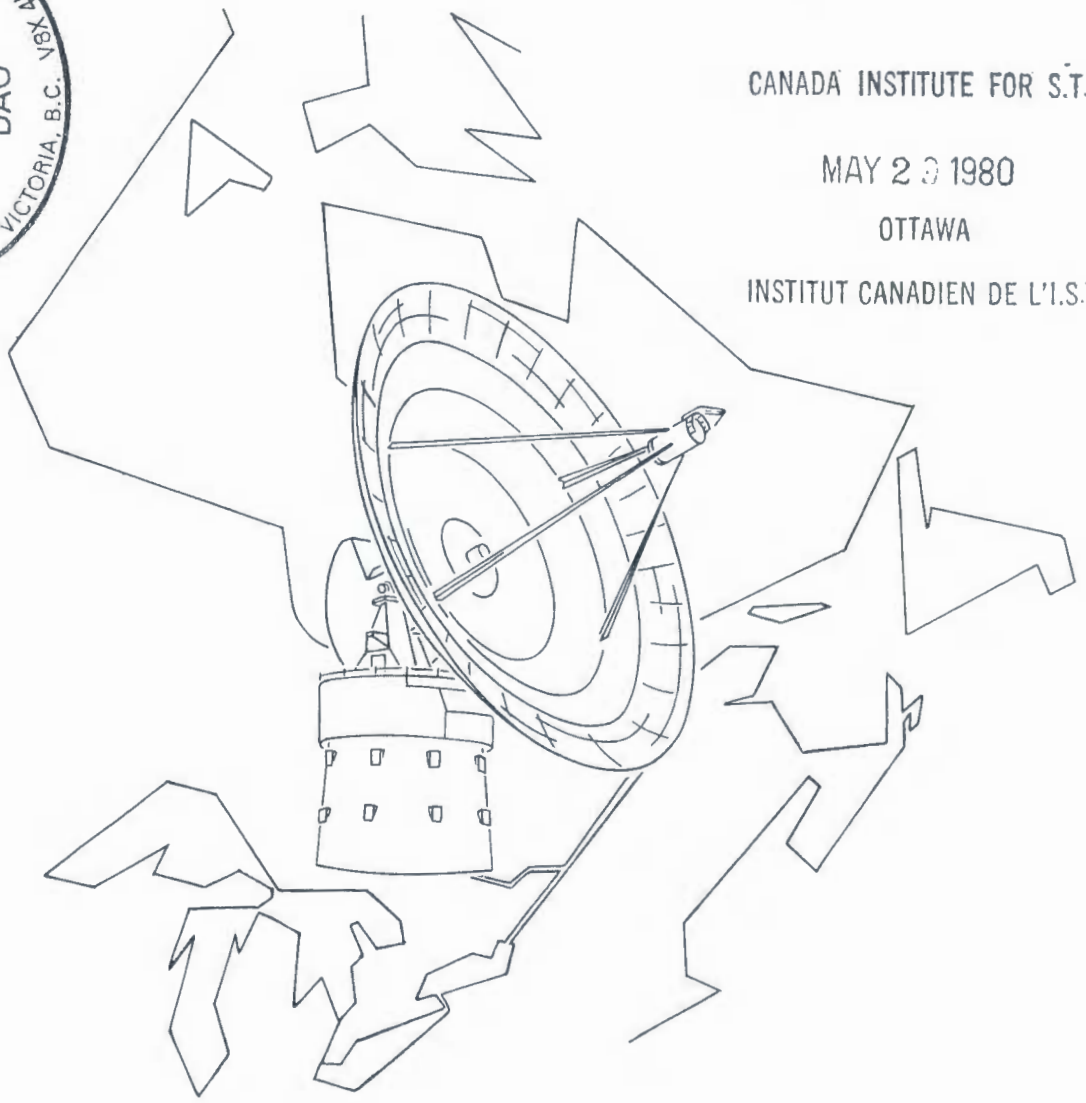
The A.R.0. observer, issue no. 3

The A.R.O. OBSERVER



National Research Council Canada
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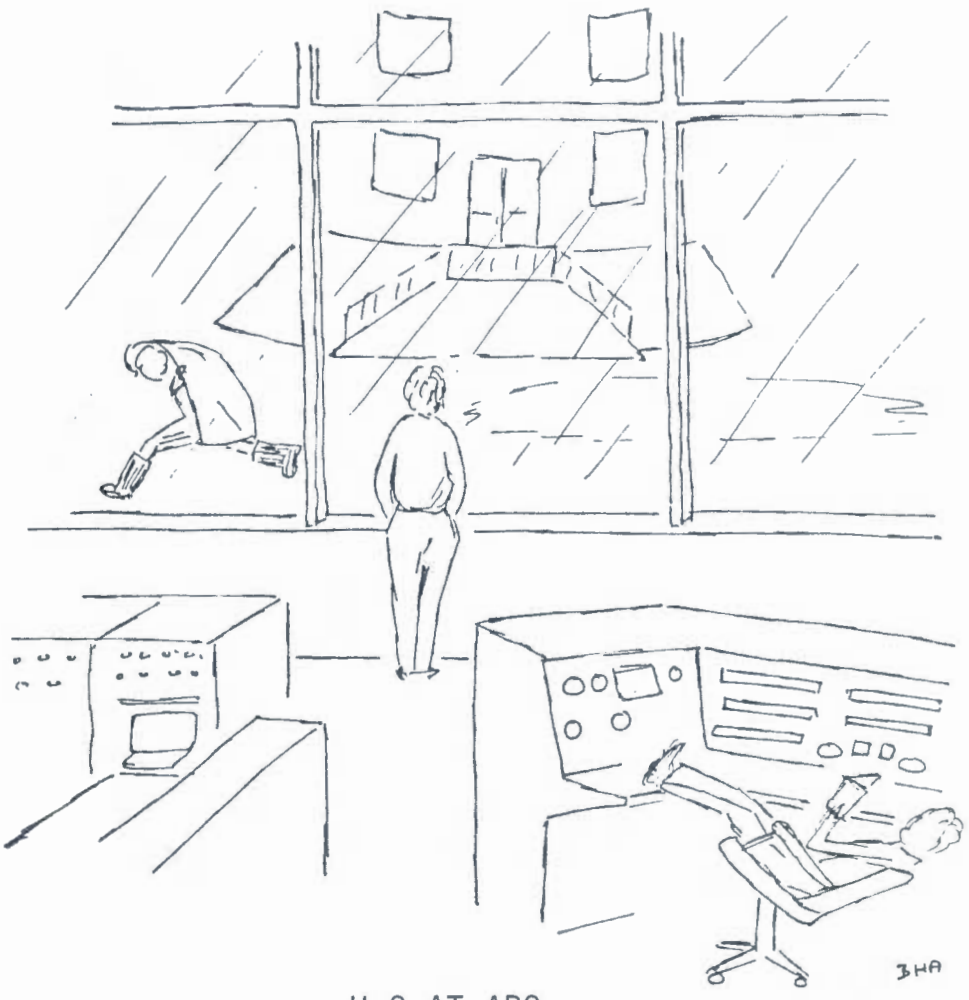


H_2O AT ARO

The new 1.4 cm paramp receiver went into operation at ARO at the beginning of the year. We have discovered so far at this wavelength that we have a darn good receiver and a ho-hum telescope.

First the good news. The system noise temperature is between 200 K and 250 K, depending on weather, zenith angle, and whom you believe, and the bandwidth is between 400 MHz and 600 MHz. Both the noise temperature and the bandwidth depend to some extent on the centre frequency to which the paramp is tuned.

That brings up the first of the bad news. The limits to the tuning range are 22.0 GHz and 23.45 GHz, so we won't be able to reach all the main lines of ammonia, and we'll need to operate at the very edge of the pass band to reach any of them. Furthermore the local oscillator system is a temporary one, so the receiver has to be carefully nursed when doing line work. A much improved Mark II temporary system should be in operation by the time you read this.

The receiver appears to be ideally suited to continuum work. Certainly the ambient conditions experienced in mid-winter show that ARO is a good site. The noise contribution from the atmosphere was

about 7 K, and for long periods of time there were no interruptions due to the weather. It remains to be seen if the same can be said in summer when we have water vapour up there instead of ice particles.

