the OBSERVER

VOL. 21, No.2 JULY 1980

The Cover

The magnificent American (white) Elm located near the Reber Radio telescope is genus Ulmus, species *americana*. As far as we know, the only one on the Green Bank site. American Elms have two distinctive shapes: some grow in the form of a vase and others grow in the form of an umbrella like the one on our cover. We've no idea how old this particular elm is. However, American Elms are known to live for more than 200 years.

Besides its value as a beautiful shade tree, the elm is valued for its lumber -- tough, hard, and light brown in color. Since it doesn't split easily, it is useful for making barrels, farm implements, fence posts, furniture, boats, and veneering.

Look closely at the right side. That's a bearing butternut tree growing under its protective canopy.

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The Observer Distribution

We've had some interesting comments on the timeliness of *The Observer* issues. These recommendations have been digested and the results are as follows.

We will "attempt" to have the following schedule for the production of *The Observer*.

Articles to Editor
March 1
June 1
August 1
December 1

The Observer Distribution
April 1
July 1
October 1
January 1

These dates will be adhered to as much as possible, remembering that the persons who compile *The Observer* have regular duties which must be attended to first.

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A special thanks to all the people who contributed articles and who helped with *The Observer*.

Robert E. Hughes

HUGHES NAMED AUI PRESIDENT*

Robert E. Hughes, Professor of Chemistry at Cornell University and former Assistant Director of the National Science Foundation, has accepted the position of President of Associated Universities, Inc. (AUI), it has been announced by W. Donald Cooke, Chairman of AUI's Board of Trustees.

Dr. Hughes will join AUI on July 1, 1980, as President-Elect, and will become President on October 1, 1980. He succeeds Dr. Gerald F. Tape, who requested retirement from the fulltime duties of President.

"We are extremely pleased that Dr. Hughes has accepted the position of President," said Dr. Cooke. "This appointment is the culmination of a national search begun at AUI in 1978. Dr. Hughes' distinguished scientific background, and his experience in helping to set national science policy, make him eminently well qualified for this important position."

Hughes has had a distinguished career as a university professor and a government official. He has been a Professor of Chemistry at the Univeristy of Pennsylvania and at Cornell University. He served as Assistant Director of the National Science Foundation for Astronomical, Atmospheric, Earth and Ocean Sciences, and has assisted the government as a consultant. Most recently he has been associated with the Cornell program on Science, Technology and Society.

Robert E. Hughes was born in New York City in 1924. Following his military service, he attended Lehigh University, where he was awarded a B. S. in engineering chemistry in 1949. He received his Ph.D. in chemistry from Cornell University in 1952 and continued as an Instructor in Chemistry for one year.

In 1953, Hughes joined the Chemistry Department of the University of Pennsylvania as Assistant Professor, rising later to the rank of full Professor. At Pennsylvania, he was one of the organizers of, and served on the Executive Committee of the Laboratory for Research on the Structure of Matter, a major interdisciplinary materials research laboratory supported by the Advanced Research Projects Agency.

Hughes returned to Cornell as Professor of Chemistry in 1964. He served as Director of the Cornell Materials Science Center from 1968 until 1974.

In 1974, President Ford appointed him Assistant Director for National and International Programs of the National Science Foundation (NSF). With the reorganization of NSF in 1975, he became Assistant Director for Astronomical, Atmospheric, Earth and Ocean Sciences, his primary responsibility until he returned to Cornell in January 1977. The National Science Board recognizing his many contributions, noting that Dr. Hughes "...contributed immeasurably to the development and advancement of the National Science Foundation programs under his direction and to the welfare of science in the Nation..."

His research interests include X-ray

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crystallography, crystal and molecular structure, oligopeptide and antibiotic structures, boron and boride crystal chemistry, non-stoichiometric systems, and physical chemistry of macromolecules.

Hughes has served as a consultant to the research laboratories of a number of major industries, to the Science and Technology Policy Office and to the Director of the National Science Foundation.

He was a co-founder and an editor of the Journal of Solid State Chemistry, and an associate editor of Materials Science and Engineering. He has been on the editorial advisory boards of the Journal of Polymer Science and the Journal of Non-metals.

Dr. Hughes and his wife Lou now reside in Ithaca, New York. They have one son, Jeffrey, who will be enrolling in graduate school at Stanford University.

* *Reprinted from the Brookhaven Bulletin*

* * * * *

THE IVY ROAD GANG

Sandy Weinreb

What NRAO facility is located within 100 feet of Hardee's Hamburger Joint, Snappy's Photo Parlour, and the Seven-Eleven Emporium? You guessed it, the Ivy Road Electronics Center, also located within 2000 feet of 3 banks, an 8000 seat auditorium (University Hall), an Olympic size pool, 8 restaurants, a gourmet food shop, and a motel (Cavalier Inn). What a contrast to the wide open spaces around our other sites!

This branch of NRAO was started in 1972, when it was evident that insufficient space existed for the VLA project and Electronics Division within the Edgemont Road building. In the first few years the building housed the VLA business office, Modcomp computers, and electronics design group. The VLA electronics system was prototyped at Ivy Road before shipment to New Mexico in June of 1975. NRAO presently rents 1 1/2 floors of the building which is owned by a security systems (burglar alarms, etc.) company, Dynamics, Inc., occupying the upper 2 floors. A photograph of the building and staff as of mid 1979 is shown. (See page 5)

During the past 8 years, Ivy Road has produced 80 racks and 1500 electronic modules for the VLA. This work has been under the leadership of Jack Campbell with testing and design coordination by Garey Barrell and Ron Harris, expediting by Rick Bearfield, and fabrication by a very skillful group consisting of Ruth Saunders, Alice Shiflette, Blanche Wade, Nadine Owens, and Irene Morris. The purchasing of approximately $500,000 per year of components for this work has been handled by Karen Thach.

The second major group at Ivy Road is the Electronics Division Central Development Laboratory consisting of a millimeter wave group (Neil Horner, John Archer, and Larry D'Addario), an FET amplifier group (Charlie Pace and myself), a correlator group (Art Shalloway and Gene Runion), a VLBI group (Benno Rayhrer and Walter Brown), and an all purpose engineer-mathematician (John Granlund). These are supported by a machine shop (Luckie Luckado, Garnett Taylor, and Matt Dillon), a chemical laboratory (Cam Coates), and a secretary (Janice Mole).

The purpose of the Central Development Laboratory is to develop electronic components or systems which are needed to advance radio astronomy. The millimeter wave mixers produced for the past several years are among the best anywhere and have greatly advanced millimeter wave astronomy. The cooled FET amplifiers which are now constructed are the world's lowest noise transistor amplifiers above the frequency of 2 GHz. The correlators which have been constructed are the most heavily used systems in the Observatory and are copied by other organizations. In the VLBI area a special magnetic tape head which has been recently developed allows 20 times more data to be stored on a single tape. These developments bring a steady stream of visitors to Ivy Road and have made it a world-wide center for expertise in radio astronomy instrumentation.

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CHERYL SLOCUM
SELINA MORRIS
ALICE SHIFLETTE
RICK BEARFIELD
RON HARRIS
DELURE HENSLEY
GAREY BARREL
KAREN THACH
BEV GIBB
JACK CAMPBELL
HEIN HVATUM
JOHN GRANLUND
MIKE BALISTER
SANDY WEINREB
THE IVY
ROAD
GANG
JULY 1979
JANICE MOLE
RON HARRIS
BILL BOND
N.V.G. SARMA
GENE RUNION
ART SHALLOWAY
BENNO RAYHRER
RICHARD DECKER
BEV GIBB
NEIL HORNER JR.
GARNETT TAYLOR
LUCKY LUCKADO
MATT DILLON
MIKE BALISTER
MARIAN POPIESZALSKI
CHARLIE PACE
DARRELL BURNS

DISCOVERY OF THE THIRD BINARY PULSAR

Mark Damashek

A few years ago, when I was still at the University of Massachusetts and about to embark on a search of most of the northern sky for new pulsars (using the 300-foot telescope), various well-wishers stuck their heads in my office door with words of encouragement. The words most often heard were, "Go find another binary!" This, to a pulsar hunter, is tantamount to a religious benediction; I am delighted to be able to report that the admonition was heeded, and we do indeed now have another member of a small but growing family of celestial prodigies.

When the first pulsar was discovered by astronomers in Cambridge, England in 1967, the notion was briefly entertained that the radio signals being received were coming from an extraterrestrial civilization (of Little Green Men, naturally), but when three more were found shortly thereafter, it became apparent that they represented some previously unobserved and natural phenomenon. It also was clear that the signals must be originating under extraordinary physical conditions, because the radio pulsing was taking place on a time scale of about one second; this implied that the size of the emitting region was no more than one light-second across (about 20% of the diameter of the Sun), and in fact it was probably a good deal less, since the signals showed structure on a time scale rather smaller than one second. There was a good deal of imaginative pushing and pulling in the astronomical journals by a great many astronomers and physicists, who were all trying to get to the bottom of what the pulsating radio sources were.

The pieces fell beautifully into place when Staelin and Reifenstein, working at the 300-foot, discovered a pulsar in the Crab Nebula in 1969. This remarkable pulsar was emitting 30 pulses per second, and as with all previously known pulsars, the energy levels involved in the radio transmissions were packed into an astonishingly small region, astronomically speaking. It had been known that there was a prodigious source of energy within the Crab Nebula which was causing it to glow (in virtually all regions of the electromagnetic spectrum) for more brightly than would be expected for the remnant of a supernova explosion that had taken place 900 years earlier; the nature of the source had been completely baffling. With the discovery of the Crab pulsar, at least three important questions in astrophysics were answered at once: neutron stars, whose existence had been postulated in the 1930's, really do exist; the stellar remains of at least some supernova explosions become neutron stars; and the source of energy in the Crab Nebula was in fact a rotating neutron star. Thomas Gold of Cornell showed quite convincingly that a rotating highly magnetized star, composed of neutrons packed cheek by jowl as they are within an atomic nucleus, could account for the mysterious energy source in the Crab Nebula. At present, most astronomers are confident that pulsars do represent the long sought-after neutron stars.

It was therefore very exciting when in 1974, Joe Taylor of the University of Massachusetts and his graduate student Russ Hulse (later of NRAO) announced the discovery of the first known pulsar in a binary system. Binary star systems, which are simply two stars moving around each other due to their mutual gravitational attraction, are a hallowed institution in astronomy, and with good reason. It is ultimately observations of stars in binary systems which have given us all the information we have on the masses of stars other than the Sun. The discovery of a pulsar in a binary system (a "binary pulsar") raised the tantalizing prospect of actually measuring the mass of a neutron star (indirectly, of course, as with all astronomical observations). But there was more: the elliptical orbit in which the pulsar and its unseen companion moved was highly eccentric; it was squashed, not circular, and now there was jubilation.

