supply lead and then the power supply can be turned off. The current will continue to circulate through the coil windings and across the shunt. Since there is no resistance in the wire, no power is dissipated and the current remains constant. The resulting magnetic field is extremely stable, since no electrical connections are made to an external power source.

The magnet is shielded from the earth's magnetic field and the effects of various positions of the telescope by an iron case. A special iron is used which has a very low resistance to magnetic fields (high permeability) and thus shunts the earth's field away from the ruby. The stability of the field applied to the ruby is important since this field determines the frequency of operation of the maser. Of course, nothing in the real world is quite like theory, and so our magnet will eventually run down. The calculated time constant is about 500 years, but I doubt that the astronomers will leave the receiver tuned to the same frequency for that long.

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A SLICE OF THE SOUTHWEST

Doris Gill

There will probably be an opportunity any given weekend to attend a rodeo, participate in a fiesta or listen to a fiddling contest. There is usually some event or dance going on at the different pueblos. Ruidoso and Santa Fe have horse racing. Santa Fe has the opera. Should you live here, or be planning a visit soon, keep this special calendar of events in mind.

June 17, 18, 19 - Press time may interfere with this announcement, but this is the time of the MAGDALENA RODEO. The children have their rodeo on Friday afternoon. There is a full schedule of events for the adult rodeo Saturday and Sunday afternoons (that is a polite way of saying side bets, dances at the local drinking establishments, fights, monied challenges among the ropers, and whatever else might occur).

July 8, August 19, October 7, November 18 - Crownpoint Rug Weavers' Association Rug Auctions, approximately 7:00 p.m., Crownpoint, NM (remember this is Navajo time so it could start anytime after 7, maybe). Locals may get rave reviews concerning the rugs, the Indian Tacos, the hard chairs....from the Balicks, Maas', Jude Myers, Doris Gill, Nancy Vandenberg, Candy D'Addario - and maybe some of the easterners saw the samples of Henny Kellermann.

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July 8, 9, 10 - Another chance to partake of the splendor of the bawdy Magdalena cowtown. This 6th Annual Old Timers Reunion will feature a rodeo open only to contestants over 50 for male, over 40 for female - and in the Century roping, naturally the team must total over 100 years of age with no one under 40! Street dance Friday evening, free barbecue Saturday noon following a fantabulous parade in the a.m. featuring the Old Timers Queen (usually someone in late 70's), afternoon rodeo, evening fiddling contest and dance following (probably other dances also at the local drinking establishments) - breakfast Sunday morning, rodeo Sunday afternoon. No fees - everything funded through donations.

July 27-30 - Montosa Camp Meeting. A little of something for everyone. This is not a revival type meeting but a non-denominational religious camping experience. All meals are provided - breakfast, lunch, and dinner. There are morning services, afternoon services, and evening services. People congregate from all over in their campers, tents, and sleeping bags for all or part of the meeting. No fees - everything is funded through donations. The camp site is located just off US 60 west of Magdalena 12 miles.

September 10-25 - STATE FAIR TIME.

September 16-18 - 265th Annual Fiesta de Santa Fe. Oldest non-Indian celebration in the USA; largest and most famous fiesta in the Southwest.

September 3, 4, 5 - Socorro County Fair rodeo, fiddling contest, etc.

September ?? - Navajo Rodeo, Alamo Reservation, Magdalena. Usually announced two to three days before occurrence - may start any time after lunch. If attendance is high (last year it occurred in October and it was pinon harvesting time and lots of Navajos were not at the rodeo but earning money) it is a good chance to buy jewelry, eat Indian Tacos, and try roasted corn - Indian style! Of course, the announcer may lapse into Navajo and it becomes hard to follow the rodeo...it is not always apparent why he is chanting...but it can be a most interesting afternoon.

October 7-16 - 6th Annual International Hot Air Balloon Fiesta, Albuquerque.

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WHAT'S COOKING?

Chocolate Chip Cake

from the kitchen of Freda McKean

Grease and flour tube or bundt cake pan.

Cream together: ½ cup softened margarine
1 cup sugar
1 teaspoon vanilla
½ pint sour cream
2 eggs (beaten)

In a separate bowl, sift:
2 cups flour
1 teaspoon baking soda
1 teaspoon baking powder

Combine all ingredients and mix till smooth.

Mix into batter: 1 6-ounce package chocolate chips

Pour ½ of the batter into pan and sprinkle with cinnamon and sugar mixture (1/8 cup). Add remaining batter.

Bake in 350° oven for 40 minutes.

Pizza-Burgers

from the kitchen of Linda Gibb

2 pounds lean ground beef
¼ pound chipped ham
4-5 slices American cheese
½ pound pizza cheese, grated
2 cans Del Grosso pizza sauce

Mix together beef, ham, ½ of grated pizza cheese, American cheese, and 1 can pizza sauce. Pat onto ½ of sandwich bun. Top with 1 teaspoon sauce and 1 tablespoon pizza cheese. Bake in 350° oven for 20 minutes.

These can be frozen before being baked for later use. If frozen, bake in 400° oven for 10 minutes.

REMEMBER WHEN?

How many of the people in the cover photo can you identify? Can you remember when it was taken? According to information we have gathered from various employees, this photo was taken during the summer of 1960.

Of the 67 employees pictured, 21 are still employed by NRAO, and four are on our retirees listing. For those who are unable to put a name with a face, a key follows.

1. Phyllis Jackson
2. Beverly Lynds
3. Naomi Daniels
4. Beaty Sheets
5. Harry Wooddell
6. Frank Callendar
7. John Findlay
8. Otto Struve
9. Dave Heeschen
10. Virginia Irvine
11. Nellie Arbogast
12. Verna Tracy
13. Estelle Lambert
14. Mary Jane Wade
15. French Beverage
16. Bill Kuhlken
17. James F. Wanner
18. Margaret Hurley
19. Ellen Chan
20. Ellen Gundermann
21. Sebastian von Hoerner
22. Mike Waslo
23. Roger Lynds
24. Frank Drake
25. Warren Wooddell
26. Arnold Davidson
27. Lyndell Brooks
28. Jim Elliott
29. Ed Monahan
30. Kwan-Yu Chen
31. Dick Hiner
32. Eugene Capriotti
33. Ted Riffe
34. Charles Phillips
35. Mike Belton
36. Bob Elliott
37. Carl Adler, Jr.
38. Bill Waltman
39. Lillian Ness
40. Hein Hvatum
41. Peter Vandervoort
42. T. K. Menon
43. Jamie Sheets
44. Don Bodner
45. Joe Carter
46. Cam Wade
47. Dewey Ross
48. Merritt Gum
49. Marvin Taylor
50. Basil Gum
51. Jim McLaughlin
52. Bob Aldridge
53. Dewey Pritt
54. Maxie Gum
55. Clifford McLaughlin
56. Fred Cole
57. George Grove
58. John Dickel
59. Forrest Ervin
60. Troy Lusk
61. Bedford Taylor
62. Bill Gandrud
63. Bill Brundage
64. David Brown
65. Don Hobbs
66. Fred Crews
67. Lewis Hobbs

REPORT FROM SAN AUGUSTIN

Bruce Balick

Chapter 1. VLA Trek

After a long winter drought, it looked as if the weather in the Pacific Northwest was returning to normal. Normal weather in March means a new storm every thirty-six hours. On March 15 the last storm had moved south from Seattle (my home) dropping two inches of rain on thirsty northern California. Today was March 16 and I was about to leave for a six month stay at the VLA, some 1600 miles to the southeast. Sure enough, another storm system was off the coast of British Columbia and expected to head toward Utah. I too was headed there. It was clearly time to leave.

It struck me as I crossed the Cascades how dry Washington state is this year. Last year at this time there was 100 inches of snow at the Cascade crest; this year there is 30. That extra missing margin of snow becomes the water that drives the hydroelectric plants in September. Seattle could be pretty dark when I return from the VLA. I also remembered a trip we took to Mount Ranier in March of last year. The road to the 5000 foot level was literally dug out from under twenty feet of compacted snow. Not so this year, however.

I left Seattle shortly after midnight on March 16. By sunrise I was in northeastern Oregon in one of the driest regions of the U. S. Dry, yes, yet very striking. As I was to learn the next day, this part of Oregon looks surprisingly similar to the plains of San Augustin. At the time, however, my main concern was getting to Utah before the storm, now over central Washington. Ahead to the east I could see sunlight from under the clouds. Later that morning as I entered Idaho the sky became an innocent shade of deep blue.

By mid-afternoon Salt Lake City was just 50 miles distant. I tuned in a radio station for a weather report. The latest word was that both the storm behind me as well as the one in California were scheduled to convene in central Utah by morning. So much for spending the night near Salt Lake. I pressed onward.

Southern Utah was extraordinarily beautiful at sunset as the sun fell behind a rich array of gathering clouds. The upper level clouds were a fiery orange; lower clouds cast streaming shadows through the low altitude haze. Nonetheless, the visibility was at least 50 miles, and distant mountains, all without snow, loomed in all directions.

I spent the night in Moab near the Canyonlands and Arches National Monuments. Someday I'll see them in daylight. By 5 AM I was on the road again. The leading edge of the storm and I crossed the New Mexico state line at 7:00. Ahead was "Shiprock", a mammoth spire of stone rising 4000 feet out of the desert. In the light of a stormy dawn it looked colossal. After Shiprock, U.S. 666 heads due south for 100 miles with nary a bend in the road. It splits the Navajo reservation in half, yet somehow the desolation and poverty remain completely unbroken.

U.S. 60 East crosses the Continental Divide at Pie Town some 40 miles west of the VLA. What a name! Pie Town appears on every map of New Mexico by the mercy of the map makers. The only difference between Pie Town and a gas station is that Pie Town has a state sign with its name on it 20 miles down the road. Beyond Pie Town U.S. 60 drops through a valley into Datil on the western edge of the incredibly desolate plains of San Augustin. Someday the southwest arm of the VLA will come within about ten miles of Datil. It is a magnificent view indeed to look across the plains, 7000 feet in altitude, which are large enough to hold Boston and most all of its suburbs. Listed in order of their numbers, the permanent inhabitants of the plains are cows, people, and telescopes. Before long, people may drop into third place.

After an 18 hour drive, the trip across the plains seems like an eternity. The telescopes are very conspicuous, but the road to the site is not. One navigates by sight and instinct since no signs to the site exist. Guessing at the proper entrance, I turned off U.S. 60 onto state route 78, a narrow 2 lane road, and was met within a mile by a sign saying "Winston - next facilities 63 miles". They mean it. A few miles and another turn

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later my trip from Seattle finally ended. It was, by now, 11:30 AM and I was three hours late for work.

Once inside the control building, many friends and familiar faces came by. It was very pleasant re-establishing many old acquaintances, yet it was somehow strange to see these people in New Mexico and not in Charlottesville or Green Bank. In the days ahead many new friendships were made.

Chapter 2. A Lovely Life in Scenic Socorro

The film "Alice Doesn't Live Here Anymore" opens with a shot of a city, and in the foreground is a fence on which "Socorro Sucks" is painted. The scene also shows a reddish desert setting with mountains in the distance. Natives of Socorro are quick to point out that the pictured city is not, in fact, Socorro. Actually, it makes no real difference. The desert is everywhere. It is very dry, and the blowing dust is known locally as New Mexico rain. However, abundant water lies not far below the surface. The desert is quick to turn green - just keep adding water. Because of this the cities, including Socorro, are greener than I had expected.

We were warned that we would have a great deal of difficulty trying to locate a house, furnished or otherwise, to rent. Florence Foster graciously (but not too hopefully) began looking for housing in December. In Socorro, a town of only 6500 people, even just a little new growth can make housing shortages endemic. So we arrived homeless.

Meanwhile our NRAO friends, all of whom we had known from CV and GB, had realized that our only opportunity for domicile was for an unfurnished house. They had arranged among themselves (and before we arrived) to locate spare furniture and had almost completely furnished our as-yet-to-be rented house. I must say I am truly impressed and grateful. Our visit here could have begun as a serious maladventure if it had not been for their thoughtfulness.

Specifically, some of the people who contributed to our furniture collection are:

The Bignells-	A bed, curtains, table, chairs, a place to stay for a few days, and lots of enthusiastic help.
The Maas'-	A bed, chairs, end tables, and more great help.
The Brockways-	Two rocking chairs and a recliner.
The Spargos-	A bed.
The Napiers-	Studio couch and yet more help.
The Hjellmings-	Lamps and other miscellany.

