The OBSERVER

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"THE TATEL TELESCOPE – DEDICATED 20 YEARS AGO"

(Story on page 12)

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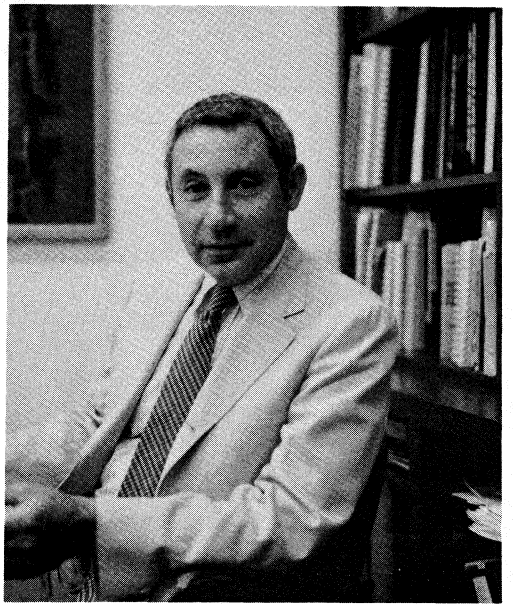
MORTON S. ROBERTS - NEW NRAO DIRECTOR

Dave Hogg

As this issue goes to press, the NRAO welcomes its new Director, Dr. Morton S. Roberts.

Dr. Roberts has had a long association with NRAO. The (somewhat scattered) early records show him as a visitor in the summer of 1963, when he used Bertil Höglund's 20-channel hydrogen-line receiver with the 85-foot in a program of extragalactic hydrogen observations. Those readers who have seen the film on radio astronomy produced for the American Astronomical Society will recognize Morton as the visiting observer who was chauffered to the telescope, in a Jaguar, by the Director, David Heeschen. Suitably impressed by this glimpse of la dolce vita, Roberts joined the staff of the Observatory in 1964, and currently holds the rank of Senior Scientist. In addition to his research, he has made many contributions to the operations at the NRAO, including serving as Assistant Director for Green Bank Operations during 1969-1970.



Dr. Morton S. Roberts

Dr. Roberts' research interests have encompassed both optical and radio astronomy. His recent work, primarily using the 300-foot and 140-foot telescopes, has been concerned with the study of neutral hydrogen in galaxies, a field in which he is the recognized authority. Amongst the highlights of his research are the first measurement of extragalactic HI absorption in radio galaxies; the first high-redshift hydrogen detections, with a resultant determination of the remarkable constancy of several fundamental constants of physics over a look-back time of one-third the age of the Universe; and the first clear enunciation that many, if not most, galaxies have flat rotation curves--a fundamental datum describing the mass distribution in the outer regions of such systems.

As the Directorship changes hands, it is also a pleasure to recognize the many contributions which David Heeschen has made to the NRAO. During his tenure, the NRAO grew from a one-telescope observatory to its present position as a major center for radio astronomy, with the completion of the 300-foot and the 140-foot telescopes, the building of the interferometer and the 36-foot telescope, and, after a long and difficult struggle, the construction of the VLA. Fully 80 percent of those now employed at the Observatory began their service during his sixteen years as Director. We wish him great success as he resumes his research career.

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SIRIUS PROBLEMS

Lee J Rickard

One of the tragedies of city life is the dimming of our mythological heritage by the brightening of street lights. Nearly every bright star has been linked to some ancient story of love or war. Many have served as homes for gods or objects of veneration themselves. Some have been navigational beacons for explorers on the seas and in space. A dark starry night is filled with reminders of the history and culture of humanity.

Not surprisingly, the brightest stars have had the greatest significance in our past, and chief among them is Sirius. The brightest star in the night sky, it was known to the Arabs as Al Shira, and to the ancient Egyptians as Sihor, or Sothis (in Greek transliteration). Modern astronomers call it Alpha Canis Majoris, but most people still refer to it by its old Roman name, Canicula, the Dog-Star. A brilliant white star, Sirius is particularly attractive when seen low in the sky, as atmospheric turbulence stirs its image into excited scintillation. This striking aspect has been mentioned by poets from Homer ("the autumnal star, whose brilliant ray/Shines eminent amid the depth of night") to Tennyson ("the fiery Sirius alters hue/ And bickers into red and emerald"). Indeed, its name is probably derived from the Greek word seirios, meaning sparkling or scorching, which was originally applied to all stars with strong scintillations.

Sirius was preeminent in Egyptian cosmology because of a coincidental link to the most important event in Egyptian life, the flooding of the Nile River. After being hidden within the brightness of the Sun for a month, Sirius becomes briefly visible in the morning twilight just before sunrise. During the early dynasties, this brief visibility, the heliacal rising, occurred just before the annual flooding, when the sun-parched agriculture of Egypt was revivified. Precession later shifted the timing of the flooding to before the heliacal rising, but by then its significance as a fixed point of the calendar was firmly established.

Astronomical interest in Sirius involves several of its characteristics. Most important of these is the fact that it is quite nearby, less than 10 light years away, and thus relatively easy to study. It was used as a timekeeper for astronomical work up until the mid-19th century, when it was found to be a binary system (and thus an irregular clock). Its companion (Sirius B) turned out to be a white dwarf star, a star that has used up its nuclear fuel and subsided to a dense (2000 tons per cubic foot!) dim ball only 3 times the size of the Earth. The two stars orbit one another with a period of about 50 years.

Recently, there has been some interest in the Sirian beliefs of a West African culture, the Dogon of Mali. The Dogon are a tribe of some 200,000 members who farm the plateau above the Bani River, a tributary of the Niger. They have a rather sophisticated cosmology (as reported by French anthropologists M. Griaule and G. Dieterlen in 1950) that includes the facts that the Earth rotates on its own axis and revolves around the Sun, that Jupiter has four moons and Saturn a ring, and - most remarkably - that Sirius has a tiny companion of incredibly high density orbiting it every 50 years. These facts correspond to the state of our astronomical knowledge at the turn of the century, yet appear to have been part of the Dogon religion for 700 years!

Incredible facts invite incredible explanations, and the Dogon now find themselves competing with Erich von Daniken for center ring in the Ancient Astronaut Circus. R. K. G. Temple, an orientalist, has sifted through the French reports (which was not easy since he doesn't speak French) and collated the results with a range of Egyptian and Babylonian myths in order to deduce that the earth was visited by amphibians from Sirius 5000 years ago. In The Sirius Mystery, Temple claims that the Dogon traditions about Sirius were obtained from the Egyptians, who themselves inherited them from the Sumerians, who were the originally visited parties. He argues very strongly that the Dogon have an intimate knowledge of astronomical facts that could not be obtained without modern telescopes; and that, while obvious in the Dogon traditions, this knowledge can also be found in Egyptian and Babylonian writings, where it

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has hitherto been concealed by poor translations.

When confronted with such extravagant hypotheses, it is best to first remind oneself of the need for caution in interpreting anthropological data. Folklore can give the patina of great age to stories that are actually recent. For example, M. Eliade tells of a Rumanian story, full of supernatural events that supposedly happened in remote antiquity, which was actually an embroidered version of a story only 40 years old, one of whose principals was still living. Also, information that comes from outside contacts can be so thoroughly mixed with native material as to totally obscure its origin. Thus we have the story of Alice Marriott who, collecting the tales of a South Dakota Indian tribe, repaid her informant by telling the story of Beowulf. Several years later, she came across a paper by an ethnologist who had visited the tribe after her, reporting on the "Occurrence of a Beowulf-like myth among North American Indians".

Returning to it in a more suspicious frame of mind, the tale of the Dogon begins to appear a trifle hairy. Have the Dogon lived without interference since the time of the Egyptian kings? Hardly. Mali was the site of the great Malinke (or Mandingo) Empire between the 13th and 16th centuries, whose chief city of Timbuktu was a great center of Islamic culture. The Niger basin was vigorously explored by English, German, and French explorers in the 19th century. Mali was a French colony until 1960, and many of the Dogon had attended French or Islamic schools long before the visits of Griaule and Dieterlen in the 1940s. Clearly, the Dogon could have obtained their astronomical lore from many sources, incorporating it into their Sirius worship.