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Here, finally, was a chance to measure the subtle effects predicted by Einstein's General Theory of Relativity within a reasonably short length of time.

Continuing observations over the ensuing five years have justified the optimism; it now appears that the Hulse-Taylor binary has confirmed the existence of gravitational radiation, a phenomenon predicted by Einstein in 1916, and that the amount of power being radiated in gravitational waves by this system is accurately predicted by Einstein's theory.

A second binary pulsar was found by Dick Manchester and his group in Australia last year, but unfortunately it proved to be less promising as a touchstone of physical insight: the orbital period appears to be about four and one-half years, which means the pulsar and its companion are both too far apart to show any meaningful interaction with each other which might shed light on the physical properties of the neutron star, and moving too slowly to exhibit any relativistic behavior. By way of contrast, the Hulse-Taylor pulsar and its companion are separated by somewhat less than a solar radius on the average, and they orbit each other once every eight hours!

Now that the stage is set, let me briefly explain how one knows that a pulsar is a member of a binary system. The key is that the radio pulses received from an "ordinary" (non-binary) pulsar are extremely regular. The time of arrival of successive pulses typically changes over the course of time (due to a slowdown in the rate of rotation of the neutron star because of radiation) by only several parts in 10^{15} per second. This means that a pulsar with a pulse period of one second (a typical value) might eventually lengthen its pulse period to 1.001 seconds over the course of a hundred thousand years. But if a pulsar moves in an elliptical orbit around another star, the picture changes dramatically. The apparent pulse period will then change in a regular, periodic fashion because of the ubiquitous Doppler effect: as the pulsar moves in its orbit in a direction which takes it farther from us, the pulse period appears to increase, while its motion in the opposite direction (on the other side of its orbit) makes the period appear to decrease. In the case of the first binary, PSR 1913+16, the rate at which the period changes due to the orbital motion is one trillion times as great as the change due to the actual rotational slowdown of the pulsar, and it is periodic, with a period of eight hours. We can, in effect, watch the orbital velocity of the pulsar change in the course of its orbital motion by watching the change in apparent period of the pulsar.

Pete Backus (also of the University of Massachusetts), Joe Taylor, and I have for the past two years been conducting a series of period measurements on a sample of about 100 pulsars approximately every 10 weeks. Included among these pulsars were the 23 which I had found in the search of the northern sky. The main purpose of the measurements was the clarification of the slowing down behavior of pulsars (in other words, the measurement and study of period derivatives). One subject, PSR 0655-64, was a persistent non-performer; when we set up to observe it on any given day, the chances appeared to be about five to one against our seeing it. It was one of the 23 newly found pulsars, and we managed to find several tentative explanations for its frustrating behavior; but I have to admit that somewhere back in the bleachers of my mind there were some fans rooting, "Binary! Binary!", since if the apparent period of the pulses was different from the period we were set up to observe, we would not see the characteristic pulse profile. I know that Pete was entertaining the same cheering section, because we actually joked about it several times.

A number of pulsars are known to fade from sight for periods of several hours at a time, mainly because of intervening clouds of ionized gas between them and us; and some pulsars actually seem to "turn off" for extended periods of time and then switch

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on again. But what we saw one day in April, 1979 was enough to stop the jokes and start the adrenalin flowing, when we realized we were missing PSR 0655+64 because we had the wrong period! The pulsar was there all right, but the normally sharp peak in the pulse profile, which should have amounted to only 5% or less of the total pulse period, was smeared out to almost 50% of the pulse period, and that behavior continued for 20 minutes or more. At 5:00 p.m. the next day, we came to watch, and there it was again; and it was drifting across the face of our signal averager, a sure sign that our original period determination was no longer valid. We then did something you never do in pulsar timing observations: we changed the rate of the signal averager while the observation was going on, in effect telling it to look for a different pulse period. And as the synthesizer was changed, digit by digit, the drifting stopped, and we finally had our sharp pulse back again.

Despite the seeming success, months of uncertainty followed; we had only two reliable period measurements, not enough to predict the future period behavior. As luck would have it, the next regular run, in June of 1979, was devastated by thunderstorms -- we got nothing on 0655. It was not until October that we got another chance, and this time we saw what was fast becoming our favorite pulsar again; the period had again changed! Now we had no doubt that we were on the right track, and it was time to start the real work.

A seemingly endless string of 300-foot observers were asked to relinquish 30 minutes to one hour of their observing time per night so that we could start to nail this binary down, and to my utter amazement, there were no dissenters. There was no arm-twisting, and their generosity was overwhelming.

In February, 1980, we had our answer; the pulsar was indeed in a binary system having an orbital period of 88877.7 seconds--24 hours, 41 minutes, 17.7 seconds (it might amuse you to consider what it means to do nightly observations on such a system with a transit telescope like the 300-foot). But the shocker was that the orbit was almost perfectly circular.

Now if in a binary system of evolving stars, one star undergoes a cataclysmic explosion, becomes a supernova, and leaves behind a pulsar to orbit its companion, there is virtually no chance whatsoever that the explosion will be so symmetrical as to leave the pulsar in a circular orbit; the orbit must be eccentric to some extent. Yet here we had clear evidence of a post-supernova binary system with essentially zero eccentricity (the actual number is 0.00034 ± 0.00010). What gives?

The answer comes from the theory of close binary systems, a field which was well-developed before pulsars were ever discovered. It turns out that in a close binary system, one in which the separation of the two stars is comparable to the radius of at least one of them, the gravitational (tidal) distortion of the star(s) is sufficient to circularize the orbit in a relatively short time; short, that is, compared to the normal life-span of a star and, we think, compared to the normal life-span of a pulsar (several million years). The circular orbit of PSR 0655+64 appears to be giving us a message; it is telling us that within the past few million years, the pulsar's companion star was a normal extended star like the Sun, and not a compact object (neutron star or black hole). But several million years is a short time in the life-span of a normal star, whose lifetime is expected to reach several billion years. So we have the distinct possibility that the companion star is still an extended object.

The distance to PSR 0655+64 is approximately 1000 light-years (this miraculous piece of information is derived from what is known as the dispersion measure of the pulsar, a measure of the smearing out of the pulses on account of those intervening ionized clouds I mentioned a while ago). At that distance, a star 10,000 times dimmer than the Sun would still be visible to Earth-based optical telescopes. This is a tantalizing propostion, because if we

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could see the companion star, we could measure the ratio of the masses of the pulsar and that star (using Newton's laws and a few other facts). This in turn is important because a knowledge of the mass of an actual neutron star would tell us if we are on the right track in understanding the structure of these beasts.

I would like to end this account with the happy news that the companion has been observed, but I can't. It was not until the first week of June, 1980 that we managed to derive a precise position in the sky for the pulsar (accurate to several arc seconds). There is, on the Palomar Sky Survey plates, a faint red star quite close to the radio position of the pulsar (and well within the displacement which might be expected over the thirty years since the plates were taken if there is proper motion -- if it is the right star!). But alas, the star is now in the bloody daytime part of the sky and won't be observable optically until the fall! So as Pete Backus and I have been fond of saying for the past two years in the case of doubtful pulsar observations, the red star is a definite maybe, and we devoutly hope that by the fall it will at least be a maybe definite. Until then, stay tuned.

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THE MYTHICAL BARREL

Reprinted from Oilways

Ever see a barrel of oil? Sure, you say. All the time. There's a bunch of them down on the loading dock.

Nope. Those are 55-gallon drums. The 42-gallon barrel which is used by the petroleum industry as the standard unit of measure no longer exists. Perhaps the standard barrel never existed at all. It's a holdover from the infancy of the oil business.

In the last century, if you wanted to buy petroleum products, you loaded up some wooden barrels and took them to your nearest refinery or bulk plant. It was to your advantage to bring the biggest barrels you could find, because you'd be charged for a barrel of oil, regardless of the volume of your container.

Obviously, arguments ensued. The seller claimed your barrel was too big, while you claimed it was too small and you were being short-changed.

Finally, in August, 1866, some West Virginia oil produces issued a proclamation which helped to end the arguments. "We mutually agree that we will sell no crude oil by the barrel or package, but by the gallon only. An allowance of two gallons will be made on the gauge of each and every 40 gallons in favor of the buyer."

While the producers' intent was to put the industry on the gallon unit instead of the barrel, they succeeded only partially. The 42-gallon barrel became the standard unit through years of usage, even though the 55-gallon steel drum became the standard-size container.

So a non-existent container has become the basis for the petroleum industry's calculations of crude reserves, refinery outputs and imports. No wonder the oil industry is often misunderstood.

* * * * *

HOW MANY OF US ARE THERE?

As of January 31, 1980, the number of permanent employees at each NRAO site were as follows:

Charlottesville	-	98
Green Bank	-	140
Tucson	-	24
VLA	-	135
TOTAL		397

6-POUNDERS IN THE CIVIL WAR

Carl Chestnut

At the beginning of the Civil War three different sized cannon were used in this area: they were the 6-pounders, 12-pounders and 2.9 inch rifled Parrotts. The most used, and probably the most interesting of the three, was the 6-pounder.

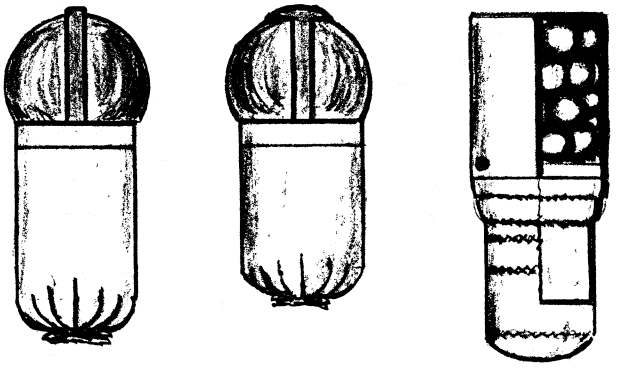

Figure 1: Three types of 6-pounder projectiles: (left) solid; (center) spherical case; (right) canister.

The smooth bore, muzzle loading cannon were classified according to the weight of a round solid iron shot which fit its bore. For example, a 6-pounder cannon had a 3.67 inch bore diameter and a 3.58 inch shell diameter. The solid shot charged with 1.25 pounds of powder, had a range of 1500 yards.

