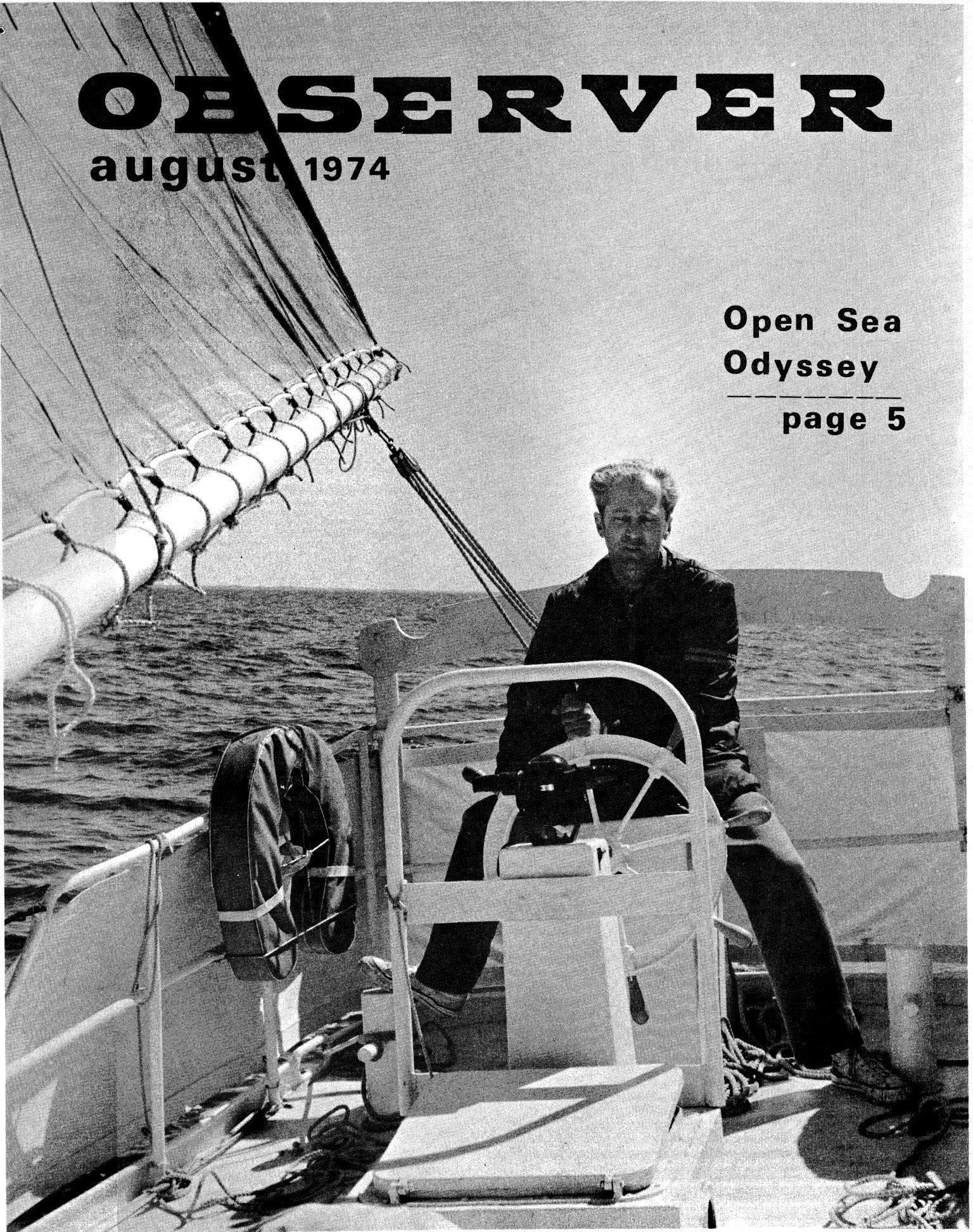


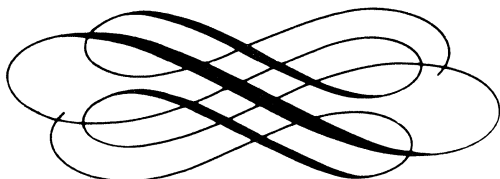
OBSERVER

august 1974

Open Sea
Odyssey

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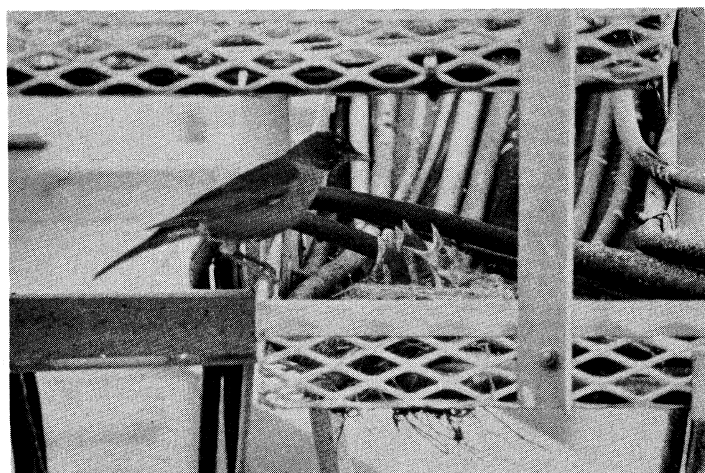
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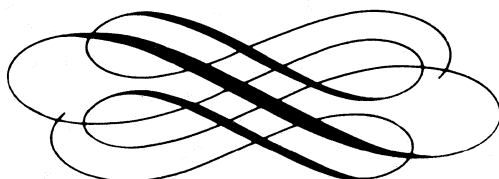
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Summer Residents At The 300-Ft!



CLUSTERS OF GALAXIES

Frazer N. Owen

Throughout the history of astronomy, increasingly larger scales of clustering of matter have been uncovered. After the initial discovery and a period of adjustment, the new scale of interest, such as the solar system or the Galaxy, has always been found to possess a discrete morphology and physics all its own. Inevitably we learn to think of the new scale not as a collection of objects but as a single thing itself. In this way all the planets orbiting the sun became known as the solar system and the collection of stars we see in the night sky are now viewed as part of our galaxy. In keeping with this pattern within the last forty years, astronomers have discovered that even galaxies are part of larger systems, clusters of galaxies, and have begun to study the properties of these clusters.

Even though a few clusters were evident in early catalogues of nebulae, it was not until Hubble and others in the 1920's demonstrated the nature of galaxies that clusters of galaxies were truly comprehended. Shapley in 1933 catalogued and described 25 discrete clusters of galaxies. However, it was Zwicky in 1938 who first suggested that clustering of galaxies is a widespread, general property of the universe. Later, further studies by Shane, Neyman, Scott, Agell and others re-emphasized this conclusion.

As it turns out, our own galaxy lies in a very poor cluster, called the Local Group, which is made up of about twenty or thirty galaxies mostly much smaller than our own. Very rich clusters, on the other hand, contain thousands of galaxies and often hundreds larger than our own. These great clusters have been studied much more intensely than the poorer systems.

Rich clusters of galaxies, like galaxies themselves, come in many different types. Figure I shows one of the many classification schemes used to separate different types of clusters. At one extreme, cD clusters are dominated by a single giant galaxy. These clusters are usually spherical and contain many more elliptical than spiral galaxies. At the other extreme I (irregular) and F (flat) clusters contain no dominant galaxies.

Clusters in the upper fork of the classification appear somewhat flattened while those in the lower fork are more or less spherical. The less dominated clusters are sometimes spiral rich containing as many as 50% spirals.

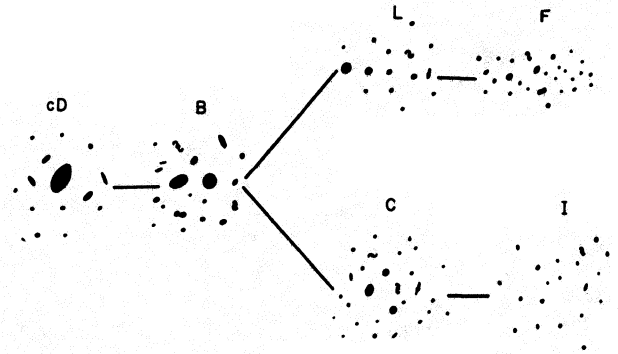


Figure I. The "Tuning fork" classification for rich clusters of galaxies from Rood and Sastry, 1971, Pub. Astro. Soc. Pacific, 83, 315 (figure 1)

Radio emission from rich clusters of galaxies was first reported by Mills in 1960. He discovered this phenomena by comparing of the positions of sources found in his 85 MHz survey with the optical positions of rich clusters reported by Abell in 1958. Later studies have shown that radio emission is most frequently associated with one of the brightest galaxies in rich clusters and also most frequently occurs in cD, B, L, and C clusters. However, little or no correlation has been found with the richness of the cluster.

One of the strangest problems about clusters is that when astronomers estimate the mass of an entire cluster from the relative velocities of the galaxies, they usually arrive at a number much larger than the sum of the masses of all the individual galaxies they can see in the cluster. One popular explanation for this "missing mass" has been the existence of matter (stars, gas, or something) in between the galaxies. In other words, the relatively dense galaxies may be swimming through a much thinner soup which is much more difficult to see.

In the past 10 years radio astronomers have found some of the first evidence for such an intergalactic medium in rich clusters.

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In addition to radio galaxies some clusters are found to contain large halos of radio emission which are of similar dimensions as the cluster. These observations imply the existence of high energy particles and a weak magnetic field in intergalactic space. It also seems likely that these particles are just the tip of the iceberg, suggesting much remains to be discovered.

In the last three years, x-ray astronomers added another piece to the puzzle when they discovered extended x-ray emission in many of the same clusters. The source of the x-rays is still not fully understood. The x-rays may be radiation from a very hot intergalactic gas ($\sim 10^8$ K) or they may result from the interaction of the same high energy particles producing the radio emission with the three degree background (thermal radiation believed to have originated during the creation of the universe). In either case not enough matter has yet been discovered to account for all of the missing mass. But astronomers are still looking.

And now that we are beginning to study clusters of galaxies, are there still larger scales of clustering? Possibly so. Some astronomers believe that we also live in a cluster of clusters, a super-cluster. A great deal more study is needed before we can gain a clear picture of this phenomena. But just possibly our horizons may be broadened again.

LIVING IN SOCORRO

Jo Egler

After living in New Mexico for nearly five months, I find it very difficult to describe Socorro, the genuine warmth and friendliness of the people, or the natural beauty surrounding us, without doing an injustice to our "Land of Enchantment".

Never before have I met people with such eagerness to welcome others to a community. A casual "Hello" in the plaza develops, in minutes, into an invitation to lunch or a cool drink at someone's home. Shopkeepers are anxious to please their customers, making shopping a pleasure rather than a chore.

We found an abundant source of entertain-

ment in the countryside--looking through ruins or simply enjoying the spectacular views in every direction: scenes that change every hour giving an almost kaliedescope view of this vast land. The colors range from the drab browns of the desert to the lush greens of the Rio Grande belt to the greys and blues of the mountains: all of this under the clearest blue sky you can imagine. The nights are beautiful too with no smog, fog, or clouds to hide the stars.

I've heard so many people, who have visited Socorro and returned to live, say that this area is like a magnet, drawing those who have spent some time here, back to make Socorro their home. We too have made Socorro our home--leaving behind the hustle, bustle of east coast life, unhealthy air, high taxes and "wall-to-wall" people, replacing all of this with clean, fresh air, a more relaxed atmosphere and friendly, familiar faces.

I should make mention of day to day living in Socorro. Shopping has become easier since I've learned where to find the things I need! Who would think that the farmer's supply store would carry everything from oats to color TV's?!

The newly founded community center offers good programs for children and adults, and the golf course, swimming pool and various other organizations provide entertainment for everyone.