The fact of Sirius' dark companion was probably very easy to accept. The Dogon religion is very heavily based on ideas of twinness and of pairings of light and darkness. Their gods Nommo and Yurugu seem to be direct analogs of the Egyptian light/dark pair of Osiris and Seth. Other ritually important stars in Dogon cosmology, such as Polaris, are assigned companions purely on this basis, and do not jibe with modern astronomical knowledge.

It is interesting that the Dogon cosmology corresponds exactly to European knowledge at the particular period of time - between the 1862 discovery of Sirius B and the 1892 discovery of the fifth satellite of Jupiter - when European incursions were most active. Where they differ from those astronomical ideas - as in asserting that there exists a third star in the Sirius system, four times lighter than Sirius B - they have since been shown to be wrong. The Dogon theories begin to seem less remarkable than, say, Voltaire's inspired guess in Micromegas that Sirius had a massive companion. At least there we have a publication date that proves that the speculation preceded the discovery by 90 years.

Sirius has been the subject for other controversies. An active one at the turn of the century was the debate over its color in ancient times. While its brilliant white color is undeniable today, there are a number of comments by ancient Greek and Roman writers that could be interpreted as saying that Sirius was red 2000 years ago. This color change was apparently accepted by early 19th century astronomers (e.g., John Herschel); but around the turn of the century it was thought to be quite inconsistent with stellar evolution theory (which then allowed white stars to become red, but not vice versa). The classical evidence was then junked on the grounds of its being poetry, and thus of a suspicious character. In present stellar evolution theory, the direction of the color change is not particularly bothersome, but its ostensible speed is outrageous.

The situations would have remained at that simple dismissal had not Thomas Jefferson Jackson See entered the fray. See was finishing his doctorate at the University of Berlin when he encountered the Sirius question in 1892. He found the classical evidence to be quite convincing, and wrote several strongly worded papers supporting it. See was good at strongly worded papers. Once, in a vigorous battle with F. R. Moulton over the interpretation of the binary 70 Ophiuchus, he wrote a paper so strongly worded that he was barred from ever publishing again in the Astronomical Journal. He also enjoyed run-

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ning counter to prevailing scientific ideas. His cosmological theories ranged from the semi-respectable to the lurid. He spent much of his later years sniping at Einstein and General Relativity. Even his practical work, measurement of double star orbits, was often spoiled by systematic errors attributable to his awful self-confidence - he seldom remembered to check the zero level on his micrometer.

The voice for the opposition, though, appears little more distinguished from our vantage point. The most extensive counter-interpretations of the classical evidence were collected by Giovanni Schiaperelli, who spent much of his career mapping the non-existent canals of Mars. He also determined, from studies of surface markings that few other astronomers could see, that Mercury and Venus rotate so as to keep one face to the Sun, an idea that was not corrected until the 1960s. (On the positive side, we should note that it was Schiaparelli who first pointed out the association of meteor showers with comets.)

It is hard now to find anything convincing in the classical evidence. Seneca appears to compare Sirius and Mars, finding the former redder. But the context is a discussion of variations in color, and so could be interpreted as saying that the color of Sirius was more variable than that of Mars. Worse, Seneca is not clear about whether he is referring to Sirius or the nearby Procyon (which is also white now, and so compounds the problem). Schiaparelli notes that Seneca was not a trained astronomer, and probably had Sirius pointed out to him when it was low in the sky, reddened by the atmosphere. (This must have been the case for the many times it was observed at heliacal rising.) See, on the other hand, claims that Seneca was an excellent and careful astronomer. Personally, I suspect that neither of them knew Seneca's qualifications.

Ptolemy calls Sirius reddish in the Almagest (at least in available copies of it), but says its color is like that of Jupiter (white) in the Tetrabiblion. Geminus seems to call it red (although See's interpretation is very suspicious); but Hyginus calls it white, like Venus.

Adding to the confusion is the common ambivalence in classical sources about whether the Canicula being referred to was Sirius (the Big Dog) or Procyon (the Little Dog). In fact, it appears that the evidence for a color change in one is as good as for the other. And, there are similar color descriptions in Al-Sufi's 10th century discussions of Algol, another contemporary white star. So, do we have three bright white stars that have mysteriously changed color in recent times? Or do we have a revised (downward) opinion of the quality of classical poetry as a storehouse of astronomical knowledge?

There have been a few recent revivals of interest in the problem, although nothing to match the hue and cry of the 1890s. Sirius B has been found to be a fairly hot, and thus young, white dwarf. Could it have been a red giant star in classical times, evolving to a white dwarf in only 2000 years? H. L. Shipman has calculated the time it would have required to reach its present state; with the latest cooling curves, he estimates 30 million years, a bit too long. Also, had it indeed been a red giant recently, it should have left some gaseous remnant. No such associated nebulosity has been found, despite searches directly motivated by the color question. On the whole, the problem seems to have been a red herring.

This is not to say that stars can't evolve on timescales of a few thousand years. If one is willing to accept less spectacular changes, they can be found happening on even shorter timescales. Consider, for example, RU Camelopardalis, a W Virginis star whose brightness changes rhythmically as the whole star expands and contracts. At the end of 1965, it stopped. No more expanding and contracting, no more brightening and fading. In 1968, it started back up again. It wasn't as striking as a change in the color of the brightest star in the sky, but it was surprising none the less.

There is a serious side to this, of course. More and more, astronomers are relying on information from ancient sources for use in modern problems. They search for records of comets and supernovae. They search for the times of eclipses in order to measure changes in the lunar cycle, and for appearances of sunspots in order to measure changes

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in solar activity. The lesson of the ancient color of Sirius is that one can be overly enthusiastic in these pursuits, especially if not accompanied by someone specifically trained in the literature under study. Otherwise, one is likely to end up like the psychologist Velikovskii, whose studies of Greek, Latin, and Hebrew literature led him to a model of the solar system as a sort of colossal snooker game. A more painful end is not to be imagined.

Speaking of which, it may not surprise you to learn that there are people who would make puns on the name Sirius. No kidding. I am not one, of course. I have found that such people are capable of wide varieties of crime and cruelty. As an example, I give you a story that would have been apocryphal had it not been told me directly by the principal: Because of its brilliant scintillation, Sirius is often mistaken for a UFO, especially at northern latitudes where it is always seen low in the sky. The nearness to the horizon also contributes perceptual illusions that can wildly distort its apparent distance. (Donald Menzel describes a very vivid case in his last book, The UFO Enigma.) Thus the graduate students at Yerkes Observatory, in Wisconsin, occasionally get phone calls reporting strange airships hovering in the southern sky. One night, Nolan Walborn received such a call. Recognizing the caller's agitation, he allowed a strong tone of concern to deepen his voice, and said, "Oh my! That's Sirius."

And hung up.

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CREF UNIT VALUES - 1978	
January	$35.72
February	34.96
March	36.10
April	39.28
May	39.52
June	38.94
July	41.03
August	42.17

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TORTILLA RECIPE

from the kitchen of
Emillo Vallez

2 gallons water
1 25-pound sack Golden Crown flour
1 cup salt
1 cup baking soda
2 cubes yeast
2 cups buttermilk

Mix ingredients and water in a #1 tub. Get dough ball 1 pound in weight and roll into a giant 24-inch flat, round tortilla. Slap the tortilla on grill until browned and cooked on both sides. Roll the tortilla into a burrito about 24 inches long, called the "Bandido".....now be ready for a giant size heartburn!!!!!

