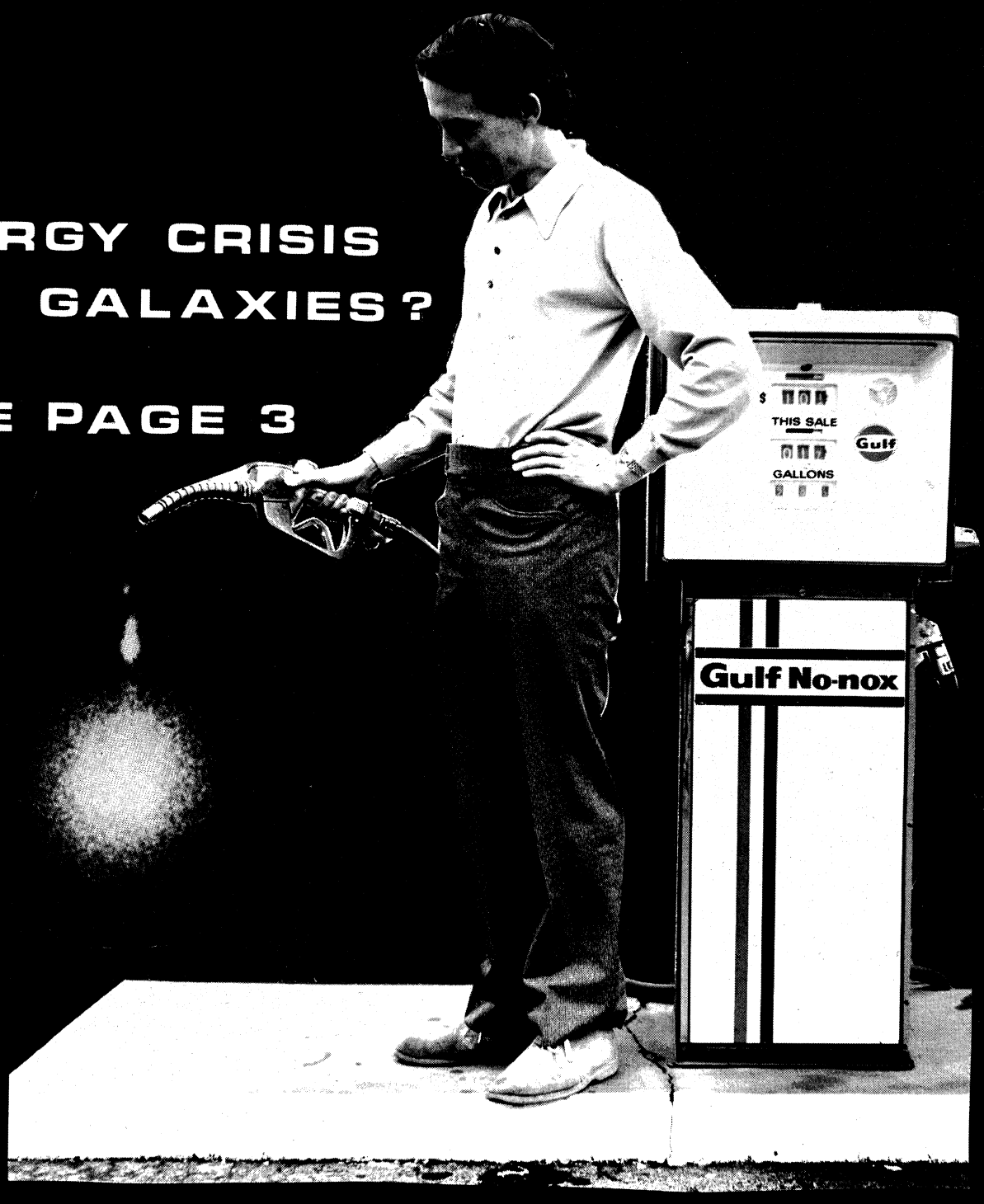
OBSERVER

APRIL, 1974

ENERGY CRISIS FOR GALAXIES?

SEE PAGE 3



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A special thanks to all of those who helped assemble the OBSERVER.

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SOME CURRENT (AND PERSISTENT) PROBLEMS IN EXTRAGALACTIC RADIO ASTRONOMY

D. S. De Young

When I was first "persuaded" to write this article, I received a note from the Editor informing me that the title was to be "What's New in Extragalactic Radio Astronomy, 1972-1973". I informed the Editor that this title was "inoperative" because: a) theorists never know what's new in any field; b) observers think they do, and so would take offense at a theorist writing such an article, and c) if I attempted to do so, I would surely overlook something that an observer thought was new (i.e. his most recent observations), and thus I would be subjected to irate complaints from my colleagues. Hence the above title.

Before being exposed to a long tale of woe about persistent problems in extragalactic astronomy, the reader may well wonder why anyone should care. A legitimate question, and in fact, very few people do. Perhaps too few, but that's another story. In any case, the interest in, and even justification of, this literally far-out area of astronomy lies in the nature of the questions it considers. Problems in extragalactic astronomy involve such topics as the creation of the universe itself, how the universe has evolved and will continue to evolve, the attempt to understand the behavior of material objects from the very small (energetic electrons) to the largest known (clusters of galaxies). It covers the evolution of matter from its original to its final state, and includes phenomena occuring on timescales from much less that a microsecond to a few billion years. Perhaps of most importance, a consideration of problems is extragalactic astronomy seriously questions whether or not the laws of physics as we now understand them are adequate. In order to understand what we see, is "conventional" physics enough, or do we have to consider the creation of matter within some objects, or the possibility that the mass of fundamental particles such as the proton changes with time, or some new, yet unimagined physical process? No one knows, but it is in this area of astronomy that some first indication may be found.

In what follows, I will be considering only the highly energetic, "pathological" aspects of extragalactic radio astronomy. I don't know very much about normal (i.e. more or less radio quiet) galaxies, but there are many around the Observatory who do. (Wally Oref, take note.) In addition, it will be possible only to discuss a few of the many problems in this area, and there is space only for a brief consideration of even these.

The radio emission we receive from these objects is almost certainly produced by electrons moving at speeds very close to the speed of light. These particles posses an enormous amount of energy, about 10 billion times the energy they would normally have on a very hot summer day in Charlottesville, due to their extremely rapid "relativistic" motion. When such particles find themselves in even a very weak magnetic field, they emit radiation at radio wavelengths. We see this radiation coming from two different types of extragalactic objects; other galaxies, and the quasi-stellar sources, which appear as star-like images when seen through an optical telescope. Distances to these objects are deduced from the amount that spectral lines observed in them are shifted to the red from their laboratory values. It turns out that the universe is expanding, and the more distant an object is the faster it is moving away from us, and so the greater its "redshift". Radio emission from these objects tends to fall into two classes--extended and compact. Extended radio sources show radiation arising in regions far away from the associated galaxy or quasi-stellar source, and very often the emission has a characteristic double structure (see Figure I, page 4). Compact sources are just that, with the radiation coming from within the nucleus of the galaxy or quasi-stellar object (QSO). Compact sources often are variable, with the intensity of emission changing on a timescale of weeks to years. Compact and extended sources are associated with both galaxies and QSO's, and it is interesting to note that from the radio data alone it would be very difficult to distinguish between the two types of object.