It turned out that a large, rustic house near one of the de facto local NRAO housing compounds suddenly became available. The furniture, which had been waiting for a house, now had a place to go. We were very, very lucky.

There are many nice aspects to life in a very small town like Socorro. Local clerks all know we're new, and love to chat about local highlights and history. (One doesn't dare enter a store in a hurry to conduct business.) Unlike bigger cities, merchants are very cooperative if we cash checks without a local driver's license. There's never very far to go for shopping provided, of course, the product you want is available. As in Green Bank, occasional shopping caravans to a nearby city, in this case Albuquerque, are organized from time to time. These are often great social affairs with people meeting after a day of shopping for dinner and a play or movie. In fact, considerable social comraderie exists among all of the Socorro NRAO families that we know well. This is, of course, not an unusual NRAO phenomenon.

Nonetheless, life in Socorro has its drawbacks. Shopping is limited, unless you're crazy about auto parts. No outstanding restaurants exist in the city (although San Antonio, 10 miles south, is well-known as the hometown of Conrad Hilton and the Owl Café and Bar with its famous hamburgers. In Magdalena, 25 miles west, the Mexican food is exceptional and very reasonably priced.) Porno and avant-garde movie fans will not derive much pleasure from the local theater. And potholes in the roads are epidemic.

The most often expressed complaint about

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life in Socorro for VLA site employees is the daily bus ride to and from work, one hour each way! It's a long, noisy uphill ride to the site 52 miles from town, especially at 7:30 AM. The ride back is downhill (and thus quieter) and follows a day at work. Somehow the return trip seems shorter.

My family has adapted well to Socorro even with its limitations (it helps to be small town freaks). Our friends have been especially helpful showing us the town and its amenities. Living is relaxed and aside from some sand, the air is unpolluted. The sun is an almost constant daytime companion - at least so far. The area is very beautiful, especially the mountains. Precious stones and avid rock-hounds abound. Indian culture is omnipresent, and several Navajo, Zuni, and other reservations are within an easy drive.

Those NRAO people who have not visited here should try to do so, if only briefly. Many of your old friends are here. The area and the state hold lots of attractions, scenic, cultural, and historic. Last, and not least, is the VLA itself. Contrary to some local opinions in CV and GB, Socorro is not within a stone's throw of the Pacific, nor is Socorro a suburb of L.A. or Houston. The flavor of the area is very distinctive and in many ways of its own, just as attractive as the other NRAO sites.

Chapter 3. Impressions Of A First-Time User

First a large lake bottom, the plains of San Augustin were, until recently, the site of Indian settlements dating back at least one millenium. The indigenous protein-rich grasses have supported an extensive wildlife population for many centuries. Within the last century cattle grazing has been very extensive and now dominates the local commerce activity. But by far the most conspicuous feature of the plains are the ten antennas reaching towards the western mountains.

The past year has seen the advent of the first VLA fringes and an intensive effort to identify and correct problems. As might be expected at about this time in its development, the VLA is in a constant state of flux. On the one hand there are considerable efforts to redesign those (fortunately) few components and modules whose original design was faulty. On the other hand there is constant pressure from various scientific and non-scientific users of the VLA to keep the existing systems well maintained. As progress continues and problems are solved at one level, new problems of ever increasing subtlety await identification and resolution.

In spite of all of these struggles and uncertainties, the VLA can be and is being used for research in astronomy. For example, even in its current state it is already the most sensitive instrument yet built for the detection of weak, small diameter radio sources of well-known position (for example radio stars and galactic nuclei). The anticipation of future successes in other areas of astronomy can be readily discerned.

The unpracticed user enters the VLA control building and immediately senses the frenzy of activity of the scientific, electronic, and computer staffs housed therein. Nearby, activity continues with a similar pace in several other buildings. Amidst the quiet bedlam, conversations span the range from immediate action (a new interim fix for locking the oscillators at 2 and 1.3 cm has just been suggested and should be tried this afternoon) to pensive contemplation (a standardization of off-line program commands must be decided sometime next week). Much of the jargon seems alien ("monitor system", "visibility data-base", "dichroic reflectors"), confusing, yet somehow tantalizing.

The only major area in which the VLA design is frozen is the antenna design. Also, the array configuration design seems nearly settled, aside from a few questions regarding the most distant stations. With the advent of two working telescopes and first fringes came the first serious tests of major portions of the electronics systems. Naturally many problems were discovered; one by one the problems are being understood. Some require only modest corrections, whereas major changes or component redesign has been necessary in a few cases. By now, substantial progress has been made, and technical success for the remaining receivers seems all but assured.

As the electronics improves, the VLA data rate continues to increase. For now,

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most of the new problems appear to arise in the area of data processing. As in the earlier case of the electronics, the computer staff is busy trying to identify the most serious problems and to see what can be done. Progress is beginning, and success appears to be gaining on the rate of new problems.

A recently written manual for prospective users reflects the state of the VLA. The section on antennas, feeds, and array design is short but quite complete. By far the longest section deals with the electronic hardware. The length reflects both the complexity and nearly completed design for the electronics. Software documentation consists mostly of program objectives, present limitations, interim solutions, and future plans.

There is little doubt: the VLA abounds with new successes, new problems, and growing pains. But despondencies are brief, and "can-do" is still the dominant note. All in all, I suspect this epoch in its history will prove to be one of the most exciting and challenging, and I am thoroughly enjoying my visit.

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LIVE LONGER

Want to live longer? Of course most people do, but few people want to practice the health habits necessary to add years to the average person's life. However, if you want to live longer and are willing to follow good health habits, here're the ones to follow:

no smoking
moderate drinking
7-8 hours of sleep a night
regular meals
daily breakfast
keeping normal weight
exercising.

A study of 7000 people in California who practiced 6 of 7 of these good health habits since age 45 lived an average of 11 years longer than those practicing only 2 or 3 of the good health habits.

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CHILE FOR AGRONOMISTS AND GOURMANDS

Jude Myers

Chile (capsicum frutenscens) is a staple in the New Mexican diet and economy. Varieties were first discovered by Columbus in the West Indies. By the time Don Juan de Onate and his colonists were settling New Mexico in the early 1600s, chile was on its way to becoming an important crop.

Today's gardeners have a variety of strains and pungencies from which to choose. A great deal of effort has been put forth at New Mexico State University in Las Cruces into developing flavorful but not too spicy pods. Sandia A is the hottest of the non-Jalapeno chiles. Slightly down the fieryness scale is NMSU's latest variety - Nu Mex Big Jim. It may be milder than the medium Rio Grande Strain, depending on the soil and growing conditions. The mildest (by New Mexican standards) are Anaheim and New Mexico 6, also known as New Mexico 6-4. All of these varieties can produce pods with a large range of spiciness if they are deprived of water.

As chile is a warm weather vegetable, it is best to start the seeds in the house or in a cold frame. To avoid damage to the seedlings, it is best to transplant them after all danger of frost has passed. Too cool weather will stunt them and turn them yellow. If you prefer to start the seeds directly outside, the earliest planting would be the last week of April. The soil should be light and loamy. Planting in raised beds and not allowing the water to stand for long periods of time lessens the chances of chile wilt. If you wish to start from seeds, they should be planted 1/2 to 3/4 inch deep in moist soil on the inside of the furrow. Once the sprouts appear they should be thinned to 12 to 18 inches. When cultivating, make sure that the soil is moved toward the plants. This will establish the plants in a raised bed and the irrigating water furrow will be wide.

The usual growing season is 80 days. Pods can be picked any time after they are well formed and several inches long. The chile can be left to ripen on the vines for

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red chile that is far more flavorful than that made from the dried pods or frozen varieties.

Green chile must pass through several steps before it is ready to use. The pods should be washed thoroughly and pricked with a large-tined cooking fork to prevent blowouts in the oven. Place them on baking sheets which have been covered with aluminum foil. Then roast the pods under the broiler until they are blistered and browned evenly, turning as necessary. Some people prefer to do this outside over the barbecue grill. The chiles should then be dumped onto damp towels and steamed for several minutes. At this point they can be frozen. If you wish, you can peel the chiles and chop them before freezing. Chile may be canned, but keep in mind that pressure-canning at 15 pounds pressure is the only safe method.

Processing red chile is slightly less involved. The pods should be thoroughly washed. Cut the stems off and remove the seeds. It is best to wear plastic or rubber gloves when doing this. The esters in chile do not wash off easily and can cause a strong burning sensation on your hands for hours. (People who wear contact lenses are especially advised to wear gloves. Being scraped off the ceiling after putting your lenses in is a time-consuming and very painful process.) Put all the chiles into a saucepan and boil gently for 30-45 minutes. Remove the chiles to a blender. Add a little of the cooking water and blend until smooth. Add one can tomato sauce or paste, a little salt, garlic and oregano to taste and enough water to attain the consistency you like. Chopped onions may also be added. Blend all these together. Put into a saucepan, add two tablespoons butter or margarine and cook 15-20 minutes. If the chile is too hot, you can add some sugar to cut the fire.

Now that the chile has been made, the cook can use it and her imagination to prepare interesting and varied meals. A good source of processing instructions and recipes is the booklet put out by the extension service. It should be available at the Socorro County Courthouse. The Public Service Company of New Mexico also has a good recipe collection. "Mexican Cookbook", by Edna Ferguson (UNM Press) has many of the older Spanish recipes. There are many other cookbooks available at libraries and bookstores. Buen provecho!

*****

RECIPES FOR "CHILE FOR AGRONOMERS AND GOURMANDS"

Jude Myers

RED CHILE ENCHILADAS

I. Flat Enchiladas

While chile is being cooked, preheat cooking oil (about 1" deep) in a small skillet. Fry a corn tortilla for just a few seconds. You want it soft and cooked through, but not crispy. Dip the fried tortilla into the hot chile sauce and coat well. Place on plate. Cover with chopped onions and grated cheese. Repeat one or two more times. An egg may be put on the top. Cover with more grated cheese and additional chile sauce, if desired. Place in a warm oven or under a broiler just until the cheese melts. Serve immediately. You may wish to serve side dishes of pinto beans and warmed flour tortillas.

II. Rolled Enchiladas

Prepare red chile sauce. Preheat cooking oil as above. Pour about half of the chile sauce into a 9" x 13" pan. Fry each corn tortilla until soft. Dip into chile sauce. Place in pan. Put grated cheese, sour cream or plain yogort, and browned hamburger (optional) on tortilla. Roll tortilla around other ingredients. Place rolled side down. Repeat until all tortillas are used. Pour remaining sauce over enchiladas. Sprinkle with grated cheese. Bake at 350° about 30 minutes.

III. Enchilada Casserole

Prepare red chile sauce. Cut one package corn tortillas into strips. Pour a small amount of chile into 9" x 13" pan. Place a layer of tortilla strips in pan. Cover with

--continued, next page--

browned hamburger (optional) and grated cheese. Repeat layers except for cheese on top layer. Pour any remaining sauce over casserole. Cover with grated cheese. Bake at 350° 30-40 minutes, or until tortillas are done.

GREEN CHILE ENCHILADA CASSEROLE

1 pkg. corn tortillas, cut into narrow strips
2-3 cups cooked chicken or turkey, shredded
Peeled and chopped green chile
1 can cream of mushroom soup
1 onion, chopped and sautéed in butter until limp
1/8 tsp. garlic powder OR
1/8 tsp. instant minced garlic
1/2 lb. cheese, grated
1 can cream of chicken soup

Mix soups, onions, and garlic. Add chile to taste. Put a layer of tortilla strips in a greased baking dish. Alternate layers of chicken, sauce, cheese, and tortilla strips, ending with cheese. Bake at 350° 30-45 minutes.

*****

WANT TO BUY

Typewriter. Will negotiate on any kind.