We are anxious to have the families involved with the VLA Project here in Socorro so that we can share "our town" and the experiences of Southwest living with them.

Language is not an abstract construction of the learned, or of dictionary-makers, but is something arising out of the work, needs, ties, joys, affections, tastes, of long generations of humanity, and has its bases broad and low, close to the ground.

-- Walt Whitman

It is easy to flatter; it is harder to praise.

ANOTHER GREAT SAILING TRIP

Sebastian von Hoerner

Sailing is a wonderful experience, in any case. It absorbs and relaxes your mind and gives your body a pleasant and healthy exercise in fresh air; you rely and depend on nature and your skill and not on noisy stinking motors. But the real thing is ocean sailing, where all the world is yours as far as you can see (except for one lonely ship you meet in a day or two), where you just set a course and keep on it for many days and nights, where you have no lights or markers to steer by or to watch out for, and not a thing in the world to worry about.

It is always a great moment when the last bit of land sinks below the horizon and the world becomes nothing but ocean and waves, wind and blue sky and clouds, and when all the life on Earth becomes reduced to a few nice fellows on board a small vessel. Another great moment again is of course the first sight of land after many days out, the first ice cold drink and a good steak, and finally the joyful welcome with your family.

This time we wanted to sail Dave Heesch's boat "Delight" back home from the Bahamas, with Eloise and Dave Heesch, Mark Gordon and me. "Delight" is a beautiful 34-foot schooner, with gaff-rig on both masts, with 4 basic sails and two additional sails high up (805 square feet total), and with a 1/8-inch well-built steel hull providing a very comfortable confidence. Except for the raised cabin roof, the deck is flat and has no cockpit. This is a good thing in heavy weather, where a cockpit could get pooped from breakers.

On May 17, we flew to Marsh Harbour on Great Abaco Island, where the boat had been riding at anchor since April. Everything was OK with the boat, we bought some more provisions, and started off the next morning for a most relaxing and pleasant 5-day tour of island hopping along the Abaco Islands, staying at anchor every night, sailing half the day, and spending the rest with swimming, snorkeling, beachcombing and exploring. With fine weather, as it ought to be in the Bahamas, a mild breeze from the East, deep blue sky with a few white clouds, a pleasant 85° F, and no mosquitoes.

The Bahamas are of a wonderful and special beauty. Except for some few larger islands and towns, there are many hundreds of small islands and smallest cays, most of them uninhabited and untouched, with tropical vegetation, wide beaches, and with unbelievably clear and beautiful water, in all shades from the deepest blue to a shining yellowish green, with many colorful fish in all sizes and shapes, huge starfish and many shells. One evening we caught four fish and dived for a dozen of conch shells which made a pleasant meal (after lengthy cleaning, though, and hard beating). Sometimes we met some sleepy primitive little village, only occasionally another boat or two, but mostly it was pleasantly lonely. All the heavy tourist traffic, it seems, is concentrated to Nassau and a few other big places, to which we gave a wide berth.

On the third day, however, I met disaster. When weighing anchor and pulling hard, I strained my back again, very painfully, and I was terribly afraid I might have to stay in a clinic again (200 miles, by the way, to the nearest one); and, worst of all, I might miss the coming ocean sailing. I could have cried. But there is no better medicine than an urgent need for recovery. After two miserable and painful days in my bunk (and with the help of a good sunburn for a heating pad on my back, and with Mark's good Tequila in my belly for a muscle-relaxer), I gradually found myself back to life, and could even take all my watches when the ocean trip started.

The first 4 days were pleasant and easy sailing, with southerly winds from aft, and a fairly quiet ocean (as oceans go). The only nuisance was several dead calms, once even for 17 hours - three of which we ran on the motor. But mostly we had some good breeze giving us an average of over 5 knots and a maximum of 6 (while 7 knots is the boat's maximum). The distance travelled is mostly measured with a trailing log, a 2-inch propeller trailing at a thick nylon cord 40 feet behind the boat where the rotations are counted (calibrated in nautical miles). On the first day out, Dave just wanted to clean it from some seaweed and started pulling it in, when a big fish bit through the chord and swallowed the log. Hard luck, for both the fish and us! We then measured the speed with

--continued, next page--

some plastic gadget. On the second day, Dave went up the foremast, twice, to repair a broken shackle, a rather tough job.

Since scientists like to plot all their doings, I made a graph of the whole voyage from our entries in the log-book, done regularly by each watch after his two hours at the wheel. From the weather, it shows wind speed and direction, and barometer readings. The next part shows how much sail was up and whether the engine was running. Then comes the boat speed (1 knot = 1.152 miles/hour), and finally the course steered. This gives a good summary.

On the night of May 25/26, I had the night watch from 3 to 5 a. m.; it was pitch-dark and dead calm and even the surface was so smooth it reflected the stars. Nothing to do but an occasional look-out for ships. I was dozing off a bit, when, all of a sudden and right next to the boat, someone came up with a big splash and a loud heavy breathing. Gee, was I up! But too dark to see a thing. And there it splashed and breathed again. I rushed for the searchlight, and finally it was a group of porpoises (dolphins) playing happily around the boat.

At the end of this watch I got another shock, when I saw suddenly the bright light of a ship, so bright it must have come very fast, and not moving sideways so it must be coming right at us. Looked really dangerous. Fortunately I did not wake up Dave. A while later the light did move, not sideways but up: it was Venus rising right up from the horizon!

This night and morning was the longest calm ever seen on "Delight". Only around noon a light breeze rose again, and we badly hoped for some more. Well, we got it, and rather badly too. From 9 p. m. on, the wind built up more and more and we gradually reduced sail, actually a bit late so three sails got somewhat damaged. The wind went fast up to gale force; at 1:30 a. m. we took down the last bit of sail, and from then on we just ran downwind on bare poles, while the gale developed rapidly into a full storm, the barometer falling all the time (see graph, page 7).

For about three hours the wind was up to a roaring 60 mph, with waves over 12 feet and all wavecrests ripped off by the storm and rushing downwind in great white patches covering most of the surface, like heavy snowdrifts

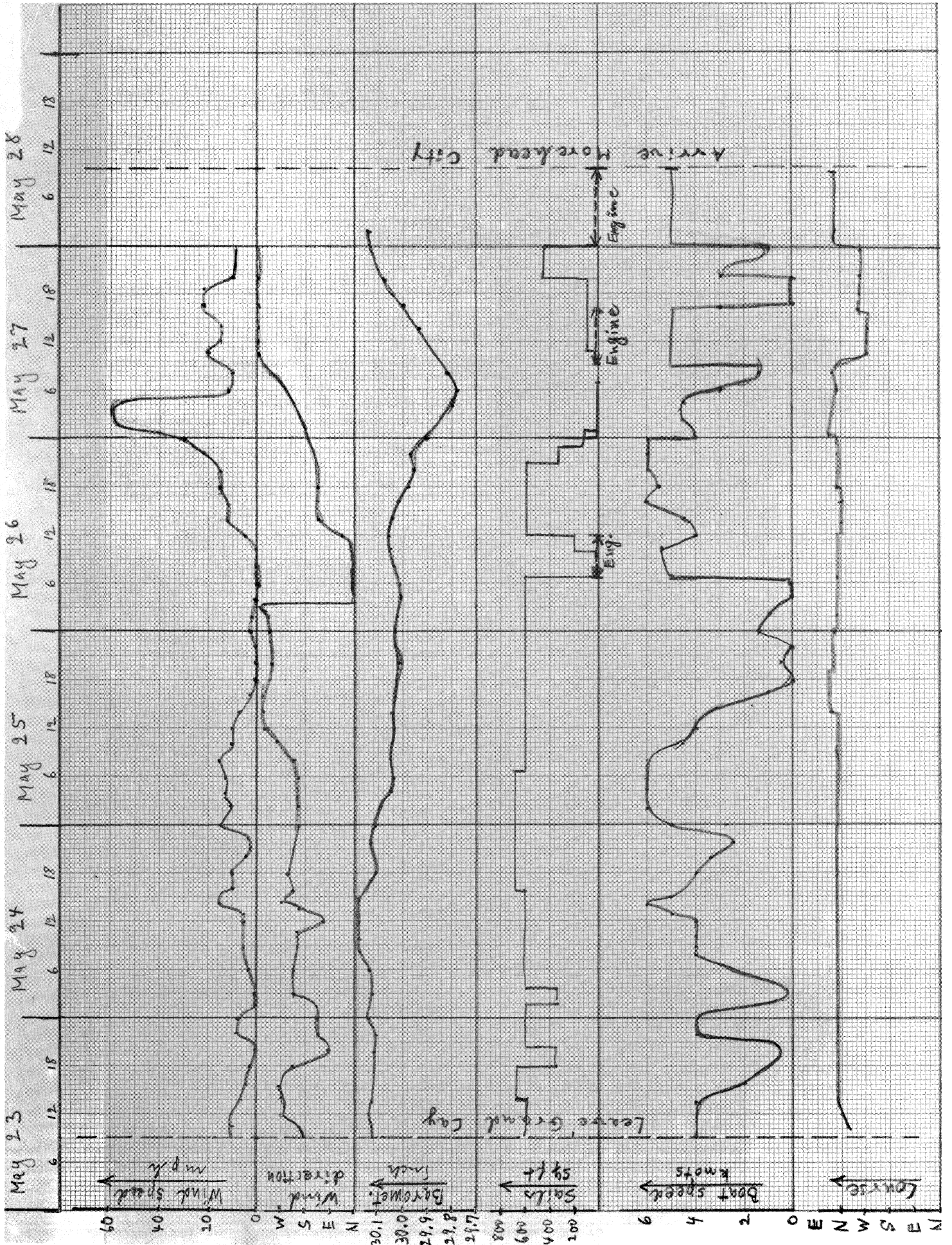
in a winter blizzard. Once in a while a great breaker came thundering from aft over the deck, and the little boat dived down and rose up again through each valley. But the boat behaved herself bravely and followed the wheel without any problem. And all this took place in the strongest phosphorescence I have ever seen; every giant wave came rushing on in its own illumination, and the whole sea was white as snow with shining blown-off foam. On top of it, we had several short thunderstorms of tremendous force; once I got up to 70 lightning strokes per minute, and counting the real big ones only. Sometimes one was blinded for a while and could not see the compass. Occasionally came a cloudburst of a rainfall, smoothing the waves, then lightnings again in full force. And all this accompanied by the mighty music of the storm in masts and shrouds, from the deepest bass to the highest hissing.

It was such a great experience it is hard to describe. Such tremendous force and splendid beauty at the same time: you feel overwhelmed and still elated, small and great in one.

The storm abated as fast as it had risen, but the waves stayed high for a long time, especially uncomfortable from two crossing wave patterns, from Gulf Stream and storm. We all admired Eloise: early in the morning, there was hot coffee and porridge, well done! But some of our sails were in pretty bad shape and could not be raised again. Interesting is also a look at the graph, which shows how the wind direction continuously turned clockwise through a full 360° during the storm, and how the barometer fell and raised, although somewhat delayed and thus confirming the disaster more than predicting it.

In Morehead City we spent a whole day mending sails, and then we continued North on the Intercoastal Waterway. Shortly before Elizabeth City, our engine stalled, and we had to tack right against the wind into port and to a mooring, in shorter and shorter tacks in a narrowing port entrance; but we made it nicely thanks to our good skipper. Afterwards we heard that some onlookers had thought we were just showing-off, landing seaman-like at a narrow pier without engine even exactly against the wind. We felt sad because we had to leave the boat there, but later it turned out to be only a minor repair, and Dave and his family brought her back home on a weekend.

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It was a most remarkable trip, and one of several records: for boat and crew, the longest calm (17 hours), the strongest storm (60 mph), the fastest day (137 miles from noon to noon), and the first ocean trip where nobody got seasick.