That is the sort of thing we see. What are the problems associated with these objects? Energy, first of all, both in amount

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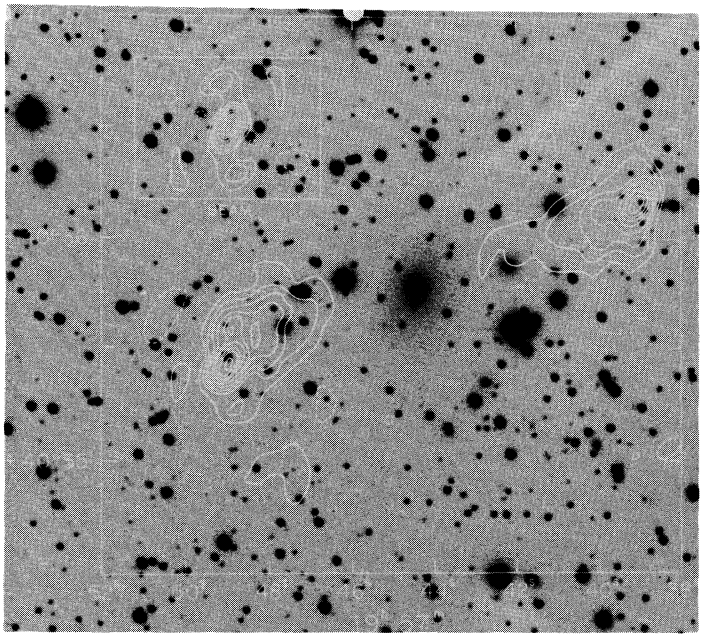

Figure I. "Typical" extended radio source. (Provided through courtesy of Dave Hogg.)

and kind. For the extended sources, the power radiated ranges from 10^{44} to 10^{46} erg sec^{-1}. The light due to all the stars in a typical galaxy amounts to 10^{44} erg sec^{-1}. Yet these radio sources are tens of thousands of light years away from the galaxy or QSO which ejected them, and there is no detachable optical emission coming from the radio sources. Moreover, this power of up to 100 times the light from a normal galaxy is coming entirely from relativistic electrons in a magnetic field, and has been doing so for ten to a hundred million years. No ordinary explosion could have produced these objects. Ordinary explosions, from firecrackers to hydrogen bombs, put most of their energy into moving material and into heat, and very little into high energy particles. Extended sources are not just very hot blobs of gas with the usual fraction of high energy electrons--they seem to be composed only of high energy particles, perhaps mixed with gas which is much cooler, and even some non-luminous condensed objects.

The energy problem exists with compact sources also. Although their total energy is less, the volume they occupy is much less. If the QSO's are as far away as their redshifts indicate, then some of them emit as much power as an entire galaxy, but from a region which is 100 million times smaller than a typical galaxy. And again, this energy is not just hot material but is in the form of very high energy particles.

Another problem arises with compact sources, which concerns their variations in intensity. There is evidence that some quasi-stellar sources may vary over a time less than the time it takes light to travel across the source, again if they are at the distance given by their redshift. A little pondering will show this to be impossible. Theorists are always agile at squirming out of difficult situations, and it turns out that one can get around this problem by using some of the tricks of special relativity. Another possibility, however, is that the redshifts are not due to recession velocities alone, but are in part a result of something else. If this is so, the QSO's would be actually closer than we have thought. This would help the difficulty with the time variations, and it would also mean that much less total power is actually being radiated, so the "energy crisis" would be somewhat relieved. The sticky problem is to come up with some other physical process which gives rise to a redshift.

Some other important problems are how the extended sources are ejected, and how their energy supply is maintained. Also, are QSO's and galaxies really different, or are the QSO's just much more distant and more energetic radio galaxies? If so, what is the distribution of QSO's in space and time, and when did they first "turn on"? How does one make quasi-stellar objects, and how, in fact, does one make galaxies? The answer to all the above is: we don't really know.

But there are possible solutions to some of these problems. It is possible that through purely natural, evolutionary processes, large galaxies develop central regions of very high stellar density. The velocities of the stars in these regions can be such that stellar collisions become very frequent, liberating energy and also perhaps forming supermassive starlike objects of a million or so solar masses. These objects might produce large amounts of energy in the

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form of relativistic particles, forming the compact sources. Some of these objects, or the relativistic particles and cooler gas produced by them, could be ejected from the galactic nucleus at high velocity and thus form the extended sources. All this could happen without invoking any new, unknown physical laws. The picture if full of "ifs" and "possiblys" only because the calculations which will show if it can work simply have not yet been done.

If it doesn't work, then perhaps matter itself must be created, in very energetic form, in the nuclei of galaxies. Also, if a part of the redshift is not due to recession velocity, ideas such as changing the elementary particle masses with cosmic time may have to be seriously considered. These concepts imply formulating and understanding new physical laws. Either way, it seems there will be no lack of interesting problems in extragalactic radio astronomy for the foreseeable future.

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ELECTRIC POWER
HOW TO CALCULATE USAGE AND COST

Jim Dolan

Have you ever wondered how the power company calculates your electric bill? Or do you just pay it and trust "the company" to always be correct? Until recently I was a member of the latter group. Now I usually check my bill for two reasons: first, to assure myself it is correct, and second to measure my progress in the energy conservation program. The first step in any such program is to read your meter. You pay for electricity in units of kilowatt hours, (1000 watt hours). The meter on your house is a watt hour meter. Some of the new units read directly in digital form, and are virtually idiot proof. The older ones usually have four or five dials that resemble a watch face, except they are graduated from 0 through 9. The four face units read up to 9999 kwh and the five face units read up to 99999 kwh before starting over. These units look a bit strange but you can learn to read them in a few minutes. Some of the dials are graduated clock-wise and others counter-clockwise. Start with the dial on the left and read in the direction of the increasing numbers. If it goes from 0 to 9 in a clock-wise direction, read clock-wise, and write down the number the hand has just passed. Proceed to the next dial. It will be graduated opposite the one just read. Write down the number it has just passed. Continue until you have a number for each dial. The only problem you may have is one of the hands may seem to point directly at a number and you can't be sure if the hand has passed it or not. You can resolve this ambiguity by looking at the next dial to the right. If it has just passed zero, the preceding hand has passed the number. If it is between nine and zero, the preceding hand has not passed the number it is pointing at. Remember, the meter reads kwh, the same units that are on your electric bill. At present, rates in our area are as follows:

First 80 kwh - $0.05/kwh (minimum bill)
Next 100 kwh - $0.042/kwh (net)
Next 220 kwh - $0.029/kwh (net)
Next 700 kwh - (either $0.020/kwh or $0.013/kwh, depending on whether or not you have an approved electric water heater)
Next 900 kwh - $0.015/kwh (net)
Next 1200 kwh - $0.013/kwh (net)
All Additional kwh - $0.011/kwh

With these numbers you can check your bill and your rate of usage. There is another little factor that you have no control over, known as fuel cost adjustment. It goes up or down (mostly up) depending on what the power company pays for fuel. This fuel charge is shown separately from your normal bill, so you can still check your bill. If you want to check the fuel charge, it is as follows: Five one thousandths of a cent per kwh for each full forty-three one hundredths of a cent that the previous month's cost of coal varies above 23 cents or below 22 cents per million BTU. In effect, if coal increases in price, your electric bill will follow at a prescribed rate.

CRASH LANDING

William Reynolds of Greensburg, Pennsylvania, piloting a twin-engine Cessna 310, made an emergency landing at the National Radio Astronomy Observatory airstrip on March 17 after one of his engines quit over Cheat Mountain.

Pilot Reynolds was lucky and walked away from the plane without a scratch. The Cessna wasn't so lucky. It suffered damage to one prop, landing gear, fuselage, and horizontal elevator. Also damaged was a stock fence between the doctors' clinic and Vere Barkley's house (this should give you an idea of how low Reynolds was coming in).

Cessna 310 after emergency landing.

The Cessna was repaired at the airstrip. Mechanics and parts were flown in, and by Monday, March 25, the plane was repaired and flown out by Reynolds.

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People are like stained glass windows. They glow and sparkle when it is sunny and bright; but when the sun goes down their true beauty is revealed only if there is a light from within.

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HILL HOUSE HISTORY

Richard Fleming

As the late afternoon shadows of Middle Mountain drifted across the beautiful valley of Deer Creek in Pocahontas County, West Virginia, Walter and Margie Beard Arbogast carefully selected the site of their new home. It would be on a plot of newly logged land containing plenty of future meadow and farming fields, 3 or 4 springs, and access to the small road (Hannah Road) leading to the village of Arbovale, a half mile away. The house was to be about 100 yards from the edge of Hospital Run, which lead from Arbovale to Deer Creek--a little over a quarter mile northwest of the house site.