Carolyn Dunkle
Ext. 320-GB

*****

A RECIPE FOR A HOME

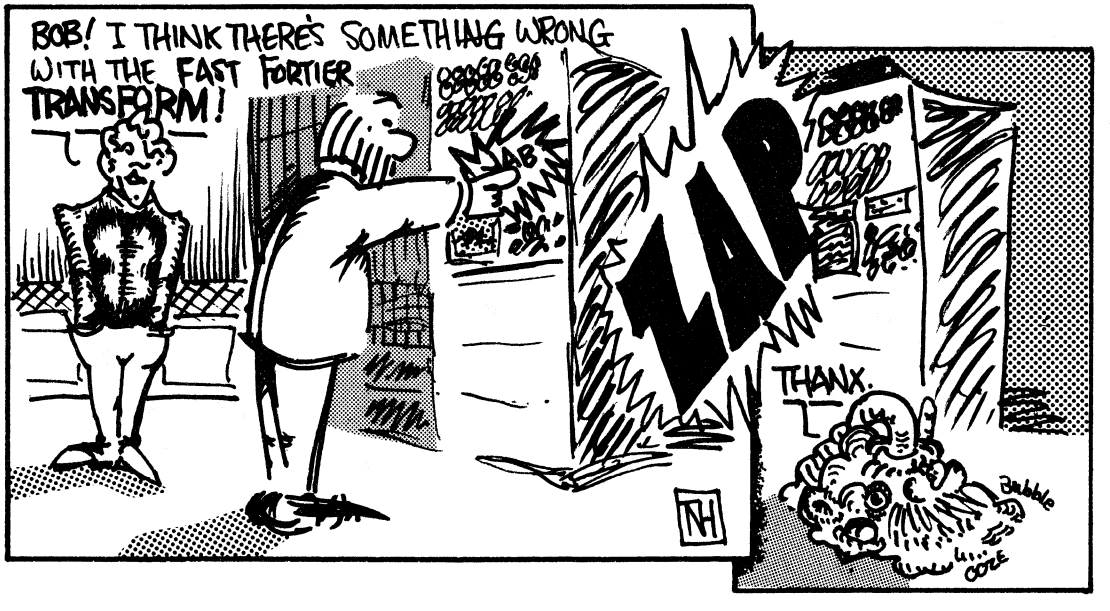
Half a cup of Friendship, and a cup of Thoughtfulness, creamed together with a pinch of Tenderness, very lightly beaten, in a bowl of Loyalty, with a cup of Faith, and one of Hope, and one of Charity. Be sure to add a spoonful each of Gaiety that sings and one of the Ability that Laughs at Little Things.

Moisten with the sudden tears of heartfelt Sympathy. Bake in a Good-Natured pan, and serve repeatedly. It is fine.

*****

The measure of our happiness
is the gifts of ourselves
which we give to others.

*****



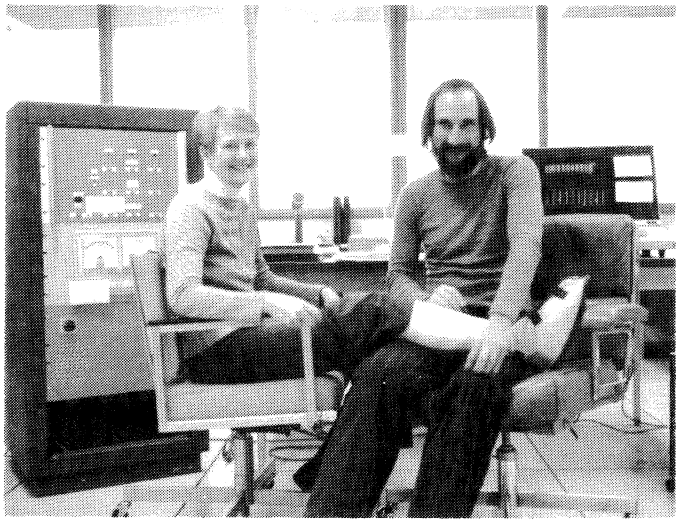
INCREASE YOUR WORD POWER

OUT WEST THE WORD "SHINDIG" MEANS:

___ A. A SPUR INJURY
___ B. A DANCE PARTY
___ C. A SPLIT HOOF
___ D. B AND C

OUT IN SOCORRO THE WORD "SHINDIG" MEANS:

___ E. A ST. PATRICK'S DAY PARTY
___ F. AN EVENING AT THE SPANISH GATE
___ G. A MUSH BALL GAME
___ H. B, C AND E



OUT 50 MILES WEST OF SOCORRO
THE WORD "SHINDIG" MEANS:

___ I. IS WHAT HAPPENS WHEN THE PROGRAM LIBRARIAN LOOKS FOR A LOST BIT AND A NUMBER CRUNCHER COMES TO THE RESCUE
___ J. A DANCE CARD FOR VLAPRA PARTIES
___ K. B, D, E AND J
___ L. NONE OF THE ABOVE
___ M. ALL OF THE ABOVE

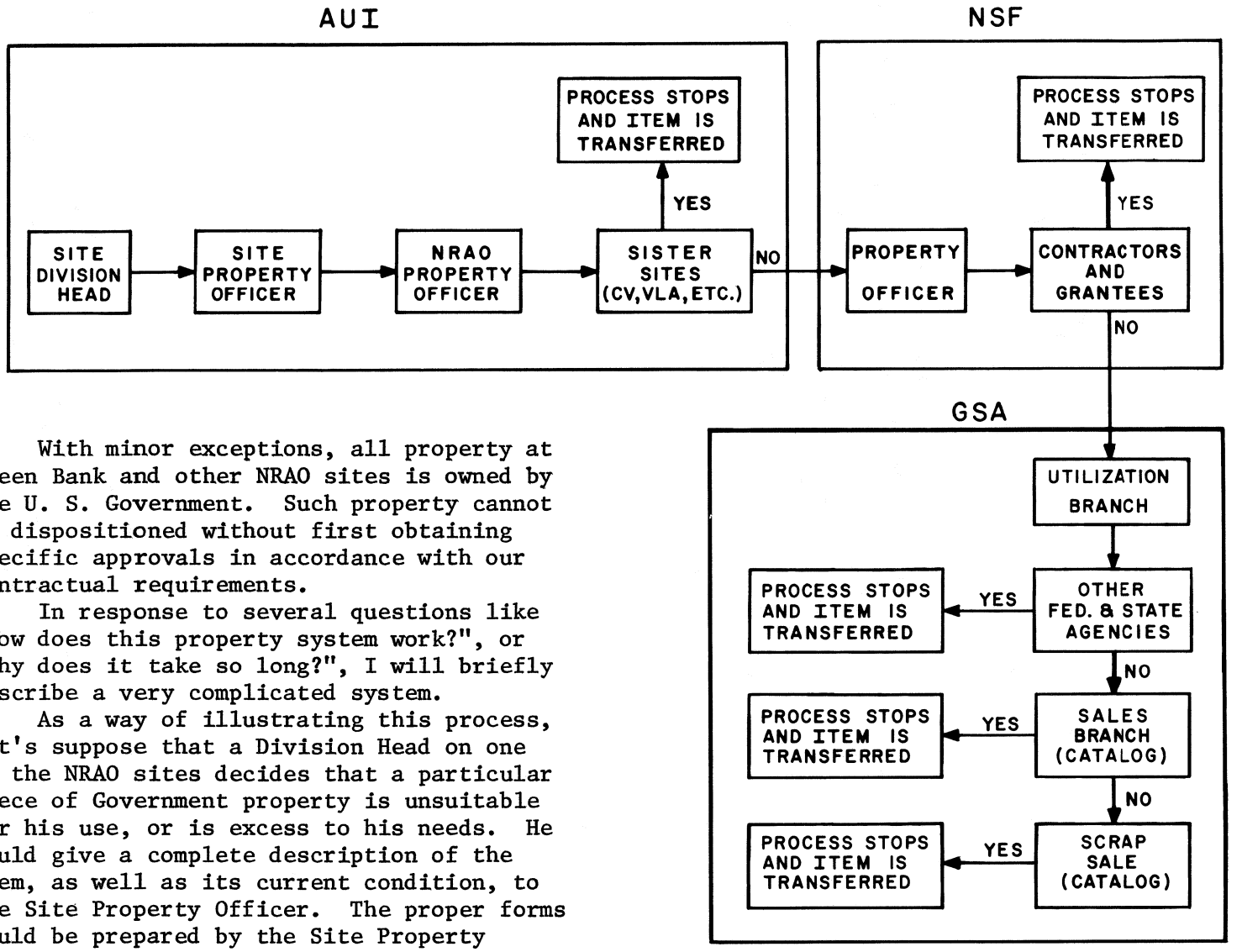
OR LOOK THAT UP IN YOUR FUNK & WAGNALL'S

OR CALL YOUR FRIENDLY LIBRARIAN (PROGRAM THAT IS) FOR THE DEFINITION

* * * * *

GOVERNMENT PROPERTY

Richard Fleming



With minor exceptions, all property at Green Bank and other NRAO sites is owned by the U. S. Government. Such property cannot be dispositioned without first obtaining specific approvals in accordance with our contractual requirements.

In response to several questions like "How does this property system work?", or "Why does it take so long?", I will briefly describe a very complicated system.

As a way of illustrating this process, let's suppose that a Division Head on one of the NRAO sites decides that a particular piece of Government property is unsuitable for his use, or is excess to his needs. He would give a complete description of the item, as well as its current condition, to the Site Property Officer. The proper forms would be prepared by the Site Property Officer and submitted to the NRAO Property Officer (Fiscal Officer). The Fiscal Officer processes all such forms for each NRAO site in the manner described in the flow chart. The first time a "yes" route is taken during the process, the property accountability is transferred from the site holding the property to the site, or agency, desiring the property. If the property is not picked up by the time it gets to the GSA sales branch it is then listed in a sales announcement, which receives general distribution.

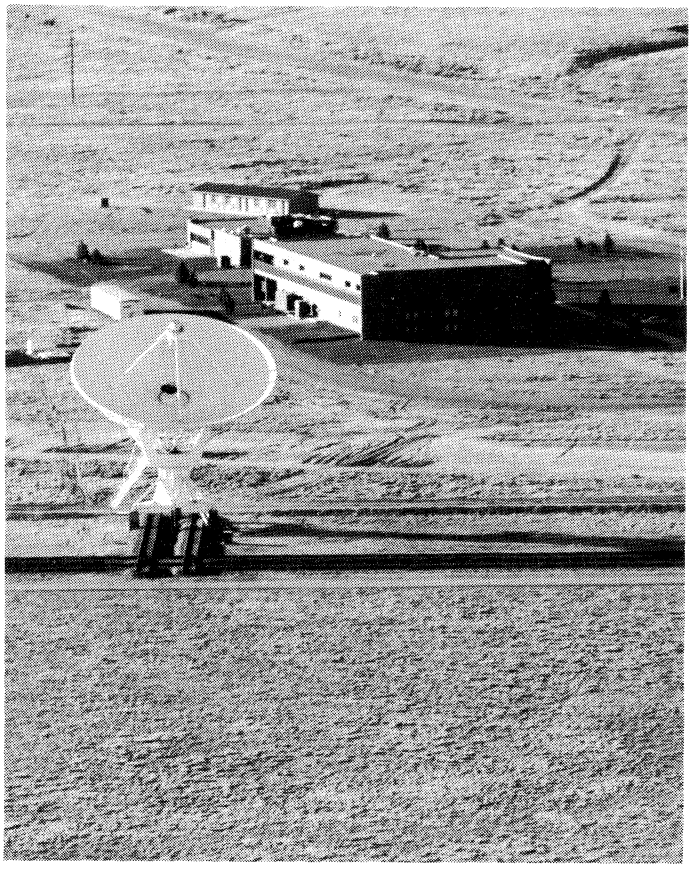
* * * * *

The three foundations of learning: Seeing much, suffering much, and studying much.
—Catherall

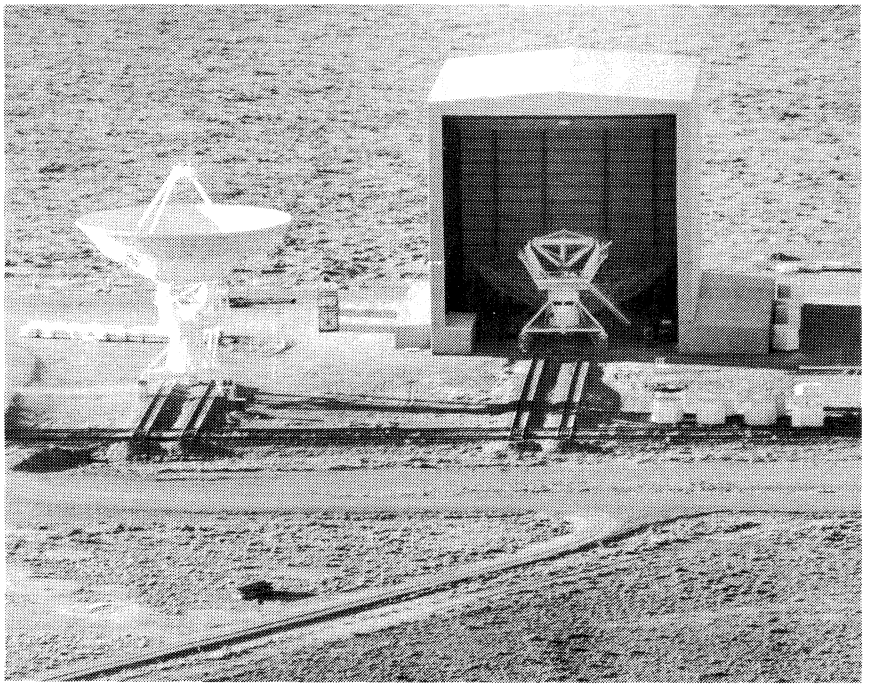
* * * * *

VLA - PHOTO UPDATE

photos by Dave Rosenbush



Behind Antenna 1, at DW8 station, a good view is seen of the north side of the Control Building and Cafeteria and a front view of the VSQ (Visiting Scientist Quarters). To the left is the liquid nitrogen storage tank and the future display trailer. Note too the cattle guard on the road through the open range in the upper right corner.



