

The O B S E R V E R

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NRAO TEN-YEAR EMPLOYEES



Left to right: G. Grandon, T. Henderson, E. Wilson, C. Davis, R. Hiner, D. Cassell, P. Clarkson, G. Crist, P. Devlin, B. Nottingham, C. Wade, and E. Gardner. (Not present when picture was taken: G. Mayes, B. Cassell, J. Shears.)

Story on page 2.

10-YEAR AWARD DINNER

10-year pins and certificates were awarded to fifteen employees on January 21, 1971, at an evening dinner held in the Green Bank cafeteria. Pins and certificates for 10 years of service were presented by David Heeschen, NRAO Director, to the following employees:

Brown Cassell
 Delbert Cassell
 Pearl Clarkson
 Gene Crist
 Carl Davis
 Paul Devlin
 Edmund Gardner
 Glen Grandon
 Troy Henderson
 Richard Hiner
 Clifford Mayes
 Bruce Nottingham
 Jerry Shears
 Campbell Wade
 Edward Wilson

CONGRATULATIONS!

In addition to the above employees and their spouses, other guests attending the dinner included past 10-year pin recipients and their spouses, division heads, and assistant directors.

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

Spring cleaning at the Arbogast House pottery: Would anyone having personal property there please contact Jean Davis or Perryn Fleming.

Happy Easter

NEW INFORMATION ON THE STRUCTURE
OF OUR GALAXY

M. A. Gordon

Man has always had a basic curiosity about his environment, and one focus for his probings has always been astronomy. However, searches for basic knowledge never seem to end; discoveries simply instigate more questions and searches. Among the searches for astronomical understanding, that of determining the structure of our own galaxy has been especially popular during the last 20 years.

Our sun is but one of some 100 billion stars gathered into a wheel-like swarm, which slowly spins about its axis. The spinning motion is a bit peculiar, though. The inner stars orbit the center faster than the outer stars, causing the stars to wrap up into a spiral pattern. The sun lies in the plane of the spiral pattern about $2/3$ of the distance from the center towards the edge. Figure 1 shows a galaxy like ours viewed from the top; Figure 2, another one like ours viewed from the side.

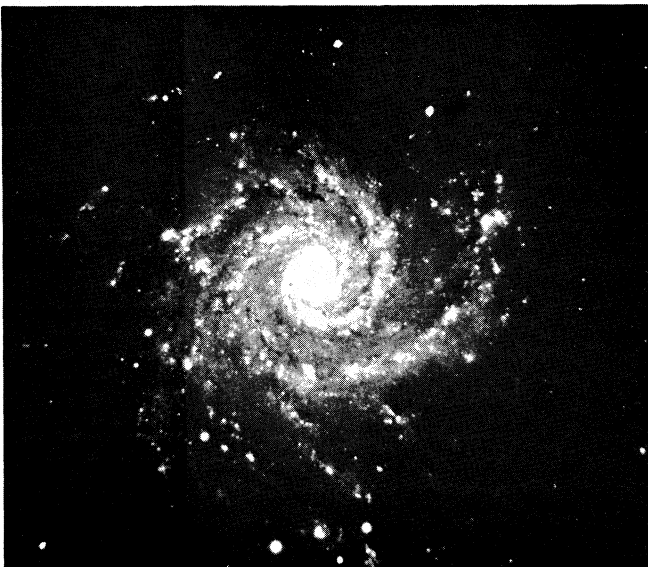


Fig. 1. The spiral galaxy M74 photographed by the 200-in. Hale telescope on Mt. Palomar.

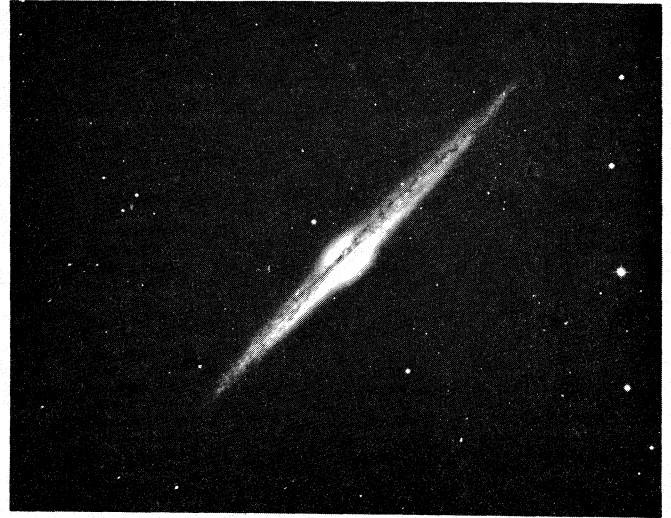


Fig. 2. The spiral galaxy NGC 4565 seen edge on. The dark areas are caused by dust.