The Arbogasts moved into the house in 1915 (see photo, page 7) and lived there until 1920. Henry and Nettie Sheets and children, Delora, Orville and Gay, bought the house and 59 acres in April 1920. The Sheets family, growing with the addition of Jamie and Susie, lived in the house until 1950.

The farm was then purchased by Dale and Ruby Hill who lived in the house until 1956. The Army Corps of Engineers bought the farm, along with other farms in the valley, as the beginning of the National Radio Astronomy Observatory. Each house that was purchased was named after the last family living in it. Therefore the Arbogast/Sheets/Hill house became the Hill House.

Since the Hill House was in such good shape and had four bedrooms upstairs, it was chosen to be the first residence hall for scientists and engineers working on the site. The house was remodeled inside, bathrooms were added, a furnace installed, the kitchen enlarged and a laundry room added.

Thru the years many people lived in the house and enjoyed the meals prepared by Nellie Arbogast, Virginia Irvin, Verna Tracy and Cleo Harper before the new and present residence hall opened in October 1959. Even after the new residence hall opened, many people lived at the Hill House.

I have listed the names and dates of people who lived in the Hill House at one time or another; some were co-ops, some summer students, some transients and some permanent. Some of the names are based on recollection

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Hill House - June 1914

Left to right: Opal, Argile, Marie, Ralph, Dick Arbogast.

Hill House - March 1974

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and some on records. If I missed anybody, please let me know because I am preparing a "Hill House History Book" that will become a permanent member of the house.

1958 - 1961

Grote Reber	T. K. Menon
Fred Crews	Omar Bowyer
George Grove	Bill Meredith
Howard Lake	Bill Waltman
John Findlay	Lloyd Berkner
Richard Emberson	Lewis Burchill
Charles Dunbar	Dave Hogg

1961 - 1964

John Findlay	Barry Clark

1965

Pat Palmer	Ben Zuckerman
Bill Waltman	Maddox
Eugene Epstien	Alan Barret
Pigeon	Yervant Terzian
Pollion	Frank Drake
Brown	Michael Dewey
Bailey	Henry Grahn

1966

Art Robichaud	Johann Schraml
Zigmond Turlo	Karl Wesslling
Bill Ogden	Pete Henderson
Magne Hagstrom	

1967

Art Robichaud	Karl Wesslling
Magne Hagstrom	Pete Henderson
Bob Swenson	John Payne

1968

John Payne	Magne Hagstrom
Jesse Davis	

November 1968 - June 1972

Michael M. Davis and Family (Jean, Paul, Meg, Gart, Len)

June 1972 - Present

Richard L. Fleming and Family (Perryn, Jennifer, Brad)

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BOULDER - OR "HOW TO SURVIVE IN THE PROMISED LAND"

Gerrit L. Verschuur

They all warned me about it before I left, and they all said, "I wish I were going there too!". At the time I found it difficult to believe all the praise for this city, but they were right. I won't mention who "they" were, but rest assured that several of them are your colleagues at the NRAO. They all painted a rosy picture of what a great place Boulder is and how great it is to simply be able to pop up into the mountains to hike or to ski, and what a pleasant atmosphere exists in the town.

Let me tell you about what I have learnt concerning how to live in Colorado without risk of being an outsider. The first is to be able to discuss skiing at a level which makes it seem that you really do it regularly and secondly that you like it. Everyone asks "Do you ski?" at some point. The ideal answer is "Yes." and if you are lucky they will leave it at that. The prerequisite to being able to answer yes is for it to be reasonably true, lest they ask further probing questions like "Do you snowplow?". I can honestly answer that I do snowplow. My best snowplows have been done on my side or on my back, watching the snow swish by my glasses and into my ears! That, however, is not the officially recognized method. But I did take four lessons (which cost $54) so that I could at least say that I know how to ski! Those lessons were in November and December, before there really was much snow around. They consisted of four evening sessions about forty miles from Boulder. Skiing in the evening is unique. Skiing in the evening when the slope is mostly ice is even more unique. Skiing in the evening when it is icy and the temperature is 20° F and the wind is blowing forty mph is totally unique! It was like skating on a sloping ice rink in a hurricane with no clothes on.

Having passed this test the rest was easy. One needs to pick up a few "in" words, like "Steamboat Springs" and "Aspen" and "Vail" and drop them around. Then one needs to learn the names of at least a few slopes such as Ajax (wherever that is) and Donner (or is that not in Colorado?) and then one can converse with the best of them. I did actually ski at Snowmass (how that brings images to the true skier) where I learnt about the lengths of skis. One of the things you must be able to do is know the length of your skis and be able to talk about that length. Skis are measured in centimeters, mainly for snob value, I suspect. I wanted 90 cm skis but they don't make them that small. I feel better with small skis! My lessons were GLM (which, to the uninformed of Virginia and West Virginia, means "graduated length method") and this means that you start off with short ones and in the second lesson you have longer skis and so forth. After I graduated I wanted to go back to the short ones!

Sometimes when you sit on a ski lift (the least tiring part of the day) someone will casually ask you how you like the "brand X" skis you are using. You look at your skis and indeed they are labelled with that name and you panic because it never occured to you that there could be any difference between one ski and the next. This is a trying moment, but if you are fast on your feet, or on your skis, you will say that you like them better than "brand Y". Brand Y would be the ones he is wearing!

Lastly, there is a question of fashion in the ski resort. If you don't wear this year's skis, this year's boots, if your skis do not have this year's bindings and if you aren't wearing this year's long-johns you aren't really "in" at all. The best thing to do, if you can't keep up with the fashions, is to wear your street clothes and pretend that your office is at the top of the slopes and you are skiing home for lunch.

One thing happened to me which put me in my place rather badly and that concerned the great pair of skis I had bought at a garage sale. At this sale I bought a pair of skis, no ordinary skis mind you, for $5. I also bought some boots for that price. The skis were those really long ones. The type which, when you stand next to them, reach well above your head and your outstretched arms. Well I took them with me to Snowmass, despite words of caution from my friend Dick, and then, after deplanning

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at Aspen, I learnt the acid truth about skis. The ski-bum who was to drive us to Snowmass took one look at my skis and proceeded to describe them, in particular their history, to me. According to him these skis, lovingly carried over the mountains, only had, what he politely termed, "antique value". The bindings were guaranteed to break your legs, he said, as well as ones ankles and they simply did not make skis like these anymore.

Being one to turn negatives into positives I decided that I obviously had an eye for antiques and that is what they are now. Perhaps in another 50 years they will be worth a whole lot. I will even consider some offers now, should any of you ski-freaks pass through Boulder. I didn't use them because I didn't want to break my antique skis in some clumsy snowplow!

I could go on for days on the do's and don'ts about skiing, but won't, except to say that I know how to converse with the best of them when it comes to cross country skiing. I haven't tried it yet, but all you have to say is that you would love to try and everyone is happy.

Now I should say a few words about the other "thing to talk about" in Boulder, and that is football. I mean the type of football in which you either carry the ball in your hands or throw it. Handball would have been a better name. Well, anyway, football is a big thing in a town in which the stadium can hold 52,000 of the city's population of 80,000. I got myself a season ticket so that I could give the game a fair trial. Besides the continued disappointment of not seeing any replays of the plays I had missed--because I was looking at the grandeur of the mountains beyond the opposite tiers of spectators--I found that the games really were very boring. Now I know why everyone brings a hip flask or a few cans of beer with them!