Antenna 11 is on the master pad and in the Assembly Building is Antenna 12. Note many pedestal rooms in front and to the right of the Assembly Building.

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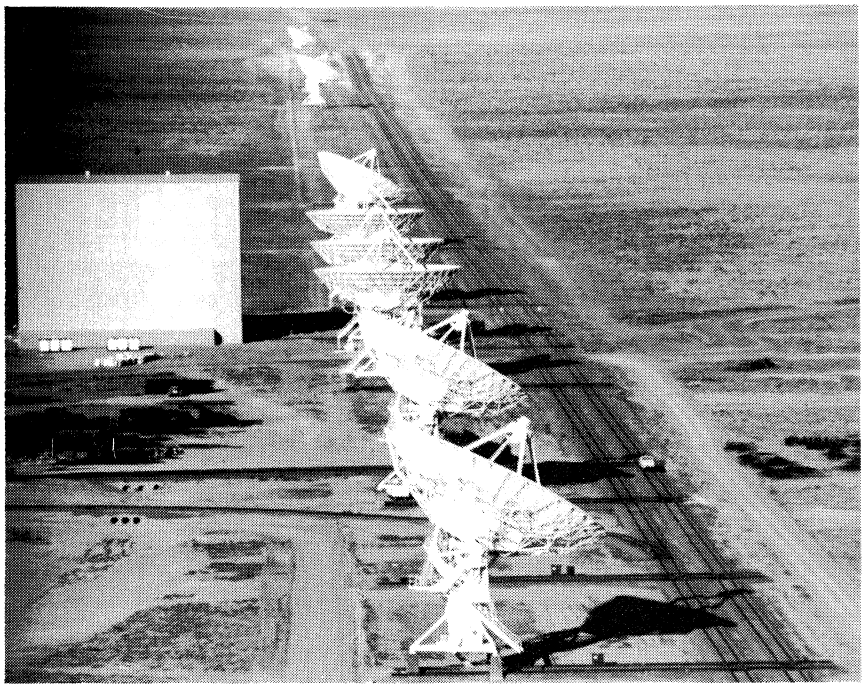
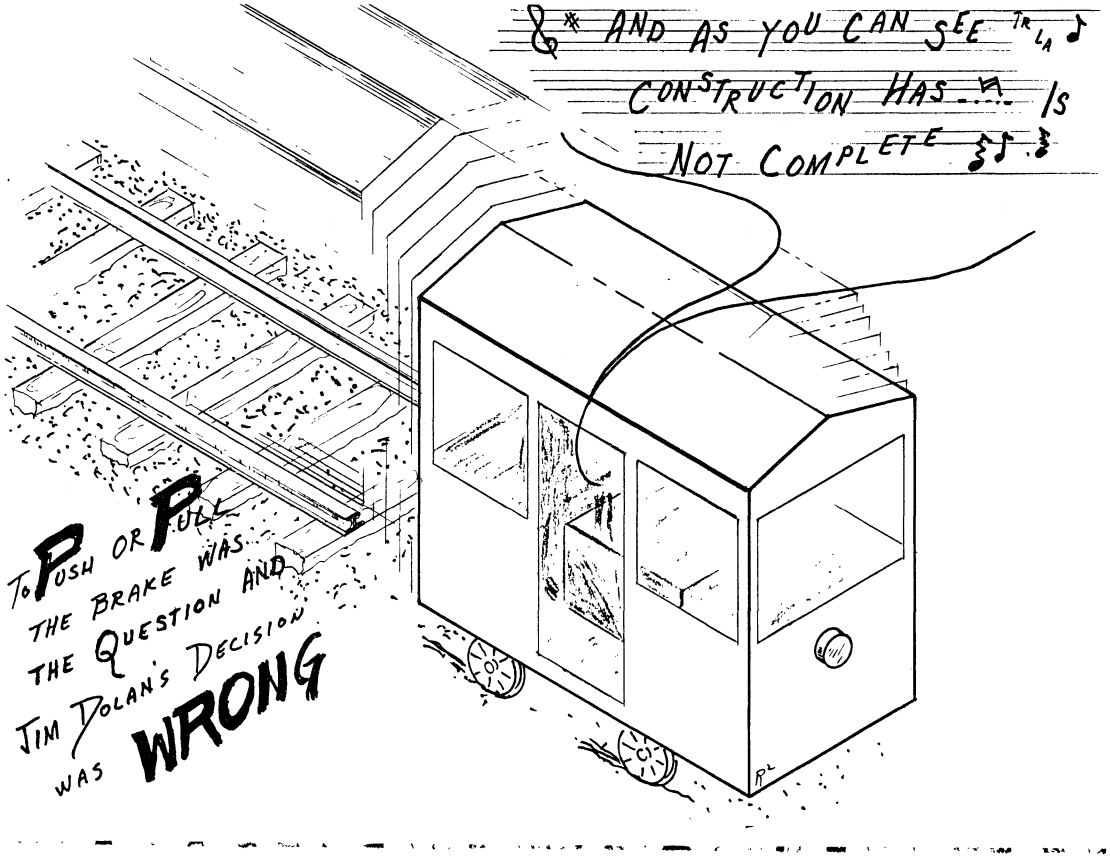


Antennas 1 (DW8), 7 (CW5), 4 (CW8), 6 (BW6), and 2 (BW8) operational during observing run May 30. Stowed are Antennas 8 (CW6), 10 (CW7), and 11 (Master Pad).

* * * * *



1977 SUMMER RESEARCH ASSISTANTS

Name	Institution	Advisor	Site
Mark T. Adams	University of Arizona	L. Rudnick	CV
K. Ajith-Kumar	Stanford University	C. Moore	GB
Greg Bothun	University of Washington	E. Fomalont	Socorro
Denis F. Cioffi	University of Virginia	T. Jones	CV
Robert C. Cooper	Rice University	H. Liszt	CV
Sanjoy Ghosh	Ohio State University	T. Cram	GB
Gregory J. Hartke	Layola College	P. Crane	GB
Andrew V. Klein	University of Chicago	L. Rickard	CV
Sumant Krishnaswamy	University of Maryland	B. Clark	Socorro
Karie A. Meyers	Penn State University	S. Spangler	CV
Richard L. Moore	University of Arizona	W. B. Burton	CV
Thomas A. McGlynn	Haverford College	H. Quintana	CV
Susan G. Neff	Indiana University	F. Owen	CV
Paula L. Petti	Brandeis University	E. Greisen	CV
Vitja Predan	Chalmers (Sweden)	Electronics	CV
Ronald C. Reitan	University of Minnesota	W. Brundage	GB
Todd K. Rodgers	Johns Hopkins University	L. D'Addario	Socorro
David W. Sayre	University of Michigan	P. Napier/S. Maas	Socorro
Richard Spencer	U. California, Berkeley	C. Leung	CV
Robert L. Varner	U. North Carolina	L. Somers	CV
W. Thomas Vestrand	University of Maryland	D. Shaffer	GB
Ashutosh Virmani	Lehigh University	R. Hallman	GB

* * * * *

NRAO ROUNDUP

Reprinted from the NRAO Quarterly Report for January 1, 1977 - March 31, 1977:

RESEARCH PROGRAMS

140-Foot Telescope	Hours
Scheduled observing	1998.00
Scheduled maintenance and equipment changes	140.00
Scheduled tests and calibration	0.00
Time lost due to:	
equipment failure	42.75
power	13.50
weather	16.75
interference	4.50

Interferometer	Hours
Scheduled observing	1843.00
Scheduled maintenance and equipment changes	116.75
Scheduled tests and calibration	145.50
Time lost due to:	
equipment failure	73.50
power	15.00
weather	100.75
interference	0.25

300-Foot Telescope	Hours
Scheduled observing	1975.00
Scheduled maintenance and equipment changes	158.00
Scheduled tests and calibration	7.00
Time lost due to:	
equipment failure	16.50
power	9.00
weather	3.75
interference	1.00

36-Foot Telescope	Hours
Scheduled observing	1901.00
Scheduled maintenance and equipment changes	125.25
Scheduled tests and calibration	120.75
Time lost due to:	
equipment failure	92.50
weather	155.75
power	0.00
interference	0.00

ELECTRONICS DIVISION

Charlottesville

The VLB Mark III system development is continuing and the current construction schedule is aimed at a July-August 1977 date for the first observations.

Development of Model IV autocorrelator is progressing satisfactorily. Programming will start as soon as the National Semiconductor SuperPace computer is delivered in the next few weeks. The delivery of the custom integrated circuits will be three months later than expected, but this will not affect the schedule significantly.

We have observed one of the University of Virginia Josephson junctions superconducting in a modified NRAO 100-GHz mount. Current work is being directed at improving the junction thermal properties and also building devices with up to five junctions in series.

The hardware for a subharmonically pumped 230 GHz mixer has been built and work is now directed to the difficult problem of whiskering the pair of diodes.

Tucson

Efforts have been made to solve various problems with the 80-120 GHz receiver. The main problems attacked were refrigerator pump modulation and variations in gain with elevation angle. As an aid in laboratory testing of gain variation with elevation angle, an outside test facility has been constructed adjacent to our mountain laboratory. Both problems have now been solved and the receiver gives close to theoretical performance for continuum observations. The receiver's poor performance at frequencies below 80 GHz has been investigated and changes have been made that give good performance down to 70 GHz.

Observing programs in both line and continuum using the new quasi-optical polarizer have been conducted during this quarter with good results.

The 30 kHz filter bank is in regular use and gives good performance.

The 33-50, 80-120 GHz receiver is complete, and after laboratory testing will be tested on

--continued, next page--

the telescope during the summer shutdown.

Tests have been made on a prototype 130-170 GHz room temperature receiver using quasi-optical techniques. This receiver will use the 4.75 GHz cooled parametric amplifiers in the 33-50, 80-120 GHz receiver as the I.F. amplifier, and a noise temperature of less than 2000 K SSB is expected with the mixer uncooled. The receiver is designed to permit cooling of the mixer with minimum modifications, and this should result in a substantial reduction in noise temperature.

Green Bank

Besides normal support of three telescopes, the Green Bank electronics group continues to be in the development stages of the next generation of NRAO receivers and telescope improvements.

Design of the servo electronics for the 140-ft deformable subreflector is well underway and procurement of actuators has begun. Digital conversion electronics for the 300-ft declination encoder are in the test stage. The microprocessor based prototype continuum standard receiver was completed this quarter, and lab and telescope evaluations are in progress to determine its future configuration.

The 5-cm front end for the excited OH line is essentially complete and is scheduled for use in April. Final trimming of the cooled diode switch for the 6/21-cm NAIC receiver is complete and initial assembly of this receiver is in progress. Some improvements of the spurious responses of the NRAO version of this receiver are being made, particularly in the area of IF reflections. One paramp channel of the 9-cm receiver was returned to allow a CH line search above 3.4 GHz. A harmonic generator for conversion of 5 MHz HI maser output to frequencies up to 3 GHz has been breadboarded. This will be added to the 140-ft for use in VLB observations.

In addition to the original JPL K-band maser, two 4 K refrigerators and one ruby/circulator structure now exist in Green Bank. Target date for installation of the single channel K-band system on the 140-ft is sometime in August. Operation of the first system, including tests of Weinreb's 100 GHz down-converter, have shown the maser/refrigerator to be remarkably reliable.

A distance discriminating reflectometer has been built and tested at 3.5 GHz and will be installed on the 140-ft for antenna reflection tests in May. Feed and waveguide loss studies continue for the new maser systems.