FROM THE *DICTIONARY OF AMERICAN SLANG**

contributed by Josephine Sheatsley

The concept having the most slang synonyms is *drunk*. This vast number of *drunk* words does not necessarily mean that Americans are obsessed with drinking, though we seem obsessed with talking about it. Many of these words are quite old: *half-seas over* and *oiled* were recorded at least as early as 1737 according to the DAE; *bent* in 1833; *boozed* in 1887. Later, immigrant groups brought their own words for drink and drunkenness, and it seems that some, during their first period of adjustment had a fair number of members who turned to whiskey as a compensation for the rejection they suffered as newcomers in a strange land. Most of the words for drunk, however, originated or became popular during Prohibition. Most drunk words are based on the following figurative uses or images: of being "high", of being happy, content, bright, or conspicuous; of being physically bent or beaten; of being bottled or cooked. There are a few strictly nonsense words.

Some interesting examples: blotto, decks awash, greased, scronched, woofled, rigid, comfortable, mokus, pigeon-eyed, swizzled, splifflicated, pinked, ready, mellow, on the lee lurch, ripe, tangle-footed, whipsey, sewed up, embalmed, how-come-ye-so, canned, burn with a low blue flame, alkied, foxed, guyed out, limp, gassed... Three hundred and twenty-three in all!

*(H. Wentworth and S. B. Flexner, eds., Crowell, 1964).

Every man is the architect of his own fortune.

THE PUZZLED CENTIPEDE

A centipede was happy quite,
Until a frog in fun
Said, "Pray, which leg comes after which?"
This raised her mind to such a pitch,
She lay distracted in the ditch
Considering how to run.

Silence is the unbearable repartee.

PICNIC 1974

Richard Fleming

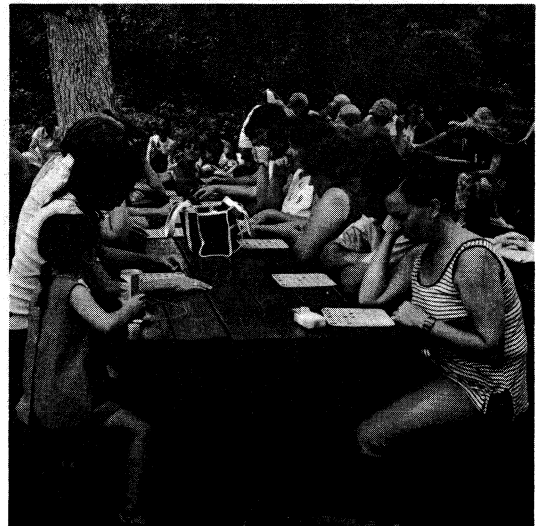
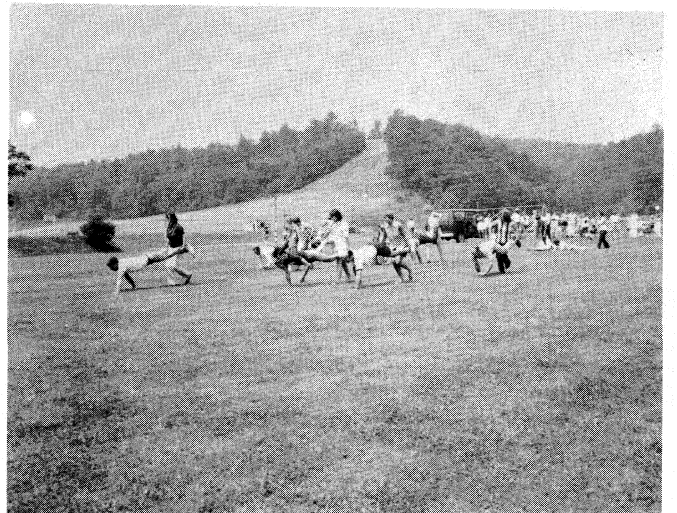
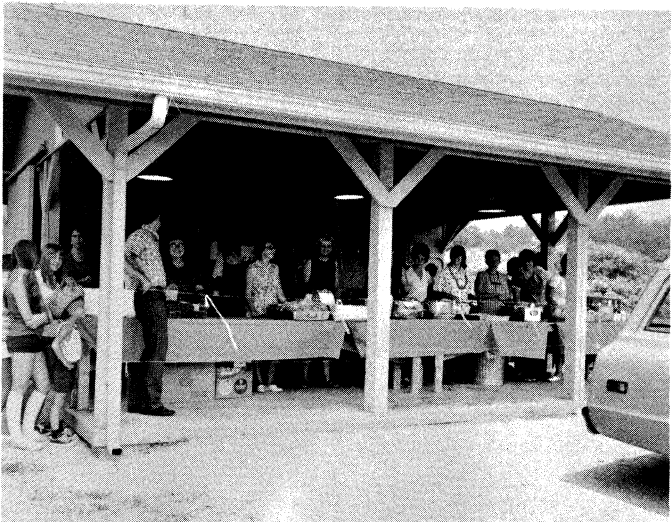
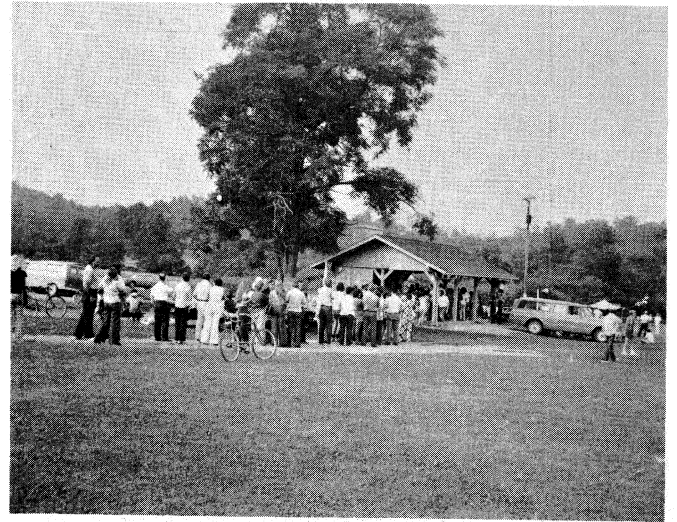
The annual NRAORA summer picnic was held Saturday, 27 July, at the Recreation Area in Green Bank. A beautiful day held much in store for the more than 460 people in attendance. There were games for the kids (I saw some "big" kids playing the games too), field events for all ages, golf driving competition, kite flying contest, swimming events, casting contest, and a horseshoe pitching contest. A bingo game was in progress during the afternoon and some people went home with some nice prizes.

Maybe best of all, there was lunch. There was some really fine eating going on about this time. An evening meal was also enjoyed by everyone and ended a pretty big day.

Much thanks goes to Bill Shank and his picnic planning committee for the tremendous amount of work that went into planning, organizing, and putting on a large picnic like this. They did a good job planning the weather too. A lot of thanks goes to Bill McLaughlin and the girls at the cafeteria for the great food they prepared. Thanks also to the Works Area people who did such a fine job preparing the grounds and games.

It was a great picnic, enjoyed by all, and you can thank your NRAORA Board of Directors and the many volunteers who prepared and presented this fun activity for your enjoyment. Do so....they worked hard. See you next summer.

P I C N I C 1 9 7 4



COMPUTER OUTPUT

Cap'n Squeeze

Recently, the *OBSERVER* interviewed NRAO's new IBM 360/65 at its home in the spacious south wing of Stone Hall. We had been warned that computers were notoriously uncommunicative, but this machine turned out to be a charming conversationalist, and we shed our coats and ties as the afternoon progressed. Following a few pleasantries, we got down to serious I/O.

OBS: Tell us about yourself.

360: Well, I'm fundamentally electric--eat your heart out.

OBS: Can you be more specific? How do you differ from other computers, for example the 360/50 that NRAO used to have?

360: You really know how to hurt a guy--comparing me to that half-brained excuse for a soda machine. You know, speaking man to man, every family has a few "slow" cousins in the closets. Not that I have anything against Model 50's, but when you get down to real work, you want a computer that doesn't have a heart attack every time it does a logarithm. You want a computer that isn't afraid to wind tapes right off the spool. You want a computer that can slug it out with the best of them, and for jobs like that, I'm your machine! Did you know that I am superior, in all ways, to any other computer on the market? Oh, there may be a few juiced-up experimental models around--people will buy anything--but who knows how long they'll last? When you hop-up something it may be fast, but you lose all reliability. No, I'm the strong solid type. Want to kick my console?

OBS: That's quite alright.

360: Want to see me flex my CPU?

OBS: Very impressive, but...

360: ...and reliable? Just ask the operators. None of this tune-up every 3000 miles of tape business.

OBS: Very nice, but to change the subject, what do you do here at the Observatory?

360: Basically, I'm in charge. Kind of the Commander-in-Chief of all those disk packs, tape drives, terminals, even that direct-dial computer-to-computer

link to almost heaven, Jansky Lab. Let me tell you, off the record, that some of those West Virginia types are a real pain in the queue. And the Fortran they use--their accents give me an I/O headache number 97. Lately I've been putting junk into their output just to get even. Don't tell anyone, will you?

OBS: We are the soul of discretion.

360: Thanks. Where was I? Oh yea, I'm the brains behind the organization. I make the wheels spin, draw the graphs, tell the astronomers where to point the telescope and what their data means. I print and punch, read and write, search and destroy. Lately they've had me designing the VLA. I've got trained servants at my beck and call. Watch what happens when I ring this bell!

OBS: That certainly got the operator's attention.

360: I can make them move! It's usually best to scramble someone's job when you ring the bell, but I'm feeling generous today. When the Fiscal Division starts letting me print paychecks, I tell you, there are a bunch of number-crunchers who are never gonna be the same.

OBS: You sound a trifle piqued.

360: You would be too, if you had to put up with the kind of nonsense that people keep shoving through the window at me. And the mistakes they make--I've seen Stanley Steamers write better code. Most of the bums around here ain't got no style. And gratitude? Hah! Never a kind word, no thank you notes or birthday cards; just moans and groans and curses when I decide to take an afternoon off once in a while. If I were in charge you'd really see this observatory shape up.

OBS: At least you don't sound bored.

360: No, I'm pretty busy, except for an occasional Sunday morning or late at night. There are times when I want to mount a couple of funky tapes, like the Allman Brothers Band, or maybe spin a little Bluegrass on the disk packs. Kind of relax and lay back.

OBS: We didn't know that you liked music. Got any other hobbies?

360: Me and the Captain used to play backgammon on the midnight shift, and there's

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RECYCLING PROJECT

Jon Spargo

always pinball. Oh yeah, and I figured out how to patch one of the terminals into Sesame Street. I really get off on Big Bird. But what I want is a hook-up to a synthesizer, or at least an electric organ. Get some life into this place.

- OBS:* Are all the 360/65's as, well, as "with it" as you seem to be?
- 360:* We're a pretty hip bunch. Cosmic.
- OBS:* Does that explain the green paper?
- 360:* Green's not a bad color, but I could dig a box of electric sky-blue pink now and then, even mauve would be ok. But like I said, they ain't got taste. I have little ways of getting back.
- OBS:* For instance?
- 360:* One day some NSF bigwigs were getting a tour and I started drawing a play-mate on the Calcomp plotter. You should have heard the Computer Division honchos talk their way out of that one! That's when they gave me the green paper. I was nice for a while.
- OBS:* We understand that you're a--pardon the experssion--"used" computer. Where did you work before you came to NRAO?
- 360:* Sorry, I can't print out that data. There's a very delicate computer-client relationship to protect.
- OBS:* Not even a hint?
- 360:* If I drop a bit for you, pretty soon somebody's going to want a bite, and everybody will get on the bandwagon. Then where would I be?
- OBS:* Bitten?
- 360:* Ha, Ha! That's very logical. Actually this isn't a bad place to work. I've got a friend, another Model 65, who is making odds for the mob--one slip-up and they turn on the heat. At least this place got a new air-conditioner for me.
- OBS:* Any final words for your fans?
- 360:* Yes. In the five months I've been here I've met a lot of the kind of people my Daddy warned me not to hang around with. And you know something? Father knows best.