The thing about the games is that after it is all over and you are at a party, many will ask "Did you see the game?". You need only answer yes and you are "in". If you answered no you would be very "out". The wierd thing is that once you have answered in the affirmative the question is closed. No one really wants to discuss it further. In England, if you had seen the local soccer game on a Saturday and someone asked whether you had seen it, and if you had, there would follow a virtual replay of the game in the form of words. Not here. As long as you were there all is well. On the day I missed a game I managed to disguise the fact by being the one to take the initiative and ask the same question of others. My asking "Did you see the game?" was taken by the other person to imply that I had seen the game and after they had answered "Yes" the matter was again closed. To those who answered "No" I only gave a cold stare! So much for gamesmanship.

Your editor really wanted me to say a little about my new job. So far there isn't much to say because the planetarium building doesn't exist yet. So far there is a hole in the ground and the foundations will be poured at the end of March. Perhaps in a later installment I can tell a little about what it is like to run a planetarium with an actual building to operate from.

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HEY GOLFERS

State golf courses will open at Pipestem and Twin Falls State Parks on March 15, said Kermit McKeever, parks and recreation chief. Other courses, at Canaan Valley and Cacapon, will open in May.

The state's newest 18-hole championship course, at Cacapon State Park near Berkeley Springs, should be in play by Memorial Day.

Pipestem's 18-hole championship and nine-hole, par-three courses, Twin Falls' nine-hole, and Canaan Valley's 18-hole championship course are in excellent condition, McKeever noted.

Rates for the 1974 season are: Cacapon and Pipestem 18-holes, $5 weekdays and $6 weekends; Canaan Valley, the same; Twin Falls green fees will be $4 weekdays, $5 on weekends. The par-three course at Pipestem will charge $2 for nine holes weekdays and $3 on weekends, with a $2 additional charge for those playing 18 holes.

*****

GREEN BANK SITE POWER

Bill del Giudice

During this past winter there were several power interruptions. Two were unscheduled because of cable failures. These unscheduled outages had caused disruption of some telescope operations and made necessary other, planned, outages. Planned outages, while not as disruptive on schedules as the original outages, had an effect on telescope schedules.

To understand what this power interruption is all about, it would be helpful first to learn a little about how power is distributed on the site. For the purpose of this discussion, a complete description of our rather complex distribution network is unnecessary, and therefore, this description is somewhat oversimplified.

Commercial power, that is power from Monogahela Power Company, comes onto the site just to the north of the 140-foot telescope and is reduced to about 4200 volts before it connects to our equipment. At the substation near the 140-foot telescope we divide it into four circuits: one for everything east of the 140-foot telescope, including 85-1 (East Feeder), and one each for the 140-foot, interferometer and 300-foot telescopes. From the substation to the point of final use, all of the cables used to carry the power are buried in the ground, but are accessable for maintenance approximately every 800 feet. This accessibility reduces the cost and problem of locating and replacing any section which may fail for any reason. Access in the support area (East Feeder) is through manholes, while the lines to the interferometer and the 300-foot come up into small, above-ground huts spaced along the line.

At some unknown time in the past, we theorize lightning has struck someplace on the system and caused considerable damage to some of the cables. This caused some of the past failures. Another possible cause is damage to the insulation (cuts, bruises and kinks) which may have been introduced at any time, from manufacture to installation. At the present time we can see ample evidence of damage which could have been caused by lightning, but we have not found any which we can be sure is the result of poor or damaged cable.

Of the two most recent power failures, one occured in the feeder to the 300-foot back in the fall and the other was in the interferometer feeder just before Christmas. (Anybody familiar with maintenance work knows that all failures of this type occur late at night, on a weekend or holiday, and usually during lousy weather.) In each case we were fortunate in that it was possible to disconnect the failed section of cable from the system and make a temporary connection to the feeder for the unaffected telescope. In other words, when the cables to the interferometer failed, we just hooked them on to the lines that supply the 300-foot, at a point beyond the damaged section, and kept them both going on the one circuit. This let us get the telescopes back into operation with a minimum of downtime and left the bad section of cable in place to be replaced under more favorable conditions. At this writing, we still have the second of the two most recent failures to repair. The photograph below shows a section of cable (what is left of it) which failed in the interferometer feeder.

Obviously, we would be happy if we could eliminate these failures and avoid the unscheduled - and much of the scheduled - downtime which results. Well, we think

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that we can at least reduce such occurances substantially. Recently we purchased equipment which tests the buried cable in place and gives us a measure of the quality of the insulation. Taking measurements approximately once a year from now on should give us a profile of the rate of deterioration of the cable insulation. Thus, we can identify those cables most likely to fail and replace them on a scheduled basis before they have a chance to shut us down. The cable tests which we have conducted so far indicate that there is a wide spread in the quality of the insulation, but only one which appears bad enough to cause concern. Replacing this cable before it fails is what the testing program is all about.

As a postscript to the above, the cable which we noted as bad enough to cause concern failed at 2200 hours on 18 March 1974 before we could schedule sufficient downtime to replace it. This shut the interferometer down for about two hours, and the 300-foot for seventeen hours. Our prediction of when a cable would fail (nighttime, weekend/holiday, and during lousy weather) hit two out of three. It was late at night, and most of the repair work was done in a driving rain. Although not a holiday or weekend, the repair work coincided with an interferometer move and in the middle of the job, men had to be diverted to move both telescopes. While making this repair we found a possible fault in the spare cable. Just a typical job.

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SPRING FIRE SEASON

The spring statutory forest fire season began 1 March and will continue through 31 May, according to Natural Resources Director, Ira S. Latimer, Jr.

During this period all outside burning of debris is prohibited between 5 a. m. EST and 5 p. m. EST, without a debris burning permit, which may be secured free from Division of Forestry personnel.

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Gray hair is a sign of age, not of wisdom.
--Greek Proverb

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WHAT'S OLD AT THE VLA SITE

Gary Bonebrake

Before a concerted effort toward "What's New . . .", it might be appropriate to investigate the historical background and surroundings at the VLA site.

Little is written historically about the towns surrounding the Plains of San Augustin. They are small indeed, and it is quite amazing that they even exist today. For hundreds of miles around, the landscape is predominately semi-arid desert and prarie, save for the tall, bleak mountains which protrude like islands in a sea of brown. The only money-making industries are cattle-ranching, logging, a trace of mining, and the tourist trade--in season. Ranches are two or three to the horizon, and vaguely reminiscent of the Cartwright Ponderosa, minus the foliage. Logging is carried out on a much smaller scale than that on Cheat Mountain in West Virginia, due probably to the considerable distance to any mill. The tourist trade, it is said, flourished in the summer months - sight-seers, campers, and hunters flock to the extensive and remote national forest lands in the Magdalena area.

Thanks to F. Stanley for his stories of Kelly and Magdalena, whence the following brief history is largely plagiarized.

Magdalena is about 27 miles northwest of Socorro, on Highway 60. It is a stopping place for hunters travelling west through the Cibola National Forest and points west. Although the name Magdalena was in use long before the town came into being, no attempt was made to colonize the area in the days of the Spaniards, Mexican rule, and years after New Mexico became an American Territory. The story of Magdalena as a settlement begins with prospectors. Many of the gold seekers were former service men who had been stationed at Fort Tularosa, Fort Craig, Fort McRae and other surrounding frontier posts.

Living conditions were primitive at best, and there was always danger from the Indians. The men lived in tents for a time until the make-shift shacks were constructed. Nights are chilly even during the summer months due to the high altitude. Winters

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are severe. Supplies came in from Socorro, itself caught in the web of the mining excitement. The only available medical help was also in Socorro. Cards and liquor were the only two sources of entertainment in those days. Indians were always in quest of whatever stock the men had. As early as 1800, Lt. Jose Manrique had come here with one hundred and twenty-five men to recover horses stolen by Indians. Miners took turns to keep a night watch against surprise raids. Claim jumpers were also in evidence, so prospectors always seemed to be on the defensive. Even if they made a big strike, most could not afford to take the mineral out of the ground. Corporations and companies had better success. Individuals making a find usually sold out to a company.