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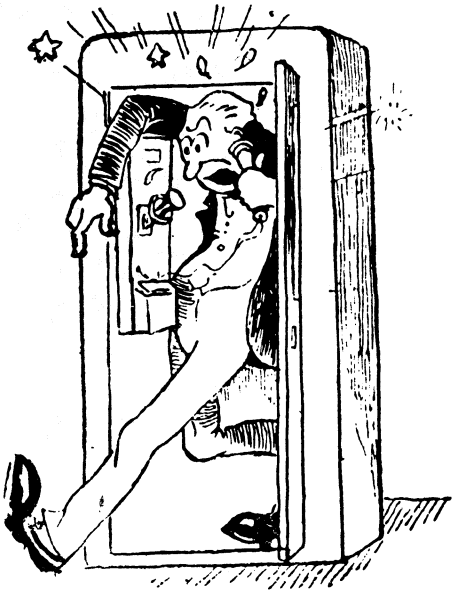
IF YOU HAVE ANY NEWS

GIVE US A CALL



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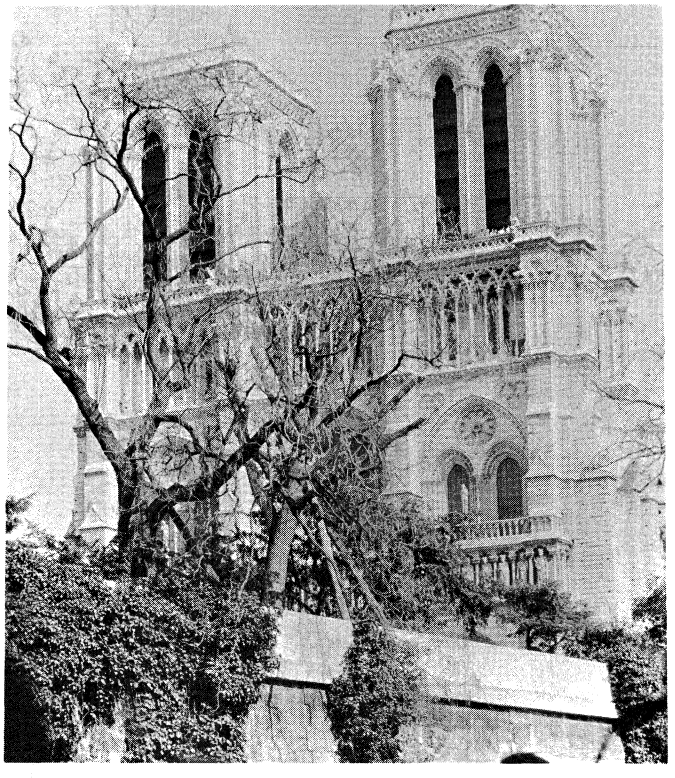
24944

NOTHING AS RARE AS PARIS

Seth Shostak

Most Frenchmen regard Paris as the central focus of the universe. This attitude is not entirely unexpected from the people who invented chauvinism, but on the other hand a strong argument could be made that the French are right. Within one day's ride of Groningen lie the bulk of Europe's major cities: Amsterdam, Brussels, London, all of Germany and Switzerland. Even Rome. But I find myself most frequently on the noon train out of Rotterdam, rolling south to the City of Light.



Notre Dame Cathedral, where Charles Laughlin once had a hunch.

And so it was that at the beginning of the recent Easter vacation, suitcase in hand, I scampered into one of the new coaches which, aligned like circus elephants, form the Amsterdam-Paris Express. The circus was not entirely metaphorical, since I found within approximately half of Holland's under-thirty-five population, chattering excitedly about the vacation's prospects. As is my wont, I took a window seat near the center of the car, and was presently joined by a meticulously dressed, red headed Dutch girl. I essayed my Dutch, but the pronounciation was unmistakable: "You're English, aren't you?" I explained that I was American. The difference in accent between English and Americans, normally sufficient to box the ears of a native speaker, is lost on the Dutch. All English speakers are assumed to be English until proven otherwise. This pretty girl, it eventuated, was on her way to spend six days with some Parisian boy she'd met for one hour in London. Plenty of possibilities for adventure there. But before I could begin a hypothetical exploration, another girl showed up and bounced me out of my seat. It seems the whole train was reserved, and I was travelling on a very unreserved second class ticket. Bidding farewell and good luck to Miss Red, I ambled down the aisle looking for an empty place.

The train slipped down welded steel rails toward exciting Belgium. I walked through the baggage car and was surprised to see a couple dancing solitaire in a manner that can best be described as slow motion go-go. I glanced incredulously. They smiled. In the following coach, I was stopped by six disheveled young men who asked in English if I would go to the bar car and bring them back coffee. For some reason, possibly criminal, they were afraid to leave their compartment. Pushover that I am, I obliged.

Ultimately I spied an empty aisle seat next to a tall blonde girl with light blue eyes and droopy lids. She was reading Time magazine. I asked her something trivial about the lead article. This time I was surprised: she was Dutch. But she had spent a summer in America, and by the tender age of nineteen had already backpacked through most of South America, including some of the more inaccessible areas of Bolivia and Peru. But now, older and better able to cope with the worst that civilization has to offer, she was making her first trip to Paris.

We talked pleasantly for the next several hours, and arrived undramatically at

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the Gare du Nord. I gave her instructions on how to reach the youth hostel, said good-bye, and then descended into the hygienically tiled bowels of the Metro.

The sun was yellowing in the western sky as I came up the stairs onto the Champs Elysees. Circling around the Arc, I started down Avenue Foch. Ah, Paris. I gazed happily down the broad street, bordered by double rows of regularly spaced trees. Oooooh, Paris. I sighed as I contemplated the splendid empire-style facades on the high buildings facing each other along the avenue. Ulp, Paris. I nearly tripped over one of the middle-aged prostitutes who had just taken up her battle station on the sidewalk. It was then I noticed the long procession of one-passenger cars inching their way down the curb lane next to me. No question about it, Paris has it all.

Hours later, having deposited bag and baggage at the apartment where I was staying, I found myself with friends seeking out a suitable restaurant for dinner. Now everyone knows that Paris is the pinnacle of gastronomical achievement, but scaling those heights every night is dangerous to both bank account and cholesterol level. Ergo, we searched among some of the lesser peaks for an epicurean experience requiring only moderate means. The range of French restaurants is enormous, on the one side dominated by the aforementioned five-star guardians of haute cuisine, flanked by their numerous imitators, ultimately running down to unsavory little cubbyholes with a single bare bulb, a greasy grill and cockroaches with names.

As I say, we were looking for that eternal dream of the hungry: a nice place with good food at reasonable prices. We began our search in the Latin Quarter on the Left Bank, where the Boulevard St. Michel meets the Seine. Now the Latin Quarter (not to be confused with the peso) is a very strange place: in front of the wonderfully hydraulic statue of St. Michael lovers attend their rendezvous, while across the street the hordes indulge themselves in other pleasures, including mammoth Lebanese sandwiches, butter-drenched, second-rate baklavah, and marginally refrigerated cans of Coke. There are vendors everywhere, selling such hard-to-find necessities as plastic African

The author, clad in nylon shirt and earth shoes to offend the natives, makes a class IV climb up to Sacre Coeur.

elephants, hand-tooled leather thongs, and those famous University of Harvard T-shirts. Carefully avoiding the horribly mutilated remains of a dropped pizza slice, I edged through the crowd to read the menu posted outside one of my favorite restaurants, La Petite Hostelerie. Peering through a layer of glass and chicken wire, I saw that the offerings were the same as always, and the prices only slightly inflated. I gestured to my friends. As they followed me to the door, one of them inadvertantly made sure that the pizza was dead with her right foot.

Once inside, we were led to a small table for four, cozily situated under some intersecting beams. The waiter thrust two menus in our direction. There was a sticky crackle of old plastic as I opened one of them up. I elected for the 25 franc ($5.00) menu, or complete meal. My companions did

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likewise. Deftly ducking around the beams, the waiter nodded acceptance, retrieved the menus, and disappeared to parts unknown. We sat there surveying our surrounds.

The surrounds were mostly dark, the sole illumination provided by candles. Dull red cloths hugged the small tables, and the walls were punctuated with miscellaneous, non-descript objects d'art. The tables were set close upon one another, with very little aisle space, but the waiters didn't seem to mind. Indeed, the restaurant undoubtedly violated a dozen provisions to the New Jersey fire code, but it was just that informality which made it thoroughly charming. I smiled to myself.

Soon the first course arrived: crudités. Not to be confused with locker room banter, crudités are various raw vegetables, such as carrots, beets, cabbage and celery, finely chopped, and drenched in an oil and vinegar dressing. Delicious, really. With typical first-course gluttony, we quickly cleared our plates, distracted only slightly by the two arriving young Americans who were wrestling their backpacks to the floor at the next table.