All cannon field carriages were attached to a limber carriage, a two-wheeled vehicle with a single chest over the axle, and were normally pulled by a team of six horses (total weight: 3,178 pounds). When in use the cannon required seven men to operate. Extra ammunition was carried on a carriage called a caisson. The front half was exactly the same as the limber of the field carriage. The rear half was also a two-wheeled vehicle but had two limber chests and a spare wheel. It took six horses to pull the caisson (weight: 3,509 pounds). Each limber chest held fifty rounds of ammunition. A properly packed limber chest carried twenty-five solid shot, twenty spherical case and five canisters -- all with cartridges (or powder bags) attached. A 6-pounder with caisson could carry 200 rounds of ammunition.

Each type of projectile had a different use: solid shot was used to break up fortifications and destroy cannon; the spherical case was used against troops and cannon crews (it had a timing fuse and could be made to explode overhead; the canister was used for close range (400 yards or less) against troops. The canister might be compared to an oversized shotgun shell.

I believe the spherical case (See Figure II) is the most interesting of the three shells. Its construction was relatively simple. After packing the case with about fourty-one 69 calibre lead balls, molten sulphur was poured over the lead balls and cooled. A 3/4 inch hole was drilled through the shell opening and through the lead and sulphur and packed with black powder. A fuse support plug was screwed into place over the powder followed by a Bormann time fuse. The Bormann time fuse, invented around 1840, was generally called a five second time fuse although it was graduated by quarters to five and one half seconds. It was made of equal parts of tin and lead, 1.65 inches in diameter and 0.45-inch thick. Figure II shows a Bormann time fuse attached to a 6-pounder spherical case and a cutaway showing the 69 calibre lead balls.

Beneath the time marking was a horizontal, horseshoe shaped powder train. Cutting through the thin metal at any timing mark exposed the powder train to the discharge flame. It burned at a uniform rate around the horseshoe to zero and ignited a cylindrical powder magazine, or booster, in the center. This flashed into the bursting charge through a small hole in a plug beneath the fuse.

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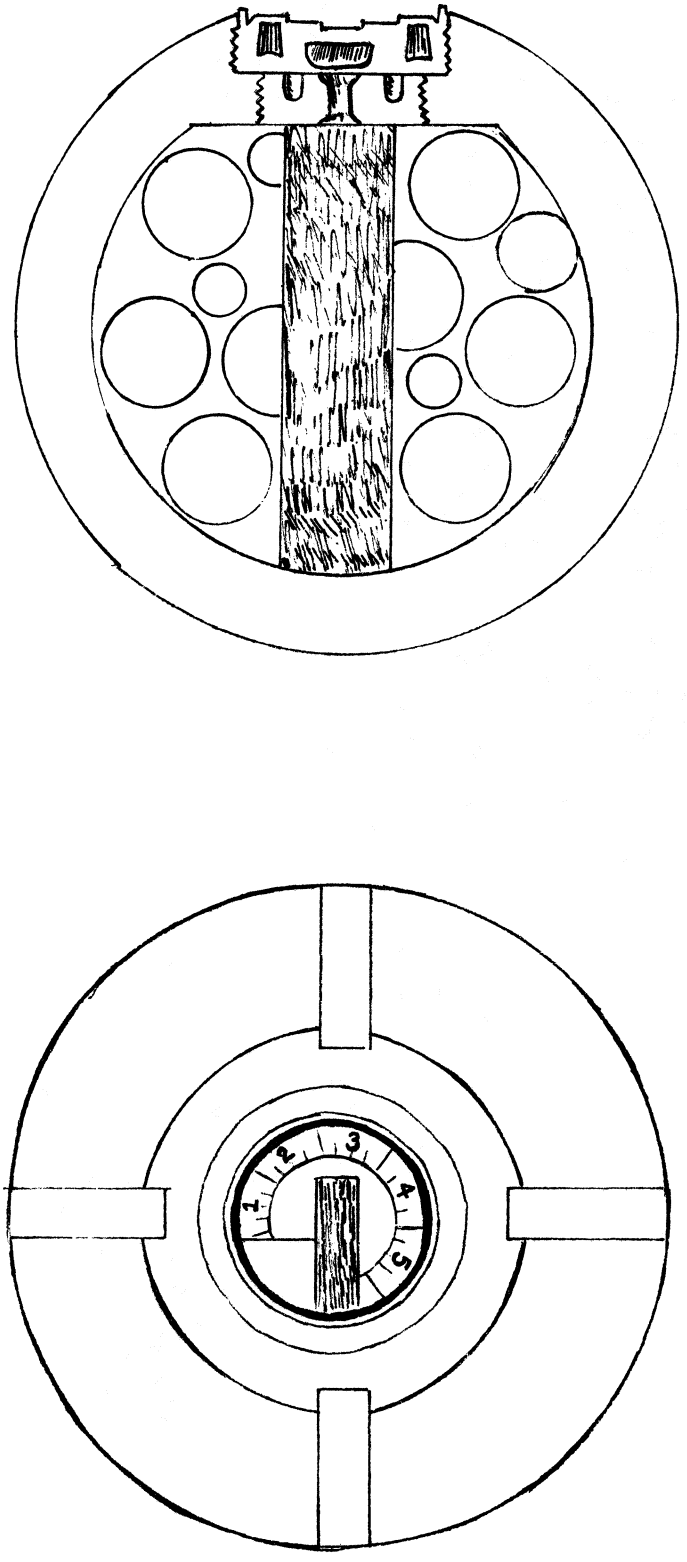


Figure II: 6-pounder spherical case with Bormann time fuse.

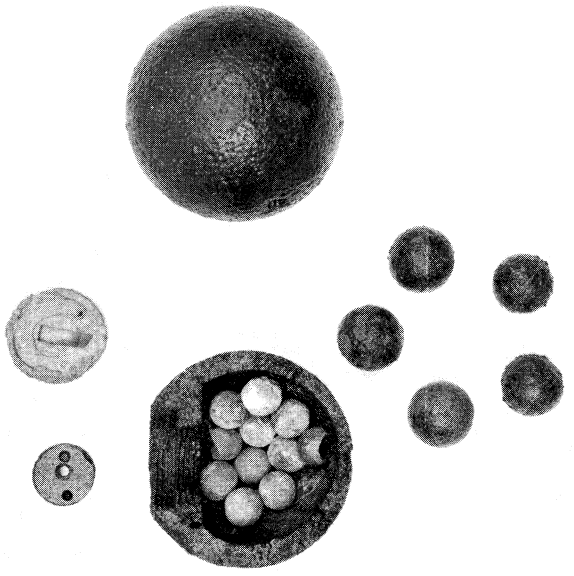


Figure III: Ammunition from author's collection

These plugs were made of either brass or iron. Their function was solely to form a solid base for the fuse which, due to its soft metal construction, might be driven into the shell through the shock of discharge. (Note the off-center hole in the plug of Figure III, this could be the cause of failure of this shell to explode.)

The battle of Greenbrier River or Bartow on October 3, 1861, was strictly a cannon duel between the Federals under command of Brig. Gen. J. J. Reynolds and Confederates under Brig. Gen. H. R. Jackson. The Confederate gun emplacements and trenches are still visible on the farm of Mrs. Jessie Powell (intersection of routes 92 and 250 near the Hermitage Motel). In this duel the Confederates used seven cannon and the Federals, entrenched near the present rail mill and the town of Bartow, used nine cannon. The battle lasted four hours and ended when the Federals withdrew to their fortifications on Cheat Mountain. All three cannon mentioned at the beginning of this article were used in this battle.

Note of caution: Old, loaded ammunition should be handled with extreme care and deactivated only by professionals. The black powder in Civil War ammunition is still active and should not be stored where temperatures reach 300°F or more.

They don't even have to explode to hurt. Ask Mike Balister how a 6-pound ball feels when it hits the toes from a height of four feet.

* * * * *

A POEM FROM THE VLA FRONT END LAB

Stephen McCrary

The ray from the quasar boasts
Of a distance much greater than most.

Redshift, the astronomer would say
Will answer the question of how far away.

But what if our ray
Has been shifted in some other way?

The gravity of a black hole, it's
   been said
Can redshift light until it is dead.

Somewhere a distance from singularity,
   a sphere exists I call (B)
Where light will be redshifted the
   proper degree.

Next comes sphere (A), a place where
   no one would want to be
Where matter is altered and light
   set free.

If spin and mass are right
It's much to our delight.

(A) meets (B) and now we see
The results of the quasar recipe.

Quasars, I decree
Are not what they appear to be.

* * * * *

MAUNA KEA SURVIVAL KIT

1 ea. live pig, complete with mud puddle, and wood trough with pig slops.
1 ea. hang-glider with magnetic compass
1 ea. J 38 surplus telegraph key, and BC-610 transmitter

The above mentioned equipment would be used only under emergency conditions.

Example: An earthquake on the ocean floor triggers off the eruption of our favorite volcano.

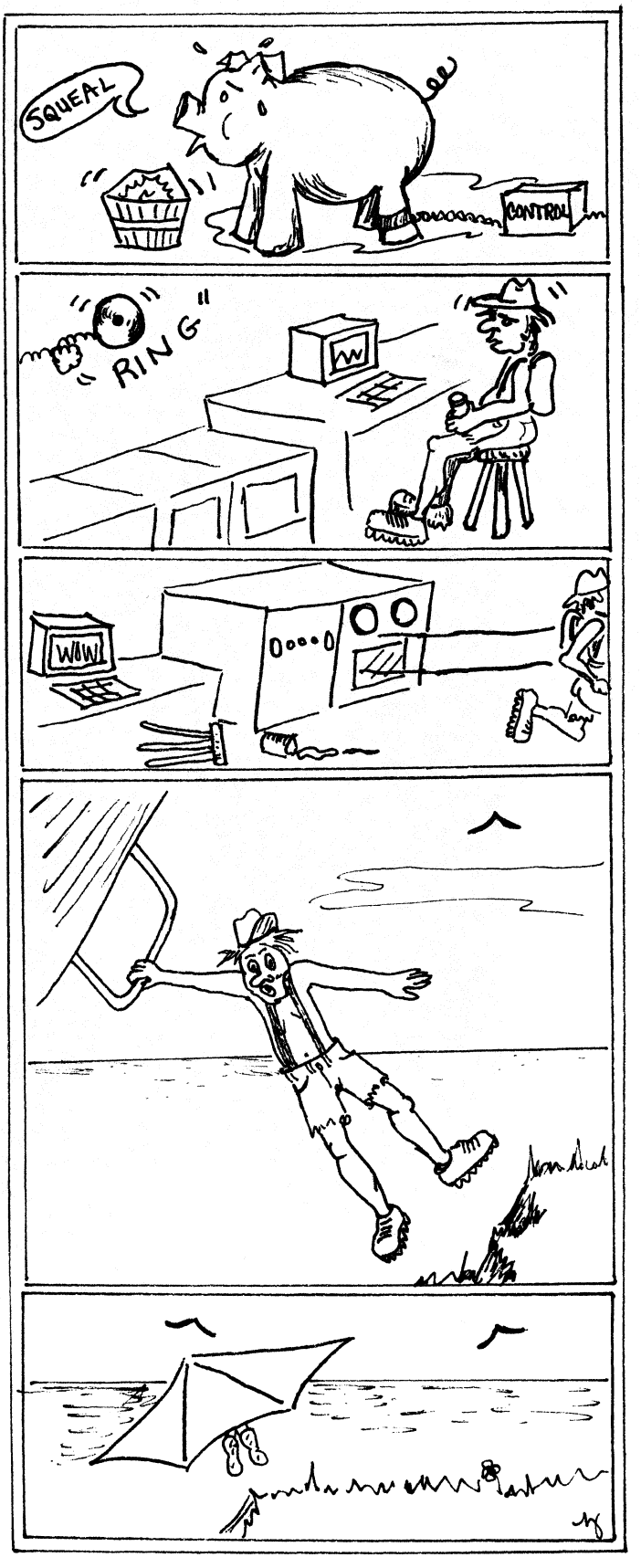
The pig begins to squeal, alerting the observer who is sitting at the Tektronix terminal (face glued to the screen) and dressed only in jogging shorts and shoes with a serendipity day pack strapped to his back.