From an ecological point of view, the galaxy is like Pittsburgh (Penna) prior to the 1955 pollution clean-up, or like Charleston (W. Virginia) on a day when a west wind is blowing. Dust, gas, and debris comprise much of the interstellar gas with the consequence that we can't see very far into the galaxy. (In fact, if there were no dust, the sky would be bright at night). Radio waves can penetrate the debris much the same way that navigational radar penetrates clouds. The detection, in 1951, of radio waves from interstellar hydrogen, gave astronomers a new tool to investigate the structure of our galaxy.

Astronomers classify hydrogen gas in the galaxy into two categories: HI and HII. The first, HI, usually refers to "cold" gas, that is, the bulk of the interstellar gas having a temperature of approximately -240°F . The second, HII, refers to regions of "hot" gas (including stars) where the temperatures range from 1400°F to $14,000^{\circ}\text{F}$. HII is thought to be heated by nearby stars. For

Continued, next page --

example, stars are continually forming from the galactic debris. Soon after a star is formed, it radiates enough energy in the ultra-violet to heat up the surrounding HI gas, thereby changing it to HII. Those of you having binoculars or optical telescopes should be able to pick out the fuzzy images in the sword of the constellation Orion, which are regions of glowing HII gas.

The hydrogen atom is the simplest of all, and its basic structure is perhaps the easiest to visualize. It consists of a positively-charged nucleus and a negatively-charged electron. The electron generally moves in orbit around the nucleus, held by the electric attraction between the opposite charges. These orbits can be thought of as forming a spherical shell around the central nucleus. If the atom gains energy, the diameter of the shell increases; if it loses energy, the diameter decreases. For reasons we don't understand and can only describe, energy can be added and subtracted only in discrete amounts. In other words, if the atom were to lose energy, the radius of the shell would decrease suddenly by a predictable increment. The size of this increment varies as the inverse square of the shell radius. If the shell initially was very large, then the incremental change in radius would be much, much smaller than the change in the case of a small shell. Large changes in shell radius generate radiation detectable optically; small changes generate radio waves.

Atoms in an HII region receive large amounts of energy from the associated stars. Usually the energy is so great as to increase the radius of the shell so much that the attractive force between the electron and atom is no longer strong enough to hold the electron. This "freed" electron then wanders about until it accidentally strays so near to an unattached nucleus that they recombine into another atom. Then the radius of the newly formed shell gets smaller and smaller by a series of jumps until "normal" size is reached. The whole process may be repeated.

By measuring the strength of radio waves emitted in this process, we can estimate the number of electrons which are recombining. Furthermore, the ratio of the number of electrons which are free to those which are



M. A. Gordon

"bound" is an indication of the temperature of the HII gas. Radiation from the free electrons appears as a broad-band signal (like radio "static") whereas that from the recombined electrons (atoms) appears as narrow-band signals (like the signals from radio stations) which we call "lines". Thus the astronomer can easily recognize the two types of radiation by their observed characteristics and can measure the ratio of free electrons to those which have recombined and are bound into hydrogen atoms.

Since 1963, these recombination lines have been used to investigate the characteristics of HII regions in our galaxy. Recently, Steve Gottesman and I wondered if we could detect these lines from the gas between HII regions. Just as for the HII regions, the detection of these lines would permit us to measure the temperature of this gas. A major problem is that this radiation is incredibly weak--so weak that large amounts of observing time are required. (Bill Howard: This is an indirect appeal for more observing time.) As luck would have it, we were able to detect the lines in the three places we looked.

These initial results are interesting because they suggest the existence of conditions unlike those predicted theoretically

Continued, next page --

(another example of why never to trust a theoretician). Based primarily upon these three observations and one more made at the 140-ft. by Pete Jackson and Frank Kerr of the University of Maryland, the inner region of the galaxy appears to be filled with diffuse HII gas which has a temperature of 1400°F and a density of at least 4200 electrons per cubic foot. Whether or not this HII is gathered into a number of exceedingly weak HII regions, scattered uniformly along the line of sight, is not yet known. The significant result is that the inner regions of the galaxy, out to about the position of the sun, seem to have 20 times more free electrons than anyone has suspected. Perhaps there are a lot more sources of radiation in the galaxy than thought previously. If so, why is this radiation confined to the inner parts of our galaxy?

We hope to be able to answer some of the questions when more observations are available, but as stated in the beginning of this article, discoveries usually lead to more questions and searches.

HOW NOT TO FLY TO CHARLOTTESVILLE

Phil Kronberg
U. of Toronto

It was a blustery day on the 26th day of January as we sat in the flight line at LaGuardia airport, watching with only slightly detached anxiety while planes wallowed onto the runway. The wind was best described by parameters something like \bar{v} 60 MPH, 5 sec. S.D. \pm 30 MPH. Then, suddenly, our plane swung in place by approximately 90°. Somewhat less detached, I eyed the emergency doors -- it was a long, though not impossible jump. The pilot revived up on engine, readjusted the pointing, then, finally, we made a bumpy ascent into the tranquil, azure void.