COMPUTER DIVISION

140-Foot Telescope - Work is continuing on the new 140-ft control system. Installation is scheduled for May 1977.

Manuals

Charlottesville - 360 System

TPOWER/SPOWER - A new edition of the TPOWER/SPOWER manual describing use with the IBM 360 system has been produced and is available.

CONDARE - A draft version of the CONDARE manual describing use with the IBM 360 system is available.

Green Bank - 140-ft

TPOWER/SPOWER/CONDARE - A manual describing the use of the 140-ft Modcomp has been completed and is in print. It should be available in the near future.

VLA Post-Processing - A set of programs has been developed which process VLA data starting with the output of the VLA Modcomp system. The programs resemble very closely the interferometer package used for the Green Bank interferometer. Their use is considered temporary, and they will eventually be replaced by programs which read the output of the DEC 10.

VLBI - The VLBI processor is now run by trained operators 120 hours per week.

ENGINEERING DIVISION

Engineering efforts this quarter were utilized in various on-going projects: In improving the design and specifications for a deformable subreflector for the 140-ft telescope; modifications to the 140-ft structure to prepare for the installation of a maser receiver; changes in 36-ft structure to minimize thermal deformations; updating the electrical system at the 36-ft; repairs to the brake system for the 140-ft; design of a jig for calibrating and testing inductosyns; research and conceptual design for astrodome, telescope structure, surface panels, radome

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fabrics, and surface measuring procedures and equipment for a future 25 meter millimeter-wave telescope; field inspection assistance to the VLA; general engineering assistance to Green Bank, Charlottesville and Tuscon.

VERY LARGE ARRAY PROGRAM

Array observations throughout the first quarter are averaging one 40-hour and one 88-hour run every two weeks. The array continues with a 5.2 km baseline and six element array maximum.

Antenna #9 was accepted February 25, 1977 and Antenna #10 was moved on March 28, 1977 to the Master Pad for final alignment and servo installation. Assembly of Antenna #11 began March 30, 1977.

The new L-band feeds are currently being installed, with work completed on Antennas #4 and #6. The installation of the redesigned local Oscillator System was completed on Antennas #3 and #5 with testing in progress.

In the computer area, the update of the Modcomp units were completed and the disk data base system for the DEC-10 became operational.

The visiting scientist's quarters were completed and occupied during the quarter. On March 18, 1977 the New Mexico State Highway Department agreed to resurface the portion of the old Highway 60 used as an access to the VLA site.

*****

ON TOMATOES

Wally Oref

"It's a nice place to live in the summer but it's a helluva place to raise tomatoes." This is a quote from a native and he isn't speaking with a forked tongue. After a few years gardening in the Green Bank area one soon realizes tomatoes here set half as much fruit as in Charlottesville and many tomatoes are still green by first frost. This is because here the growing season is short. The last spring frost can come in late May and the first fall frost by September. Even this short season would be long enough if our night time temperatures were higher than they are. Throughout the summer, night time temperatures fall below 64 degrees most of the time, a temperature plant scientists say is critical to raising tomatoes.

At the University of California, tests conducted on tomatoes in two special greenhouses where all sorts of climatic factors could be controlled revealed some very interesting insights on raising tomatoes. For example, when greenhouse tomatoes were kept at constant temperatures of 79 degrees but kept at different relative humidities (70% in one and 40% in the other) relative humidity made little difference but constant temperature did. Tomatoes grew in both greenhouses at about the same rate but they never developed a deep, green color, were spindly, and worst of all, they failed to set fruit. This was wholly unexpected since tomatoes in the field grow well at average temperatures much higher than the 79 degrees maintained in the greenhouses. However, when the temperature was dropped to 64 degrees and kept there, interesting things happened to the tomatoes.

At a constant 64 degree temperature, plants immediately started to set fruit and ripen normally. Further experiments determined that many plants need a daily cycle of temperature change, and they did best if the night temperature (i.e., during the dark period of the plant's growth) was near 64 degrees.

In Pocahontas County, and especially around the Green Bank area, temperatures at night average below 64 degrees. This means we don't have the optimum temperature to set fruit and ripen tomatoes. As a result our standard variety of tomatoes rarely bear heavily and a lot of green tomatoes freeze. We go through this every year accepting it as our fate for living in God's country (as the Tucsonians would say). Yet there is something you can try this year that might help you raise a better tomato crop than in past years.

In the same experiments at Cal Tech, plant scientists found that covering tomatoes with a dark cloth during the late afternoon while temperatures were in the proper range enabled tomatoes to set and mature fruit one

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month ahead of uncovered plants. A less expensive and time-consuming way to obtain similar conditions is to plant tomatoes on the east side of a wall or shade tree. This way they are shaded and start their night activities while the temperatures are still high enough. Why not give these ideas a try. It might be a way to beat our Green Bank weather and get more tomatoes.

*****

Every day stop before something
beautiful long enough to say,
"Isn't that b-e-a-u-t-i-f-u-l!"

*****

GREEN BANK BOWLING - 1976-77

Dick Hiner

The Green Bank bowling team has completed the 1976-77 bowling season. A record of 69.5 wins - 74.5 losses gave us fifth place in the Tuesday night league at the Elkins Recreation Center. In the first half of the season (thirteen weeks) we posted a 32 - 40 record, and finished the second half with a 37.5 - 34.5 record.

The following employees bowled this past season: Bruce McKean, Jim Gibb, Harold Crist, Larry Miller, Howard Brown, Bob Vance, Wendell Monk, Ed Burke, Albert Wu, Bill Vrable, Don Hovatter, Dick Hiner, and Russ Poling.

Wendell Monk took the honors with a high series of 623 on December 21, 1976, and high game of 243 on May 10, 1977.

Every Tuesday night - come hail, rain, or snow - we traveled 50 miles one way to Elkins, over Cheat Mountain. Despite some hectic trips over the mountain and some disappointing bowling nights, most everyone who bowled enjoyed the season. If you want to number yourself among the stalwarts and would like to bowl next season, please contact me at extension 309. The next bowling season will begin about August 30 or September 6.

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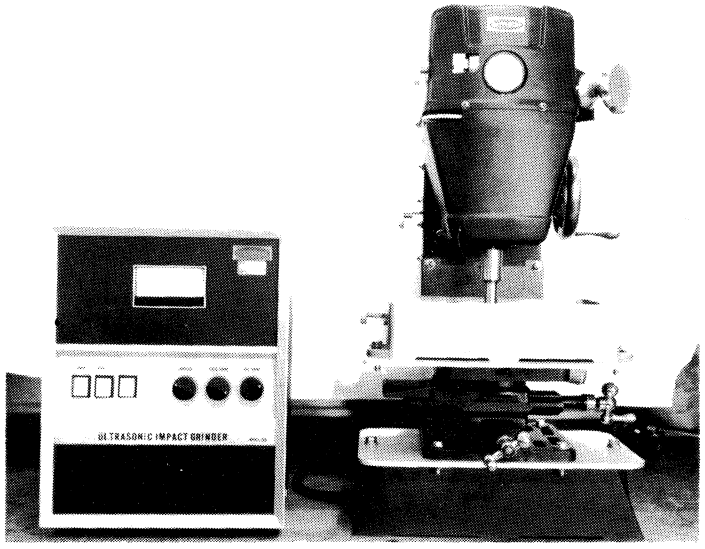
ULTRASONIC MACHINE

Omar Bowyer



100 Watt Ultrasonic Mill

Pictured is a 100 watt ultrasonic mill now in use in the Lab. This mill will be used primarily to make parts for the maser receiver. Ultrasonic machining is the removal of material from the workpiece with the wearing action of an abrasive grit and a tool vibrating at a frequency of between 20 and 30 KHz. A power source drives a series of coils wound on a stock of magnetastrictive material which provides the vibrating action of the tool. These vibrations move the tool up and down from 0.0005 to 0.005 of an inch. The abrasive slurry is fed between the workpiece and the tool.

The tool design is very important and tricky. It must first be the shape of the finished product (a different tool for each size and shape) and must resonate between 20 and 30 KHz. A properly designed tool and tool holder will give an amplitude gain of six times the input power. The tool can be made of brass, stainless, mild tool steel to tungsten carbide (we use Monel R-405). Tool wear to work piece ratio can be as high as 200:1. For example, 200 inches of material will be removed as the tool wears 1 inch. The idea is to make a tool that is ductile and tough (not hard), with not too much mass

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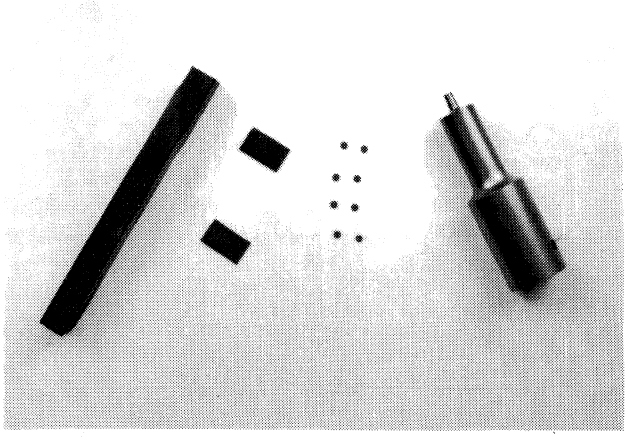
(this absorbs energy) and not too long (this causes overstressing) that gives maximum amplitude and wears well.

Some very hard and brittle materials that could be machined at NRAO with this mill include alumina, ceramics, carbon, ferrites, germanium, load materials, quartz, ruby, etc. Parts will be machined into circles, squares, rectangles, angles, etc. This will be used for matching, terminating, insulating, mounting, etc.



Before ultrasonic milling begins, stock material (ferrite bar in photo) is diamond sawed into thin slices and lapped to thickness. Lapped slices are machined with an ultrasonic mill into super accurate circular discs (OD - 0.147", thickness - 0.29"). Also shown in this photograph is a tool and tool holder made by Wendell Monk.

Operating this mill is much different than operating traditional milling machines. You use different size grits to get specific dimensional tolerances, surface roughness, and cutting speed. For example, #800 grit gives a 10 microinch finish but cuts very slowly. #180 grit increases speed of cutting, but gives poor finishes. With all of these facts, and many more, they say they can achieve tolerances of 0.0005 of an inch.

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

Doris Gill

One of the truly significant prospects of the sixties, and one of the highlights of prospecting in New Mexico mining, was the discovery of silver ore at Pueblo Springs, near Magdalena, in 1863. The silver content was low and little or no mining took place at the time, but this discovery was one of the first indications that New Mexico might have valuable silver deposits. While no great silver strikes were made, an important lead deposit was discovered on the western slopes of the Magdalena Mountains by J. S. Hutchinson. This discovery led, in a few years, to the great mining enterprises at Kelly. By 1864 prospectors were working the area west of Socorro, encouraged by the proved silver and lead values. In that year, the first discoveries of silver were made in the mountains just west of Socorro, leading to the formation of the Socorro Peak Mining district, which boomed in the 1880's.

Just south and a little east of Socorro, coal had been mined on a small, local scale in the 1850's. In 1861, it was reported that United States Army troops from Fort Craig had "opened an important coal mining area" north of the fort, the same area worked from Socorro. Thus, the beginning of the famous Carthage coal field that produced considerable tonnage of coal until the middle of the 20th century.

In the 19th century, Socorro County, which included what later became Catron County, boasted a number of important mining centers, and for a brief time in the 1880's it seemed the county and town of Socorro would emerge as the center of mining in New Mexico. It did not, but the people of Socorro in the hectic 1880's did not know that. To them, the ores being ripped from the mountains of the county were the beginning of an endless stream of wealth insuring the city of Socorro as a rich and populous center of mining in New Mexico.

In central New Mexico, in the Magdalena mining district, 26 miles west of Socorro, mining got under way seriously in the early seventies. Important lead mines, with some

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silver as a by-product, had been prospected earlier. The first claim staked out was the Juanita, and 3 weeks later the Graphic was discovered. By 1870 the lead ores were being mined, then smelted locally in adobe furnaces. The product of this primitive process was shipped over the Santa Fe Trail to Kansas City. Around the mines in the Magdalena Mountains, two towns sprang up; Kelly at the mine site proper, and a few miles north, the town of Magdalena. For 20 years the mines in the district produced most of the lead in New Mexico and had to be rated a bonanza. The value of the lead-silver ores in the Magdalena district amounted to nearly $9,000,000 by the end of the century, most of which was produced before 1890. The Kelly and the Graphic mines were the major producers, accounting for nearly 90 percent of the total; the Juanita was of secondary importance, followed by a number of lesser mines and many claims. While only a small fraction of that amount was produced in the seventies, that was the period when the mines and roaring camps began near the Magdalene (the face on the mountain).