The observer arouses the operator who is catching a 40 wink catnap. The operator then takes a quick reading on the seismograph chart (paper chart #B302149A) and announces that the all-time big blow off (Krakatoa proportions) is about to occur.

The operator then types in the word "escape" at his terminal, this automatically lines up the antenna portal with the escape tunnel. While this was taking place, the operator was jamming hard copies of the spectra along with a three day old bag lunch into the observer's day pack; now the observer is racing down the tunnel (look at that turkey run) for the hang glider which is mounted out on a jib pole, one shot at the grab bar is all he gets!

The operator then fires up his BC-610 and sends out a quick message to the Hotel Royale in the Phillipine Islands reserving the presidential suite for Dr. Turkey. The operator having performed all assigned tasks thoroughly, displays his true spirit, and resumes his nap (last one).

An alternative use for the pig and his accessories would be as follows: The road washes out, and after three days all of the bag lunches have been eaten. One may eat the pig and/or his slop while using the wood trough for the fire. Bon appetite mon ami!



I SING THE BODY ELECTROMAGNETIC

Lee J Rickard

Raymond Sokol, in a recent article on inflation, remarked: "Everything Milton Friedman sees reminds him of the monetary system, while everything I see reminds me of sex -- but I try to keep it out of my writing."

Worrying about the relation between theory and observation is much like questioning the priority of chicken over egg. It is our consensual conceit that theories are explanations, or at least interpretations, of the facts of experience. But observations are actually selections. Without some reduction, the tumult of phenomena inspires awe, and perhaps madness, but no science.

This reduction must be done from a framework of theoretical precepts. Indeed, some would argue that scientists only perceive that which is theoretically permissible. But then, how was the structure of reducing precepts erected? One might argue, even if only in a spirit of irony, that it evolved from daily confrontation with the order of things. We live in a comprehensible world precisely because we live in the world, with predispositions hammered out through millenia of hard knocks.

One could argue further. Indeed, my own inclination to do so is partly responsible for the decline in my party invitations.

Still, it is amusing to speculate how our theoretical vision of the world might have been different had we perceived it differently. Suppose our eyes had been sensitive to ultraviolet light, like bees, or to infrared, like snakes. Suppose we could sense ultrasonic echoes, like bats, or electric fields, like fish, or the polarization of sky light, like birds. Would our physics be different?

In a sense, we can see the process happening in astronomy. As new parts of the spectrum become accessible, new phenomena -- wildly unexpected phenomena -- captivate the attention and redirect the efforts of the community. The newly perceived universe seems to require different explanations for traditional problems, explanations more appropriate to the new viewpoint. Thus, as x-ray and gamma-ray astronomers are more and more preoccupied by violent events (like supernovae), those violent events take on significant roles in interpreting all problems (like supernova-induced star formation, supernova-induced galactic spiral structure, supernova-induced dinosaur extinction, supernova-induced Sumerian civilization, etc.).

Prematurity is part of the scientific gamble. You are always betting sufficiency of your data, and surprise is an occupational hazard. We were, for example, a bit premature in dismissing the possibility of humans seeing polarized light. If you stare into a clear twilight sky for a while, you will notice a yellowish dumbbell-shape, sandwiched between two blue pillows, about four degrees long and pointing toward the sun. The image is called Haidinger's brush, and is the direct perception of the polarization of sky light.

A lot of recent work in biophysics has been devoted to uncovering and elucidating unsuspected sensitivities like these. Much effort in particular has been expended on magnetotaxis, the tendency of a wide variety of animals to orient themselves according to the Earth's magnetic field. The discipline is not without its scandals, such as the "magnetic" termites that turned out to have less interest in magnetic fields than high-school football players. But over the past decade, magnetic senses have been firmly established in bees, birds, beetles, elasmobranch fish (like sharks and rays), and even simple bacteria.

Every year, billions of birds migrate over distances of thousands of miles to well-established nesting areas. The accuracy of these biannual flights demands sophisticated means of navigation, and many have been suggested. These include celestial navigation (by sun, moon, and stars); monitoring of the geographical cues by

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infra-sounds, odors, and patterns of temperature, pressure, and wind; and awareness of the contours of the Earth's gravitational and magnetic fields. In fact, the basic problem confronting researchers is that most of these ideas are true. Birds have backup systems in depth; when one method doesn't work, they rely on a completely different one, and usually foul up the experiment.

The geomagnetic hypothesis was one of the earliest suggested in 1855 by von Middendorf. But the failure of Henry Yeagley in the 1940's to verify the current version of the theory, and the fact that hypothesized magnetic sensors seemed too insensitive to detect the Earth's field, rather stifled the idea for several decades. It was revived by a variety of experiments that combined magnetic confusion, obtained by putting magnets or Helmholtz coils on the birds' heads, with disorientation of the other mechanisms, achieved through releasing the birds in unfamiliar locations under cloudy skies. The problem of the sensing device remained, though.

The solution was actually found first in bacteria. In a variety of magnetotactic bacteria (found near Woods Hole, Massachusetts, by Richard Blakemore), an M.I.T. magnet expert named Richard Frankel found chains of magnetic particles. Each particle was large enough to maintain its magnetic properties against thermal agitation, yet small enough to remain a single magnetic domain and thus avoid scrambling its own ordered field. The whole chain was strong enough to orient the bacteria against Brownian motion, and enable them to follow the vertical component of the Earth's field down toward food-rich sediments.

Given that clue, and some extremely careful dissecting work, David Presti and John Pettigrew have recently been able to isolate the probable organ of magnetic sense in birds. They found diffuse patches of permanently magnetic material, probably magnetite, organized in single domain particles, in the neck muscles of pigeons and migratory sparrows. They suggest that, as the birds fly through the geomagnetic field, the torque exerted on the magnetite tries to twist the muscle fibers, evoking a response from the associated nerves. They also note that such a mechanism could explain how dowsers accomplish their feats.

There are few things as depressing as watching someone follow a bright new idea off a cliff. Presti and Pettigrew seem quite pleased by the dowsing connection, even choosing to introduce it with the same phrase ("It has not escaped our notice ...") with which Watson and Crick connected the double helix and heredity. Suffice it to say that it doesn't seem worth the effort. Dowsers claim the ability to find water, precious metals, dead bodies, etc., through interpreting twitches in crooked sticks or mystical plumb bobs. Unfortunately, they can never do so under controlled test conditions, so there seems to be little reason to believe them. Furthermore, its hard to see the magnetic stimulus to be found in either a subterranean river or a misplaced corpse.

There have been some laboratory investigations into human sensitivity to magnetic fields. One Z. V. Harvalik claimed to have isolated the magnetic organs of dowsers -- within their kidneys. (Again, what is the magnetic link with running water?) But it seems that the more careful the test, the more negative the result. For example, Robert Tucker and Otto Schmitt made a series of tests for perception of 60 Hz, 10 gauss fields. In their early, loose experiments, they "quickly learned that some individuals are incredibly skillful at sensing auxiliary non-magnetic clues, such as coil hum associated with field, so that some 'super perceivers' were found who seemed to sense the field with a statistical probability as much as 10^{-30} against happening by chance." As their techniques became more sophisticated, and their controls more rigorous, the success rate dropped to chance level.

Some of the subjects reported "magnetic headaches", suggestive of the Eastern European literature on the physiological and psychological effects of electromagnetic

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fields. I discussed some of these ideas in an earlier *Observer* article, in the context of direct hearing of pulsed microwave radiation. The subject remains controversial, especially since the experimental data are rather far removed from the subtle claimed effects (malaise, irritability, etc.), and the economic aspects are rather significant. Questions about electromagnetic pollution could affect leakage allowances for microwave ovens, placement of power lines, installation of television broadcasting towers and airport radars, and even the operation of subways. (Complaints about the electromagnetic smog surrounding San Francisco's BART and D.C.'s Metro systems have appeared in the newspapers.) Clearly, some of the effects are unrelated to the radiation itself, as many of the magnetic migraines in the Tucker and Schmitt study occured during placebo tests.

There's nothing particularly mysterious about being sensitive to electromagnetic radiation. After all, we do see things, we do get suntans; we do synchronize our circadian rhythms with the day-night cycle. But all those effects involve radiation with a lot of energy per photon. The problemaicle microwave effects involve photons whose energies seem to be toollow to do more than mildly heat the body. This combination of theoretical incompatibility with a confusion of experimental data tends to keep people from committing much time to the question.

There is also a certain unsavoriness to the subject, because of its historical association with the pseudosciences. Psychic phenomena have often been interpreted as low-frequency electromagnetic perceptions. For example, Upton Sinclair called his book on telepathy Mental Radio. One of the major recent proponents of this idea was John Taylor, of King's College, London. Already well known for a lurid book on black holes, Taylor was attracted to ESP research by the notorious Uri Geller. In the laboratory, Taylor was astounded to discover that ordinary children had the power to bend silverware with their minds -- provided that one didn't watch them to make sure they weren't cheating.

He wrote a big book on the subject, called Superminds, in which he argued that only electromagnetism could explain ESP. He was immediately upbraided for his loose experimental work, mostly by magicians. In The Magic of Uri Geller, the Amazing Randi describes how Taylor was completely flummoxed by reproduction of the Geller effect, accomplished through fairly crude magic tricks. In the face of so much negative evidence, Taylor began to have second thoughts. Curiously, he expressed them by reporting a test for electromagnetic phenomena associated with ESP. Finding none, and having already decided that only electromagnetism could explain ESP, he concluded that ESP must not be real. It was not a graceful retreat.