During our descent into Charlottesville we were occasionally informed, when it was

thought necessary, that the pilot was experiencing some turbulence. It could not be called smooth but, ah, much smoother than the Charlottesville runway -- that is, when traversed and decelerated upon with locking wheels. The fuselage underwent sympathetic (to the locking wheels, that is) radial oscillations of undetermined Fourier spectrum (runway not sufficiently long for adequate observation). Nevertheless, the damping was low enough that an odd precipitation occurred inside the "equipment" (English: aircraft) to wit, objects migrated from ceiling to floor. This included lighting panels, fresh air nozzles, oxygen masks, other panels, seat number plates, etc.... again, inadequate opportunity to observe completely. At long last a final shuddering halt. Because the landing gear was damaged, we couldn't leave the runway or the plane until help arrived some quarter of an hour later.

All this is recorded for the benefit of members of NRAO and others who, for lack of alternatives, may find it necessary to fly in and out of Charlottesville.

Subsequent intelligence revealed that the seizure of the landing gear on the aircraft concerned (denoted by the pseudonym IIIOIIIII) had happened several times and, while the same intelligence declined to reveal the probability per flight of this curious aircraft pathology, it revealed that future occurrences were not entirely ruled out.

Hence, how not to fly to Charlottesville -- without a pogo stick having a strong, poised spring, and sitting anywhere in plane IIIOIIIII except next to the emergency exit (for the extracautious and/or under-insured a parachute could be worn also). Finally, wear a hard hat -- this helps inside the plane (air nozzles are hard), and also should the aircraft repose in the inverse position. Do not, however, dread the long wait for assistance if the event should befall you, since re-assembling the interior of a IIIOIIIII is a challenging and mind-exercising occupation which will quickly pass the time.

A FORMER EDITOR WRITES BACK

A Letter to the Editor/Observer from a former Editor/Observer - name withheld until completion in order that more people will read this considerable attempt at narrative.

Just to get you all in the same frame of mind that this observer is in; this morning (1-19-71) I slewed out of the rack to find the outside ambient -29°F (felt like Kelvin - bring on the gas bags George!). Having acquired this data input my first consideration was "*? - ? - hmmm I wonder - will it start?" Obviously I was referring to my heart. But my wife was most clever and got me fired right up - showed me the fuel oil bill! Geeez Suz! My next thought was to resuscitate the car. It was so cold that the starter wouldn't start, the carburator couldn't carburate, gears wouldn't gear and the pistons wouldn't work. Just then I thought I heard the delicate sounds of the glacier heading south, for the winter, no doubt. Well, time for drastic action; scientifically thought through, logically planned, and skillfully executed. A large bucket of boiling water dumped on the motor. Would you believe that it was so, so cold that as soon as I got the boiling water into the garage it froze up solid. Yup - in fact, it was so cold and the water (boiling) froze so quickly, the damn ice was hot!

Many ampere-hours later I came to the realization that I had a potential failure on my hands. So I got my wife to assist me with a tow. Had a hell of a time hooking up with tow chain. Kept slipping off her belt! Managed to start her car (sure, she parked in the warm side of our garage) and towed with it. My car started right after we pulled onto the interstate. I now gave out with the pre-arranged "O.K., slow down, I'm running" signal. She accelerates to 35 MPH! Damn! Plan B - pre-arranged high sign and horn-honking, slow rate. 40 MPH! Hell!!! Improvised Plan: Pre-arranged high sign with left hand flailing out window and horn honking, rapid rate and verbal barrage, fortissimo, 45 MPH. Damn it-to-hell!!! ((Pause in story whilst author wipeth brow, even now)). State Police car, coming from opposite direction. PANIC!! At this point let me clarify the picture.

- 1) Woman with determined look, wearing man's coat - deliberately maneuvering white Mercury Montego MX, license N.H., JA 414.
- 2) dragging along behind via TOW chain
- 3) man with look of dynamic, animated helplessness and fear, wearing a perspiration stained loden green car coat having battery acid holes in it - involuntarily co-piloting a black Ford Falcon - - -. With engine running perfectly, as evidenced by clearly visible exhaust.

My panic waned into curiosity (the reverse of normal engineering situations). What's the cop thinking? Perhaps; an elaborate kidnapping of an ABM engineer, by a non-violent peace group from Detroit! Or --- and then sudden hope - oh God, pull her over, pretend you're searching for pot -- hell, a ticket even - I'll pay, gladly -- anything -- just stop this damn caravan. - - - - You can never get a cop when you want one. No, oh no, she's --- she's not going to pass that truck! Ye Gods, Nancy, --- think of the children --- I can tell you, I have known fear!

Well, fortunately, some fine New Hampshire farmer couldn't start his 1949 Ford stake truck and was towing it behind his John Deere Tractor, and cut into our interstate immediately prior to our arrival at the same place and both of our cars managed to get stopped, in time, but only after - - - well, that's a story for another time. By the way, there are 11 farms in the city limits of Nashua, N. H., which is the second largest city (60,000) in New Hampshire. The previously mentioned farmer is from Nashua (Nashua is also the only city in U. S. with triangular man hole covers - they don't rattle).