The main course: entrecôte grillée, better known to Americans as steak. Now there's no getting around the fact that most European meats are inferior to what you get in the States, and the entrecôte was no exception. Thin and sinewy, the raw material for this main course would qualify for use as black-eye therapy in the U.S. Nonetheless, it was lightly seasoned and attractively served, and I sawed away contentedly. One of my companions applied a bit too much force, and a small piece of meat catapulted to an adjacent table. It was graciously returned.

Cremè caramel, a sort of custard with caramel sauce, topped off the repast. Settling back with a cup of coffee, I reflected on the meal; the unpressured, unpretentious style, the attention to detail. Typically Parisian. I decided in favor of paying the bill, and we were soon outside, walking up the Boulevard.

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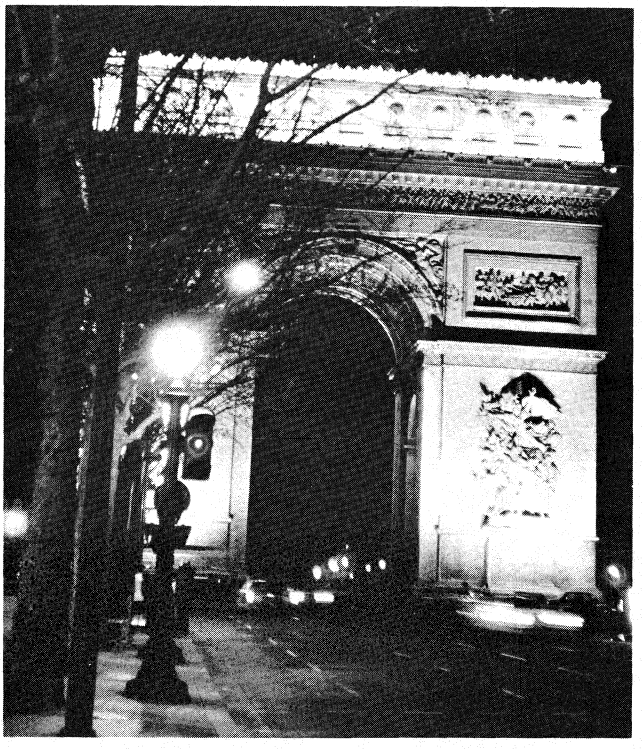
Blasé tourists watch as author leaps over side of Eiffel Tower to get this exciting photo.

As it slowly climbs away from the Seine, the Boulevard St. Michel changes character considerably. The crowd of sidewalk food vendors and junk hawkers give way to cheap shops and unappealing restaurants, crowned by a MacDonalds which, in its mismanaged sloppiness, is all that a MacDonalds shouldn't be. Nevertheless, within but a half mile of the tawdry Latin Quarter, traffic jogs to the west along the nearly posh Boulevard St. Germain. Soon we are walking past Paris' famous sidewalk cafés. It's early evening, and the air is warm. The small tables and chairs spreading out of the cafés are jammed to the gunnals with well dressed protoplasm, watering itself on beer and campari. For this bubbling mass we, and the others who pass in front of the café, are the entertainment. It's amazing how popular people-watching seems to be, and I can't bring to mind any other animal species which finds so much satisfaction in sitting and watching other members of its kind parade by. I begin to think of hippos rocking back on their haunches to whistle and roar at other hippos floating downstream, when I suddenly see a ragged old man staggering a few dozen feet ahead of us. He appears drunk and aggressive. The girl at my side grabs my arm tightly, realizing that the old man has seen us. I try to figure a way around him, but it's not going to be easy: we're hemmed in by the traffic on the left and the tables on the right. The man is big, hunched over, blocking our path, and fixing us with a menacing stare. Helpless, we come within a few yards of this creature, when suddenly he utters a loud, vomitous growl, and thrusts a filthy clenched fist in the face of the girl. The fist opens, and a rat springs out. A scream, and muffled laughter. The rat drops five centimeters and stops, tethered by a thin cord to the old man's middle finger. It's a rubber rat. I look quickly around, and realize that the café customers are watching ratman's performance, laughing at our expense. We pass quickly by as ratman re-palms his rubber rodent and sizes up his next victims.

Ten minutes later, sitting at a café a few hundred meters down the boulevard, I reflect briefly on our experience. Ratman



The Arc de Triomphe, site of world's worst permanent traffic jam.

wasn't really either boozed or balmy. His performance was too deliberate, too practiced. He knew perfectly well what he was doing. I toyed with the thought that he might be a high level executive from Renault, having fun on his night out. Or more likely, hired by the city of Paris to bemuse its citizens. Apropos this latter hypothesis, I feel absolutely certain that all those caressing couples seen lining the banks of the Seine are civil servants, employed solely to give Paris a romantic image. Only a month earlier I walked by one of these non-stop embracing duos and heard the boy mutter "Only three more hours to go."

My companions were talking in Dutch, which if nothing else is a useful secret language. I looked around at the smartly dressed, animated Parisians, enjoying the pleasures of a warm city night. Paris was alive, throbbing with the collective pulse of five million souls, secure in its self-

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conceived and self-effected position as nucleus of all that's civilized. Groningen seemed far away, an insubstantial mirage shrouded in northerly mists. How unreal it would seem to these people, and how unlikely, that the long somber trains sliding out of the darkened Gare du Nord, twisting through the concrete block suburbs of St. Denis, should ever have as their destination the cold, wet and hazy tracts of north Holland. How unlikely indeed.

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TWENTY YEARS AGO

Twenty years ago on October 17, 1958 a group of scientists, citizens and politicians gathered at the Green Bank School to dedicate the 85-foot Howard E. Tatel radio telescope, the first large observing instrument at NRAO. The dedication of the Tatel Telescope followed by one year the groundbreaking ceremonies for the National Radio Astronomy Observatory.

The Tatel Telescope was not planned to be the first large instrument. In fact, there were several larger telescopes proposed for NRAO: (1) a 600-foot telescope, (2) a 250-300-foot telescope, and (3) a 140-foot telescope. Plans for a 600-foot radio telescope were abandoned when it was learned the Navy at Sugar Grove, West Virginia was going to build a 600-foot diameter steerable radio telescope. Emphasis then shifted immediately to building a 140-foot general-purpose research instrument.

It was soon evident, however, that it would take many years to build the 140-foot, but astronomical observations needed to begin sooner. Only an already proven design of intermediate size could be built quickly enough. For this reason NRAO purchased an 85-foot radio telescope from the Blaw-Knox Company who was able to have a fully steerable (equatorial) 85-foot telescope that could observe down to wavelengths of three centimeters.

On February 13, 1959 Frank Drake and David Heeschen made the first observations with the Tatel Telescope and for several years thereafter the Howard E. Tatel radio telescope was the workhorse of the Green Bank observing program. It is credited with doing much of the pioneering radio astronomy at NRAO. However, by 1964 the Tatel Telescope was being used less and less. The 300-foot was operating, the 140-foot was nearing completion, and many other institutions had telescopes as large and larger than 85 feet in diameter.

Retiring the Tatel Telescope from the NRAO observing program was strongly considered. Fortunately, before any action was taken, a proposal was submitted and approved to build an interferometer at Green Bank. Only one more 85-foot would be required to have an interferometer: another 85 like the Tatel Telescope but mounted on wheels so that it could be moved along a baseline. The Tatel Telescope would be the fixed element. Becoming a part of the interferometer extended the useful life of the Tatel Telescope for several more years.

Now in 1978 the ole workhorse is once again threatened with mothballing. In October 1978, the Green Bank interferometer is scheduled to be phased out of operation. It's work will be taken over by the VLA. Despite the gloomy prospects for the 85s, don't count them out. They still might see their ship come in.

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TURQUOISE

Wally Oref

Turquoise is a hydrous phosphate of aluminum and copper, in which some of the aluminum is usually replaced by iron. The dark to sky-blue color to which the gem chiefly owes its attraction is due to a copper compound, while iron when present tends to impart a far less desirable greenish tint. For practical purposes turquoise is uncrystallized (amorphous), though small crystals of the mineral have been found. In thin sections under a microscope, turquoise consists of crystalline particles, interspersed with amorphous whitish material. Specimens containing a lot of amorphous matter are more

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porous, less dense, paler in color, and softer than purer types.