There is one area of investigation into electromagnetic sensitivity that is not only respectable, but even potentially profitable. Curiously, the entry point into this field is the observed ability of animals to regenerate lost limbs.

If you cut a flatworm in half, it will grow a complete replacement half. Cells that have lain around the body, not specialized to any particular organ or function, rush to the site of injury and begin specializing into whatever kinds of cells are needed. At the same time, an electrical change, called the current of injury, develops at the injured point. Although this current was first noted in the late 1700's, it was only in the late 1950's that Robert Becker constructed a theoretical link between it and the regeneration. Becker's theory, that the cells respond to a constant electric current maintained by the nervous system, stimulated some remarkably successful attempts to regenerate limbs in animals that cannot ordinarily do so, via applied electric fields. The resulting techniques have also proven useful in encouraging human bones to mend.

More recent work suggests that it is the skin, rather than the underlying nerves, that generates the current of injury. The currents themselves seem to be flows of sodium ions, absorbed by healthy skin from the outside world. The prospect of using artificially imposed currents to speed healing, perhaps even to regenerate lost

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human limbs, is understandably exciting.

One curious sidelight that it brings to mind is the old idea that the skin could serve as a substitute visual system. There was some discussion in the 1960's, both by Soviet and American researchers, of people who seemed to be able to read with their fingertips, even though securely blindfolded. Similar phenomena were reported by the French novelist Jules Romains after World War I. Alas, the key to this mystery turns out to be very mundane. Magicians will tell you that it is virtually impossible to completely secure a blindfold. Minute chinks will always remain, sufficient to allow reading, playing ping-pong, and even, in the case of one spectacular magician, driving a horse-drawn carriage through Paris. When properly blinded (as by putting a box over the head), the finger-readers become illiterate.

While dermo-optical perception does not seem to hold any promise for the handicapped, there is a new perceptual channel that does seem to be present in a small minority of blind people. Lawrence Weiskrantz, of Oxford University, has found that some people, whose visual impairments originated in brain cortex damage, have a kind of "blindsight". Shown some event, they do not see it; but when asked to guess what it was, they guess correctly 90% of the time! Apparently, there is a neural path from eye to brain that goes through the midbrain rather than the cortex. The resulting sensation is not of an image, but rather a feeling of something happening. Extreme peripheral vision seems to be an analogous phenomenon in sighted people. Weiskrantz has shown that the accuracy of blindsight could be improved in both human and ape subjects through special training.

The blindsight phenomenon involves cases where the damage is not to the sensory organ, the eye, but to the cortex, which organizes the visual stimuli into a coherent image. Apparently, we do only see those things that are permissible within the reducing framework of the brain. We seem to have returned to the idea that evolution has produced a physical structure adapted to perceiving the important patterns of objective reality. And that some of these structures, these brains, are more sensitive to the pattern of the monetary system, while others are more attuned to sex.

Perhaps this is better continued over drinks.

* * * * *

What's Cooking?

SUMMER SQUASH CASSEROLE

Janet Warner

2# yellow summer squash - sliced (6 cups)
1/4 cup chopped onions
1 can cream of chicken soup
1 cup sour cream
1 cup shredded carrots
1 - 8 oz. pkg. herb seasoning stuffing mix
1/2 cup margarine

In saucepan, cook sliced squash and chopped onions in boiling salted water 5 minutes. Drain. Combine cream of chicken soup and sour cream. Fold in squash and onion. Combine stuffing mix and margarine. Spread half of stuffing in bottom of 12 x 7 2 baking dish. Spoon vegetable mix on top. Sprinkle remaining stuffing over squash. Bake at 350° for 25 to 30 minutes.

CREF UNIT VALUES

January	45.37
February	44.59
March	40.83
April	41.82
May	43.70

SHOPPING BY MAIL

When you're 50 miles from the nearest shopping center, as we are in Green Bank, you shop a lot by mail. The headaches come with merchandise arriving late or worse, not at all. Most of us have experienced these troubles with mail order and we sometimes accept these shortcomings in the shop by mail business because we feel we can't do much about them. Not quite so. The Federal Trade Commission says you have some rights when merchandise arrives late or not at all.

The Mail Order Merchandise Rule

The Federal Trade Commission has a rule that gives you some rights when you order by mail. The mail order rule, adopted by the Commission in October, 1975, provides that...you must receive the merchandise when the seller says you will; ... if you are not promised delivery within a certain time period, the seller must ship the merchandise to you no later than 30 days after your order comes in; and ... if you don't receive it shortly after that 30-day period, you can cancel your order and get your money back.

How the Rule Works

The seller must notify you if the promised delivery day (or the 30-day limit) cannot be met. The seller must also tell you what the new shipping date will be and give you the option to either cancel the order and receive a full refund or agree to the new shipping date. The seller must also give you a free way to send back your answer, such as a stamped envelope or a postage-paid postcard. If you don't answer, it means you agree to the shipping delay.

The seller must tell you if the shipping delay is going to be more than 30 days. You then can agree to the delay or, if you do not agree, the seller must return your money by the end of the first 30 days of the delay.

If you cancel a prepaid order, the seller must mail you the refund within seven business days. Where there is a credit sale, the seller must adjust your account within one billing cycle.

It would be impossible, however, for one rule to apply uniformly to such a varied field as mail order merchandising. For example, the rule does not apply to mail order photo finishing, magazine subscriptions, and other serial deliveries (except for the initial shipment); to mail order seeds and growing plants; to COD orders; or to credit orders where the buyer's account is not charged prior to shipment of the merchandise.

Protect Yourself

Whenever you order anything through the mail, take these precautions:

1. Read the product description. Don't rely on pictures only. Make sure the product offered is what you really want.
2. If possible, investigate the advertiser's claims. Find out if the product will really do what the advertiser claims it will.
3. Note the delivery time stated. Allow plenty of delivery time before holidays or other special days so you won't be disappointed by a late delivery.
4. Find out the merchant's return policy. If it isn't stated anywhere, ask before you order.
5. Keep a copy of your order blank.
6. Make a note of the merchant's name and address and the date you sent in your order.
7. Hold on to your cancelled checks and charge account records. If you have a problem later, these papers would be necessary to prove your side of the case.

Unordered Merchandise

Have you ever received something in the mail you did not order? If so, you may consider it a gift and keep it without paying for it.

Only two kinds of merchandise can be sent legally through the mails without a consumer's prior consent: (1) free samples,

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clearly marked as such, and (2) merchandise mailed by a charitable organization for contributions. Even though unordered merchandise from charitable organizations can legally be sent to your house, the same rule applies: you don't have to pay for it.

It's illegal for the sender to pressure you to return unordered merchandise or to send you a bill for it. Just to be sure, you might write the sender and ask for proof that you placed the order. You might have forgotten you did. Or a friend may have ordered the merchandise for you as a gift and you were mistakenly billed for it as well. But if it was really unordered, you may keep it at no cost.

What To Do If You Have A Problem

If you have a complaint against a mail order company (non-delivery, misleading advertisements, damages because of poor wrapping), you may have trouble resolving it: the company may be in another state or not have a listed telephone number.

In any case, your first step is to write directly to the company (the address will be on that order blank copy you saved). Tell them about the problem. If it's not resolved, you can take further action:

- Call your local or state consumer protection office or Better Business Bureau. They may be able to help you.
- Contact the state or local consumer protection agency closest to the company. Ask for their assistance, also.
- Call your local postmaster. Ask for the name and address of the appropriate postal inspector-in-charge. That person may also be able to resolve your dispute.
- Contact the book, magazine, or newspaper publisher that carried the advertisement. Publishers often try to resolve problems between their readers and their advertisers.

Help Solve the Problem

Send copies of your correspondence to the FTC, Washington, D. C., 20580. Although the FTC generally can't resolve individual disputes, the information you provide may help show a pattern of practices requiring action by the Commission.

Regional Office:
118 St. Clair Street
Cleveland, Ohio 44114
(216) 522-4207

Central Office:
6th Street & Pennsylvania Ave., N. W.
Washington, D. C. 20580
(202) 523-3598

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NRAO SERVICE AWARDS BANQUET

R. K. Moore

The 13th Annual NRAO Service Awards Banquet was held in the Green Bank Cafeteria on March 28, 1980.

Employees were honored who had completed ten and twenty years of service as of December 31, 1979. Employees included those qualifying from both Charlottesville and Green Bank. Mark Gordon and Jesse Davis both from Tucson have received their 10 year award.

TWENTY YEAR AWARDEES

Omar Bowyer	Hein Hvatum
Jamie Sheets	T. Riffe
Bob Viers	Bill Kuhlken
George Grove	Naomi Daniels
	Phyllis Jackson

TEN YEAR AWARDEES

J. Marymor	Harlan Tallman
Garnett Taylor	Ronald Gordon
Buck Peery	Robert Brown
Don Morris	David DeYoung

This brings to 160 the number of employees who have completed ten or more years of service. Of this number 20 have completed 20 years. 122 of the 160 are still employed by the NRAO.