New Hampshire has a population of less than 850,000, no sales tax, no income tax and no towed vehicle laws.

So, after starting a day as described above, who could work. Everything I might touch would turn to - - - er, ah - - - um - - - would go badly! So I sat down and wrote my protest hoping I could get someone to publish it.

Will you?

H. D. Logan
Amherst, N. H.

COMPUTER OUTPUT - WHAT HAPPENS
TO ALL THAT PAPER?

G. L. Verschuur

During 1970 the NRAO computer in Charlottesville used 755 boxes of paper and 247 (215 white, 32 color) boxes of cards. That amounts to 16 tons of paper and 6-1/2 tons of cards. Obviously it isn't all kept after use because, as the people in the warehouse well know, it would fill several rooms in the office building. Although some rooms in Charlottesville appear to be full of junked output (some scientists have a hoarding instinct comparable to squirrels and others have a sentimental attachment to their carefully prepared data), most of the paper and cards are ultimately thrown away. What happens to it when it is thrown away? Usually it is burned and helps pollute the Charlottesville air. But the paper and cards are both very high grade materials and can easily be reused. The paper goes to making napkins and toilet paper and similar quality goods, and the cards make that thick grey card-board type material. There are those who feel that much of the output produced here could have been printed straight onto toilet paper, thus avoiding the re-cycling process. In fact, a test by someone here (I can only disclose his initials, J. B.) shows that the line printer does accept this type of paper. But we are getting away from the point.

The computer output can be re-used provided we take it to a scrap dealer who pays good money for it. This has not been done in the past since various authorities here have claimed it economically unfeasible to do so. Even if this were so, it should not be a consideration in deciding whether one sells scrap. After all, the U.S.A. is using more trees every year than it grows, so any little saving helps. Another fact you might not be aware of is that forest fires in 1970 destroyed an area equal to that of the state of Maryland, so, unless we all take these and other aspects of pollution seriously, the U.S.A. will be unlivable before the end of the century.

Scrap dealers pay in the range of \$20 to \$30 a ton for print-out and up to \$60 a ton for non-colored cards. Color cards bring the same as paper. In Charlottesville we get \$50 a ton for cards and \$20 a ton for paper. For comparison newsprint brings \$8 a ton.

Last year at the end of August, we started a campaign in Charlottesville to get all computer users to throw their cards and paper into boxes provided instead of into trash baskets. Every time about 800 or 900 lbs. are collected, it is taken to "Coiners", the local scrap merchant. Everyone has been very co-operative with only one exception. Everytime someone leaves NRAO he needs empty boxes to pack his books, etc., and therefore takes them from the computer room. This means that at times there are not enough boxes in which to throw the print-out; but it has never become critical. On another occasion we were throwing away more cards than we were using so we ran short of card cartons (each carton contains 5 boxes). The total quantities re-sold so far to the scrap dealer is given in the table. Note that the money that is collected is still the property of AUI although it is scrap material that was sold and therefore has to go back to Fiscal. We can't even use it for a party or free coffee and doughnuts all year for everyone!

In the table we have lumped color cards in with the paper since records were not kept which show the difference. This is because Coiners pay the same for the color cards as the paper.

Some other useless facts of interest. Total number of sheets of print-out used in 1970 is 2,280,000. Total number of cards used in 1970 is 500,000.

There are approximately 30 scientists in basic research. In other words, each scientist used 200 sheets of print-out and 45 cards per day. I find that difficult to believe. Of course this does not include the computer center staff and users. Perhaps we'd best leave the percentage they use to the imagination!

Continued, next page --

While the summer students were here, about 50% more cards and paper were used.

The 1970 usage of cards and paper was down by 25% over 1969 on paper and down 32% on cards. Why?

So, if you in Green Bank have used cards and paper, collect them and send them to Charlottesville, or organize your own salvage program. I want to thank everyone who is co-operating so well in Charlottesville, and John Matheny for the figures he dug out of the records at the warehouse.

TABLE

Summary of Computer Paper and Card Usage

1970

	<u>Paper</u>	<u>Cards</u>
Average monthly consumption of:	66 boxes	18 cartons
Average monthly quantity resold to scrap dealer:	38 boxes	16 cartons*
Percentage re-cycled:	58	89

*This includes two large batches accumulated over the last few years by various people.

Total weight resold in 6 month period:

Paper - 9740 pounds
Cards - 5280 pounds

Total income - \$211.40

Total cost of paper and cards used in 6 months - \$5400

% \$ Returned on Scrap - 4%.

Although the last figure is low, I figure that I spent 19 hours in this project

(sparetime) and that still means earnings at the rate of \$11.20 an hour. That is a nice salary if one could collect scrap full time!

My special thanks to Woon Yin Wong and to Keith Sword for their help.