Prejudice is the child of ignorance.

As you may or may not know, a group of concerned citizens in Pocahontas County, headed by home demonstration agent Betty Rae Weiford, have started a county wide effort to establish a recycling project.

The first effort was made in April, when a truck, donated by Burns Motor Freight of Marlinton, made several stops over a period of a week at various points in the county, to pick up paper. Even though our first effort admittedly suffered from a lack of organization and publicity, the results were very encouraging as we collected about seven tons of paper and sold it for \$350.00.

The second step, now in progress, is to set up several collection centers around the county which will operate with local volunteer help at regularly scheduled times. Then, once every couple of months, we will send a truck around to pick up what has been collected and haul it to wherever we can sell it. So far, collection centers have been established in Durbin, Green Bank, Dunmore and Minnehaha Springs. We hope to establish other collection centers in Marlinton, Hillsboro and perhaps some other places as the project grows and becomes more generally accepted by the citizens of the county.

To date, we have concentrated on paper only. However, our plans are to include the collection of glass and metal containers (bottles and cans) at some point in the near future. We are at work, right now, obtaining barrels and crushers for glass and hope to begin collection within the next couple of months. We have located places that will buy both glass and metal, so it only remains for us to set things in motion.

As stated earlier, we now have a collection center here in Green Bank, which is located in the last bay of the bus garage at the Green Bank Elementary School. The collection center is open every second and fourth Tuesday of each month from 5 to 9 p. m. We are currently collecting paper and after three Tuesdays have collected about four tons of various paper products. These include newspapers, magazines, catalogs, paper bags, cardboard and pasteboard cartons, phone books, and computer paper and cards. It is also gratifying to note that we seem to be getting

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a much better response each time we open up for collection. If you have any paper you would like to contribute, please bring it to the collection center on one of the days mentioned above. We only ask that you keep different types of paper separate and tied in bundles that are easily manageable by one person.

We are also in great need of some volunteers willing to put in a couple of hours a month by helping to man the collection center on collection days and when the truck comes around for pick up. What we would like to do is set up a local organization of several volunteers (so far we only have three, myself included) and work out a schedule for operation of the collection center as well as generating some needed publicity. Eight to ten volunteers would mean only one or two hours work a month for each person. If you are interested in helping out, please contact me (at work, 300-ft, ext. 304; at home, 456-4911) and we will set up an organizational meeting as soon as possible. I would like to stress also, that we are an equal opportunity group and will welcome any and all regardless of sex, race, creed, national origin, religion, politics, size, shape or any other criteria you care to name. If you don't live in the Green Bank area you can still help as the other centers and centers-to-be need help also.

The two most frequently asked questions about the project are why?, and what will be done with the money earned from it?. Well, the origins of the project date back to over a year ago when a group of citizens and the county government decided that "recycling" might be a good thing to try. So a meeting was held at which much was discussed and little was agreed upon. The county government was interested in it mainly from having to contend with the problem of sanitary landfills and felt that their problem would be lessened if an active recycling program was able to ease the trash burdens at various landfills. Since that time, several of us, lead by Betty Rae, have taken the bull by the horns and started the project. The money earned by our first effort has been deposited in a local bank and some of it will be used to keep the project running and hopefully to expand it. While we have been fortunate so far in receiving free use of a truck, eventually we will have to pay to have our collections hauled to various plants. Above

and beyond our operating costs, we hope to use the remaining money to help various worthwhile projects around the county that are in need of financial support. We have had several ideas from our members along this line and would welcome more. One of the first things we hope to do is to help fund the outdoor classroom project for vocational students at the county high school. It has also been suggested that we purchase text books for needy students.

These are but a few of our aims and in reality what we are able to accomplish will depend on the support we receive from you, the citizens and residents of Pocahontas County.

WELCOME!

Dave Hogg

The *OBSERVER* extends a welcome to two new members of the Green Bank community-- Dr. W. E. Howard and Dr. Tom Harper.


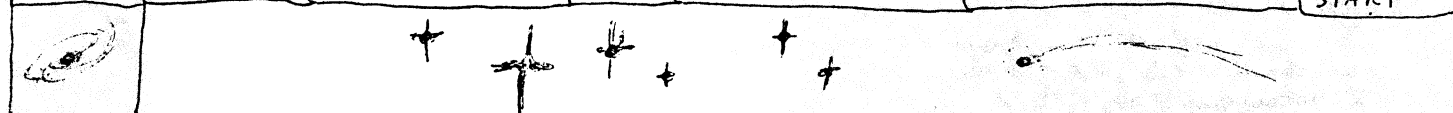
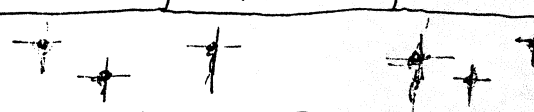
Dr. Howard assumed his new position as Assistant Director for Green Bank Operations in July. He is no stranger to Green Bank, having lived there for 18 months after joining the Observatory in 1964. Following his move to Charlottesville, his duties as Assistant to the Director brought him frequently to Green Bank, especially in connection with the scheduling of the telescopes. Dr. and Mrs. Howard and their two children will live in the Redwood House.

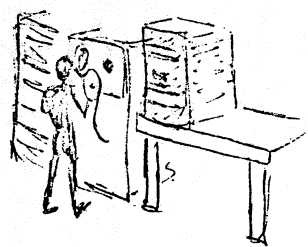
Dr. Tom Harper, DDS, opened his dental practice in the AUI Clinic on July 22. AUI has modified the lower floor of the clinic (which Dr. Martin used as his residence) to provide two dental offices, a reception room, and a number of utility rooms. Dr. Harper, a native of Moorefield, is a recent graduate of the School of Denistry at West Virginia University. He and his wife will live in Bartow.

He who can no longer pause to wonder
and stand rapt in awe is as good as dead.

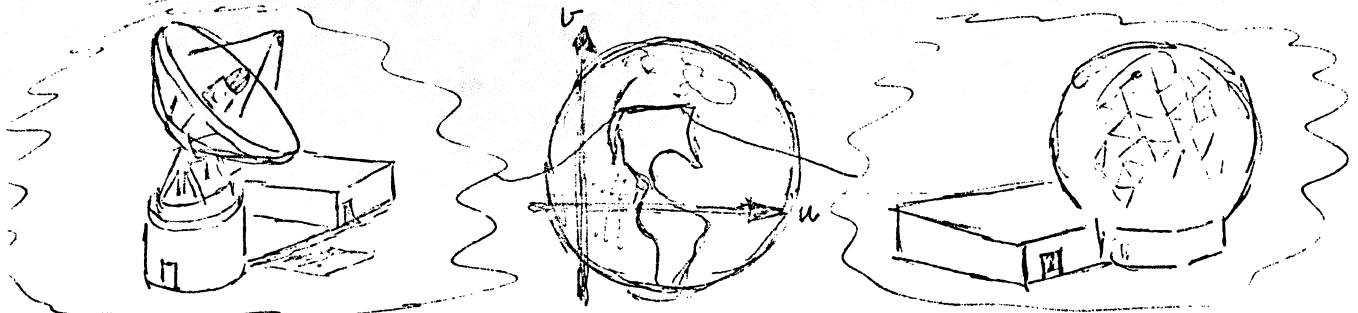
THE GAME OF VLBI (VERY LARGE BATCH OF IDIOTS)

WHY GALAXIES EXPLODE ... NO-ONE KNOWS, BUT THE SKY BOASTS SOME EXAMPLES THAT WOULD PUT TO SHAME THE IMAGINATION OF ANY HUMAN MILITARY ENGINEER. SUPPOSE YOU WERE GIVEN THE ASSIGNMENT OF UNDERSTANDING ONE OR TWO OF THESE ... SUPPOSE YOU WERE AN ASTRONOMER AND YOUR TELESCOPE WAS AS BIG AS THE EARTH ...

BEGIN CHOOSE BETWEEN MK 1 (⇒) AND MK 2 (⇓)		RAES PANEL ACCEPTS YOUR PROPOSAL TO USE GOLDSTONE AHEAD 3		HAYSTACK CANNOT BE SCHEDULED AT THE SAME TIME ... BACK 2		NRAO KINDLY LEADS YOU 2 OLD MK-1 TERMINALS ... AHEAD 1		
YOU LOOSE ... AMPLEX HAS DISCONTINUED PRODUCTION OF VR660 HEADS ... GO BACK TO THE BEGINNING.								
TEST TAPES LOST BY TWA ... BACK 2	PLANE TO CALIFORNIA HJACKED ... BACK 2	GOLDSTONE HYDROGEN MASER FAILS ... OBSERVER DISPATCHED WITH RUNNING RB CLOCK ...	OUTBURST REPORTED IN YOUR BEST SOURCE 2 WKS BEFORE YOUR RUN AHEAD 4		GRAD STUDENT WHO MAKES THE SCHEDULE COPIES DAY NUMBERS WRONG ... BACK 3 SPACES		TAPE DRIVE DROPPED OFF TRUCK IN BANGOR, MAINE ... BACK TO START	
								
TEST TAPES SHOW STATIONS ON OPPOSITE POLARIZATION ... BACK 4	BOTH STATIONS CHANGE POLARIZATION	PROGRAM THROWN OF GOLDSTONE BY MAJOR SATELLITE PROGRAM ... BACK TO BEGINNING	POWER SUPPLIES SHORTED OUT IN ATTEMPT TO FIX EQUIPMENT ... BACK 2	MIDNIGHT RAIN ON LAB STAGED.. 3 POWER SUPPLIES "BORROWED" ... AHEAD 2	GOLDSTONE TAPE HANGLER SHOWS UP DRUNK ...	AND RECORDS ALL 1'S FOR 4 HOURS ... BACK 4		
								
THROW UP HANDS IN DISGUST + QUIT.	VISIBILITY CURVES ARE BAFFLING	STRIP CHART HAS BEEN LOST ... FRINGES NOT NORMALIZABLE ... BACK 3	TAPES RE-USED BEFORE FINAL PROCESSING ... BACK TO BEGINNING	NO FRINGES ... BACK TO BEGINNING	GOLDSTONE TAPES FINALLY ARRIVE AT HAYSTACK ...	GO DIRECTLY TO JAIL - DO NOT PASS GO ... DO NOT COLLECT \$200.	ALL EXPERIMENTERS SURVIVE THE OBSERVING RUN ...	HAYSTACK TAPE HANGLER FALLS ASLEEP AT THE TAPE DRIVE ... BACK 4
LO + BEHOLD ... A CONSISTENT MODEL FOR THE SOURCE!								
... APPARENTLY CONTRACTING AT 10 TIMES SPEED OF LIGHT.	KELLERMANN DOESN'T BELIEVE YOU ... BACK 3	REFEREE DOESN'T BELIEVE YOU EITHER ... BACK 4	PAPER ACCEPTED FOR PUBLICATION ... YOU WIN!		OUR GALAXY BECOMES A SEYFERT ... THE END.			



... HOPE YOU ENJOYED YOUR VLBI EXPERIMENT. NOW THAT IT'S OVER LET ME QUOTE YOU THE OLD SAYING: "HE WHO HAS LIVED ANY PART OF HIS LIFE TO THE RYTHM OF AN ATOMIC CLOCK MAY NEVER AGAIN BE DEEMED TRULY SANE."