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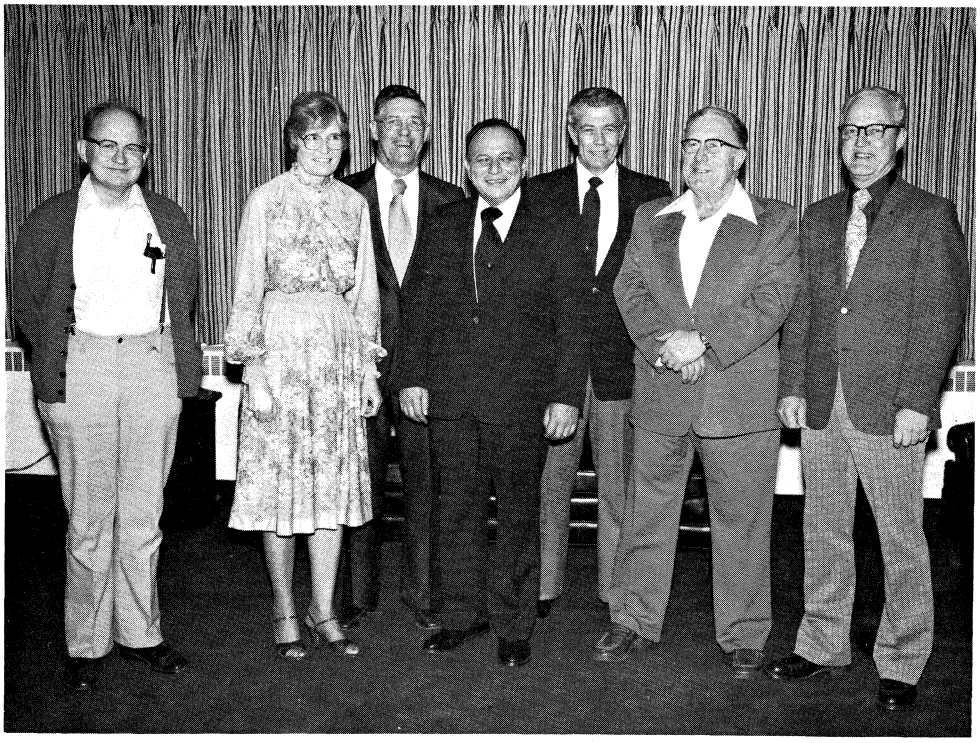
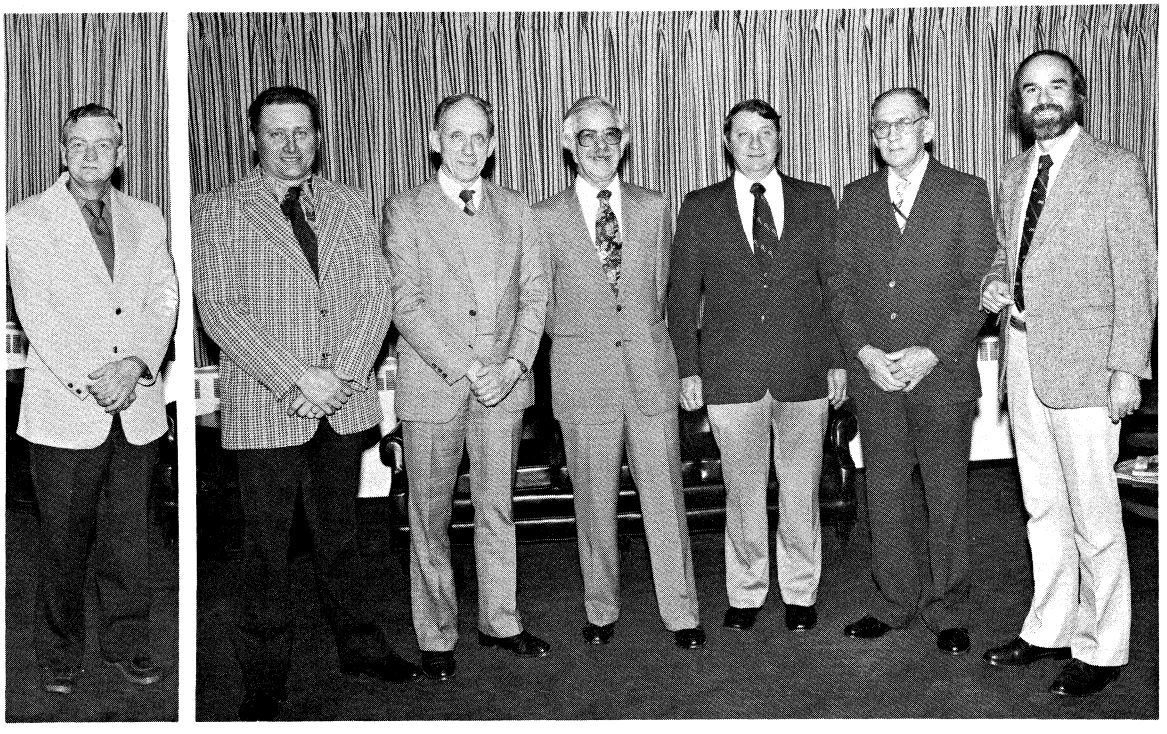


Twenty Year Awardees

From left to right: George Grove, Naomi Daniels, Jamie Sheets, Bob Viers, T. Riffe, Bill Kuhlken, Omar Bowyer



Ten Year Awardees

From left to right: Don Morris, Ronald Gordon, Buck Peery, J. Marymor, Garnett Taylor, Harlan Tallman, Robert Brown

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DETECTION OF INTERSTELLAR BS IN THE CIRRUS * DARK CLOUD OF THE NUMBBUM ASSOCIATION

I. AN INTUITIVE MODEL AND ITS SUBSEQUENT OBSERVATION

J. J. Charfman
Bora-Bora Radio Observatory
Tahiti, South Pacific

Abstract. Previous suspicions of large quantities of BS in large astronomical associations have been confirmed by observation.

Interstellar boron sulfide, BS, has been predicted as a fragment of the detailed ion-molecule chain outlined by Dack and Balgarno (1980). Its significance in the grand cosmochemical scheme of Charfman, Houdini, Aardvaark, Raoul, and Finzi (1974, hereinafter referred to as CHARF) was pointed out by Sollenoid and Haltpeter (1978) in predicting the correlation between radio map contours and chemical reaction routes. Figure 1 illustrates this correlation.

Searches for the gaseous phase were first carried out in 1963 by Zen Buckerman while seated in the lotus position at the 2-m Charfman Memorable Telescope on Maidenknoll in Tahiti. We have subsequently repeated these observations with increased sensitivity. Our search was restricted to the Cirrus dark cloud centered on the BO star HD 1, located in the Numbbum Association and referred to as OMCTMCGMC-280Z, and noted for its intense wind. Figure 2 illustrates a typical line of BS. Figure 3 is a composite photograph of the BS source taken B. and D. Greenerelm (1981) with broad-band alphabetical filters (see codpiece).

Alternate theories of BS formation on solid surfaces by Mayonnaise Hamburger (1977) have been considered, but only gas-produced BS can account for the amount reported here.

BS emission was generally observed in mornings and evenings, but was finally detected on Friday afternoon at a 1.8σ level. Its lifetime was estimated to be approximately 5 days, but the level of emission was generally variable. The detection of this molecule has considerable impact on our understanding of Giant Gas Clouds which will be discussed in a later paper, but we want to note the most important of these at this time: as predicted by B. Bok (1979) "the only way you play the piano is at all ends-simultaneously."

This research was supported in part by the Office of Navel Research and GNASSAU.

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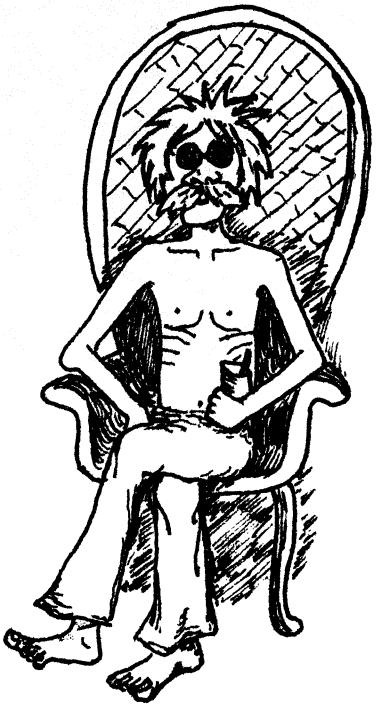
* A late paper presented at IAU Symposium 87