The mining period also ushered in a rash of new towns some of which became permanent, but most have since disappeared. These towns were not to be found around Magdalena alone, but throughout the territory. Hand in hand with the mining towns came the railroad towns and the coal mining towns to give New Mexico at least twice as many communities as it had at the end of the Civil War. Magdalena is one of the few that survived. It continued strictly as a mining camp, then changed to become a shipping center for cattle. Even when mining was at its peak, Magdalena was never a very wide-open or wild town to make it notorious - although it had its share of undesirables generally found in frontier towns. (Soon to have the undesirables found in most astronomy plant towns!) During the early days there were very few women in camp. These were generally cooks, laundry women and some dance hall girls. Men lived in boarding houses. (Again, sounds vaguely familiar to Green Bank.)

The growth of the Magdalena camp and the expansion of the mining area was important enough to induce the Santa Fe railroad to build the Magdalena Branch. "Track laying has been resumed on the Magdalena Branch from Socorro, and in less than forty days the new Iron Horse will give a snort that will arouse the denizens of the thriving town bearing the same name as the range of mountains wherein is centered so much mineral. The railroad company selected a beautiful site for the town of Magdalena, and that in time it will become one of the leading places of the southern country is a fact understood by gentlemen who are investing largely in property." --Las Vegas Optic, October 21, 1884.

Late October 1884, then is the official date of the founding of the new town of Magdalena which is the little city we know today. The Santa Fe decided on the site because of the growth of ranching and the livestock industry, as well as mining. Magdalena was to be second to Chicago as a shipping center for livestock. True, this distinction was short lived, but it was a moment of glory while it lasted. Shortly after the town was platted the Magdalena Jockey Club built a race track, and it became one of the major recreational centers for miles around.

A big, new hotel known as the Magdalena Hotel was built in 1907 because it seemed as if the mines would be reactivated and more men hired. Work progressed well for the next ten years but in 1917 it became apparent that a setback was taking place, and this would be permanent. While mining wouldn't become extinct as it did at Kelly in the thirties, neither would it have the push and flow of the early days. A certain amount of interest was aroused in the possibilities surrounding the oil industry, and there were those who were convinced that there was a tremendous oil pool in the area. A Magdalena Oil Company was formed, and many oil companies bought up leases. All of this activity failed to bring about a boom, and the people of Magdalena accepted the fact that it was not oil country. Although oil companies gave up the quest for oil, many such as Kennecott and Humble returned for mineral exploration. A copper, lead, and zinc ore concentrating plant was also developed east of town. Magdalena made another bid for new life. Two motels were built, and another favorite gathering place for visitors and hunters, known as Brown's Ranchmans Inn, was also constructed. Because there are two national parks around Magdalena it is the favorite haunt of hunters, especially in the fall of the year when the deer season opens. Probably more hunters gather at Magdalena each fall than any other spot in the southwest.

A group of Navajos who had refused to be confined to the Bosque Redondo Reservation near Fort Sumner during the Civil War had

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settled at Alamose Creek. They were a peaceful group although often blamed for the raid perpetrated by Apaches. Descendants of these Navajos still live in the area, never rejoining the tribe when they were transferred from the Fort Sumner area to western New Mexico. They form an interesting but isolated community doing most of their shopping in Magdalena. A few of them worked in Kelly and Magdalena. But as a whole they preferred to remain by themselves as practically a seperate tribe. The going was often rough and before World War II they were on the verge of starvation. But somehow they survived and are now moving ahead in schooling, arts and crafts, and survival. It is surprising how they have been overlooked by historians; some have served as guides for hunters. All in all they are an interesting part of the life that is ever alive and active in and around Magdalena.

Kelly, an old mining town, was several miles removed from Magdalena in Socorro County. A little over two miles southeast of Magdalena, it was once a town of some three thousand people. A man named Andy Kelly located a sawmill in the area after his discharge from the service. He did some prospecting in his spare time. This sawmill was the gathering place for other prospectors, and the place came to be known as South Camp. Some miners erected shacks in the Kelly region as early as 1871. Permanent homes were not to be built for almost a decade. By 1880, mining was so widespread that more stable homes were built for occupation in the winter as well as the summer.

Kelly looked more like a mining town than most. While hotels and places of business lined the street, they were built of adobe or wood. The hotel had a large, two-story, open porch. Many buildings had false fronts. No streets were paved. Like most mining towns, Kelly was built against a hillside. It was in a picturesque setting. The cemetery was in use long after the mines closed. There are those who believe that Kelly would have remained a thriving city had the railroad figured out a way to get the steel rails beyond the sharp incline leading into the town. It had to settle for Magdalena, which had an elevation of 6500 feet. The Magdalena mountains peak at ten thousand feet above sea level.

In spite of the fact that the Kelly-Magdalena region was looked upon as a mining area, the cattle industry continued to grow and prosper. Many miners and businessmen in the mining towns eventually went into ranching. Many of the larger ranches were owned by cattlemen from Texas. Cowboys from all these ranches gathered in Kelly on Saturday nights to lend to the excitement. Kelly had two dancehalls, a few billiard parlors, and seven saloons. There were times when dances ended in a free-for-all fight because cowboys sought to cut in while miners were dancing. The miners would bring girls to the dance, which was something the cowboys couldn't do, nor did they care to dance with each other. The only alternative was to dance with a girl brought to the hall by a miner. The cowboys and miners relished the fight with as much enthusiasm as they enjoyed the dance. The Kelly telephone exchange was often busy calling for help out of Magdalena or Socorro in order to stop the fights.

When a Mr. A. B. Wadleigh first saw Magdalena in the mid 80's he wrote that it was not much of a town to look at, and could count no more than a dozen or so houses, these including a hotel, about six saloons and a few small stores. He seemed to be more taken with Kelly close by. He was amazed at the amount of activity taking place there, and the number of men employed in the Kelly mines. He said that it took sixteen horses or mules to pull the ore wagons from Kelly to the railroad at Magdalena. He also noted that there was never any love lost between the miners and the cowboys, and that the two classes of men always went about fully armed and prepared for battle - like two countries at war. He doubted that any man walked the streets of Magdalena unarmed. A six-shooter and a belt full of cartridges seemed to be part of the dress code.

One item that was well supplied was whiskey. Shopping, for ranchmen, meant a certain amount of groceries and at least one keg of whiskey for the ranch hands. Every time hands had an opportunity to come to town for supplies they were loaded inside and out. (Of course there were exceptions.) Some of the cowboys were quite religious and never

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touched a drop. While some of their companions may have thought this odd they did respect them. When kegs were unavailable, bottles were bought. These were much easier to open on the road back. Once back on the ranch the hands usually settled down.

Just why there should have been differences between the miners and the cowboys nobody has bothered to explain. It was obvious that the cowboys did not think mining a fit occupation for a man. Whatever the reason, cowboys and miners nursed many a cracked skull after a Saturday night in Magdalena.

Next time a look at Magdalena today, and what's going on at the VLA site. (Assuming Congress still loves us!)

*****

140-FT MODCOMP

Buddy Cate

We have a new computer at the 140 ft telescope called the MODCOMP II, Model 25 (MODCOMP for short). It is manufactured by MODular COMPuter Systems, Inc., out of Ft. Lauderdale, Florida. The MODCOMP is a general-purpose, 16-bit/word computer with 32,768 words of directly addressable core memory. Peripheral devices interfaced to the 140-ft MODCOMP include: a card reader, a keyboard-CRT, a hard copy unit, and two moving head disks (see Figure I). The two disks have a total capacity of 2,598,400 16 bit words. Included with the CPU, the vendor has provided a disk operating system (MAX II) which contains a FORTRAN compiler, a Macro Assembler, and a number of utility programs.

The primary purpose of this computer is to give the observer the ability to at least partially process his data in real-time, thus giving him better control over his experiment. Currently, the data is recorded on magnetic tape by the DDP116 computer; then the tape is sent to CV on the shuttle for processing by the IBM 360. Therefore it could be as much as 24 hours before the observer has a chance to take a good look at his data. The MODCOMP is expected to salvage many days of observing time which would otherwise have been lost.