Of all the stones commonly used in jewelry, turquoise is probably the easiest to fake. Being subtranslucent its internal features cannot be studied; being multicrystalline its refractive indices yield only an average figure of no exact significance; and being porous it lends itself only too readily to impregnations with wax, plastics, or silicate solutions. Moreover, there are several natural minerals which resemble, or can be made to resemble, turquoise in appearance, and there are all manners of sheer imitations.

Because turquoise is so easily faked, be suspicious when strangers offer turquoise jewelry at seemingly bargain prices. However, there is the chance the offer is a bargain but in a 'one on one encounter' how do you know the turquoise is genuine? Even though sophisticated laboratory equipment is required for 100% accurate identification, careful examination with the eye and a hand lens can reveal real turquoise or alert you to possible fakes.

The surface structure of true turquoise is rather distinctive, the amorphous-looking pale blue background being interspersed with tiny shreds and speckles of whitish material. Often small brown veins of limonite are also seen. In 'Egyptian' turquoise, which is of more intense blue and more noticeably translucent than other turquoise, small dark blue disks are noticable against the paler background.

The hardness of the best turquoise is about 6 (on a scale of 1-10 talc is 1 and diamond is 10) or a little less--and thus can hardly be scratched with a penknife or a needle. Lower grades and 'made-up' imitations are decidedly softer. Another point worth noting in turquoise is the waxy lustre it reveals at any chipped or broken surface. In this it differs from most of its substitutes.

Imitation turquoises have been made from suitably coloured Plaster of Paris, and from various strongly compressed powders, some of which may have a similar composition to that of turquoise itself. However, these lack the typical turquoise surface structure, are softer, more porous, and of lower density. Glass imitations and porcelain will show small bubbles just below the surface when diligently examined; enamel and stained chalcedony lack the surface structure of turquoise and have a vitreous luster. Specimens of the hydrated boro-silicate mineral howlite have been dyed blue to form a reasonably effective substitute for turquoise.

Several types of 'bonded' turquoise have been produced in the U.S.A., making use of natural turquoise too pale and soft to have any place as an ornamental stone unless it is treated in some such way. Some of the crushed material has been bonded with polystyrene resins: such pieces are of lower density than true turquoise, cut with a knife without powdering, and yield a characteristic odor when a fragment is heated in a small glass tube--though a destructive test of this kind is against the normal canons of gemnology. More difficult to detect, because the density is nearer that for untreated turquoise, is a similar mass bonded with waterglass (sodium silicate). However, the lack of the normal surface structure should serve as a warning.

Odontolite or 'bone turquoise' is a fossil ivory or bone which has become stained blue by the iron phosphate mineral vivianite. Odontolite invariably contains some calcium carbonate and thus effervesces when a drop of dilute hydrochloric acid is applied to it. The hardness is about 5 and can be scratched with some difficulty with a knife or window glass.

Amazon stone feldspar may also be mistaken for turquoise of poor quality, but it has a 'shredded' structure. Chrysocolla, the hydrated copper silicate, can form sky-blue cabochons resembling turquoise, but is much softer and can be scratched with a copper coin (hardness = 3). Impure chrysocolla can vary from blue to brown and black.

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NRAO ROUNDUP

Reprinted from the NRAO Quarterly Report for April 1, 1978 - June 30, 1978

ELECTRONICS DIVISION

Charlottesville

Model IV autocorrelator development is continuing. Work has started on the IF section of the instrument in Green Bank.

VLB Mark III record terminal work is continuing; the first terminal will have a complete complement of video converters and an updated formatter by November, when a further experiment with Haystack is planned.

Work has continued on improving the performance of the 2-mm mixers. The 1-mm harmonically pumped mixer has been modified to improve the signal and local oscillator tuning.

Green Bank

The deformable, correcting subreflector was installed and tested on the 140-foot telescope in early June. Although the deformation was limited by the available actuators, substantial improvements in aperture efficiency were measured. The largest gains of as much as a factor of two at 22 GHz were realized in the southeast pointing directions. There is a strong east-west asymmetry in the aperture efficiency curve of the 140-foot which remains to be explained. This asymmetry is accentuated by the correcting subreflector. Only first order astigmatic deformations produced much improvement. The new subreflector without deformation showed a higher efficiency than the old one so it could be that the first one had deteriorated with time.

A new Versatec printer/hard copy unit was installed on the 140-foot to replace a much less reliable Varian device.

Bandwidths as wide as 560 MHz have been achieved with a longer magnet on the 22 GHz masers. All future masers will incorporate the new magnet. The first 8.2-10.8 GHz upconverter was delivered by AIL in April, and work is well under way for incorporating it in the second phase of the 140-ft Cassegrain system which will also include a 12-16 GHz upconverter. A corrugated, conical horn, Cassegrain feed which provides a constant illumination taper and VSWR < 1.2:1 from 11.5 to 15.5 GHz was built in the Green Bank shop.

A 22 GHz dual, movable feed correlation radiometer is being built to measure the focal plane field distribution on the 140-foot in an effort to understand the surface deformations.

Tucson

Progress has been made this quarter with the 130-170 GHz mixers. Present performance is now equal to that originally hoped for and comes as a result of a new batch of University of Virginia 1.5 micron diodes.

One of these mixers has been successfully cooled and will be incorporated in a 1mm/2mm cooled mixer receiver that is currently being developed.

A baud rate converter to interface the DEC 11/45 computer with slower peripherals has been built during this quarter.

Another 1020 refrigerator compressor is being assembled in Tucson and is almost completed.

ENGINEERING DIVISION

The correctable subreflector was completed and installed on the 140-foot telescope for a test observation period. Design of a new traveling feed with supporting back-up structure continued for the 300-foot. A surface measurement was made on four radii of the 140-foot telescope using the new "stepping bar" method for surface measurements. Preliminary work was started to measure 48 radii, the complete surface, of the 140-foot with the "stepping bar". Conceptual design and research continued for a future 25-m millimeter wave telescope in such areas as structures, astrodome, door covering fabrics, site and buildings. Design of stow pins for the 36-foot was completed and drawings turned over to the shop for fabrication. Routine engineering assistance was provided operations and maintenance in Charlottesville, Green Bank and Tucson.

COMPUTER DIVISION

IBM 360/65 System

HASP has been updated to release 4.1c. The operating system has been updated to release 21.8E, which is IBM's penultimate

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operating system for the 360 series. The latest PL1 compiler and ASMG assembler are currently being tested by selected users.

140-Foot Telescope

Two procedures (POINT and PEAK) have been added to the control program. 'POINT' drives the telescope through a source in right ascension and declination, calculates the best gaussian fit through the half-power points and calculates the pointing correction. 'PEAK' automatically calculates the position of the peak and positions the telescope there.

VLBI

The spectral-line post-processing package is available to users. Mark Reid has volunteered his services as consultant. The missing 15% fringe amplitude on the B-C baseline has been restored at the processor. See VLBI newsletter No. 103, March 23, 1977, B. Clark, D. Shaffer, and B. Rayhrer for an explanation.

Map Processor

Bids have been accepted for the purchase of an array processor and an image display system.

VERY LARGE ARRAY PROGRAM

The array was scheduled for observations and test 55% of the time during the second quarter of 1978. At the last of June the array was operating with 12 antennas on an 11.5 km baseline. The eighteenth antenna was accepted from E-Systems on June 19, 1978.

The electronics group completed the current retrofit program with all antennas now having the same electronics. In the cryogenics area, planning is in progress for a new cryogenics laboratory and clean room. The new CTI 1020 cryogenics systems are being purchased for $9,900; this compares very favorably with prices of $16,490 for the old CTI system and $17,900 for the Air Products system. Six extra systems are being purchased to allow retrofitting of Air Products or Cryomech systems. In the digital area, work is progressing satisfactorily towards a first test of the new correlator system in July. First fringes were obtained with antenna number 13 on April 28, 1978 and with antenna 14 on June 22, 1978.

In the computer area, an additional 32 K words of memory and a 179 MByte disk have been delivered for the map display (PDP 11/40) system. The Modcomp backup system (named "Backus") has been delivered, and some software work is under way to make it a convenient background system for doing software work while observing. The RSX-11 operating system for the PDP-11 display computer has been generated and installed (this system supports the large RP06 disk and the DA-28 communications system to the DEC-10). A remote terminal for access to the DEC-10 has been installed in Socorro.