THE 300-FOOT BACK AT WORK

Mike Davis

The 300-foot telescope went back into operation on December 8th, after a six-month absence. The new surface came through a ten-day test period with flying colors.

The aperture efficiency curves measured during the test period agreed with the predicted curves very well and show that the telescope will be quite useful even at wavelengths as short as 6 cm.

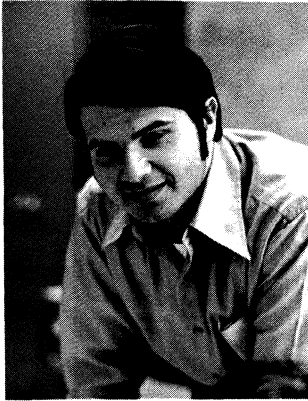
The first observing program was a highly successful search for new, faint radio sources at 6 cm. The figure shows a 40 milli-flux-unit source found during the 6 cm



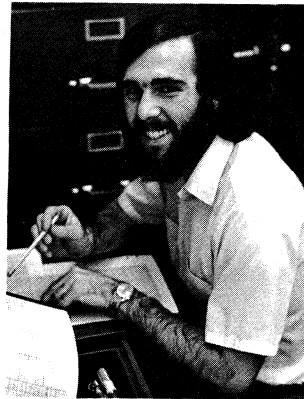
survey. Detected by averaging together seven scans, it is about three times fainter than any source previously detected with the 300-foot telescope.

Other programs in progress are flux density and polarization measurements, and pulsar observations. Another jump in performance is expected in April, when the new Sterling box mount is installed. This will permit up to four minutes of tracking at the equator, together with box rotation and focussing. Taken all together, the "new" 300-foot offers an interesting array of applications not previously possible with this telescope.

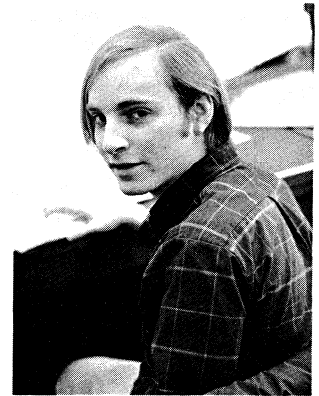
NEW EMPLOYEES



Sol Lawand is a co-op from Drexel University. He is a 3rd-year student in mathematics and is working at NRAO under Steve Gottesman.



C. Keith Sword is a co-op from Virginia Polytechnic Institute where he is a junior majoring in physics. At NRAO he is working for Gerrit Verschuur.



Philip Hirsch is a co-op from Drexel University. He is a sophomore majoring in mathematics and works for Barry Clark.

Rehires

Claude Williams - (Co-op)
 William F. Beyers, Jr. -
 part time, Computer
 Division
 Gary Bonebrake - Tempo-
 rary, Electronics



W. Butler Burton joins us as a research associate. He studied mathematics at Swarthmore College and took his Ph.D. in astronomy at Leiden (Holland). His speciality is galactic structure.

Transfers

Neil Albaugh - to Tucson
 George Grove - to Green Bank

Terminations

Stephen Manzo - Electronics

PAUL J. DEVLIN

The Observer is sorry to report the death of Paul Devlin, who died on January 23. Paul came to work for NRAO as Fire and Safety Officer in 1960. At the time of his death he was Assistant Supervisor of Plant Maintenance. Before coming to NRAO, Paul was a Chief Petty Officer in the Navy and worked for the Commonwealth of Pennsylvania as Deputy Game Protector. He was very active in conservation and sportsmen Clubs. He will be particularly remembered for being available in times of accidents, fires, and sicknesses. Paul was an unselfish person and we will miss him.

AN UNASTRONOMICAL FISH STORY

Elizabeth B. Conant

Every sane person knows that fish breathe by means of gills and live in water. But would you believe that there is a fish that has lungs as well as gills, - and can spend up to three years buried in clay soil as dry as concrete? There is such a creature, amazingly enough called a "lungfish", and specimens can be found in Australia, equatorial South America and tropical Africa. I have been enjoying the company of a dozen or so African lungfish for several years, and the more I watch them the more remarkable they appear to be.

Lungfish resemble eels in over-all proportion (and in slipperiness), but actually they are more closely related to frogs than to eels. Having lungs and nostrils and many unfishy biochemical attributes, they represent the tip of an evolutionary branch whose base is close to the earliest amphibians, and so they are very interesting as representatives of transitional forms.

Modern lungfish, however, are an evolutionary dead-end, having specialized their life-styles for tropical environments with sharply defined wet and dry seasons. When the rainy season is at its peak, all the rivers flood, and uncounted square miles of adjacent land becomes temporary marshland in which fish abound. When the rains stop, most sensible fish return to the river, but lungfish stay in the swampy area, and as the water dries up they tunnel into the mud, secrete a protective cocoon around themselves, and stay entombed for the length of the dry season (perhaps 7 months), breathing only air and reducing their metabolism like a hibernating bear. You can dig them up in this "summer" sleep" (estivation), take them home in their mud clod, and keep them for as long as three years in suspended animation. When the rains come in the natural habitat, the mud softens and then is flooded again and they can swim once more in their swamp. But in the lab, you simply add water at any season, -- and poof! instant fish.