The town of Socorro, supply center for many of the mining camps of central New Mexico, had its own mining district. Discovery of silver on Socorro Mountain in the late seventies led to active mining as the eighties progressed. In October, 1881, some preliminary work was done, according to one report: "200 feet of exploratory shaft was done but no stoping. About 3000 tons of ore in sight." Much of this early work was done by William Courtis. Although a 10-stamp mill was built to handle ores, the production from these mines was disappointing, and the district only produced about $750,000 over its lifetime. While mines did not produce the large amounts of wealth hoped for, the wages generated during the middle years of the 1880's helped to support the most significant boom in the history of Socorro. The principal mines were the Torrance and the Merritt. The latter is still utilized for scientific research purposes by New Mexico Institute of Mining and Technology.

While discovery at Kelly dated back into the 1860's, active large-scale mining began in 1881. In that year, the Kelly mine, which became one of the most famous in the district, was acquired by Gustav Billing, who developed the lead deposit to its fullest potential. The mine remained in the Billing family until 1904 when it was sold to the Tri-Bullion Mining and Smelting Company by Mrs. Billing. The Juanita, also near Kelly, was owned by E. W. Eaton in 1882. Eaton, involved in ranching in Socorro County, founded the Socorro Vigilance Committee in 1881. In 1882, he reported about the Juanita: "One million pounds of this (lead) bullion is on the ground, it assayed 5 ounces of silver to the ton of ore in addition to the lead. Pinon charcoal was used in the smelting. As soon as the connection with the AT&SF is complete, cheap coke at Socorro will become an important factor in the Metallurgical operation."

Gustav Billing built a smelter at Socorro to handle the lead carbonate ores from Kelly as well as custom smelting for other mining areas in New Mexico. During the first years of operation, ores were hauled from Kelly to Socorro in huge ore wagons pulled by oxen. Transporting ore down Blue Canyon was difficult, treacherous, and time-consuming. In 1883, the Santa Fe Railroad agreed to build a spur to Magdalena and Kelly if the mines at Kelly guaranteed a certain tonnage per year. The immense amount of ore being recovered made such a guarantee easy to meet, and the road was completed the same year. With the railroad to the mines and the smelter at Socorro, the expansion around Magdalena and Socorro was staggering. Socorro grew rapidly to a town of nearly 5,000 during the middle eighties. Magdalena grew to nearly 1,300, and Kelly fluctuated between 500 and 800, depending upon the intensity of mining activity. The Magdalena district was one of the most productive in the territory prior to 1900. While its product was primarily lead (certainly less romantic than gold or silver), nonetheless the values were great and the volume high.

The construction of smelters for the reduction of the lead carbonate ores was just as important as mining to the growth of Socorro and Magdalena. Early smelting in Socorro and Magdalena was crude and simple. Lead carbonate ores, which could be reduced in an ordinary kiln, were simply mixed with the right proportions of fuel and fed into

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adobe furnaces. Metallic lead was collected as it ran out of the fire door onto the hearth. No slag was formed, and the dross from such crude operations retained a higher proportion of lead than some ores now rated as rich.

A plentiful supply of cheap coal at nearby Carthage was a distinct advantage for Socorro, which helped determine the locations of smelters. Good quality limestone was readily available. The coal, reduced to coke, was delivered in Socorro at $8.00 per ton. The limestone cost $1.90 per ton. The first modern smelter to take advantage of these factors was the Billing smelter, built and put in operation at Socorro in 1883 - the first and only custom smelter in the territory; a distinction it retained until 1891. During 1884, probably the peak year, the Billing works produced bullion valued at $1,078,266.59. In 1893 Billing sold the smelter to the American Smelting and Refining Company, which shut it down. The Graphic Mining and Smelting Company also built a smelter at Magdalena, in connection with the Graphic mine. First mentioned in the *SOCORRO SUN* in 1881, it was called the New Orleans and La Joya Smelting Company; in 1882 it was sold to the Graphic Company. In 1885 it started full production and for 3 years processed ores from the Graphic mine. In 1888 the smelter was closed down. A third smelter was constructed in Socorro in 1885, but was short-lived, as decreasing lead prices forced both mining and smelting to shut down.

--THE STORY OF MINING IN NEW MEXICO, Paige W. Christiansen, Socorro 1974.

*****

WE'RE LOOKING FOR PEOPLE WHO LIKE TO SEEK

Lee J. Rickard

On the average, astronomers may not be rowdier than the general public, but neither are they more sedate. Still, the popular image has us dull and grey, "poor old astronomers/Who totter off to bed and go to sleep/ To dream of untriangulated stars". So the provocative Objections to Astrology - the 1975 statement by 186 astronomers, astrophysicists, and miscellaneous scientists - must have seemed quite out of character. Imagine, distinguished Bart Bok taking a swing at Sydney Omarr. That may partially explain the statement's wide press coverage; that and the fact that newspapers know well the public's appetite for all things astrological. (You may recall my discussion of this in the last *OBSERVER*.) Whatever; press coverage it got, as well as much greater public response than anticipated.

Reactions to the statement were not altogether favorable, even among scientists who agreed with its sentiments. Many objected to it as authoritarian, asserting an opinion and then throwing around academic credentials rather than proof. (Which is true; the statement alone is authoritarian. But those who read the statement in its original source, The Humanist, rather than reprinted in the newspapers, also saw the accompanying articles on the scientific and statistical evidence against astrology, written by Bart Bok and Lawrence Jerome.) It was the size of the response, however, that counted to the members of the American Humanist Association and the American Ethical Union, joint publishers of The Humanist. After years of concern about the rising influence of pseudoscientific beliefs, this was the first evidence they'd seen that more than a few scientists were willing to sacrifice time and effort to the problem. It seemed wise to take the tide at the full.

Hence the formation, in May of 1976, of the Committee for the Scientific Investigation of Claims of the Paranormal, or CSICP (which is unpronounceable, so everyone calls it the Committee). The Committee consists of 35 Fellows, a mix of astronomers, psychologists, science writers, statisticians, philosophers, and magicians. It includes such eminent debunkers as Milbourne Christopher, C. E. M. Hansel, Carl Sagan, Philip Klass, Bart Bok, Martin Gardner, and Lawrence Kusche. It is chaired by Paul Kurtz, a philosopher at SUNY Buffalo and editor of The Humanist, and by Marcello Truzzi, a sociologist at Eastern Michigan University and specialist in patterns of occultist belief. Truzzi also edits the

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Committee's biannual journal, The Zetetic, a name derived from the Greek word zetein, meaning to seek, to inquire. And to what purpose? Basically, to champion critical inquiry into reports of paranormal phenomena, and to provide a public voice to refute invalid claims. The Committee hopes to organize published critical examinations of parascientific ideas for use by the news media and by the general public. Through The Zetetic and through special conferences and meetings, it will try to provide neutral forums for objective discussions of parascience. And where necessary (and where the limited funds will stretch), it will sponsor research.

So far, the Committee activity with the highest profile is an outgrowth of Objections to Astrology. In his article accompanying the statement, Lawrence Jerome took a fairly critical stance toward the work of Michel and Francoise Gauquelin. The Gauquelins have analyzed the birth times and places of more than 40,000 Europeans in order to check the claims of natal astrology. They argue that there are statistically significant trends for successful individuals in some professions to be born preferentially at times when certain planets are in particular parts of the sky. For example, of 1553 sports champions, an unusually large number were born within two hours after either the rising or the upper culmination of Mars. (Not a very large number, really, but a statistically significant excess.) Some astrologers have seized upon these results as a scientific verification of astrology; M. Gauquelin rejects that interpretation, pointing out that he has found no evidence for traditional horoscopic interpretation. (He has not, however, resisted the embraces of more distinguished borderline scientists, such as UFOlogist J. A. Hynek and ESPer H. J. Eysenck.)

The Belgian Committee Para used a separate sample of 535 athletes to verify the correctness of the Gauquelins' calculations, but strongly disputed two fundamental assumptions: that all possible configurations of the daily motion of Mars were equally probable during the sample time base (they aren't), and that the frequency distribution of the hours of birth during the day (the nychthemeral curve) is a constant distribution for the sample time base (it isn't). Jerome echoed these criticisms in his article, Gauquelin objected, Jerome responded, Committee members George Abell and Martin Zelen responded, etc. The argument has raged through the pages of The Humanist for nearly a year. Now, the Committee has sponsored a large-scale statistical study (by statisticians Zelen and Elizabeth Scott, and astronomers Abell and Owen Gingerich) which both sides agree will be a definitive test of Gauquelin's "planetary heredity". The results are expected in about a year.

Other present activities range from the scientific to the legal. There is a subcommittee on UFOs, chaired by Philip Klass, which sponsors investigations of new sightings. Klass is featured in the upcoming Zetetic with an article on Peter Sturrock's collection of UFO reports by A.A.S. members. Another subcommittee member, Robert Schaffer, recently made the Washington Post with his identification of Jimmy Carter's UFO sighting. (It was Venus.) Martin Gardner has been analyzing purported proofs of Uri Geller's spoonbending abilities; the latest appears in the May/June Humanist. For a year now, the Committee has been offering Geller the chance to demonstrate his psychokinesis under controlled conditions. (Meaning, of course, controlled both by scientists and by professional magicians.) Geller has not responded. The Committee is preparing a complaint to the FCC about NBC's predilection for the occult. [Not content with prime time rehashings of the mysteries of von Daniken (Rod Serling returning from the grave to ask just one more rhetorical "Could it be...?"), NBC has taken to padding the evening news with credulous reports about dowsing and precognition.] And, the Committee is investigating the use of psychics as witnesses in jury trials.

There are hazards to these enterprises, as manifested in several historical examples. There is the possibility of incorrectly debunking a real phenomenon. In the face of 300 reports about a meteorite fall in 1790, the French Academy of Sciences ridiculed the popular credulity about falling stones. To be fair, though, almost all of them were

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opining outside their realms of competence; and, it was another Academy committee, led by Biot, which later proved that some rocks did indeed fall from the sky. Consider as well the effects of the Academy committee that correctly debunked Mesmer's theories of animal magnetism. It missed the underlying real phenomenon, and could be held responsible for a 50 year pause in the scientific study of states of enhanced suggestibility. Conversely, what are the chances of an erroneous favorable endorsement? A Scientific American committee on spiritualism would have validated Margery, the Boston medium, had it not been for Houdini's virtually last-minute intervention. We may soon see another example, if the I.E.E.E. persists in supporting Geller groupies Targ and Pughoff. And finally, what is the utility of reasoned scepticism if the public considers the source authoritarian, arrogant, and obscurantist? The Condon Committee's apparently negative bias seems, in the long run, to have aggravated the UFO fervor, not settled it.

The Committee has taken some anticipatory steps. The Fellows' heterogeny is insurance against the naive credulity of all about any one issue. Also, the Committee asserts that, while it may initiate and support research, it will never endorse any Fellow's particular conclusion. (The seeking is what counts' if anyone thinks he's found something, let him start his own journal.) And of course, most Fellows feel that the possibility of error is no excuse for avoiding a stand. Besides, there are advantages: the satisfaction of doing a public service, the respect of one's peers, the pleasure of being funded to do what one used to do out of simple biliousness. (In addition, I suspect that techniques devised for handling borderline science may be useful for borderline problems within science. Consider: "Evidently, any particular ESP example can be contested or explained separately by specific characteristics. However, the evolution of the experimental situation is presently weighting the scales (in the author's opinion) in favor of ESP's existence." How do you argue with that? The answer may interest Jean-Pierre Vigier, whose words those were before I substituted 'ESP' for 'anomalous redshift'.)

I cannot resist pointing out some of the ironies of the name Zetetic, though. The original zetetics were the followers of Pyrrho, who founded a school of scepticism around 330 B.C. Pyrrho argued that reason was insufficient to reveal truth, that all knowledge was uncertain, and that one had to suspend judgment to achieve happiness. Not, I think, the appropriate role model. The earliest modern reference to zetetics was by Franciscus Vieta, a top mathematician of the 16th century, who used the term 'zetetic logic' to refer to the algebraic search for unknown quantities. A sceptical fellow himself, Vieta rejected Copernicus' work as utter nonsense. Unfortunate, that. Finally, the O.E.D. refers to S. B. Rowbotham's (1849) book: Zetetic Astronomy. A description of several experiments which prove that the surface of the sea is a perfect plane and that the Earth is not a Globe! Oops.