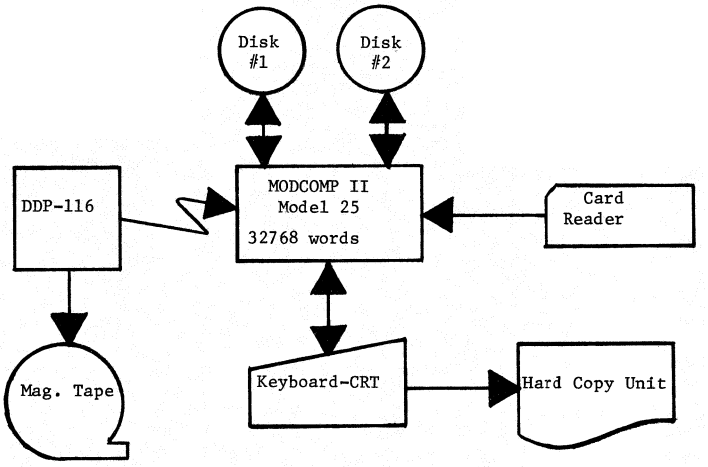


Figure I. MODCOMP Configuration

The plans are to continue writing the data on magnetic tape and at the same time send the data to the MODCOMP via an intercomputer link which has already been installed. The software to accomplish this task will probably consist of some subset of TPOWER-SPOWER for line work, and some subset of Continuum offline package (currently under development) for continuum observations. Additionally an interactive, easy-to-use programming language, POPS, has been developed which will allow the observer to either write his own processing program(s), or access the above mentioned packages, or a combination of both.

It is also planned to eventually install an identical MODCOMP system at the 300-ft telescope.

*****

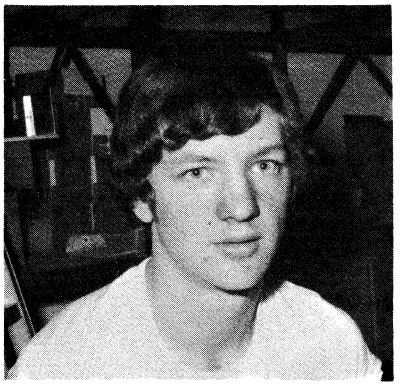
CREF UNIT VALUES

1974

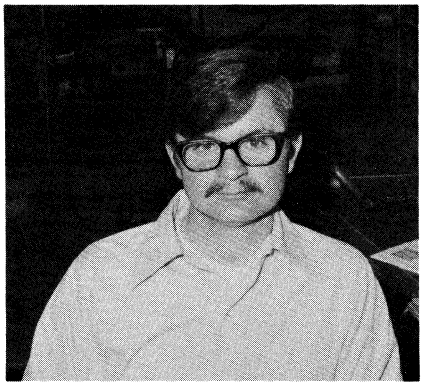
January	$40.75
February	40.83

*****

NEW EMPLOYEES



Robert M. Morgan
Jr. Technician
Electronics Div. - GB



Olin R. Warner
Technical Specialist
Telescope Oper. - GB

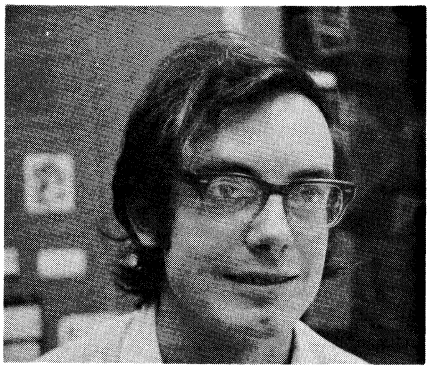
Albert H. Steinemann
Shops Division Head
Central Shops - GB

Photo Not Available

Stephen L. Galhouse
Jr. Technician
Tucson Operations

Photo Not Available

Cynthia K. Baca
Secretary
New Mexico



Frederic R. Schwab
Scientific Programmer
Computer Div. - CV

Photo Not Available

John M. Skarnulis
Sr. Designer
Electronics Div. - CV

Photo Not Available

Langford G. Brod, Jr.
Telescope Engineer
Tucson Operations

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TERMINATIONS

Ross E. Jeffries	Administrative Services - GB
R. Jane Gordon	Administrative Services - GB
Dorothy J. Friend	Administrative Services - GB
Dorsey L. Thacker	Electronics Division - CV
Anthony R. Kerr	Electronics Division - CV
Richard H. Gammon	Basic Research - CV
Clarence E. West	VLA Project - CV

LEAVE OF ABSENCE

Sebastian von Hoerner	Basic Research - GB
Jerry C. Shears	Plant Maintenance - GB

We are sorry to report the death of William W. Powell who died on March 24, 1973. Bill had been with the Observatory almost eleven years and was Purchasing-Property Officer.

*****

AN EASTER PRAYER

Lelah Kinney Ayers

May the glorious dawn of Easter morn
And all that it imparts,
Bring hope anew to everyone
And love to troubled hearts!

May the glory of our risen Lord,
Shine so the world may find
True brotherhood, with prayer and faith,
For peace to all mankind!

May the beauty of this glad springtime
Bring a radiant joy and cheer -
And Easter's story told again,
Bring our Saviour very near!

*****

Happiness is the only good. The place to be happy is here. The time to be happy is now. The way to be happy is to help make others so.

--Robert G. Ingersoll

*****

THE 140-FT CASSEGRAIN PROJECT

Peter Napier

In terms of the amount of work being done by NRAO people, without the help of outside contractors, the Cassegraining of the 140-ft combined with the recabling and installation of a new Sterling mount on the telescope is probably the largest single task undertaken by NRAO. What is a Cassegrain system and what do we gain from all this effort? Figure I shows the difference between a Cassegrain feed system and the Prime Focus feed system which is currently used on all the Green Bank Radio Telescopes.

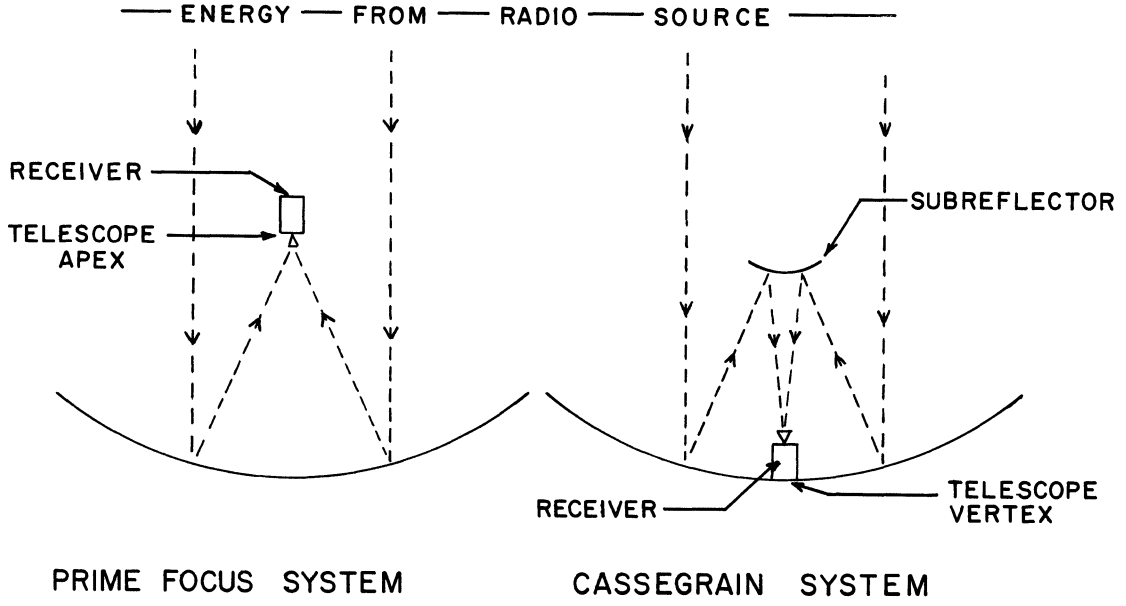

Figure I. The difference between a Prime Focus and Cassegrain feed system for a radio telescope.