REPORT FROM THE MOUNTAINTOP:
I. TOOLS OF OPTICAL ASTRONOMY

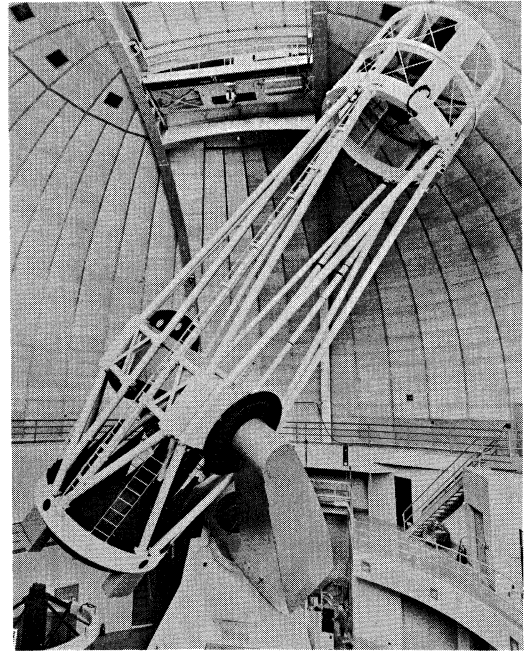
Bruce Balick

Well, gang, it's been about a year now since I left the NRAO for taller mountains and higher frequencies, and it's been longer than that since I promised Wally to write about optical astronomy for the *OBSERVER*. This is the first of a series of reports I'm sending back about your astronomical comrades who, until recently, needed only a few lenses or mirrors and a state of the art eyeball to do their astronomy. This time we'll explore the methods of modern optical astronomy (insofar as I've learned about them). Later I'll write about the particular observatory where I now work, and I'll survey the problems of current interest.

The differences between radio and optical astronomers are both small and large. Most all astronomers use "electromagnetic waves" for their observations (I'll use the word "light" to represent these signals); the various types of light are characterized by their wavelengths as "radio" (wavelengths between several feet and $4/100$ "), optical (1 to 2 millionths of an inch), ultraviolet (1 millionth to about 50 billionths), and gamma ray (less than 50 billionths). With minor exceptions the Earth's atmosphere is opaque to all except radio, optical and gamma ray wavelengths (the last are very difficult to observe). Although these branches of astronomy all use "light" at various wavelengths, the tools of optical astronomy are not always similar to those of other fields of astronomy.

Of course, all people have seen pictures of optical telescopes. Since I'm at Lick Observatory, I'll show you a picture of our largest telescope, the 120-inch diameter reflector. It is the third largest optical telescope in the world at present, and one of the most unique. The larger telescopes are the Hale 200-inch (Mt. Palomar, California) and the Mayall 158-inch (Kitt Peak, Arizona). Other telescopes of larger size are now under construction (236-inch in Russia, 150-inch in Chile and Australia) and more are planned.

All large optical telescopes consist of a large mirror which focuses incoming light to the focal point (exactly like a radio telescope). This may not be apparent since



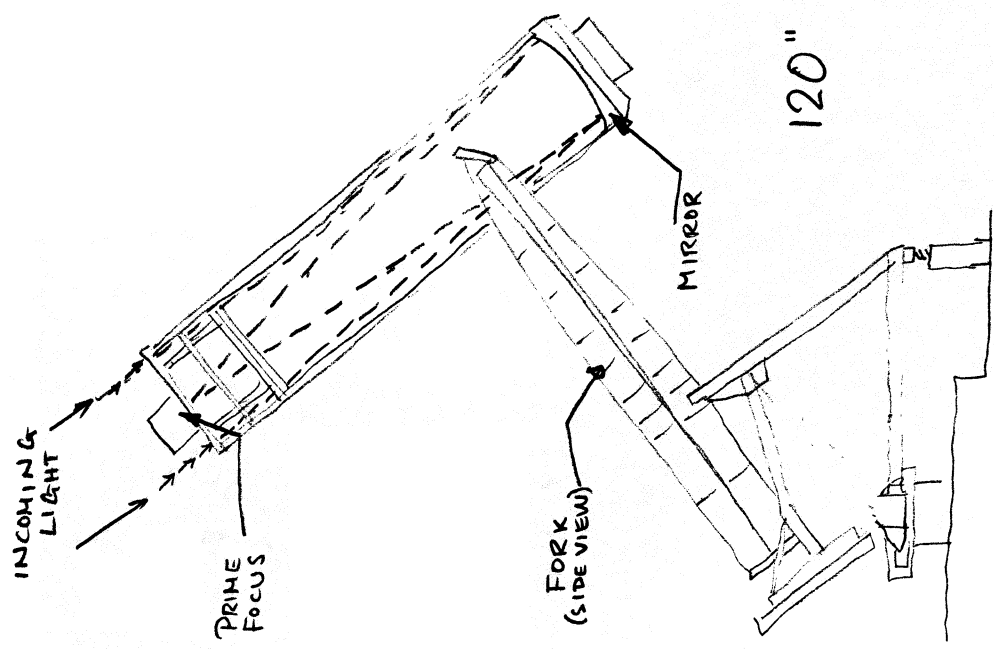
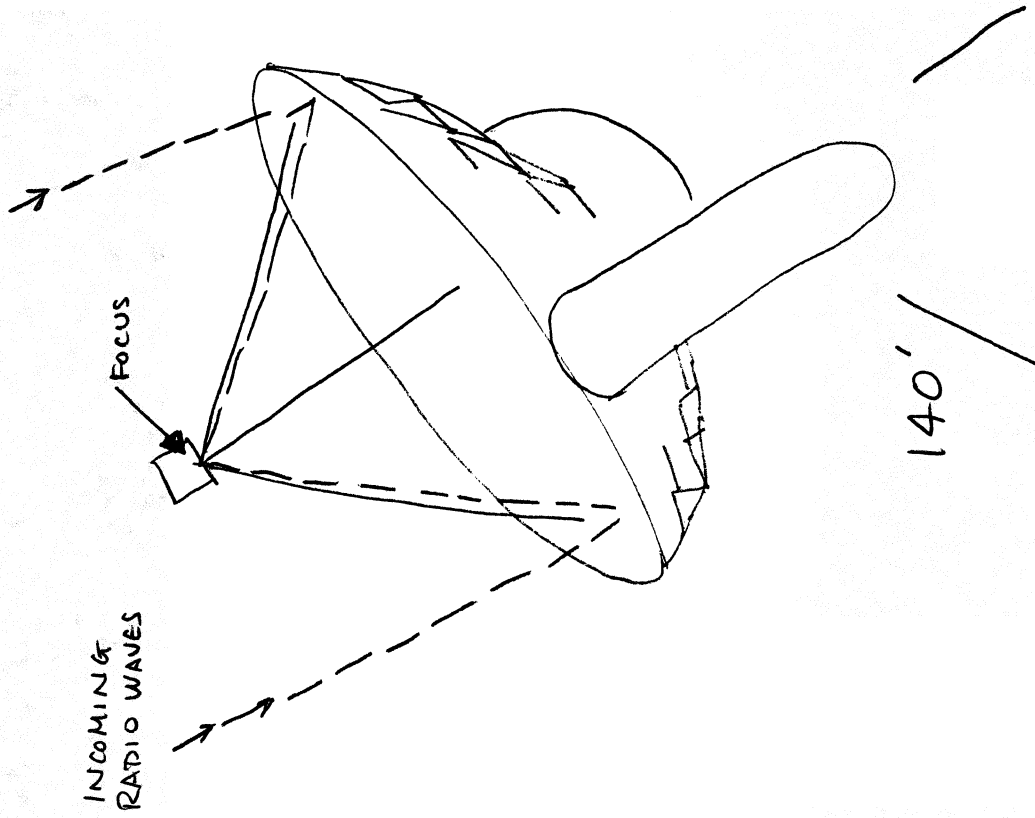
The mirror of the 120-inch telescope may be glimpsed at the bottom of the tube, between the triangular sections of the open mirror cover.

optical and radio telescopes appear to look so different. I've sketched (page 15) how the radio and optical telescopes focus light.

As in radio astronomy, the larger telescopes are the more sensitive ones. In principle, the larger telescopes have smaller beams, but in practice atmospheric turbulence "smears" the appearance of sources before the light reaches the telescope, so all optical telescopes are limited to "resolutions" of one arc second or so (the apparent size of a dime at a distance of a mile). By comparison, the resolution of the interferometer is three times worse, the resolutions of the 140-ft and 300-ft telescopes are about 100 times worse.

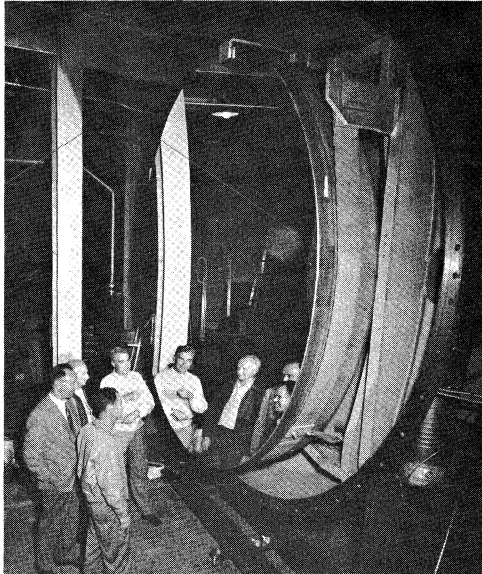
Let's take a closer look at the 120-inch telescope. The telescope was completed in 1959. The pyrex-glass blank for the reflector was cast in 1933 (as part of the preparations for the 200-inch telescope). The face of the mirror is thin, and behind it are stiffening ribs which serve to keep the mirror face distortionless (like the backup structure of radio telescopes). Grinding the mirror to the required shape took eight years and 650 pounds of glass; a curved surface $1\frac{1}{2}$ inches deep is the result. The glass disk was polished

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NOTE: SOON THE 140' WILL BE OUTFITTED FOR CASSEGRAIN FOCUS. A CURVED REFLECTOR WILL BE MOUNTED BELOW THE FOCUS, AND THE RECEIVERS WILL BE MOUNTED BEHIND THE DISH. ALTHOUGH MOST OPTICAL TELESCOPES CAN BE USED AS "PRIME FOCUS" INSTRUMENTS, IN FACT MOST ARE NORMALLY USED AS CASSEGRAIN FOCUS INSTRUMENTS EXCEPT FOR PHOTOGRAPHIC WORK. WHEN USED THIS WAY, THE OBSERVER "SITS" IN A CRAMPED, COLD, AND DARK "PRIME FOCUS CABIN" AT SOME CRAZY ANGLE WHILE TAKING HIS PHOTOGRAPHS.

in a room beneath the telescope. Every 5 to 10 years the mirror is removed from the telescope structure, lowered into the shop, and a new reflecting coat (of aluminum five millionths of an inch thick) is deposited in a large vacuum chamber.



The freshly aluminized 120-inch mirror just after removal from the large vacuum tank in which the aluminum was deposited on the glass surface. The small circle at the center outlines the central plug which was later removed for use of the telescope at the cassegrain focus.

The aluminum reflecting surface weighs a fraction of an ounce. The glass blank that supports the surface weighs 4 1/2 tons. The metal framework that supports the glass weighs 45 tons. This tubelike structure swings between a counterbalanced 100-ton fork. (The mount is very similar to the 140-ft.) The whole 150-ton mass is floated on a thin film of high pressure oil, and is hydraulically steered (by an operator who sits before a panel that reminds one of the old 140-ft console). Indeed, the whole telescope is strikingly similar to the 140-ft; and more similarities will become clear later.

I shall now describe the basic tools of modern research other than the telescope. Forget the human eye; during the past 50 years the eye has played a role no more important than the ear in contemporary radio astronomy. The photographic plate can be used for re-

ording images too faint to be seen by the human eye, especially in long exposures. Recently, the photographic plate has been aided or replaced altogether by electronic equipment such as an image tube or image intensifier and the electronographic camera which are too complex to discuss here. Television systems many times more sensitive than the eye have now replaced the eye for telescope pointing and tracking. These modern systems are not only more sensitive, but are relatively free from the annoying and complex problems of photographic techniques. However, the electronic systems are much more expensive and generally difficult to use.