J. J. Charfman

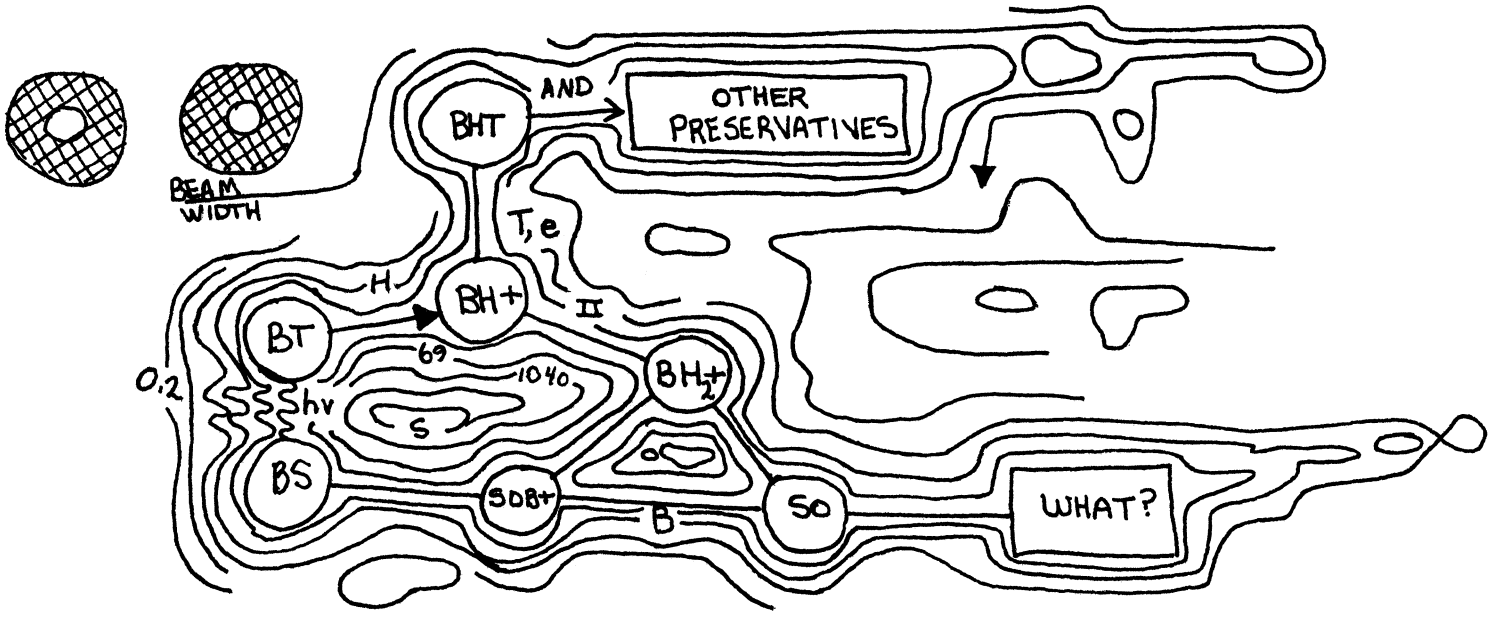


Figure 1

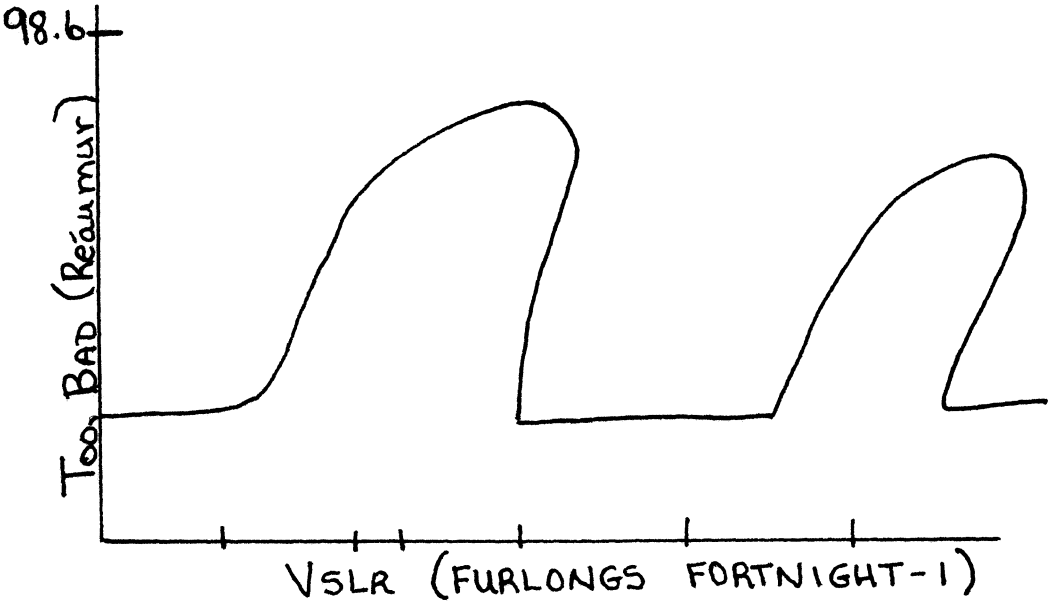


Figure 2

GROWING IN GREEN BANK

Carol Ziegler

A little house near the woods nestled in trees with flowers growing under the front window...a big tree out back for your little boys to climb...vegetables from your own garden and freshly caught trout for Sunday dinner...a few chickens and your own fresh eggs...all these things and more are thoughts that come to mind when you think about living in the country. For a big city girl like myself, life in Green Bank held all this and quite a few surprises.

It had always been a dream of my husband's to be able to live in the country and enjoy the natural things that the earth at its best can offer. I entertained this fantasy like a dutiful wife, never fully realizing what it meant. I truly do believe that Green Bank is fresh and natural and mostly unspoiled. I feel that way because I have lived here for three years now and it has been proven to me in ways I never dreamed of.

Back at "home", I spent a good deal of my time in what I called recreation. I hardly ever knew I was bored. I never had time for it. There was perpetually something that had to be done. A store was always my destination. We did the usual weekly shopping for food and the return trips 2 or 3 times for things we craved or forgot. There were the great sales and trips just to get out of the house. We'd always stop off for a taco or a Mcburger. We'd get a pizza now and then for a change. There was an occasional movie, but not much else. Just shopping and eating junk and eating junk and shopping. I do admit that we weren't perfectly typical city dwellers (or at least I'd like to feel we weren't). We had become the people I used to sneer at when I was a teenager. Unmotivated, survivors in a swamp that was pulling us down a little more each day. For us the city would have been terminal.

My husband rebelled and uprooted me. Taking me off to parts unknown, to dreams unrealized.

We moved into our country cottage in June of 1977. We brought our possessions in four loaded pick-up trucks, one station wagon and a Vega. Very generous and loving relatives helped in the move and my gratitude extends to them still. Curiosity had a lot to do with some of the help offered. My aunts and cousins were anxious to see where I was going to live. The place with the strange name, in the mountains, so far from everything. They had all loaded into the vehicles and come along for the ride. Dressed in the usual summer garb, shorts, little tops and sandals, they didn't stay long when we were met with temperatures in the mid 30's. "It was a long trip", they said. They had to get back for the ball game. They hadn't intended to be away so long. It was good that they decided to make it a short visit. We didn't have much in the way of accomodations. No heat, no plumbing, no electricity. Just bugs, lots of bugs, a little rat poison scattered here and there and all the furniture of course was stacked in one room. My aunts looked at me sadly, on the verge of tears. My husband was beaming. His dream was on the edge of becoming a reality. His lifestyle laid out before him. I was just numb and cold.

The relatives went home. We started to unravel the snarled up things around us. My husband began to try to patch the house together. We had "some" electricity. We could burn one bulb fairly brightly until we turned another one on. Then we had half the power in each place. Things got dimmer as they went along.

We discovered our plumbing had frozen and thawed out at least twice a year for each of the 10 years that the house had been unoccupied. It all had to be replaced. The water we did have was a lovely shade of orange. All the fixtures in the bathroom were burnt sienna on white. There was one receptacle in the kitchen, hanging from the middle of the ceiling on a cord. That was alright since we couldn't operate anything electric

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anyway. There were 13 layers of wallpaper in the kitchen. I didn't count in the bedrooms. The corners in most of the house were rounded. There were 3 layers of linoleum on the floors and the whole house seemed to list at about 10 degrees. I put a block under one side of the kitchen table so everything wouldn't roll off. All this was ours.

We did a lot the first week. My husband worked and I cried. He called local people (from the gas station down the road) to see about getting repairs made. I cried. He called the power company and argued that the problem was the transformer. I cried. He called the telephone company -- six weeks to get a phone. By this time I had cried enough. It was time for me to pick myself up and get to work. I had to make this place a home for us. My sons were into all sorts of interesting things, new bugs, new rocks, toads, lizzards, poison ivy. This was going to be the place for them.

We worked hard and we accomplished a lot very quickly. The good Lord blessed us with a little ingenuity and my husband with a lot of very practicle skills. We learned that local repairmen work at a very different pace. It is difficult to swallow all your plans and schedules for getting things done. Throw away any idea of appointments being made for much of anything. Being typical, hyper city dwellers, this was hard for us to handle. The pain is excruciating. I cried some more.

Then there was shopping. I needed to get out of the house for a minute, break away, back to the big city. I threw the boys into the car and "ran" down to Marlinton for a minute, just to pick up a few things.

Marlinton is a lovely little town with one main street, two traffic lights and a few shops. It has an old hardware store with wooden floors and a variety store complete with all the gadgetry I associate with my childhood. There is even a flower shop or two. It has grocery stores about the size of the corner carry out I used to go to, stocked with all the things you really need, but I was spoiled. I was looking for a big market. Where was the deli section? No bakery! No gourmet isle to look through. My whole being was going through a type of withdrawal. I grabbed what I felt I had to have and drove the 37 miles back home. Three hours after I had that urge to get out for a minute, I pulled into the driveway with the awful realization that getting out for a minute to the supermarket or any other store was a thing of the past.

I knew I couldn't do it anymore but just like someone who has to have that last cigarette, I had to try again. The next time I went the other direction. It is nearly 50 miles to Elkins, over Cheat Mountain (elevation 3800 feet plus). My youngest little boy cried because his ears hurt. I gave him some chewing gum and hoped it would reduce the pressure he was feeling because of the elevation change. My oldest kept asking me when we would get there. An hour and a half later, we arrived. There were a few more stores. My pangs were soothed somewhat. I strolled up and down the tiny isles and looked at each thing until my urges were satisfied. I decided it was time to eat.

We looked up and down the streets. No Mcburger, no Taco Bell, we had to settle for a Big-T instead. It was like suddenly discovering an old friend had died. The commercials on TV would mean nothing anymore. The 2 stations we get (with snow) are from Roanoke, Virginia, where all those old familiar things are still thriving.

We headed back over the "big mountain". My little boy started crying, he didn't want to go back up there. I knew I was in trouble when it came to going to Elkins again.

Seven hours after we had left, we came home. I was beaten. One child was asleep, the other leaned listlessly against the door. I discovered I had forgotten half of the things I really needed. I knew the trip was eminent again, soon. My husband wanted his dinner. I cried.

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Three years later and much wiser, I hardly ever cry anymore. I have learned that it is useless to struggle against generations of tradition. I appreciate our way of life here. It is clean and uncomplicated. The people I did not understand have made themselves clearer to me. There is no reason to hurry through life. I have adjusted to the idea of cooking every meal at home. The city is gradually being rinsed from my system.

There are many people who thrive on city living. It has a lot of advantages and it has taken me a while to love the country. I fought hard against it but the odds were too heavy. This is where I was meant to be. I'm happier than I thought I could be and I'm satisfied with my little house, my flowers, my chickens and the big tree.

* * * * *

NATIONAL RADIO ASTRONOMY OBSERVATORY
QUARTERLY REPORT
January 1, 1980 - March 31, 1980

ELECTRONICS DIVISION

Green Bank

The 5-25 GHz upconverter/maser receiver is undergoing final testing prior to its installation on the 140-foot telescope this summer. The X-band upconverter and maser have both been tested and close to the expected performance has been obtained. At K-band the room temperature flange noise temperature is between 19 K and 25 K over the 18-26 GHz frequency range. The upconverter, covering 8-11 GHz, gave noise temperatures in the range 23-35 K. It is hoped to improve on these modifications to the Cassegrain house needed to fit this receiver will be done in June 1980. If testing is completed by this date, the receiver will be installed at this time.

The 300-1000 MHz cooled upconverter/GASFET amplifier receiver for the 300-foot telescope will be ready for testing within the next month. This receiver should be ready for use this summer on the 140-foot telescope and on the 300-foot telescope this fall after the new travelling feed track has been installed and checked out.

The single stage maser for 40-50 GHz has been improved and has been working for several months. The current performance is as follows:

Net gain	9 ± 1 dB
3 dB instantaneous bandwidth	180 MHz*
Approximate noise temperature	50 K

*limited by pump tube

A four-stage maser is being fabricated for operation in the 40-50 GHz frequency range.

The local plane measurement receiver has been completed and is now ready for use on the 140-foot telescope.

The spectrum expander for the 36-foot telescope will be completed during the next quarter.

A second universal local oscillator rack for the 140-foot telescope has been assembled.

Charlottesville

Development of millimeter wave doublers is continuing. A unit providing > 1.5 mW from 155 to 165 GHz has been shipped to Tucson and a reduced-height waveguide unit giving > 1.0 mW from 127 to 167 GHz has been tested. The latter unit gives a peak efficiency of 20% and power output of 10 mW at 143 GHz.

A comprehensive paper describing theory, evaluation, and construction of cryogenically-cooled FET amplifiers had been written and submitted for publication. Eight 5 GHz FET amplifiers have been shipped to the VLA during this quarter.

Encouraging results have been achieved concerning a technique for increasing the tape recording density by a factor of 20 on the Mark III VLBI recording system. The technique involves modified home videorecorder (inexpensive) recording heads and a precision head-positioning mechanism. Construction of a second Mark III terminal

--*continued, next page*--

and expansion of the Mark II processor are continuing.

The Mark IV 1024-channel, 80 MHz bandwidth correlator has been completed and is undergoing laboratory tests.