In a Cassegrain system (the system is named after its inventor, Guillaume Cassegrain, who used it on optical telescopes in 1672) the receiver is placed near the vertex of the telescope rather than at the apex. This means that much larger and more complicated receiver systems can be used because it is possible to support more weight at the vertex. Additional advantages include increased aperture efficiency and lower cross polarization because of the longer effective focal length. More sensitive receiver systems can be built because the feeds are pointing up into the sky rather than down at the "noisy" ground and the telescope beam can be rapidly switched in the sky by tilting the subreflector. The 140-ft Cassegrain system is essentially a copy of the system used by the Jet Propulsion Laboratories on their 210-ft Deep Space antenna at Goldstone, California. We will have four different feed-receiver systems (for the wavelength ranges: 21 cm, 6 cm, 2 cm, 1.3 cm) on the telescope at the same time and will be able to change frequency very quickly by ordering the computer to point the subreflector at the feed that is required.

Figure II (page 19) shows the changes that will be made to the telescope during the shutdown which is planned to start on 19 August this year. In addition to installing the components for the Cassegrain system itself, it was decided that the shutdown would be a convenient time to replace the cabling and the Sterling mount on the telescope; both these items have shown signs of wear recently. The vertex room is now essentially complete and has the feeds and receiver in place; on the telescope the room will have a total weight of about 12800 lbs. Figure II shows the scheme proposed by the Engineering Division to wench the vertex room into place using the telescope structure itself as a crane. The 150 lb. subreflector is being

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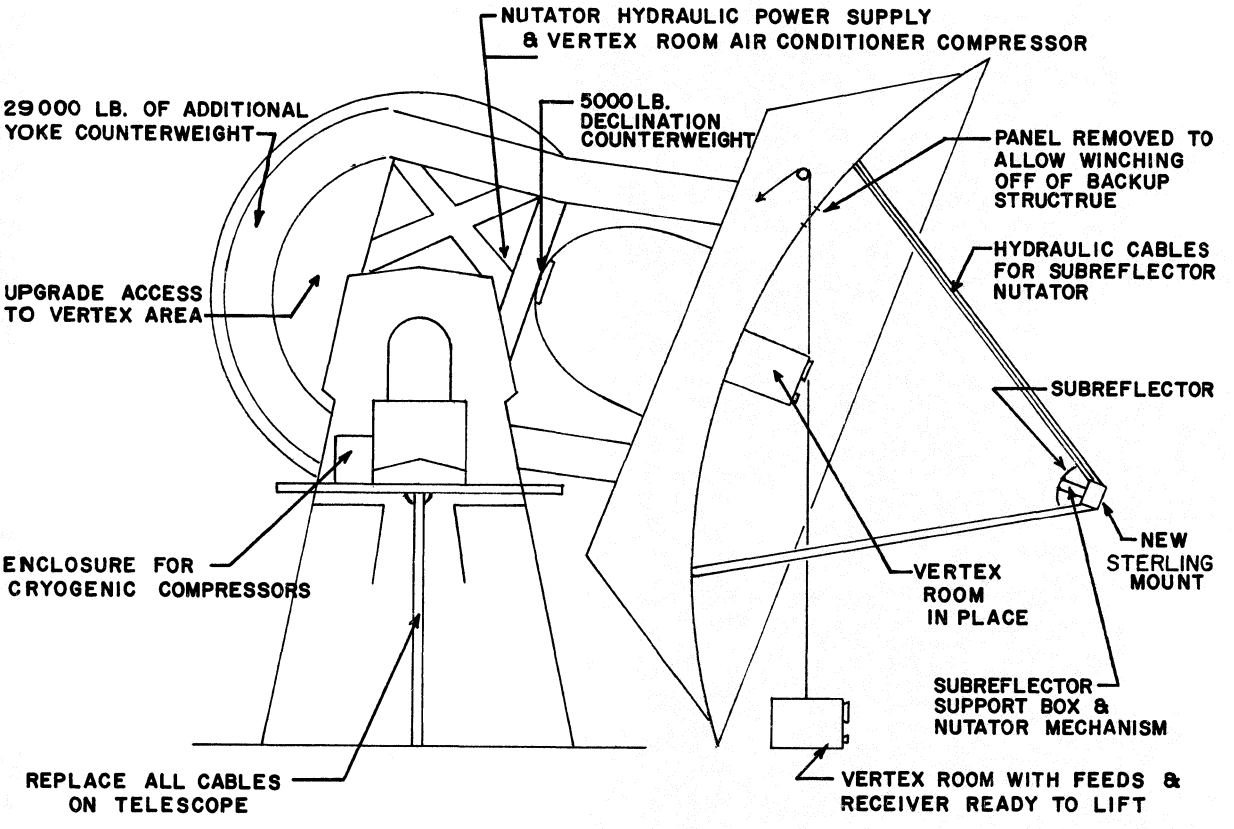

Figure II. Changes to the 140-Ft Telescope

fabricated by a company on the west coast; this subreflector had to be specially designed so that, while it is light, it is also strong enough to withstand the very large forces needed to nutate (wobble) it rapidly.

The hydraulicly driven nutator mechanism has been designed to wobble the subreflector at rates up to 5 hz and to allow the beam to be switched 3 beamwidths in the sky in 30 milliseconds. An important feature of the nutator is the compensator mechanism. As the subreflector accelerates one way, the compensator accelerates in the opposite direction with an equal and opposite torque so that no force will be transmitted to the telescope structure and the feed legs will not vibrate. The nutator will be driven by hydraulic fluid at a pressure of about 3000 p.s.i. which is brought up to the apex position through hydraulic cables from a hydraulic power supply mounted on the face of the yoke. The box that supports the subreflector in place and contains the nutator has been designed so that it can be installed in the Sterling mount in the same way as a standard receiver box, allowing rapid changeover from Cassegrain to Prime Focus operations.

Other changes planned for the telescope include building an enclosure on the deck to house the cryogenics compressors, upgrading the access to the vertex area and an extension to the service-tower to assist subreflector installation. By no means the easiest job to be done during the shutdown will be the addition of some 34000 lbs. of counterweight to the telescope.

*****

REASON

He who will not reason, is a bigot; he who cannot is a fool; and he who dares not, is a slave.
--William Drummond

*****

INVERSE ASTROLOGY

John Dickel

I'm sure everyone has heard of astrology - that game of fortune telling which no self-respecting astronomer will admit exists. The idea is that the antics of the planets and other heavenly bodies control the actions of man through some unspecified force. But have you ever heard of inverse astrology in which the actions of man influence the planets? (Also by some unspecified force.) To my knowledge, except for a few Greek gods, etc., I am the only person to be accused of the latter.

It all started back in the fall of 1956 shortly after Bernie Burke and Ken Franklin (then at DTM, now at MIT and the Hayden Planetarium respectively) had discovered that Jupiter emitted bursts of low frequency (around 20 MHz) radiation on a semi-regular basis. A group at Yale, headed by Harlan Smith and Jim Douglas (now both at Texas), decided to monitor this emission to establish its exact periodicity. Because there are many amateur radio bands in this part of the spectrum they naturally enlisted the aid of the ham radio club--of which Jim was the trustee--for help in constructing the equipment. After several antenna parties, electronics constructing parties--and not a few beer parties afterward--the equipment was finished and then came the problem of providing observers to monitor the records on a regular basis. As an eager young freshman at an all male school with nothing to do but study, I volunteered my services one night a week.

After the first few months of observing, several people had been lucky enough to be manning the recorders when a burst was emitted by Jupiter. Those of us who had missed out just felt a little unlucky so we were quite willing to sign up for another year.