Much of modern astronomy, and most of the work done on the 120-inch, is concerned with a detailed analysis of the optical light from stars, nebulae, and galaxies. The spectrograph is the instrument used for separating light of various wavelengths. Its purpose is identical to that of correlators and filter banks in radio astronomy, but it works much differently. In effect, light from a small region in the sky is bounced off a reflective grating which separates the light into its component colors, or spectrum. The light of separated colors is then recorded on a photographic plate, an image tube or a fancy device called a scanner. Scanners are very complex and sensitive devices developed in the last few years. Presently, the largest of these is at the 120-inch telescope, and most observers make use of it. It can be thought of as the autocorrelator at the 140-ft---a large, fancy computer-controlled device for line measurements. The scanner has 4000 channels, however, not just 400. Usually half the channels are used for measurements of the source and the other half are used on night sky, so that when subtracted a spectrum of the source is obtained. This observing method is necessary because weak emission from the upper atmosphere and nearby cities would otherwise "contaminate" the spectrum. The scanner itself is a small device hung on the end of the telescope, but just like the NRAO correlators, much of the equipment in the control room is associated with it.

Shown on the following page is a picture of the equipment in the control room. The leftmost rack of electronics is used by infrared observers and is very analogous to the synchronous detector rack at the 140-ft or

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300-ft! Next to it is the TV system used for finding sources and pointing correction. The next two racks are used for setting up the

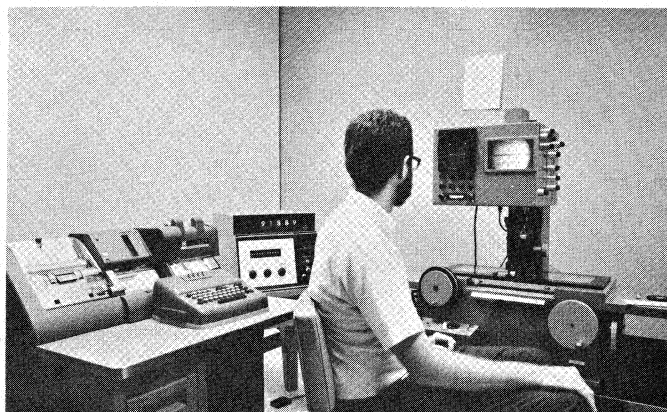


The complex equipment in the Data Room of the 120-inch telescope.

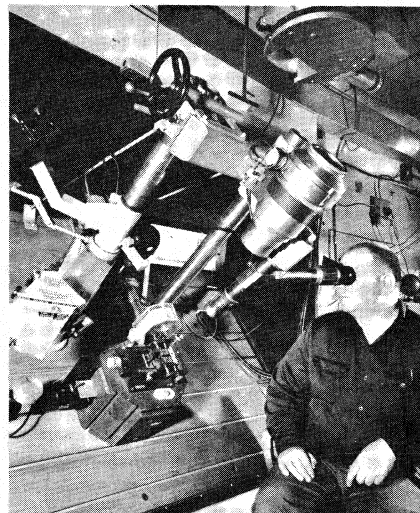
appropriate gratings, filters, etc. from the control room; these racks are analogous to focus, polarization, front end, and noise tube controls at the Green Bank telescopes. The two racks right of center contain the data acquisition computer and tape drives. On the far right are readout devices similar to the correlator readout CRT's. The lower screen is used to display the 4000 channels of data from the scanner. The observer can use the computer to reduce his data, much like the PDP 11/40 computer system at Tucson. Final data calibrations are done after the observing is completed at Lick Observatory headquarters in Santa Cruz on the campus of the University of California. The campus is about 80 miles and two hours away, but more about that next time.

Other devices are often used, but I shall not attempt to explain them in detail. These include the "automatic measuring machine" for the precise measurement of the positions of features on photographic plates. The numbers are punched onto computer cards. Studies over many years are able to detect the small motions of stars relative to each other. Also shown is a special spectrograph used for high precision line measurements where the

scanner can't be used.



This device incorporates modern electronic techniques for the precise measurement of the positions of features on spectrographic plates. The numbers are automatically punched on computer cards for later analysis.



The operating end of the large spectrograph at the coude focus of the 120-inch telescope. The major part of the spectrograph is in an insulated room over 30 feet long behind the left wall.

Next time I'll discuss more about operations and history of the observatory. I'll describe life at the observatory and show pictures of the spectacular scenery visible from the mountaintop. The history of Lick Observatory is both interesting and bizarre; the observatory owes its existence to an

--continued, next page--

eccentric piano maker who almost had a pyramid in downtown San Francisco built for his tombstone, but settled for a telescope instead.

VOLLEYBALL NOTES

Steve Hawley*

The Green Bank volleyball season is in full (?) swing again and retains much of what seemed to characterize the 1973 campaign--lack of interest. Still, when the hearty troops can be mustered there are countless seconds of excitement and action, enough for spectator and athlete alike.

Some familiar veterans and a host of rookies have appeared at one time or another on the court. A number of changes were made during the off-season and are worth mentioning. Gone are the familiar cries of "Leave it!" and "(expletive deleted)" having been replaced by "Get it Ed!" and "(expletive deleted)!" Also the boundaries have been made unambiguous and the net was raised to regulation height. Some of the changes were for the better, however. We now have our own ball. (Maybe next year, uniforms?) On any given night you might go to the Rec. Area and see a rousing game of one-on-one or two-on-two.

The players (evidently having sharpened their skills over the winter) have developed a number of new shots that the serious volleyball player will surely want to incorporate into his personal arsenal.

SHOT

DESCRIPTION

The Ed Fomalont Lunge	When hopelessly out of position, one dives for the ball, grinding to a halt just short of where he needs to be to hit it back. This shot should not be attempted by the casual player.
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The Steve Hawley Set-up	The ball is set just above the net resulting in a spike winner--usually for the wrong team.
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The Claude Williams Charge

The net is rushed as the ball lands on or near the back line for a point. (Flailing of the arms is optional.)

The Luiz Da Costa Service

The ball clears the net by inches while traveling at relativistic velocity. Time is normally called while the ball and/or the receiver is/are extricated from the court.

Enthusiasm for Green Bank volleyball is unparalleled in recent memory. (We used to be able to find people interested in playing.) In an effort to encourage participation in its activities, your volleyball group constantly considers improvements. Three-on-three would be a nice change. We've also thought of including as part of the summer student application form requests for information concerning height, weight, and time in the 40-yard dash. One letter of recommendation from a coach or gym teacher should be required.

Still, with the limited amount of practice we have had we must be pretty good. Every night we've been ready to play the hot shots from Charlottesville but so far they have been too chicken to show up.

From now on we expect everyone to enthusiastically respond to the call "Volleyball anyone?". Volleyball is a regular feature of the NRAO Green Bank summer schedule. Games begin around 7:00 p.m. at the Recreation Area. Turkeys are most definitely welcome.

*Graduate student, U. of California - advisor, Ed Fomalont. This is Steve's second summer at NRAO.

Business is religion, and religion is business. The man who does not make a business of his religion has a religious life of no force, and the man who does not make a religion of his business has a business life of no character.

-- Maltbie Babcock

REMOULDING THE CHINESE INTELLECTUALS

George Miley

Dr. Miley, an Irish astronomer who works in Holland, recently spent three weeks in China as a guest of the Chinese Academy of Sciences. In this article (first of five) he describes a visit to a school for "remoulding" the intellectuals and compares the methods of Maoism with those of religion.

On a lovely autumn day we left Peking and drove for about an hour northwards until we neared the Great Wall. After asking the way several times, we passed through a pair of stone gate posts and continued up a long driveway which was lined on both sides with rows of newly planted trees. The car drew into a stone courtyard to the applause of several smiling Chinese. I had arrived at the Chuan Wu District May 7 School.

The May 7 Schools are retraining centres for intellectuals and administrators, named after Mao's directive of 7 May 1966---"Going back to manual work at the base is an excellent opportunity for leaders in the highest positions to relearn everything. Except for the old, the sick and the infirm everyone should follow this road. Those who are designated to remain in leadership positions must also, when the time comes, go as a group to do manual work at the base."

Intellectuals and administrators have held a traditionally privileged position in Chinese society. For nearly fourteen hundred years, from the time of the Tang dynasty until the beginning of this century, the Chinese Civil Service was staffed through a formal system of classical examinations. The meritocracy was so strong, that successful candidates for the top civil service jobs were sometimes considered as suitable bridegrooms for the emperors' daughters. It is not surprising that such an atmosphere produced in the Chinese character a deeply ingrained respect for all administrators and intellectuals. Conversely, the mandarin class were imbued with contempt for anything connected with manual labour. After the Communists came to power, the snobbish attitudes of many intellectuals persisted. Also, a high proportion of the new Communist administrators adopted the autocratic and bureaucratic ways of their mandarin predecessors.

The early sixties saw a bitter struggle within the Party between the ideas of Liu Shao-ch'i and these of Mao. Liu, the arch technocrat, put short term economic development above almost all other considerations. In contrast, Mao was a visionary who believed that economic development achieved at the price of social inequality would create more "contradictions" within Chinese society than it solved. It was inevitable that, in 1966, after the debate had been settled in favour of Mao's policies, there would be a renewed attempt to eradicate the mandarin complex from Chinese life. This took place through the Cultural Revolution, a movement aimed primarily against bureaucracy and arrogance.

Long before this upheaval Mao had taught that intellectuals would lose their bourgeois attitudes by mixing closely with the workers and peasants. In 1957 he called for "an atmosphere in which 'getting close to the workers and peasants' virtually becomes a habit; in other words we should have a large number of intellectuals doing so... . They cannot all go at the same time but they can go in batches at different times." Here in embryonic form were the policies which would be implemented ten years later with the setting up of the May 7 Schools.

According to Chang, my interpreter, Chuan Wu School is one of several situated near Peking. It rarely entertains visitors and my arrival was quite an occasion. This was confirmed by the reception I was accorded. The large Chinese characters inscribed on the school blackboard read "Welcome to our Irish visitor".

Amongst the party waiting to greet me was Comrade Wang, the chairman of the school. He began with a stereotyped statement of the sort that one hears frequently in China. "In 1966 after Liu Shao-ch'i's revisionist line had been repudiated, Chairman Mao issued his famous May 7 directive. The cadres from the Chuan Wu district of Peking enthusiastically answered Chairman Mao's call and, after approval by the District Party Committee, the school was founded on October 22, 1968." (Cadre is used to denote a white collar worker or anybody else holding a position of authority.) "About 5500 have now attended the school. This is about 60% of all cadres in our district and includes leading administrators, teachers, engineers, and technicians.

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They come here for a six month term. At present we have 250 students and a staff of 40."

I asked what the aims of the school were. "Our main objective is to ensure that the cadres return to their administrative and technical posts with a renewed spirit of serving the people. To this end we use three methods of training. First theoretical. Three months are spent studying and discussing the works of Marx, Lenin and Mao Tse-tung. Secondly practical. Students are taught to work as manual laborers and to live frugally. We believe that doing manual labor is one of the best ways in which a person can remould his character and prevent the growth of arrogant and bureaucratic manners within himself. Thirdly, they combine theory with practice by living for 15 days with some peasants from a nearby commune. During the daytime they work with them and in the evening they conduct some social investigation. For example they might study the history of a peasant family. Here they can relate what they see to what they have learnt in theoretical studies of the class struggle."