Tucson

During this quarter the cooled single channel 2-mm receiver has been converted to operate from a doubler instead of the expensive, unreliable fundamental klystrons. The doublers provided by the Central Development Lab in Charlottesville give good performance and are very reliable. A prototype dual polarization L. O. injection system has been built for this receiver and is now being evaluated.

The progress on the ^{3}He bolometer system has been slower than we hoped for. All the crucial components have now been fabricated and have to be integrated into the final configuration. A mechanism for beam switching at high rates (50 Hz) has been developed and tested. This quasi optical beam switching system is low loss and broad band and should prove useful for systems other than the bolometer.

ENGINEERING DIVISION

Design and fabrication was begun for a prototype measuring instrument to measure reflector surface plates. Studies and tests were performed on cast aluminum and composite reflector surface plates for the proposed 25-m millimeter wavelength telescope. The design of a new travelling feed for the 300-foot continued, incorporating latest thoughts and requirements. The design and drawings for modifications of the installation of the automated feed mount on the 140-foot were completed and sent to the shop for fabrication. Further study and research were carried out on the parts for the 140-foot braking system. Changes were made in the design for the modifications of the Cassegrain house on the 140-foot. A feasibility and cost study was prepared on the proposed addition to the interferometer baseline. Design was started on new inductosyns for the 85-foot telescope. Studies and research for the proposed 25-m millimeter wavelength telescope continued. Routine engineering assistance was provided operations and maintenance in Charlottesville, Green Bank, Tucson, and the VLA.

COMPUTER DIVISION

VLBI

Closure phase for 3-station continuum processing has been implemented. This requires a slightly different version of PREPTAPE.

The NRAO spectral line post-processing programs have been transferred to the VAX 11/780 computer. The CIT continuum post-processing programs are now running on the VAX.

IBM 360/65

Two of the three bays of IBM core storage have been removed and the third has been deactivated. One megabyte of Electronic Memories and Magnetics (EM&M) memory has been added to the existing 1/2 megabytes of EM&M core. Total storage is now 1 1/2 megabytes.

VLA Post-Processing

The I^2S display device from Stanford Technology Corporation and the array processor from Floating Point Systems have arrived in Charlottesville for use with the VAX. The software development for the post-processing system is continuing. The initial file management and basic operating system are working and application software development is beginning.

THE VERY LARGE ARRAY

The array was scheduled for observations and tests for approximately 57% of the time during the first quarter. The maximum number of antennas used for an astronomic observing program during the month of March was 22. Our longest usable baseline is approximately 24 km. To date, 25 antennas have obtained first fringes.

The delivery of AIL parametric amplifiers

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has improved. The CTI contract is complete with all cryogenic hardware on site and the final batch of 60 mm waveguide has been accepted. All waveguide needed to complete the project is now on hand.

The order for the PDP-11/44, which will replace the PDP 11-40 as the output map display computer, was placed in January. The Modcomp Classic 7810 has now been tested satisfactorily so that appropriate software changes may proceed in order to incorporate it into the synchronous system to drive the CRT terminals. The additional memory for the DEC-10 has been received, although it has not been entirely incorporated into the system as yet.

The interim observing system for spectral line mode is currently being modified to allow the observer to select a subset of the total number of channels. This will allow observation with a larger number of antennas than at present when using the narrow filters.

The major overhaul of Antenna No. 1 was nearly complete at the end of the quarter.

By the end of the first quarter of 1980, Phase IV Site and Wye construction work was 99% complete and Phase V was estimated at 86% complete.

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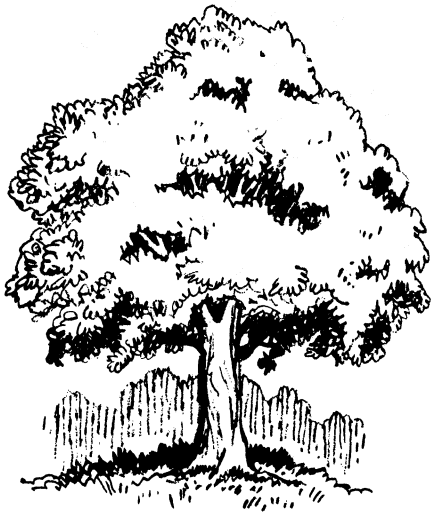
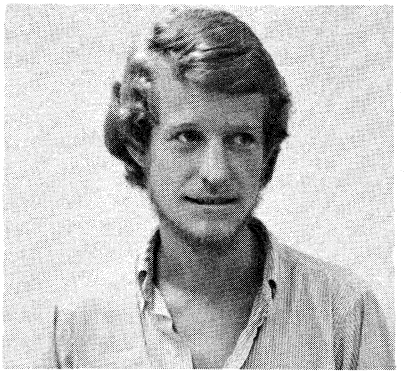
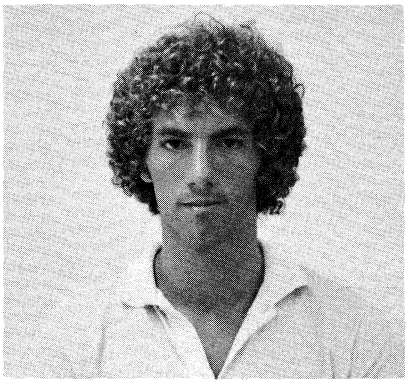


PERSONNEL UPDATE

New Employees
Charlottesville



Dan L. Fenstermacher
Electronics Engineer
Electronics Division



James S. Henley
Technical Trainee
Computer Division

Terry Lynn Jenkins
*(will advise)
Electronics Division

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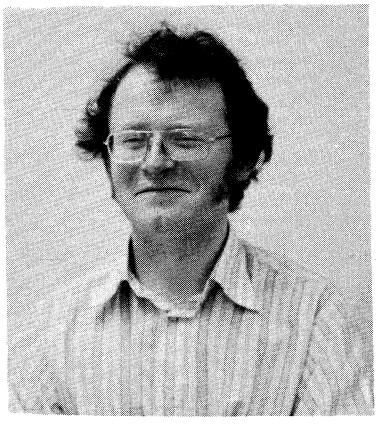
PERSONNEL UPDATE

New Employees (Continued)

Charlottesville



Robert A. Laing
Research Associate
Basic Research

Saundra P. Mason
Secretary
Director's Office

Photo
Not Available

Craig L. Sarazin
Visiting Associate Scientist
Basic Research

New Mexico

Mark W. Jenkins
Advanced Technician
VLA Construction

Tom J. Olney
Maintenance Trainee
Project Management

Robert J. Kummerer
Scientific Programming Analyst
VLA Construction

R. M. Price
Visiting Scientist
Basic Research

Shirley A. Melton
Accounting Clerk
Common Cost

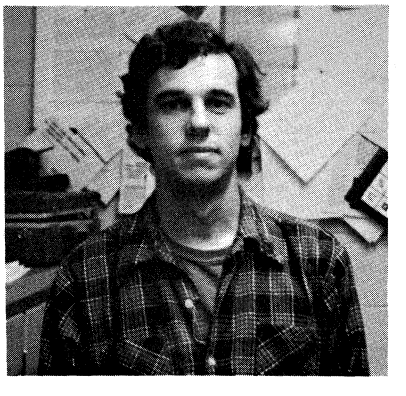
Eva J. Rigby
Secretary
VLA Site Management

Zbigniew Nosal
Electronics Engineer
VLA Construction

Christopher J. Salter
Scientific Programming Analyst
VLA Construction

Green Bank

Charlotte L. Poling
Janitor
Plant Maintenance



Stephen Fleckenstein
Technical Specialist
Telescope Operations

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PERSONNEL UPDATE

New Employees (Continued)

Tucson

Photo
Not Available

Magne B. Hagstrom
Electronics Engineer
Electronics

Terminations

Eugene L. Aragon
Sylvia M. Bennetts
John W. Benson
William R. Bond, III
Catherine F. Burgess
Frutosa S. Cermak
Naomi F. Daniels
David DeYoung
Raymond Escoffier
Doris R. Gill
B. Murray Lewis
Linda S. Martinic
Hazel McQuain
G. G. Nadkarni
Jerrold Parmer
Edward J. Rockafellow

Leave of Absence

J. R. Fisher (Extended)
Linda C. Sowinski
James Torson
Stephen R. Spangler
Craig R. Moore

Return From Leave of Absence

Robert L. Brown

Transfers

John C. Bishop - from Computer Division/ CV to Tucson Operations
John A. (Jack) Campbell - from Charlottesville to Socorro

* * * * *

What's Cooking?

BLACKBERRY CAKE

Ryanna Moore

2 c. sugar
1 c. vegetable shortening
4 eggs
1 1/2 c. buttermilk
3 tsp. baking soda (scant)
4 c. flour
2 tsp. cinnamon
1 1/2 tsp. clove
2 tsp. allspice
1 1/2 tsp. nutmeg
1 c. blackberries with the juice (rubbed through a sieve to remove seeds)

Cream shortening and sugar; add eggs, one at a time, beating well after each. Stir in buttermilk and baking soda. Sift together the flour and the spices. Add gradually to egg mixture. Beat well after each addition. Stir in the blackberries and juice. Pour into a greased 13 x 9 x 2 pan. Bake in preheated 375° oven for approximately one hour. Remove from oven. Let cool in pan. Spread with Caramel Icing.

CARAMEL ICING

2 c. brown sugar (packed)
6 T. vegetable shortening
4 T. butter
1/2 c. milk
1 T. vanilla
Confectioner's sugar

Combine first four ingredients in saucepan. Bring to boil. Boil for three minutes. Remove from heat and cool. Stir in vanilla. Add confectioner's sugar gradually until stiff enough to spread, blending well with cooked mixture. Spread on cooled cake.

BLACKBERRY COBBLER

Dort Oref

3 c. flour
4 tsp. baking powder
1 tsp. salt
2 T. sugar
1/3 c. shortening
1 1/4 c. milk

4-5 c. berries
1/2 c. sugar
1 tsp. cinnamon

2 c. sugar
2 1/2 c. water

Sift together first four ingredients. Cut shortening into flour mixture. Add milk. Blend well. Turn onto well floured board. Roll dough into a rectangle approximately 1/4 inch thick. Spread dough with berries. Sprinkle 1/2 cup of sugar and 1 tsp. cinnamon over berries. Roll up in jelly roll fashion.

Combine 2 cups sugar and 2 1/2 cups water in saucepan. Boil for 5 minutes. Pour into a 13 x 9 x 2 pan. Slice dough into 1 to 1 1/2 inch thick pieces. Place cut side down into syrup in pan.

Bake in a 375° oven for 35-45 minutes (or until the dough is thoroughly cooked)

Serve plain or with cream or milk.