The additional Visiting Scientist Quarters and Library-Office buildings were completed and partially occupied during the quarter. Work on the archaeological excavation has been completed. Phase IV construction contracts were awarded on June 23, 1978.

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AMERICA IS FLEAING

Omar Bowyer

Garage sales, yard sales, and flea markets are noticeable social phenomena taking place in America. The reasons are simple. Psychologically we have a need to barter, to make a deal, to recycle and flea markets provide an excellent outlet. You can buy, sell, or trade. You can talk, laugh, and argue. You can walk, look, and feel. You can and will have fun.

All types of people cater to flea markets. Some come in beat-up trucks, while others are chauffered in big, black limousines. But we all go for the same reasons - to search, to haggle, and to make a deal. Our basic needs are met fleaing.

There are loads of bargains at the flea markets. In fact, you can find almost anything from clothing to food, antiques to automobiles, tools to toys, from paintings to junk, and on and on. There is one of everything that has ever been made.

Flea markets range in sizes from the largest in San Jose, California covering 130 acres to the thousands of small yard sales everywhere.

According to an article in 'Mechanics

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Illustrated', fleaing is one of three best ways to earn spare time money. I list it also as the best way to have spare time fun. We can all use both. Everything is priced low to move - money is not the game. Yet some very successful fleaers sell $70,000.00 worth annually.

You may now want to go rent a stall and set up your own business. Rose and I did and had a great time. We went to the Farmers' Market in Beckley, WV and rented a stall and set up business along with 20 acres of other fleaers.

Although we arrived before seven o'clock (one or two hours too late) on Saturday morning, we found that the professional fleaers were already busy buying before the non-fleaers arrived. They check out all the stalls and buy up the best items at the lowest prices. These items are resold later at some other flea market. With a little experience, it's easy to spot a professional fleaer.

By eight o'clock hundreds of people were really fleaing, and it lasted most of the day. The best buys were clothing (especially socks), fresh vegetables, fresh fruit, books, and tools. We bought several items and sold a lot. We made a few deals and they made some.

We are considering starting a flea market in Green Bank if there is enough interest. To start it off we need at least eight people to commit themselves to renting stalls and selling items. Stalls will rent for $2.00 each. For more information call Omar Bowyer.

*****

MY SUMMER STUDENT EXPERIENCE AT GREEN BANK

Fran Verter

"Hi! I'm a summer student here, and I'm going to demonstrate the operation of this 2-foot radio telescope. As you saw in the movie, the radiation is incident on this parabolic dish and is reflected to a waveguide which carries it...blah,blah,blah." For five days in mid-July I assailed the NRAO tourists with various versions of this spiel. Among the survivors the most frequently asked question was, "Where are you from?" In fact, almost everytime I said something this summer I left people asking, "Where is this girl coming from?" Perhaps I should clear the record by formally introducing myself and telling you about my background.

My name is Fran Verter. I've just graduated from Brooklyn College with a B. S. in physics, and in September I will go to Princeton to begin working towards a Ph.D. in astrophysics. That sounds rather dry, and I'm sure most people don't remember me that way. I'm best known to the Green Bank staff as "the girl that runs". I'm best known to the Charlottesville students as the girl at the Summer Student Picnic who spent an unusually long time in the bushes with a male student "looking for the volleyball". I spent the rest of the summer trying to convince people that was all I was looking for. Let me tell you how all this began:

Previous to my stay in Green Bank, I had spent almost the entire 20 years of my life in Brooklyn. I am a city girl to the core. I love the throb of the metropolis that never sleeps, where something of every variety is always happening, where humanity rises to a crescendo that entwines its pinnacles and deeps. Yes, I'm waxing poetic, but the beauty of the Big Apple encompasses its ugliness, and to appreciate it you must either thrive on contrasts or be born there. Still I wanted to experience other lifestyles, and I was very pleased when I was assigned to work in Green Bank, West Virginia, the fork in the road that always sleeps. I had come to discover America.

As I alighted from the plane, the first native I met was Merle Kerr. He was very friendly. He proceeded to take me on a torturously twisting mountain drive, chatting away about the size of the poisonous snakes he'd killed at the Observatory and taking his eyes off the road to draw diagrams of the layout of the grounds. I gritted my teeth and held on to the dashboard. Seriously, though I have enjoyed my stay here. The people have been effusively friendly, although it still unnerves me the way everyone knows everyone

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else's affairs, not to mention family histories going back four generations. Another thing that took some getting used to was leaving possessions unlocked and expecting to see them again. But despite the unmitigated dullness of life in Green Bank, the environment was very refreshing. I never failed to get a charge out of the open spaces, the greenness, the wide sky. I also tried my best to learn all I could about the life of a typical Pocahontas County native. To this end I attended local festivals and social events, explored the backroads by bicycle, visited the historic attractions, and shopped at Trent's. I even had rocks thrown at me by a car-full of local adolescents.

Amazingly enough, I also learned quite a bit about radio astronomy. The engineers would always cluck over their morning coffee when I came down to breakfast at 9:30, but where were they when I was studying on weekends or running computer programs at 4:00 a.m.? As the man who sweeps the second floor of the lab on weeknights is my witness, I put in my time. Pat Crane was my advisor, and in the course of the summer I found out more about the VLA program package and a galaxy called NGC3504 than most decent people would care to ask. I also had the opportunity to meet a lot of radio astronomers and get a feel for what practicing astronomy is all about. However, the scientific community regarded me as somewhat of a rebel, because my attendance at regularly scheduled coffee and lunch breaks was spotty at best.

All this happened this summer, and more. No discussion of my experiences would be complete without some mention of volleyball and teasing. As far as volleyball goes, suffice it to say that I'm still working on my famous wind-up serve. The teasing is something I was subjected to constantly as soon as it became obvious that I'm the type of patsy who asks for it. My Brooklyn accent was one of the first victims. Even I have to admit that I "tawk" poorly, but one visiting observer went too far when he told me that I reminded him of Kojak. Then there was "Brooklyn toughness", also known as "How To Talk Dirty And Influence People". It's true that I once pulled a knife on a fellow astronomer and threatened to cut her cantaloupe to ribbons, but she was exasperating me by trying to throw a napkin in my tea. In general, most of the resident and visiting counselors at camp NRAO joined in the ribaldry, and a good time was had by all.

As the summer draws to a close and I prepare to leave, I keep trying to sum up my experience as a summer student. Perhaps I'm supposed to feel scientifically enriched, but my memories are mostly bittersweet. Despite all the hilarity and NGCs I'll remember this summer mostly for the friends I made and the growing up I did inside my head. And though I couldn't stand to live in Green Bank permanently, it saddens me to know that I may never pass this way again. To all of you who shared in my summer here, GOOD-BYE!

*****

BLACK HOLES - WHAT ARE THEY?

Jetta Bowyer Coleman

After the discovery of quasars in 1963 there was a tremendous amount of interest in relativistic astrophysics. Not only Einstein, but men like C. Brans, R. Dicke, and P. Jordon studied the theories of relativistic astrophysics. 1965 marked the beginning of intensive investigation into the physics of black holes, which are one of the most exciting predictions of Einstein's theory of relativity. A black hole can form when gravitational forces become so intense that they prevent the escape of light waves, radio waves, and even particles that move with the speed of light. This can happen to a massive star which reaches the end of its thermonuclear life and continually collapses, until gravity overwhelms all other forces. P. J. Peebles of Princeton University has estimated that our galaxy may contain approximately one thousand million black holes.