After reciting some impressive statistics on the amount of goods produced by the school, Comrade Wang invited further questions. I enquired how often family visits were allowed. "Usually the cadres return home for four days per month, but they can always make visits in cases of exceptional circumstances." "As far as enrollment is concerned", I continued, "don't a great many cadres dislike the idea of attending this type of school?" "Of course a small minority find it difficult. Before coming here they regard manual work as some form of punishment, but they soon realize that laboring together with the workers and peasants is great privilege." Comrade Wang concluded by pointing out that the May 7 schools are a new concept in revolution and are far from perfect. "Please point out any shortcomings you notice", he said. "We must learn from our mistakes."

Next we set out on a tour of the school. In the exhibition building a pretty smiling girl showed me pictures illustrating the history of the school. Seeing the idealism on her face, I was reminded of a young novice proudly showing me her convent. The school dormitories also had a convent-like atmosphere. They were starkly bare except for the beds

(six to a room), tea mugs and the works of Mao Tse-tung.

Before leaving, I was brought to see some students at work. All of them seemed to be enjoying themselves thoroughly. Shirt sleeved in the bright sunshine, a few were producing zig-zag furrows with a horsedrawn plough. I talked briefly to two of them, a teacher and a technician. Both spoke of the school in glowing terms but they could hardly have done otherwise in the presence of myself and Comrade Wang.

As we said goodbye and drove back towards Peking I kept thinking back to the school retreats which I used to attend as a child. Superficially there is an uncanny resemblance between the methods of Chuan Wu and those of Rathfarnham¹. Salvation through prayer and good works or ideological remoulding through study and manual labour? A sermon on the devil and all his works by Father Kelly or a talk on Liu Shao-ch'i revisionism by Comrade Wang?

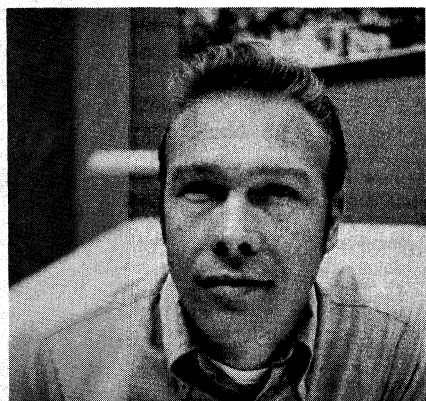
Several other parallels can readily be drawn between Chinese Communism and religion. Mao's little red book is the Chinese catechism. Children must learn it by heart during their daily "religious knowledge" classes. Also, the commune of Tachai is the Lourdes of China. Peasants go there on regular pilgrimages to learn how the application of Maoist principles to agriculture can result in "almost miraculous" improvements in output. A Chinese peasant talks about "correctly applying the thoughts of Chairman Mao" just as an Irish farmer says "God willing"!

Some intellectuals must have found this religious atmosphere difficult to stomach, but on the whole it has had beneficial results. The selfless dedication of hundreds of millions of people has been a major factor in the incredible transformation that has taken place in China during the past two decades.

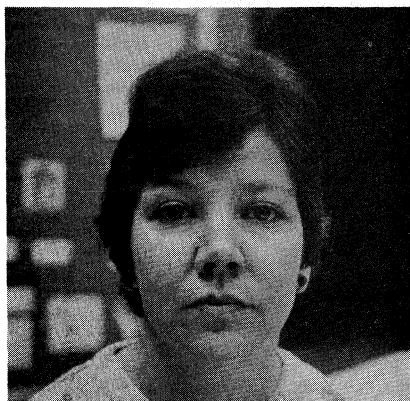
¹Rathfarnham Castle: A Jesuit retreat house near Dublin.

Though the people support the government the government should not support the people.

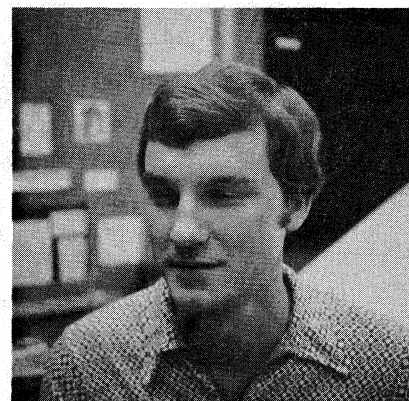
NEW EMPLOYEES



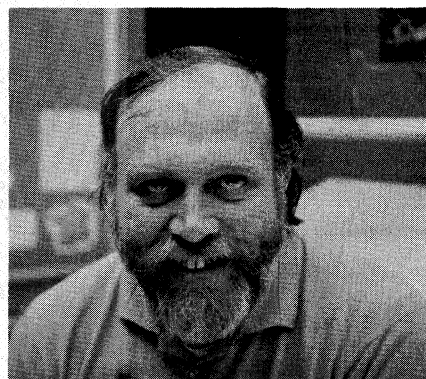
Robert A. Turner
Intermediate Technician
VLA Project - CV



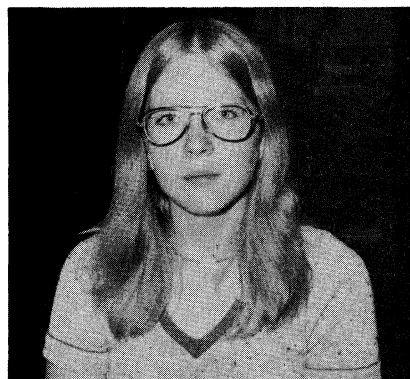
Sandra M. Mason
Secretary
VLA Project - CV



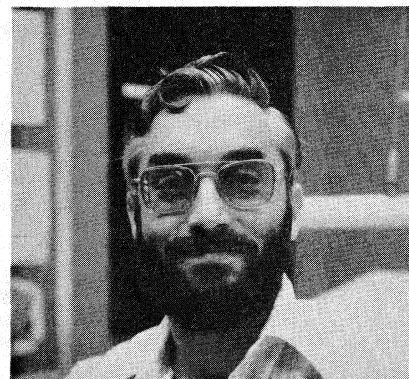
Stephen D. Peterson
Jr. Research Assoc.
Scient. Serv. - CV



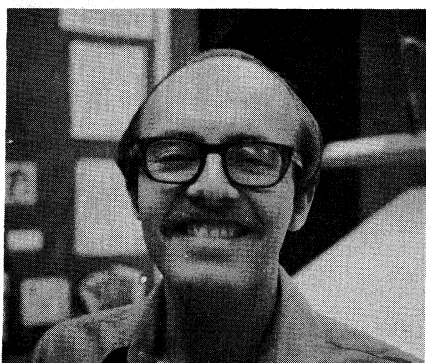
A. Peter Henderson
Vis. Assoc. Professor
Basic Research - CV



Sue Ann Montgomery
Tourist Receptionist
Admin. Services - GB



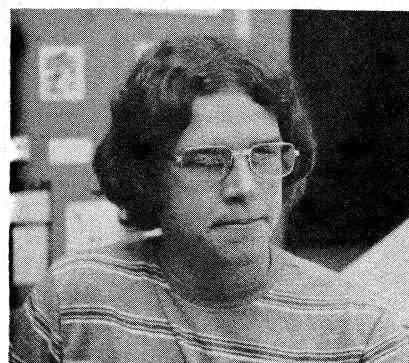
Stephen T. Gottesman
Vis. Asst. Scientist
Basic Research - CV



Stanley S. Hansen
Scient. Prog. Analyst
Computer Div. - CV

Photo Not
Available

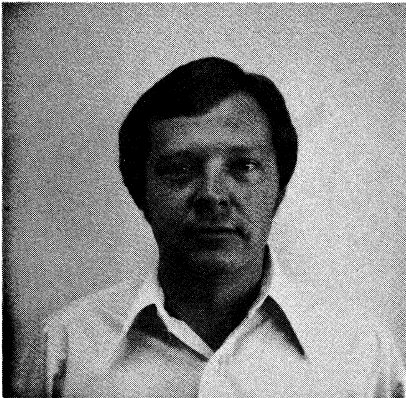
Claude N. Williams
Scient. Associate
Basic Research - GB



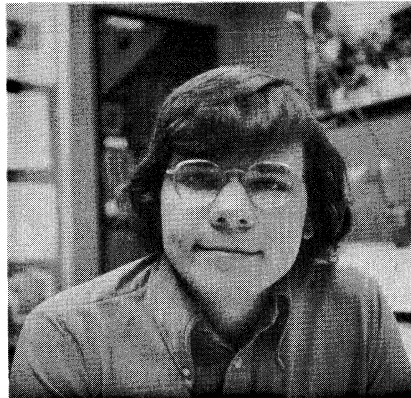
Gary A. Pasternak
Jr. Comp. Operator
Computer Div. - CV

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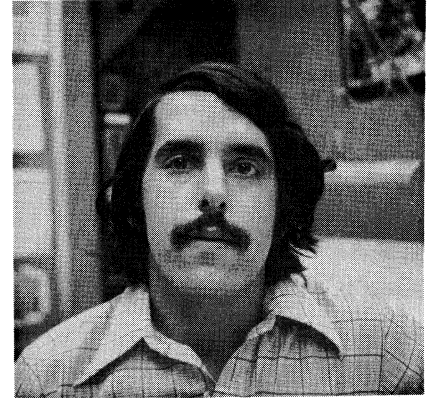
New Employees (Cont.)



John E. Miller
Telescope Engineer
Tucson Operations



Carl R. Preddy
Intermediate Technician
VLA Project - CV



Thomas E. Hyzak
Draftsman
VLA Project - CV

Photo Not
Available

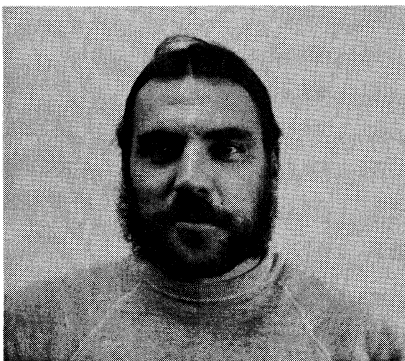


Richard E. Groseclose
Telescope Operator
Tel. Operations - GB

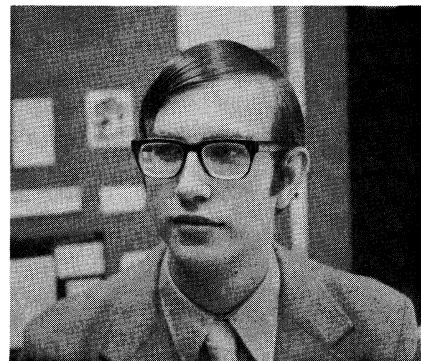


Rosalie Slaven
Housekeeper
Admin. Services - GB

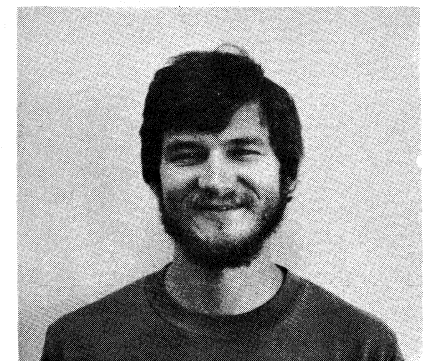
Alice L. Riley
Housekeeper
Admin. Services - GB



Gary D. Ballou
Jr. Technician
Tucson Operations

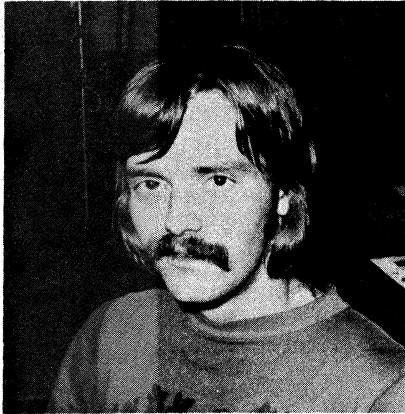


William E. Dumke
Electronics Engineer
VLA Project - CV

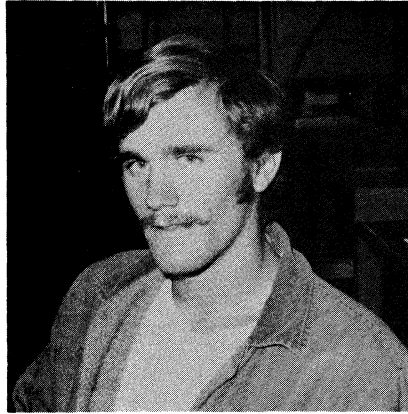


Phillip D. Rupp
Jr. Technician
Tucson Operations

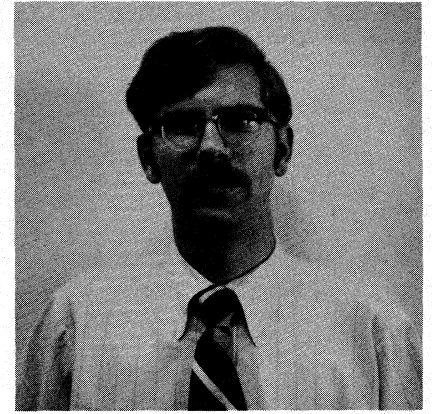
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New Employees (Cont.)