Anyway, subscriptions to The Zetetic can be had by sending $10 to Box 29, Kensington Station, Buffalo, NY 14215. I can guarantee one thing: it won't make a believer out of you.

*****

OBSERVER DISTRIBUTION

Over the years the *OBSERVER* mailing list has been steadily growing. In an effort to update this list the editors distributed request forms to *OBSERVER* subscribers in 16 states and 7 foreign countries, asking if they wished to continue receiving said publication. The response was amazing! Of the 76 request forms distributed, 65 were returned.

For March 1977, distribution totaled 504 copies. In addition to 69 (the list continues to grow) subscribers (including 13 retired employees), copies of the *OBSERVER* go to employees of NRAO-Green Bank, -Charlottesville, -Tucson, -Socorro, and to the National Science Foundation.

Several of the returned forms carried messages from the subscribers. Since just about all these folks worked at NRAO at one time or another, we thought it would be nice to share their news and whereabouts with you. So.....

--continued, next page--

Dr. Gart Westerhout
Department of Astronomy
University of Maryland
College Park, MD 20742

☑ Check here if you wish to receive future issues of the *OBSERVER*.

Is the above address correct? If not, please indicate corrections in the space below.

And I very much appreciate being on the mailing list! Compliments to the Editors for excellent productions.
/Art Westerhout

Mr. Tom Williams
920 W. Vanmeter Street
Kankakee, Illinois
60901

☒ Check here if you wish to receive future issues of the *OBSERVER*.

Is the above address correct? If not, please indicate corrections in the space below.

Greetings to one and all
Willy and many thanks
Tom

Dr. Joe Maslowski
Astronomical Observatory
Jagellonian University
Cracow, Kopernika, 27, POLAND

☒ Check here if you wish to receive future issues of the *OBSERVER*.

Is the above address correct? If not, please indicate corrections in the space below.

MASLOWSKI

I am very sorry for this delay in the answer. Your letter lost I was not present in Poland since June 76.
I will be very happy to receive future issues of the OBSERVER.
Best wishes, Joe Maslowski

Mr. Lyle McPherson
Cass
West Virginia 24927

☑ Check here if you wish to receive future issues of the *OBSERVER*.

Is the above address correct? If not, please indicate corrections in the space below.

[redacted]

Look forward to each issue
You are doing fine Job
Pete

--continued, next page--

Dr. Bertil Hoglund
Onsala Space Observatory
S-430 34 Onsala
SWEDEN

☑ Check here if you wish to receive future issues of the *OBSERVER*.

Is the above address correct? If not, please indicate corrections in the space below.

Dear Wally:

I'm happy to announce my continued interest in your excellent publication. Best regards to you and your family,

Bertil

Ms. Bernice Peterson, Editor
Brookhaven Bulletin, B.N.L.
40 Brookhaven Avenue
Upton, L.I., New York 11973

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Is the above address correct? If not, please indicate corrections in the space below.

you have a very lively publication.

BP.

Mr. Nigel J. Keen
M.P.I.F.R.
Auf dem Hugel 69
53 Bonn, WEST GERMANY

☒ Check here if you wish to receive future issues of the *OBSERVER*.

Is the above address correct? If not, please indicate corrections in the space below.

And thanks for keeping it going: it is read by many colleagues here.

Nigel

Mrs. Cleo Harper
Green Bank
West Virginia 24944

Boy Sz—

☒ Check here if you wish to receive future issues of the *OBSERVER*.

Is the above address correct? If not, please indicate corrections in the space below.

I look forward to receiving the observer. Especially the What's Cooking and the kid garden by Claude Kitchens and the little things that are useful, like the soap saver. Also the human interest stories by Mr. Ulf Lundie.

I would like to thank you very much for thinking of me. I miss the nice people. Friends again.

Sincerely,
Cleo B Harper

Bengt A Pettersson, MSEE
Briljantg 55
S-421 49 V FROLUNDA
Sweden

Moreover, I should like to take the opportunity to wish you and all at NRAO a Merry Christmas and a Happy New Year. As I worked at NRAO back in 1970 a little part of my heart is still there after a very pleasant summer with you. If possible a special greeting to dr Weinreb.

All the best.

--continued, next page--

Dr. Rolf Dyce
Arecibo Observatory
P. O. Box 995
Arecibo, PUERTO RICO 00612

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Is the above address correct? If not, please indicate corrections in the space below.

— Please —
RBD
1 Nov 76

Mr. Bert Hansson
Onsala Space Observatory
S-430 34 Onsala
SWEDEN

☒ Check here if you wish to receive future issues of the *OBSERVER*.

Is the above address correct? If not, please indicate corrections in the space below.

Dear Wally,
I really hope that I can receive the observer in the future, Birgitta & I read it carefully and it is a good connection to "good old days" at Green Bank for us. We often talk about the wonderful time we had in West Virginia in the beginning of the 60's.

Best

Mr. Peter B. Good
22748 Flamingo Street
Woodland Hills
California 91365

☑ Check here if you wish to receive future issues of the *OBSERVER*.

Is the above address correct? If not, please indicate corrections in the space below.

Hi Wally!
Here's my chance to say HI! I'm still in the film business and still married. Have a new boy (2 yrs old) cultivating my backyard and pulling weeds. In other words, I'm domesticated, raising a family and attempting to pay my taxes.
Say hi to your family. Gee, the kids must be grown up by now.
Best regards, Peter

Dr. Michael M. Davis
P. O. Box 995
Arecibo
PUERTO RICO 00612

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Is the above address correct? If not, please indicate corrections in the space below.

Absolutely! Keep up the excellent work.
Say hello for me,
Mike Davis

Mr. Magne Hagstrom
Onsala Space Observatory
S-430 34 Onsala
SWEDEN

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Is the above address correct? If not, please indicate corrections in the space below.

Thanks for your kindness to still send it to me. It is a pleasure to read it.
Magne Hagstrom

--continued, next page--

Mrs. Richard Van Brunt
3836 Wonderland Hill Avenue
Boulder, Colorado 80302

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Is the above address correct? If not, please indicate corrections in the space below.

Dear Barbara, I really do enjoy reading the Observer — it's like having a friend down for a visit! How are things with you? Can you believe Nicholas will be 4 = next month?! I am still working part-time on an "acting" basis in the Business Library here at the University - Nick is in a musical pre-school 2 mornings per week and in a day care home the

Dr. Frank O. Clark
Dept. of Physics & Astronomy
University of Kentucky
Lexington, Kentucky 40506

☒ Check here if you wish to receive future issues of the *OBSERVER*.

Is the above address correct? If not, please indicate corrections in the space below.

J. W. M. Baars
Max Planck Institut für Radio-astronomie
Auf dem Hugel 69
53 Bonn, GERMANY

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Is the above address correct? If not, please indicate corrections in the space below.

The Obs. is a lot of fun. Greetings from

Dr. Alan Parrish
MIT Room 26-321
Cambridge, Massachusetts
02139

☑ Check here if you wish to receive future issues of the *OBSERVER*.

& Greetings from the "Blue Grass"!

Is the above address correct? If not, please indicate corrections in the space below.

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Darn tootin'!

Is the above address correct? If not, please indicate corrections in the space below.

Yep.

Ms. Sharlene Wiley
London Squire Mobile Court
Route 2, Lot A48
Evington, Virginia 24550

☒ Check here if you wish to receive future issues of the *OBSERVER*.

Is the above address correct? If not, please indicate corrections in the space below.

Mrs. Sharlene Wiley
P.O. Box 3131
Lynchburg, Virginia 24503

As a former employee of NRAO in Charlottesville, I enjoy very much receiving The Observer and keeping informed of the latest events and activities of NRAO. Thanks for keeping my name on your mailing list.

Dr. John Broderick
Physics Department
V.P.I. & S.U.
Blacksburg, VA 24061

☑ Check here if you wish to receive future issues of the *OBSERVER*.

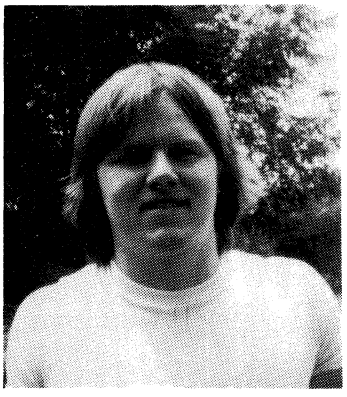
Is the above address correct? If not, please indicate corrections in the space below.

Thanks Wiley, please.
Really enjoy

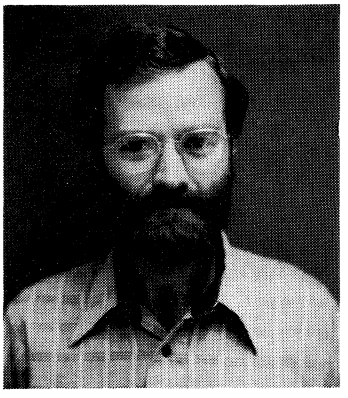
* * * *

PERSONNEL UPDATE

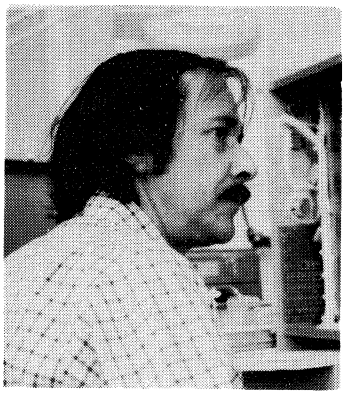
NEW EMPLOYEES



Gregory A. Brubaker
Laborer
Plant Maintenance - GB

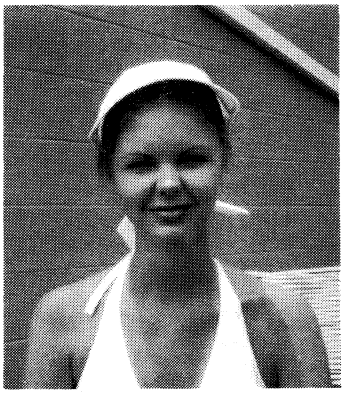


Frank O. Clark
Assistant Scientist
Basic Research - CV

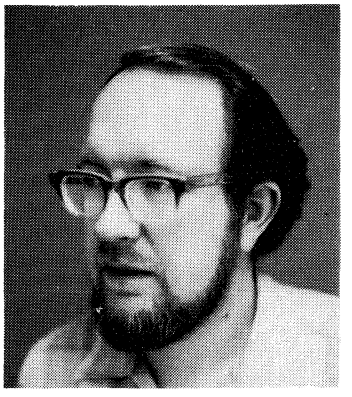


Wilbur J. Crouch, Jr.
Technical Specialist
VLA - New Mexico

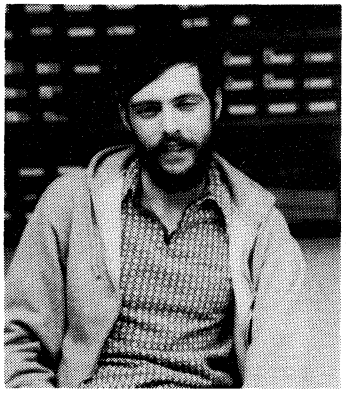
Patricia J. Crowley
Secretary
VLA - New Mexico



Nathalie K. Dolan
Lifeguard
Plant Maintenance - GB

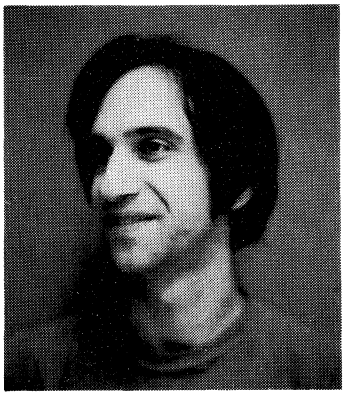


John Faulkner
Visiting Scientist
Basic Research - CV



Paul M. Harden
Technician
VLA - New Mexico

David C. Hudson
Technician
VLA - New Mexico



Walter J. Jaffe
Assistant Scientist
Basic Research - CV

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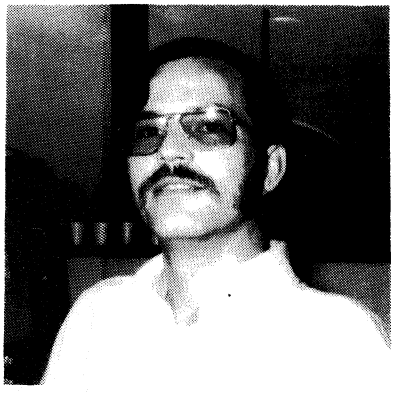
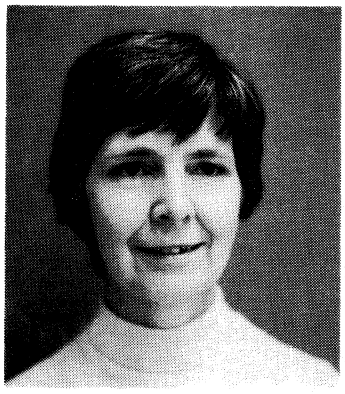
NEW EMPLOYEES (continued)