The drawback to continuum observations is the performance of the telescope itself. The efficiency is only about 10% to 12%, and it takes somewhere between 15 and 20 flux units to produce a degree of signal. The gain of the telescope changes by about 25% between the zenith and the horizon, and what is worse, changes unpredictably with time. There is some suggestion that the gain varies diurnally, and that there is a correlation between gain changes and the appearance of the sun. In any event, you have to work very hard to measure flux densities more accurately than ±15%.

On the credit side the beamshape (84 arc secs wide) is symmetrical and stable, despite the presence of a few 7% sidelobes, and the pointing, once determined, seems to remain constant. The focus is no more changeable than it is at 2.8 cm, though there is a peculiar secondary focus which is not seen at other wavelengths.

The next step must be a series of surveys of the dish surface to see if any substantial improvements can be made to it. That involves getting our survey camera working, or at least getting a working survey camera. It won't happen next week.

B.H.A.

MY PET PEEVE

Many speakers dull the alertness of their audiences by needlessly leaving the room lights off during slide presentations. Yet most slides presented at scientific meetings are simple line diagrams of high contrast; little or no dimming of the room lights is necessary for easy viewing.

When the lights are dimmed more than necessary (or left off long after the speaker has finished referring to the slide), the speaker hinders his communication with at least two sizable groups within his audience: those who take notes and those who find it difficult to stay awake during long sessions (particularly sessions held in crowded and stuffy rooms). I'm sure we've all found (through observation and/or embarassment) that this second group often includes a significant fraction of the audience.

Conference chairmen might make it a practice to instruct projectionists to dim house lights no more than absolutely necessary and to remind speakers to leave their slides on only as long as they are needed.

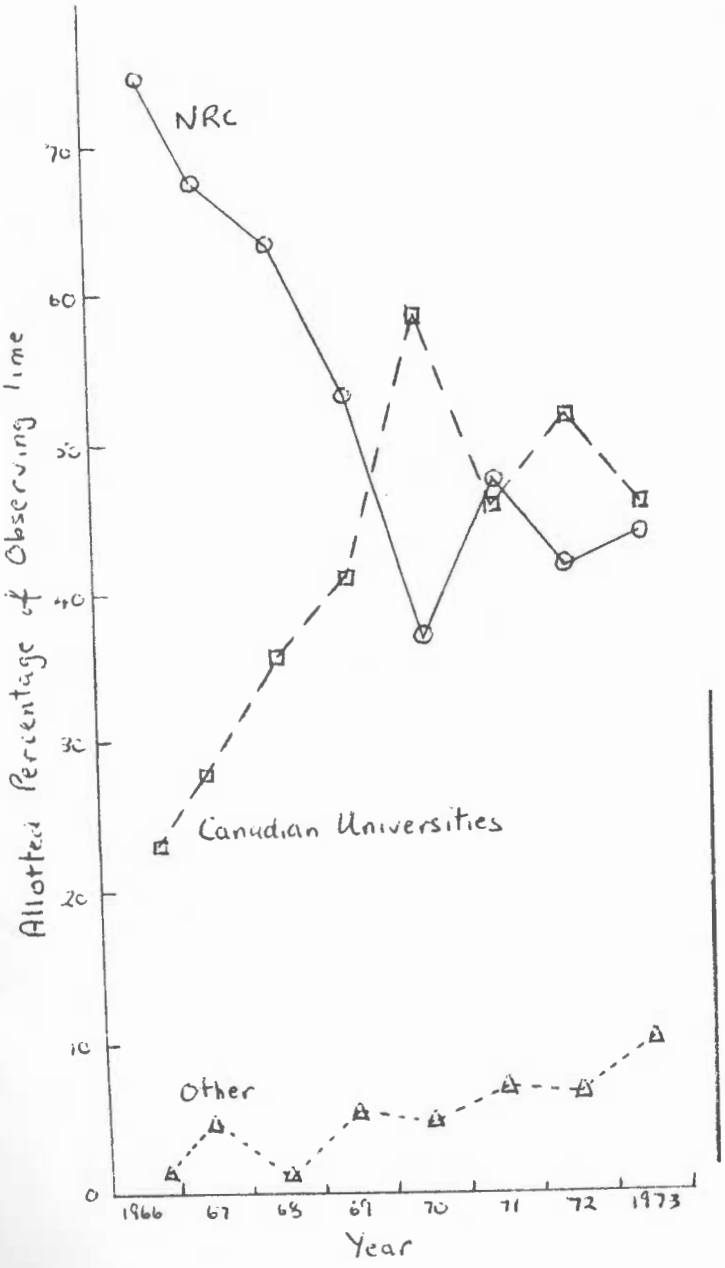
They might also remind speakers that rather than concluding their presentation with something like a mumbled "Well, I guess that's all I have to say", a good, pithy few-sentence summary leaves the audience with a much clearer (and more favorable) understanding of what the speaker was saying.