They have many remarkable aspects. If, as often happens in the wild, either a limb or the tail is bitten off, the lungfish can regenerate a whole new structure with all the parts and functions of the piece removed. Alas, this capacity is limited to lower Vertebrates, and we higher Vertebrates would like to know the secret, which is one reason I have been studying it. Surprisingly enough, the summer sleep is so deep that even regeneration, a life force that is usually hard to inhibit, is slowed almost to a halt. In fact, a researcher in Colorado has found that extracts made from sleeping lungfish can on injection cause wide-awake rats to become torpid rats. So who knows, perhaps future tranquilizers may be labelled "Elixir of Lungfish."

There are dozens of other things to tell you about lungfish, but I shall spare you. Thus ends the fish story for this month.

WELCOME TO DR. AGA AND FAMILY

We are happy to welcome to the Green Bank community Dr. Odd Aga, his wife, Angela, and their daughter, Felicitas.

Dr. Aga has taken over the Green Bank Clinic medical practice and has been seeing patients since January 15.

His hours are 1-5 p.m., Monday thru Friday. The clinic phone number is 456-4211 and Dr. Aga's home phone number is 456-4244.

Both Dr. Aga and his wife are graduates of the Freiburg University Medical School, Freiburg, Germany. Mrs. Aga is also a physician but is not planning to practice immediately, since an addition to their family is expected in April.

The Agas will reside in what Observatory employees call the "Wade House" in Green Bank.

GARDENS UNDER GLASS
or
HOW TO SUCCEED IN GARDENING
WITHOUT REALLY TRYING

Barbara Manchester

Anyone who feels that hard work is a necessary part of gardening should read no further, but those of you who enjoy seeing plants grow and would like a garden that is attractive and portable (ideal for the apartment dweller), needs little maintenance and thrives on neglect are invited to read on--you may decide that a garden under glass, or terrarium, is what you've always wanted.

Growing plants in this way is not a new hobby. In fact it is over 100 years old, being very popular amongst the ladies and gentlemen of England in the 1840's. They, with the inevitable passion of the Victorian era for "things under glass domes", enjoyed contriving miniature landscapes, woodland scenes, and so on, in closed glass cases, using small plants, seedling trees, mosses and ferns. This was such a popular pastime that special planting cases, looking rather like miniature glass houses, were manufactured. The glass case provides an environment with a balanced life cycle, allowing only light to enter, and trapping the moisture given off in transpiration by the plant leaves, causing it to recycle through condensation back into the soil where it is again available for absorption by the plants.

Terrarium cases, as such, are no longer produced, but not being purists, we may be content with any clear glass, or even clear plastic (not as good as glass) container that has a glass lid, or that can be closed with, say, clear cling-plastic wrap. In fact, the more unusual the container, the more interesting is the total effect. You could try using antique glass jars or decanters, or (and these are more readily available) a clear Pyrex casserole, an apothecary jar, an aquarium, or even an empty jam jar.

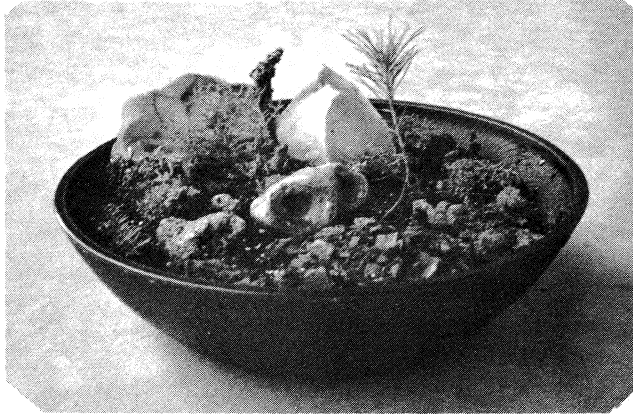
Once you have the container your next requirements are (1) charcoal chips (aquarium filter charcoal or crushed charcoal briquettes are ideal), enough for a 1/4" to 1/2" layer in the base of the container--these help keep the soil "sweet"; and (2) sterile soil with good drainage properties--sterile because non-sterile soil may contain seeds (which will germinate and produce unwanted growth in the ideal climatic conditions of the terrarium) and the eggs of plant pests, such as red spider (which will hatch and attack your plants)--any of the commercially marketed potting mixtures (guaranteed sterile) are ideal. Since the plants are to be the dominant feature of the garden, use only a thin layer of soil (say 1/2" to 3/4" in a small jar or bowl, more in a large container). This has the added advantage of limiting plant growth and keeping plants on a scale with the container. After adding the soil, dampen it slightly to prepare it for planting.