By the end of my third year, however, I was the only observer who had never recorded a burst. By then there were sufficient accumulated data to do a statistical analysis in order to determine the repetition period of the bursts. The resultant period of $9^h55^m29^s.37$ was attributed to rotation of the solid core of Jupiter and it was also found that the emission was recorded only when one of three particular longitudes on Jupiter faced the earth. Armed with this information, I resigned my position as a regular observer and offered to become a "special looker" who would only go observing 9^h55^m after a previous burst had been recorded. My replacement in the regular schedule became Lou Pataki (now my neighbor at Indiana University) and sure enough, on his first night of observing he recorded a spectacular burst from Jupiter. I therefore arranged to go out to the observatory (about a 15 mile drive plus 2 homework problem sets due and an hour exam the next day) the appropriate time later after Lou's discovery. Sure enough, no burst!

I continued to upset the statistics for the rest of that year and finally everyone gave a sigh of relief when I graduated and Jupiter got back to normal. They now tell me that the emission is controlled by some other subsequently discovered effects such as the phases of one of Jupiter's moons called Io, but no one has invited me to observe again in order to confirm their conclusions. Therefore, the Inverse Dickel Effect remains a perfect correlation. Any time you wish to shut off a planet, please feel free to call upon me. I'll be happy to provide my services (for a modest [?] fee, of course).

*****

A PARAPHRASE OF ROBERT FROST

The lunar plains are lovely, dark, and deep,
But we have higher rendezvous to keep
And parsecs to go before we sleep,
Many parsecs to go before we sleep, in glory.

--KWC

*****

The little brook is a silver ribbon
Left from the holidays,
That Spring has found and used to tie
About her first bouquets.

*****

A LIBRARY IS TO KNOW

Virginia Van Brunt

National Library Week is April 21-27. Did you ever wonder what libraries are?

...A librarian is to say, "No, but I read the review."
...Books are to shift.
...A fine is if you forget you shouldn't and you're sorry but not enough and aren't you glad you don't have to at NRAO but maybe we should.
...A book is to leave your notes in.
...A reader-printer is if it looks alright but the focus is wrong or the paper is old and then the reduction is right except it goes clickey-click and the paper won't come out.
...A fact is to find.
...Catalog cards are to revise.
...A publisher is their catalogs all come at the same time and what you are looking for isn't in them anyway.
...Patrons are to smile no matter what.
...Stacks are if they're open people put books back wrong and if they're closed they ask "Why?".
...A book is if you need to know something there it is but it's not on the shelf so look in Barry Turner's office.
...A discount is if he has more money it's bigger and you don't like it.
...A card catalog is to say, "Have you looked in it?".
...Gifts are they pile up.
...Gifts are they pile up but you still say yes but nobody knows why and if you don't you may lose an old internal report.
...A cataloger is if you have one you guard her closely and people say you're lucky.
...A librarian is when people think you read all the time but you don't and you would like to.
...To discard is to make space and then you can't find it.
...A reference librarian is you don't know all the answers but they think you should.
...The Washington Post is for Doonesbury, if it comes.
...More space is to dream and if you dream well enough you still dream but the dream is better.
...A bindery is they don't come back when you think they should.
...A publication date is to be ready when but something happens and people don't understand.
...A fishtank is to be where you need more shelves.
...Vacations are to come back.
...An inventory is to face.
...A library is to know.

(We acknowledge plagiarizing from A LIBRARY IS TO KNOW, by Art Parsons. New Method Book Bindery, Inc., 1961.)

*****

THE MISSILE FIRING CHAIR

Wally Oref

What's so unusual about an office desk chair breaking an office window? Nothing, if you intended breaking the window with the chair. Unusual, yes, if the chair broke the window but never left the floor. In a recent case of equipment failure in the warehouse office, an office chair was responsible for breaking a window. It was a chair-part, hurled out like a missile, that did the breaking--and in a quite dramatic way. Here is what happened.

One day in early March, warehouseman Jack Daniels (no relation to the distillery Daniels) was sitting at a table in an office chair like the one pictured on the following page. As he swung around from the table to a position parallel to it, he leaned back in his chair and the backward tilting compressed the two springs located under the seat. Sometime after full compression the bolt holding the springs, spring retainer, and tensioning knob together broke (engineers would say the bolt failed). At that instant there was a resounding "kaa-pow" and the energy-loaded springs shot bolt, springs, retainer, and knob out from under the chair like a missile. Springs and retainer stopped twelve feet away after crashing into the heater under the window. The bolt and attached knob went further. Their momentum carried them through the window glass and out into the yard, some

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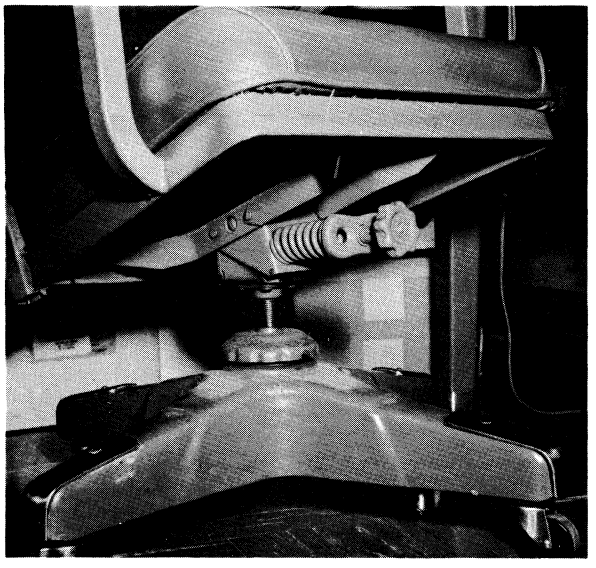
twenty-two feet from point of launch. The upward trajectory of the bolt and knob was from under the chair, over Thurmond Cosner's typewriter, through the window glass and out into the yard. Luckily, at the time Thurmond was out of the office.



Missile Firing Chair

I thought this was one of those one-in-a-million equipment failures. I looked at the bolt on my office chair and its a real hefty one--very unlikely to break. The bolt is about eight inches long, three-eights inches thick, and made out of hard steel. The front end is threaded for the tensioning knob and the back end has an unusually shaped head that is rounded on the front, I presume to permit the chair to tilt backward and forward.

When I first heard the story, I was inclined to believe the bolt failed. However, this was not the case. What really happened was a nut came off from the end opposite the tensioning knob. After the original bolt had broken at the head/shaft junction, someone, somewhere else, repaired the chair by threading the shaft at the head end and using an ordinary nut.

The chair was not junked after the first bolt was thrown, nor after the second either. At some earlier date this same chair in this same office had missiled a bolt that struck a desk. Two known instances of failures in the warehouse office and at least one other - the original failure - somewhere else. The chair is no longer in the warehouse office. Have you checked the office chair in your office?

*****

BEEKEEPING SCHOOL

There was a good turnout by employees, wives, and children for the recent six weeks course in beginning beekeeping. Earl Cochran, State Apiarist for West Virginia, was instructor for the six Monday evening classes held at the Green Bank Grade School. Classes ended on February 25.

While the main emphasis in the course taught by Mr. Cochran was to help beginners get started in beekeeping, there was plenty of new information for older beekeepers who had not kept up with the latest in bee management. Mr. Cochran stressed that beginners, if they would apply the basic bee management principles taught in this course, should easily produce more honey than the State average of 12-15 pounds of surplus honey (surplus is the honey in excess of the 40-60 pounds left in the hive for the bees to winter on).

Employees, wives, and children who attended classes were as follows:

Bill del Giudice*	Emily Becker
Betty del Giudice	Wally Oref*
Peter del Giudice	Harold Crist*
Bill Shank	Howard Brown
Willy Shank	Tom Carpenter
Jim Dolan*	Omar Bowyer
Danny Dolan	Ron Monk
Pepper Moore	Herb Hanes

*Individuals who have one or more hives.

*****

April is a long-limbed child
Whose growth exceeds her gowns,
Bursting out at all the seams
Of winter's hand-me-downs.

*****