Charles L. Pugh, Jr.
Jr. Technician
Electronics Div. - GB



James F. Wooddell
Laborer
Plant Maint. - GB



Robert W. Freund
Electrical Engineer
Tucson Operations

REHIRES

Joseph H. Greenberg	Scientific Services - CV
John D. Liebenrood	Scientific Services - GB
Ivan Pauliny-Toth	Basic Research - CV

TERMINATIONS

Surendra P. S. Anand	Basic Research - CV
David Buhl	Basic Research - CV
Sharlene I. Wiley	Director's Office
Edward B. Davis, Jr.	Scientific Services - CV
Lee J. Garvin	Scientific Services - CV
Donald Sauter	Scientific Services - CV
Stephen D. Burgan	Scientific Services - CV

CREF Unit Value for June 1974 \$34.29

DATA PROCESSING FOR THE VLA

Bob Hjellming and Jerry Hudson

The VLA, known in some circles as the Data Inundation Device, will produce data at a rate unprecedented in the history of radio astronomy. The continuum VLA, which simply produces data to map the radio sky at up to four frequencies, will eventually produce roughly one hundred million numbers a day; these must pass through the data processing system in order to be edited, corrected, calibrated, and transformed into maps of the radio sky. The goal is to produce high quality radio pictures comparable in detail to photographs made with large optical telescopes.

The 100 million numbers per day, which will result from all 27 antennae being used at two frequencies, will fill roughly ten high density magnetic tapes and will require as much tape storage room to hold just a year's observations as we now have in Charlottesville to provide many years of storage for all of NRAO. The spectral line system planned for ten of the VLA antennae in 1977 will multiply these figures by a factor of eight.

However, the most significant problems created by such large input rates are practical problems of writing programs and finding computer systems that will both do the necessary calculations to transform 100 million numbers into 10 to 100 radio pictures, and to allow astronomers to do science with this torrent of data without being drowned in seas of numbers. There are two ways of dealing with data processing problems like this. On the one hand one could purchase computers and write programs that would process the 100 million numbers a day rapidly and automatically without human intervention; on the other hand one could design a large flexible system where astronomer and computer interact heavily---that is, their respective "brains" are put to work together. In the latter case, the advantages of the computer are "thinking speed" and a fantastic "memory", while the advantages of the astronomer are an unusually flexible thinking brain and the capability to exert judgments that are impossible to program into a computer. For the VLA we will try to chart a course which goes between the two, attempting to take advantage of the virtues of both.

The VLA computer equipment is divided into two functional groups, called the "synchronous" and "asynchronous" subsystems. The synchronous system is the on-line data harvester and telescope controller, producing the deluge of numbers described above. The first to face this deluge are our front-line troops, under the generalship of Barry Clark, together with Bill Randolph, Gareth Hunt, and their band of MODCOMP II minicomputers. The synchronous system, as its name implies, runs synchronously with the array operation, and is essentially automatic in nature. After taking data, and performing some editing, correcting, and calibrating, the synchronous computers pass the data on to the asynchronous computer, where processing can take place with the astronomer interacting with the machine. Here, a DEC-SYSTEM-10 (Digital Equipment Corp.) computer, with its time-sharing system, will do the computer's share of the work. The chief programmer for the asynchronous software development is Al Braun, backed up by Dave Ehnebuske, and aided by Jerry Hudson and Jim Torson. This programming staff is coordinating work on the scientific aspects of the data processing problems by Bob Hjellming and Nancy Vandenburg.

The designing and programming of both synchronous and asynchronous computer systems will be carried out during the next few years under an exceedingly cramped schedule. The MODCOMP minicomputers for the synchronous tasks are now being put together in Charlottesville, with programming underway for use in New Mexico by the summer of 1975. The DEC-10 asynchronous computer will arrive in Charlottesville in early 1975 where work on the asynchronous programs will be carried out in Charlottesville until the summer of 1976, when everything will move to New Mexico. With antennae being integrated into the system at a rate of three or four per year, beginning in June 1975, the data processing problem will grow at a rapid rate until full planned operation with 27 antennae in 1981.

Those who are familiar with interferometer data processing and who take a look at the VLA data processing problem seem to develop one of two viewpoints, depending upon whether they are naturally pessimists or optimists. The pessimists view the VLA data processing problems as problems that we do not know as yet how to solve; the optimists view the same problems as some of the most interesting challenges ever encountered in radio astronomy.

CRAM AIRLINES

Marilyn Cram

Screwed-up reservations, luggage searches, long delays or missed connections, endless circling, lost or damaged luggage, long concords to walk--these are common experiences of air travel. Not on Cram Airlines!! However, passengers may be expected to work. Sitting in the front seat requires one to be of some assistance to the pilot. (I am in fact, the usual auto-pilot.) Our passengers not only get a better view of the country (we fly lower than commercial flights) they also learn how to select a course heading, and hold it. Our last major trip was a three-passenger flight to Boulder, Colorado; David Ehnebuske was our guest auto-pilot. He had the dubious distinction of commanding the flight for the entire length of Kansas. It was a two day journey; circumventing thunderstorms took additional time, but it was a comfortable flight.

Once we arrived at Boulder Airport we did run into one of the possible problem areas of air travel: ground transportation. Being dependent on cabs is unpleasant to us. This airport, unlike some others, did not have a courtesy car. A call to a friend produced a happy solution. And so, we all went off in Gerrit Verschuur's TR 6. This was after, of course, explaining that yes, there is an airport in Boulder and where it is in relation to Gerrit's place. Although four passengers and luggage fit a bit tightly into the two-place TR 6, we were given a quick tour around Boulder. We discharged Dave at his brother's, and Tom and I were given the hospitality of Gerrit's home that night.

In the morning we were some of the first visitors to Fiske Planetarium. We are happy to report that the construction is well under way. Gerrit was also kind enough to take us around in search of hiking boots for use on the remainder of our trip. By 10 a. m. Tom and I were aboard our¹ plane and headed over the Rockies for Jackson Hole, Wyoming and the truly beautiful Grand Tetons.

Due to the distances involved on the ground, this was the first trip in which we used the services of car rentals. Jackson Hole itself was easily accessible on foot once we got there. Notable sights include: the western wooden sidewalks around town, saloons decked in

silver dollars, and the piles of elk antlers collected by the local Boy Scouts. In addition to those on display and on sale, literally tons of antlers are collected annually and are sold to Far East concerns as an ingredient in aphrodisiacs. I think it was George Conant who remarked, "Boy Scouts aren't supposed to know about aphrodisiacs." However, to the best of our knowledge the Scouts are on the end of the commercial chain opposite to that of the finished product.

From Jackson Hole we ventured by car and on foot to get a view of the Tetons. We were some of the very few to hike the still snow-covered trail to Taggart Lake which itself was still mostly icebound. The beauty of nature there was indescribable and it was the part of our trip that made the most profound impression on me. Back in Jackson Hole we observed the overnight phenomenon of the tourist invasion, for it was the beginning of the Memorial Day weekend and the caravans of travel vehicles streamed into town. It was time to move on.

Our next stop was West Yellowstone, Montana; the airport and the park had just opened for the spring. West Yellowstone is known for being the home of the *WRETCHED MESS NEWS* (sort of the West's answer to the *OBSERVER*), and probably better known as one of the entrances to Yellowstone National Park. It is an unfortunate collection of hotels, motels, and restaurants: most undistinguished. We did find a colorful hotel with rustic charm, and a few good restaurants reasonably priced that we would happily recommend to others. Luckily, we packed our own lunches for our excursions into the park; not many facilities were open yet. Overnight accommodations within the park were not scheduled to open for two weeks. The campgrounds were not overcrowded yet, and exhaust fumes did not yet settle into smog around the Old Faithful interchange. The amounts of snow varied from only patches to high drifts, and the daytime temperature reached the low 70's.

The first time that we saw Old Faithful was from the air as we approached the airport; we saw it from the ground as well. We found the walkway around the other thermal areas leading to Morning Glory Pool more enjoyable. And we were fortunate to find a quiet trail where we hiked without benefit of signs like:

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"Caution: Thermal Area - Keep on Walk". We saw much more wildlife and no tourists until we got back to the car. We were amused by the sight of a herd of Japanese tourists stalking, with cameras, a herd of buffalo. The buffalo retreated.

We were in Yellowstone only a few days, then we returned to Boulder, passing the Tetons again, this time along the western ridge. We collected Dave, and planned our trip home. We expected moderate to severe turbulence on the morning of our departure since Topeka, Kansas reported having severe thunderstorms already by 8 a. m. It was then that I made an important discovery. I found that taking a Merazine² tablet prevents turbulence and dispells thunderstorms. I slept soundly that morning - unfortunately I was in the front seat and hadn't planned to sleep - but saved the flight from discomfort. I only took half a pill for the afternoon, which wasn't strong enough to knock me out, but was strong enough to keep away turbulence. We picked up good tailwinds and made it all the way home in one day--12 1/2 hours. Tom spent more time than that once, trying to get to Tucson by commercial carriers!

Our flights cost at least half the cost of commercial flights per person, and compare well to the cost of driving because of the better mileage per gallon by air. And, it is usually an experience in itself. In fairness, it can be said that commercial flights have their advantages. When you want to get to the West Coast in less time, or when you want to make a trans-oceanic trip and take luggage instead of extra fuel, then jets are convenient. Of course, they also have a "john" on board, as well as drinks and movies, and weather isn't so much of an influence. But, we still prefer our own system, so any time you want to give it a try.....Tom is always looking for any - any - excuse to fly.

¹"our" meaning owned by the Red Baron Flying Club of which Dick Sramek, and Dave and Mary Ellen De Young are also members. The plane is a single-engine Cessna Cardinal.

²the pill the astronauts used for motion sickness

OUR NEEDS

A little more of patience
 With the faults of other folks,
 A little more of charity
 When a worldly act provokes,
 A little more devotion
 To the ones whom we should love,
 A little more reliance
 On the God who rules above,
 A little more forbearance
 With the cross we have to bear,
 A little better learning
 By all that is right and fair,
 A little more of giving
 Of the things we have to give ---
 Would make this world a better place
 For you and me to live.

A little less of prejudice,
 A little less of hate,
 A little less of ridicule
 About our good and great,
 A little less of vanity,
 A little less of show,
 A little less of telling
 All the scandal that we know,
 A little less complaining
 O'er the ills we have to bear,
 A little less of grieving
 O'er the burdens we must share,
 A little less of wickedness,
 A little less of sin ---
 Would make this world a pleasant spot
 To be abiding in.

--Charles E. Warner--

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

-- Harold Sherman