Now you are ready to plant your garden. What can you plant? The answer is, practically anything that will not grow too large and overrun the container. The plants fall into two broad categories: (a) flowering and non-flowering moisture-loving plants, such as violets, African violets, begonias, fuchsias, herbs, ferns, ivies, mosses, etc., and (b) plants requiring less moist conditions, such as seedling trees, succulents, lichens and cacti.

The most successful gardens are those where all plants need similar moisture and light conditions; it is very difficult, for example, to grow mosses and cacti together--either the moss dies for lack of water or the cactus suffers from too much! Beautiful gardens for very small containers may be made using only different species of moss, or lichen, and with so many different sorts easily found around both CV and GB, this is an easy way to start your terrarium collection. Mosses, for group (a) above, and lichens, for group (b), provide ideal ground cover around larger plants; pebbles and small

Continued, next page--

rocks may also be used to make the garden more interesting. As with all gardens it is best to plant for future growth rather than instant effect, so leave space around the plants to allow them to spread and mingle naturally. By the way, a terrarium provides ideal conditions for germination of seeds as I mentioned above, and so it is quite easy to raise plants such as herbs and annuals from seed in, say, an empty jar.



A bowl of garden lichens and tiny pine tree planted in January. The garden is normally covered with a clear domed lid but was removed to give a clearer photograph.

With the garden planted, and placed where it will get adequate light, you come to the most difficult part of the whole procedure: watering your plants. This is to be a closed environment, so it is extremely important to get the moisture level of soil and air just right for your particular plants. The easiest way to do this is to water sparingly at first. That is, don't saturate the soil, but have it damp to the touch for plants in group (a), and then lightly spray their foliage; have it just damp for plants in group (b). Now put the lid on the container and leave it overnight. The next day, check for moisture balance. If conditions are right, then the soil should still be as damp as it was the day before, the plants should not have water droplets clinging to their leaves, and there should be some slight misting on the glass for plants in group (a) but not for group (b). If the garden looks too wet,

leave the lid ajar for a day or so to let some air circulate and remove excess water, then replace the lid and check the moisture balance about a day later. If it looks too dry, lightly spray the plants and soil with water, replace the lid and again check on conditions the next day. Continue this adjustment process until you feel all conditions are right, then just keep an eye on it for a week or so to be sure.

Maintaining your garden in a healthy, attractive state requires little effort. Pluck out any unwanted seedlings as they appear, remove any dead flowers or leaves to discourage mould formation, and prune plants that become straggly or too large. From time to time, say every 2 or 3 months, spray the plants with fresh water and leave the lid ajar for a few hours to renew the air and restore the moisture balance. If the plants are not close to a window or source of light, it may be necessary to rotate the container occasionally so the plants don't all grow slanted in the direction of the nearest light source.

Well, that's all there is to basic terrarium planting and care--for not much effort and quite a bit of fun, the result is a garden under glass that becomes quite a talking point with guests, whether fellow enthusiasts or not. Why not try planning one, then sit back, relax and watch it develop and grow.

LADIES TEA AND COFFEE

WHAT? Tea and coffee get-together.
 WHO? All wives and working ladies.
 WHEN? Wednesday, March 17, 1971, between the hours of 1:30 and 3:30 PM.
 WHERE? Residence Hall Lounge.
 WHY? To renew old acquaintances and to make new ones.

HAVE YOU HEARD ???

Virginia Van Brunt

Have you heard that the library issues a monthly NEW BOOKS LIST? If you are too busy to browse the new book shelf regularly, you can find out what has been received by checking the new books list on the bulletin board in either library. Or, if you prefer, we would be happy to put a personal copy in your mail box.

Have you heard that we receive copies of articles about NRAO through a CLIPPING SERVICE? If you are wondering what the National Observer had to say in its article titled ASTRONOMERS ARE BURSTING WITH STARTLING DISCOVERIES, or want to read the latest chapter of cycling GEORGE CONANT's suit against the State of Virginia, visit the Green Bank section of the Exchange Collection in the Charlottesville library.

Have you heard that GREEN BANK is assembling its own PREPRINT COLLECTION? No more complaints, please, about having to come to Charlottesville to find out what is going on ...

Have you heard that we are a multi-media library? A steadily growing collection of COLLOQUIA is available on Sony cassette tapes. So, if you missed that last talk, now is your chance to borrow the tape, by calling the CV library. Recorder-players are available at both GB and CV through the library.

Have you heard that we have a monster, three inch GOLDFISH in the CV aquarium that is looking for a new home? Just the pet to liven up your household -- no muss, no fuss, just a monster-sized helping of fish food now and then.

And another great buy from the Government Printing Office (GPO) -- in CV library and on order for GB library -- THIS ISLAND EARTH, edited by Oran W. Nicks and issued in the NASA Special Publication Series, No. 250. This volume includes beautiful color photographs of the Earth taken from space, primarily by Apollo spacecraft, and sells for a mere \$6. As usual, prepayment is

required when ordering from the government.