A star, reaching the end of its thermonuclear life, cannot attain equilibrium as a white dwarf unless its mass is less than 1.4 solar masses. Nor can a star contract to a neutron star unless its mass is less than two or three solar masses. What happens to a

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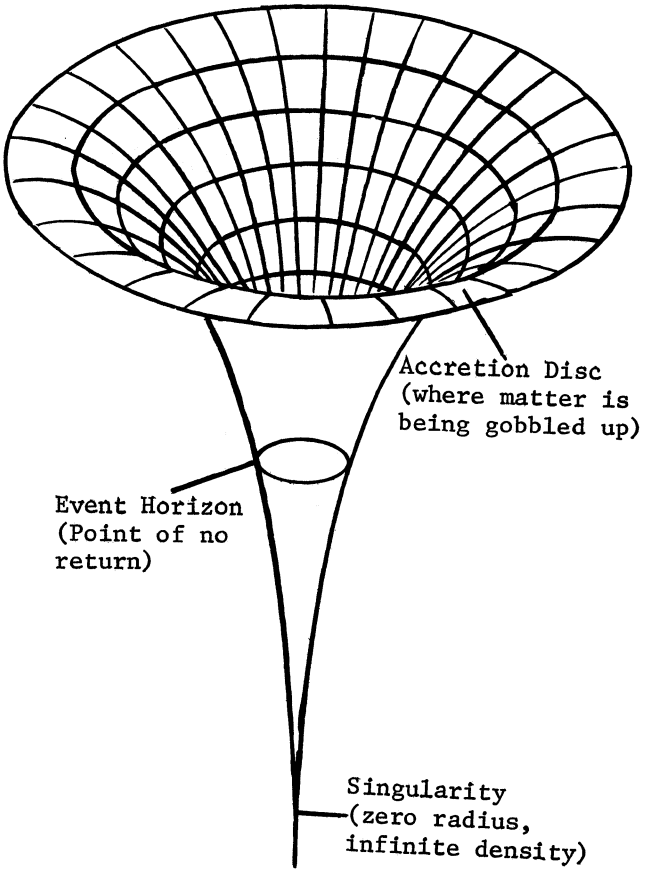
star with a greater mass? It continues to collapse because internal pressure fails to support it. Probably during the collapse the star becomes super-heated and it explodes as a supernova; after the explosion a neutron star may be left (as happened in the case of the Crab nebula in Taurus). The other possibility is that after the explosion more than two or three solar masses remain and complete gravitational collapse carries the star through the neutron star stage to form a black hole.

When the radius of a collapsing star of mass M becomes smaller than the gravitational radius ($R = 2GM/c^2$, where G is the gravitational constant, 6.67×10^{-8} dyne $cm^2 gm^{-2}$, and c is the speed of light, about 3×10^{10} cm sec^{-1}. The gravitational radius of the sun is about 3 km or about 2 miles.), gravity dominates all other forces and it crushes all matter into an infinitesimal volume. This radius determines the black hole's event horizon. Only the regions on and outside the event horizon can be seen by an outside observer. Signals emitted within the event horizon never escape but signals emitted from the exterior can.

Once a star passes inside its event horizon, it continues to contract. Nothing can stop its contraction. It will contract to zero radius, reaching what is called a singularity. The singularity is a region of space-time where normal physical theory breaks down. Strong tidal gravitational forces deform and squeeze matter beyond recognition.

Black holes may be either rotating or non-rotating. Schwarzschild geometry describes the gravitational field of a non-rotating uncharged black hole. Kerr-Newman geometry describes black holes that are rotating and electromagnetically charged. In nature, it would be expected that black holes rotate and their event horizons flatten out at the poles, just as rotation slightly flattens the earth's poles.

D. Lyndon-Bell of Cambridge University has suggested that a massive black hole might be located at the center of our own galaxy. He has further theorized that the accumulation of matter in black holes might produce quasars. This accumulation of matter might turn the hole into a "glowing



A black hole represented by curvature of space.

white body", which would shine only by light emitted by gas outside the event horizon. As matter falls in toward the black hole, it is heated. Before this matter reaches the event horizon, it might become so hot that it may emit x-rays and even gamma rays. Could gravitational collapse of a spherically symmetrical body lead directly to a quasar? This could be a possible explanation of the large redshifts in the spectra of quasars. However, W. L. Ames' and Thorne's theoretical analysis shows that the spectral lines would be greatly widened. Also the brightness of quasars would decay. These predictions are both contrary to observation.

Astronomers look for black holes by searching for their affect on matter pulled from a nearby companion star. A black hole will attract matter from its companion and

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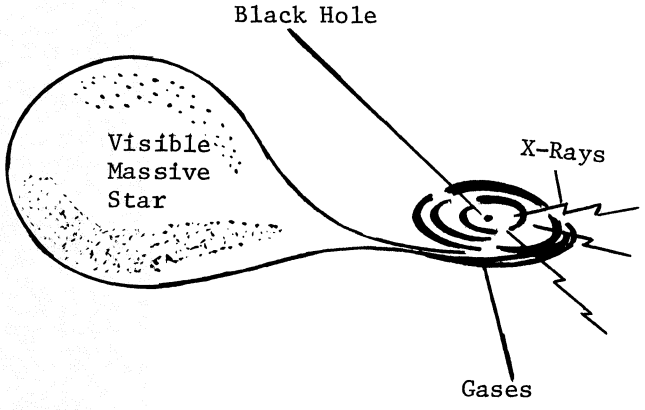
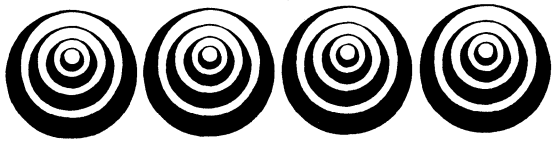
pull it towards itself at high velocities. That matter that isn't sucked right into the black hole orbits around the black hole. This matter in orbit will be heated to a point where x-rays are emitted and the region will radiate strongly in the x-ray region. Thus, though astronomers cannot observe black holes directly, they hope they can observe x-rays that black holes create.



Affect of a black hole on its visibly massive companion.

Laws of black hole mechanics have been developed by Bardeen, Carter, and Hawking. These laws are very similar to the laws of thermodynamics. The surface area and surface gravity of a black hole resemble entropy and temperature. The four laws of black hole mechanics are as follows: (1) The Zeroth Law states that the surface gravity of a stationary black hole is constant over its event horizon and is uniquely characterized by its mass, charge, and spin. (2) The First Law like the first law in thermodynamics is a conservation law. (3) The Second Law states that the surface area of any black hole cannot decrease with time. (4) The Third Law states that it is impossible to reduce the surface gravity to zero by any finite sequence of operation.



ANNOUNCING A NEW SCIENTIFIC INSTRUMENT AT NRAO: THE LTC

(Woon-Yin Wong puts his thoughts to English)

There is nothing wrong for a research institute like NRAO to have a building that does not stand straight. In fact, it may even remind visitors of the leaning tower of Pisa, tilting so gracefully amid the city square, where Galileo did his famous experiments which laid the ground work for the laws of motion. This building, called trailer for some unknown reason, is a metallic structure painted in satin white. It has an architectural style so advanced that only the people in the next century would or could appreciate it. It is truly a classic. This oblong structure, lurking futuristically behind the parking lot, is already supported by eight short pillars. But alas, this building is experiencing the same problem as the Italiano campanila. It started to tilt three or four years ago. Or, to be precise, it started to roll over.

The Japanese summarily refused to grout the foundation with cement, in spite of the rising yen. The Department of Building and Ground at UVA also refused to straighten up the trailer, due to obvious scientific reasons.

Before this beautiful structure, hopefully not with its contents, rolls itself into complete destruction, I plead for the help of all the staff of the NRAO. We need to save this building!

I have a great scheme to do just that. It will kill two birds with one stone. All we need is a modern day Galileo to transform this leaning trailer of Charlottesville (LTC) into a national monument by doing great science with it. Please take note and don't laugh: science is still a gold mine, with plenty of areas to explore. We, who consider ourselves the most intelligent beings on this planet, are still light years behind compared with those who zip-zap through the curvature of time and space, paying frequent visits to places like North Dakota. To do science, all we need sometimes is an apple, sometimes a VLA, and sometime perhaps an LTC. So ladies and gentlemen, the LTC is soliciting observing programs. All qualified observers

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are welcome to apply.

For those who are interested in it, please hurry! The engineers, equipped with an IBM-360-65, have predicted precisely the imminent moment of disaster. Some delay is possible, however, depending on how much computer print-out continues to be stored in the LTC or is thrown away.

When I told George Grove the other day that pencils roll self-propelled on the table tops in the LTC, he suggested "Why don't you use hexagonal pencils?"

*****

WHAT'S COOKING?