Michael G. Livesay
Technical Specialist
Telescope Operations - GB



Silena K. Morris
Technician
VLA - CV

Victor V. Torres
Telescope Mechanic
VLA - New Mexico

OTHER NEW EMPLOYEES - PHOTOS NOT AVAILABLE

Susan M. Novak	Tracer	VLA - New Mexico
Antonio N. Pargas	Special Services Assistant	VLA - New Mexico
Robert W. Ridgeway	Technician	VLA - New Mexico
Eugene W. Spaulding	Technical Specialist	VLA - New Mexico
Frank Tafoya	Maintenance Trainee	VLA - New Mexico

REHIRES

Ted M. Baca	Technician	VLA - New Mexico
Bruce Balick	Visiting Associate Scientist	Basic Research - New Mexico
Rick Beverage	Laborer	Plant Maintenance - GB
Luis R. Casiano	Technician	VLA - New Mexico
Alfred M. Collins	Laborer	Plant Maintenance - GB
James M. Manning	Technician	VLA - New Mexico
Daniel J. McGuire	Technical Specialist	Telescope Operations - GB
James J. Osborne	Technician	VLA - New Mexico
James F. Wooddell	Lifeguard	Plant Maintenance - GB

TRANSFERS

Kerry C. Hilldrup
Technical Specialist
VLA - New Mexico

LEAVE OF ABSENCE

Ether J. Tyson
Stores Clerk
Administrative Services - GB

RETIREE

Richard S. Skaggs
Technician
Electronics Division - GB

TERMINATIONS

Harry L. Beazell, Jr.	Joseph S. Gray, Jr.	Shelby A. McLaughlin
Raymond R. Brown	Russell A. Hulse	Steven M. Pasternak
Thurmond B. Derryberry, Jr.	Harriette Marcus	William K. Rose

* * * * *

PRECISION ELECTROFORMING AND ITS APPLICATIONS

John Lichtenberger

In the field of high frequency electronics (microwaves), there exists a unique manufacturing problem in that complex components must be fabricated with high precision, often on a microscopic scale. This has necessitated some rather exotic manufacturing processes, one of which is the technique of electroforming. In principal, the method seems rather straightforward; one merely electroplates for prolonged time periods, often for more than a week. In practice, the problems of maintaining a uniform deposit on all surfaces and of minimizing the time requirement complicate matters.

Most of the components I have been responsible for have been "wavequides", which are nothing more than metal tubes of various configurations which are used to "channel" microwave radiation to a suitable receiver for detection. These tubes (often referred to as plumbing) frequently contain various baffles and wires as integral parts of the structure, and tolerances of ± .0005" are not uncommon. These factors place severe limitations on the method of fabrication, and the inherent reproducibility and accuracy of electroforming make it the ideal choice.

To begin the process, a negative of the desired component is machined out of a suitable material (in our case, aluminum). This negative (mandrel) is then treated chemically to receive an electroplate. For microwave work, the mandrel is initially given a thin coating of gold, typically .00005-.0001" thick. The gold functions as a protective layer to prevent corrosion and also has excellent and stable conductivity at microwave frequencies.

After the initial gold plate has been applied, the mandrel is placed in a suitable electroplating bath and "grown" for a time sufficient to yield the desired thickness of metal. Most of our work is produced in copper, with a small percentage using nickel. When the mandrel has reached a sufficient size, (typically 0.125") it is removed from the bath and the aluminum is dissolved out with either sodium hydroxide or hydrochloric acid. The finished piece is thus capable of having many complex internal corners and wires, etc. grown into it, producing a solid piece of metal which would be impossible to manufacture with precision by any other means.

In order to electroform successfully, the electroplating process must be very carefully controlled. The process I use is one based on copper(II) sulfate and sulfuric acid, with an additive to control the grain size of the deposit and thus affect its physical and mechanical properties. Copper normally deposits from acid electrolytes in a coarsely crystalline collumnar structure, which is very brittle and would be unsuitable for engineering applications. By utilizing certain surface active organic and inorganic additives, it becomes possible to modify the deposit structure to a much more ductile form. This comes about because the nature of the additives is such that they are selectively adsorbed at active growing sites and shield the substrate from further growth at these points. Thus these additives also act as "levellers" in that they tend to cause the deposit to be preferentially plated into depressions and crevices eventually completely smoothing out the original topography of the surface.

Some of the limitations of the process require careful consideration in the initial design of a component. Two of the biggest problems are the inability of the deposit to plate into sharp internal corners (it is theoretically impossible to "throw" an electric field into a perfect corner) and the problem of plating into recesses which are deeper than they are wide. In this latter case, the deposit will grow over the top of the groove or recess before it fills in completely, often trapping plating solution within the finished product, a highly undesirable situation! With proper design, these limitations can be overcome, however.

Some other industrial applications of electroforming are: record manufacturing, where the original master of the desired recording, made of lacquer or wax, is given a conductive coating and then electroformed with nickel to make a perfect negative of the recording. These "master negatives" are then used to grow metal record masters, from

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which are subsequently grown the stampers used to press the final record copies from vinyl. Some not so apparent advantages of electroforming arise from the fact that the metals are being deposited at or near room temperature, often in thermodynamically unstable states. Thus nickel and nickel alloys can be deposited within an extremely wide range of hardnesses, and the well-known case of hard chromium deposition for tooling is a perfect example. In this respect, most electrodeposited metals are similar to severely cold worked metals and alloys. NASA has made use of electroformed nickel-cobalt alloys in many of the satellite and space vehicle programs, taking advantage of the high strength of these alloys.

Another application of electroforming is the field of composites. If alumina powder is uniformly dispersed in a plating bath during operation, some of the powder will be incorporated in the deposit, thereby modifying its properties. Likewise, boron filaments can be slowly wound onto a growing mandrel to be incorporated into the final deposit and improve its mechanical strength. Diamond saws are made by suspending diamonds in a nickel plating bath and growing the deposit to include them.

One major drawback of the electroforming process is the amount of time required to fabricate the component. If one adds to this the time spent in producing the mandrel, we see that the process is not readily modified to mass production techniques. The time requirement arises due to the limited rate at which a metal can be deposited from aqueous solutions of its salts. The process is diffusion controlled in most commercial plating baths; thus the problem becomes one of decreasing the distance over which diffusion influences the deposition rate thereby increasing this rate. Immediately adjacent to the electrode is a layer of solution which is depleted with respect to the bulk concentration of metal ions. It is this depleted layer, called the diffusion layer for obvious reasons, which determines the limiting current density for the plating process and thus the plating rate. Since the metal ions must move through this layer strictly by diffusion, if we decrease its thickness, we effectively increase the number of ions traversing the region/unit time and thus enhance the plating rate.

Current research in the field is involved with both increasing the rate of deposition (some baths are now available using special techniques which can plate up to .001"/minute) and with developing new processes to enable the deposition of special engineering metals (stainless steel, titanium, aluminum) from easily controlled baths.

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NEW MEXICO MADNESS

VLAPRA is at it again. HOWEVER, our timing of events with the schedule of the *OBSERVER* publication is really BAD. Ye editor doesn't like old news - so you may not see in print all the bathing beauties that will be (were) in evidence June 17 from 6:30 p.m. to ????? at the city pool at Sedilla Park.

Another recreation activity planned is the 3rd Annual Picnic to be held Saturday, August 13. This is always a well-planned, fun afternoon for the entire family and we will have more to report on that later.

For the sports minded there will be another Mush Ball League later this summer. And Tom Cote and Keith Cottom have been busy organizing a Twilight Golf League which will start Tuesday, June 7 at the Tech Golf Course. Strictly a VLA league, the golfers will tee off weekly for 9 holes of competition. Promises have been extracted from the organizers to have a full pictorial spread of the champions ready for the next issue.

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CREF UNIT VALUE - 1977

January	$40.28
February	39.30
March	38.73
April	38.73
May	37.96

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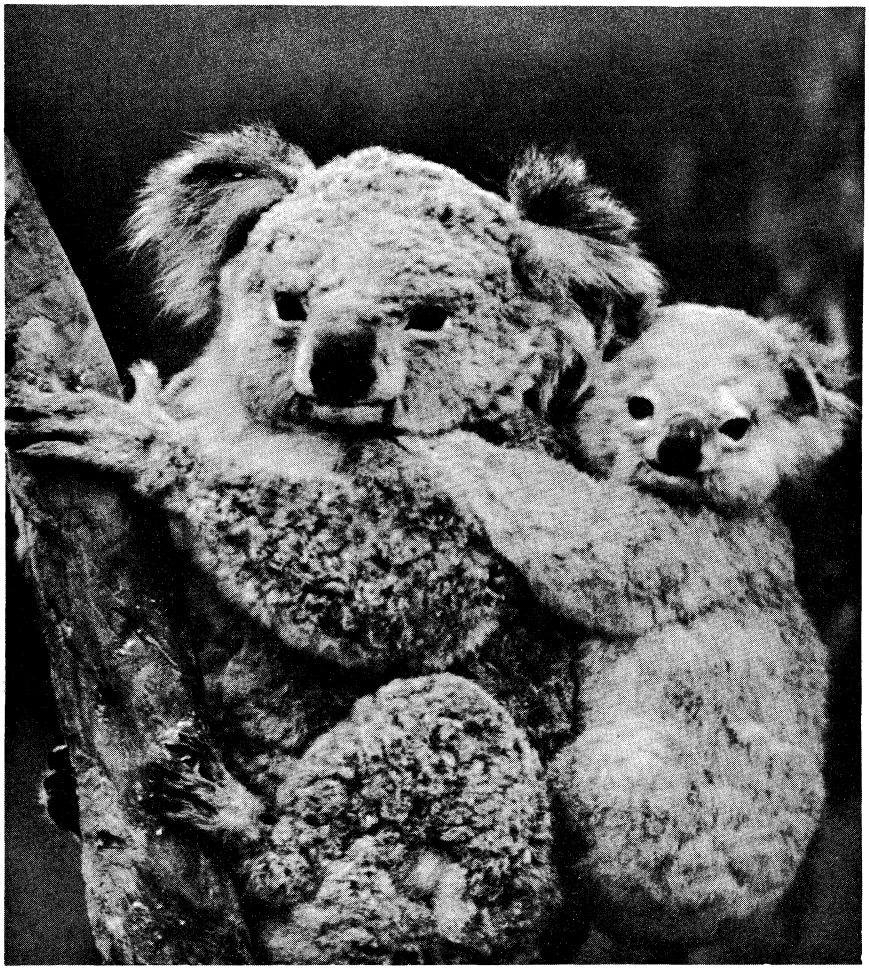
KOALA

John Brooks



The Koala bear, one of Australia's most famous furred animals, may be found down the eastern coast of Australia from Townsville in Queensland, through New South Wales, down to south-western Victoria. Its range extends inland to the western slopes of the Great Dividing range (50-100 miles from the coast line). Its favorite habitat is dry forest or woodland where it rests during the day in the fork of a tree.

The Koala is a slow, solitary animal (sometimes found in small groups) that lives in trees. It feeds entirely on leaves and shoots of eucalypts from about twelve species of gum trees, but mainly prefers blue and grey gums. Koalas eat about two and one-half pounds of foliage each day. The structure which enables the Koala to consume such a diet is its appendix, which attains a length of about seven feet. Koalas seldom drink water; the term "Koala" was borrowed from an aboriginal word which meant "no drink".

In form the Koala is large and bear-like with fluffy ears and a bulbous snout. The head and body are dark grey and the rump dirty white. They grow up to two feet long and can weigh as much as 33 pounds.

Koalas breed every second year. A single young is born after a gestation period of 35 days. The youngster is three-quarters of an inch long and weighs one-fifth of an ounce. It uses the mother's pouch for two or more months, before climbing onto her back where it remains until it's a year old. The Koala is full-grown at four years.

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