Incidentally, if you are planning a trip to Washington, D. C., the Government Printing Office maintains five book stores which are retail outlets at the following locations: (1) the Government Printing Office, (2) lobby of the Commerce Department, (3) U.S. Information Agency, first floor, (4) Department of State building, first floor, and (5) the Pentagon building. If you are interested, call me for more information about addresses.

SHORT HISTORY OF INCOME TAX

Harry Fox

Credit for the first major successful income tax in the world is given to Great Britain, who established an income tax in 1799 to finance a war against France.

The first U. S. Federal income tax was imposed in 1862 to meet Civil War expenditures. This original tax expired in 1872.

In 1913 the 16th Amendment to the Constitution gave Congress the power to tax all income and the personal income tax was immediately enacted, at a rate of 1% on incomes in excess of \$4000. The rates were sharply increased during World War I. During World War II, the tax reached down to the great majority of "workers" and brought the withholding system on wages.

More recent developments have been designed to reflect the taxpayer's ability to pay, through graduation -- large incomes at a higher percentage than smaller incomes, recognition of family circumstances, and collection of tax at the source -- withholding.

APOLLO 14
COMMEMORATIVE COVERS

In the six weeks before the Apollo 14 Space Flight, we received many letters like this: Enclosed please find two (2) self-addressed envelopes for the application of your station address and posting on the date of the forthcoming Apollo 14 Space Flight.

These letters were received at NRAO from people who collect commemorative covers. On past Apollo flights we generally received about a half-dozen self-addressed envelopes requesting our stamp and posting. For the Apollo 14 Space Flight we received 70. At first we thought these people were mistaking us for a tracking station, but several letters received for the latest flight said that they were interested in collecting covers from any facility engaged in space work.

We conclude from these requests that NRAO is becoming better known -- at least to collectors of commemorative covers.

WHAT HAPPENED TO OUR
BUFFALO DAM?

By last summer many of us thought we would be able to swim, boat, fish, and picnic at Buffalo Dam. But no so. Before the summer season last year a federal agency erected a sign at the dam with this message:

AREA CLOSED

Reduction in federal spending has deferred completion of this project. Use of this area without recreation and sanitary facilities will damage the resources and pollute the water. Therefore, the area must be closed to all activities until construction funds are available. In the meantime, we ask your help to keep the area clean. Thank you.

1970 CENSUS

The 1970 official census returns show that Pocahontas County has a population of 8,870 people. This is a population loss of 1,266 people since 1960.

Pocahontas County covers 602,880 acres -- about 68 acres per person. There's still a lot of room for everyone in Pocahontas County.

ZERO IN PROGRAM

Our Zero In program that began on January 17 ended on February 17. The purposes of the program were to encourage employees to be safety conscious on and off the job and to encourage family members to think and practice safety. The safety committee was pleased to find that the Zero In program did fulfill these purposes.

We do not intend to summarize the entire Zero In program in this article, but we do think you would be interested to know who won the safety prizes and how others answered the questions on the safety questionnaire. The latter is summarized on a separate page following this article.

Safety Prizes and Winners

<u>Prize</u>	<u>Winner</u>
First Aid Kit	Mrs. Ron Weimer
Fire Extinguisher	Mrs. Dwayne Schiebel
Electric Lantern	Mrs. Ed Wilson
Tire Chains	John Williams

Safety Questionnaire:

Continued, next page --

NRAO SAFETY QUESTIONNAIRE - FEBRUARY 1971

	Yes	No	Both	No Ans.	Remarks
1. Do you consider yourself a safe worker? YES ____ NO ____	83	2	2	0	95%
2. Have you broken any safety rules today? YES ____ NO ____	19	60	2	4	76%
3. Did you understand that the Zero In safety program was geared to off-the-job safety? YES ____ NO ____	84	3	0	0	96%
4. How many Zero In programs did you attend? 1 __ 2 __ 3 __ 4 __ 0 __	(1) 13	(2) 8	(3) 5	(4) 5	(0) 58 9.2% attendance
5. Which one of the safety programs did you enjoy? 1 __ 2 __ 3 __ 4 __ 0 __ 1 - First Aid; 2 - Fire Prevention; 3 - Walk, don't run; 4 - Off job.	(1) 5	(2) 11	(3) 5	(4) 11	(0) 58
6. Would you have attended the Zero In programs if they would have been held during working hours? YES ____ NO ____	66	13	1	4	83%
7. Did you keep your family posted with the weekly slogan? YES ____ NO ____	64	21	1	1	75%
8. Because of the Zero In program is your family more safety conscious? YES ____ NO ____	48	25	3	5	66%
9. Would you recommend continuing a Zero In type safety program? YES ____ NO ____	65	8	0	6	89%
10. Do you read your "Safe Worker?" YES ____ NO ____	77	3	1	0	95%
11. Would you recommend continuing the "Safe Worker?" YES ____ NO ____	71	7	0	6	91%
12. Who benefits more than the NRAO safety program? (1) You and your family; (2) The Observatory.	(1) 48	(2) 14	16	6	55%