CHOCOLATE PIE

from the kitchen of
Dave Shaffer

6 ounces cream cheese
2 eggs
½ cup sugar
1 teaspoon vanilla
1 cup chocolate chips
8 ounces whipping cream
1 9" graham cracker crust pie shell

Let cream cheese soften at room temperature, then cream it with ¼ cup sugar, the vanilla, and the egg yolks (save the whites for later). Melt chocolate chips over hot water. After they are melted, blend them into the cream cheese mixture. After the mixture cools, whip the egg whites until stiff and fold them into the mixture. Whip the cream, while adding the remaining ¼ cup of sugar, until stiff. Fold the whipped cream into the mixture. Pour the mixture into the pie shell and refrigerate until firm (a couple of hours). Cut and serve. 6-8 drops of mint extract may be added in the beginning to give a chocolate mint pie.

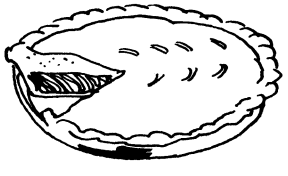
PITA (Pocket Bread)

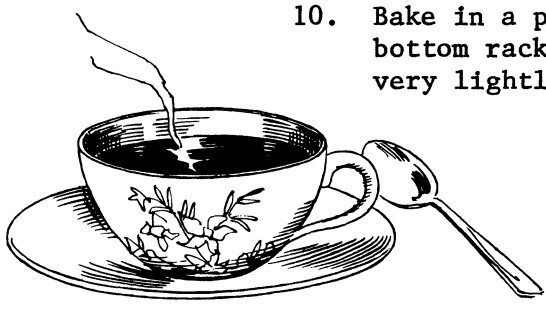
from the kitchen of
Wally Oref

These flat buns form a pocket inside as they bake. Just slit them and tuck in any sandwich filling you like. A traditional Middle Eastern bread, they go well with shish kabobs. The recipe makes 16 little flat loaves.

5 to 6 cups whole wheat or unbleached enriched all-purpose flour
2 packages dry yeast
2 cups water
¼ cup oil
1 tablespoon sugar
2 teaspoons salt

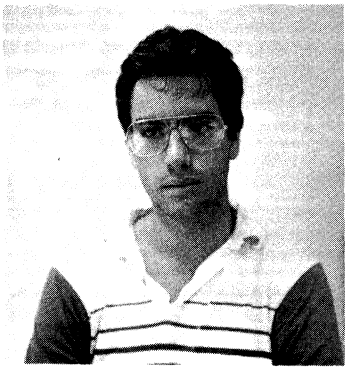
1. Stir together 2 cups of flour and the yeast in a large mixing bowl.
2. Measure milk, water, sugar, oil and salt into a saucepan and heat them over low heat only until warm (120° F to 130° F), stirring to blend.
3. Add the liquid ingredients to the flour-yeast mixture and beat until smooth, about 2 minutes on the medium speed of your electric mixer or beat 300 strokes by hand.
4. Stir in more flour to make a moderately soft dough.
5. Turn out on lightly floured surface and knead until smooth and satiny, about 5 to 10 minutes.
6. Cover the dough with a bowl or pan and let it rest 30 minutes.
7. Cut the dough into 16 equal portions and shape each portion into a ball.
8. Roll the balls out into circles 5 inches in diameter.
9. Place them on greased cookie sheets and let them rise in warm place until puffy, about 30 to 45 minutes.
10. Bake in a preheated 400° F oven on bottom rack about 10 minutes or until very lightly browned.



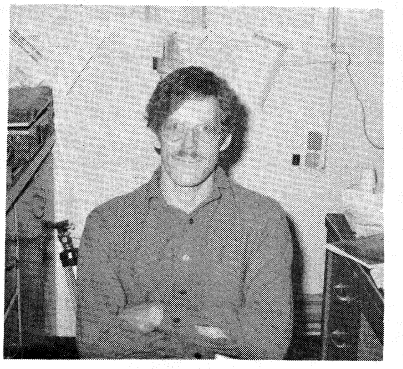


PERSONNEL UPDATE

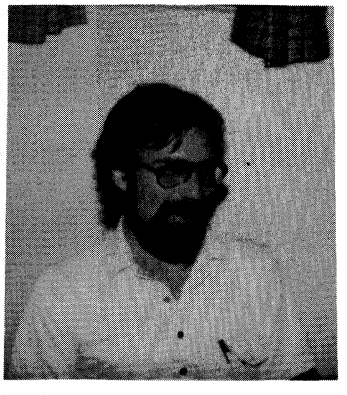
NEW EMPLOYEES



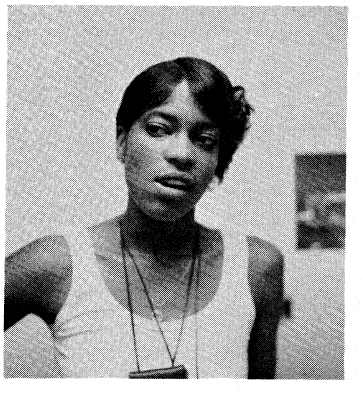
Darrell M. Burns
Research Assistant
Electronics - CV



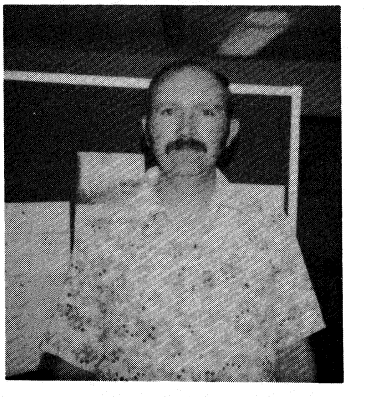
Marc Damashek
Scient. Prog. Analyst
Admin. Services - GB



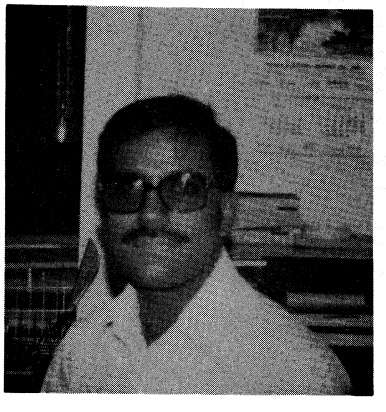
Robert R. Payne
Scient. Prog. Analyst
VLA - New Mexico



Wanda Y. Lewis
Computer Operator
Computer - CV



Stephen E. McCrary
Technician
VLA - New Mexico



Rameshwar P. Sinha
Systems Scientist
VLA - New Mexico

Russell J. Wayman
Research Assistant
Scient. Serv. - CV

--continued, next page--

OTHER NEW EMPLOYEES - PHOTOS NOT AVAILABLE

Ellen G. Ary	Assistant Cook	VLA - New Mexico
Deborah J. Brawley	Secretary	VLA - New Mexico
John W. Dreher	Research Associate	Basic Research - New Mexico
Daryl L. Grant	Technician	VLA - New Mexico
James N. Gregg	Tech Trainee	VLA - New Mexico
Phillip E. Hicks	Tech Specialist	VLA - New Mexico
Wayne M. Koski	Technician	VLA - New Mexico
Paul A. Lilie	Electronics Engineer	VLA - New Mexico
David J. Peralta	Maintenance Trainee	VLA - New Mexico
Arthur Pino	Maintenance Trainee	VLA - New Mexico

REHIRE

Richard A. Sramek	Systems Scientist	VLA - New Mexico

RETURN FROM LEAVE OF ABSENCE

Henry Taylor

RETIREES

Alfred H. Collins	Herbert W. Hanes	Virginia I. Michael
Hanson P. Hall		Mary Ann Starr

TERMINATIONS

Harold Bashaw	Samuel Goldstein	Chun Ming Leung
Gregory Brubaker	Philip Hardee	Doyle R. Marshall
Butler Burton	Francis Hart	Teddy McClung
Alfred Bustamante, Jr.	Victor Herrero	Richard Norton
James Condon	Adrian Herzog	Kimberly Nottingham
Nathalie Dolan	Michael Hogan	Craig Sarazin
Douglas Fedak	Jerome Hudson	Rosalie Slaven
Paul Ford	Annabelle Lambert	Greggory Sutton
Steven Gillispie	Feliz Landavazo	Anthony Willis

We regret to report the death of Jack L. Daniels on August 6, 1978. Jack had been an employee of NRAO since February, 1963.

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