Eugene E. Epstein
Radio Astronomy Program
The Aerospace Corporation

If you have a pet peeve, let's hear about it. - Ed.

OBSERVING TIME AT ARO

You may be interested in the allotment of observing time at ARO. The graph shows the proportions of the available time given to NRC astronomers (solid line), to Canadian university astronomers and graduate students (broken line), and to 'furreners' (dotted line).



The time considered is only that devoted to astronomy, about 5800 hours per year, and excludes all time devoted to receiver development, telescope maintenance, telescope tests, computer programming, and the like.

The rising fraction of time apparently devoted to 'non-Canadian activities' is due to an increasing number of programmes involving cooperation between the regular ARO habituees and various groups of U.S. and British astronomers.

Anyone interested in applying for time at ARO should submit a request to the Chairman of the Programming Committee, N. W. Broten, Astrophysics Branch, M-50, National Research Council, Ottawa. The application should be accompanied by a description of the intended research including such details as the scientific objectives and the estimated total observing time required.

The telescope schedule is drawn up quarterly, the Programming Committee meets at six month intervals to assign priorities to the various proposals.

B.H.A.

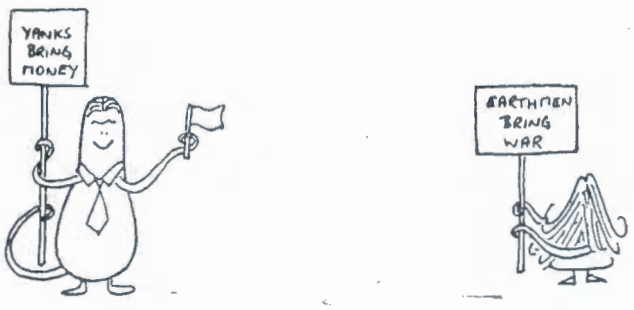
ARO RECEIVERS

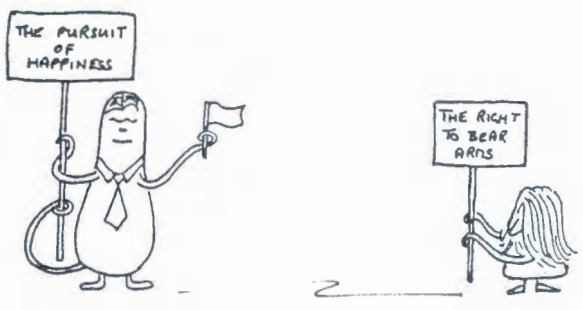
Frequency GHz	System Noise† °K	Bandwidth MHz
0.25-0.50	200	30
2.95-3.45	225	200
6.25-6.50*	50	400
10.15-10.69	120	100
13.5	300	300
22.0-23.4	200	500

†Total power operation

*Not yet in service


WELCOME EARTHMEN
GO HOME YANK


YANKS BRING MONEY
EARTHMEN BRING WAR


THE PURSUIT OF HAPPINESS
THE RIGHT TO BEAR ARMS


HAPPINESS
WAR


SEE

BHA

LIFE BEYOND THE EARTH (1)

by

Alan H. Bridle, Queen's University

Recently, through teaching an introductory astronomy course at Queen's, and through conversations with friends who have read books such as "Chariots of the Gods", I have been impressed with the importance many people attach to the question "Is there life, particularly intelligent life, beyond the Earth?" Even to guess at an answer we have to consider a fascinating range of problems spanning astronomy, biology, geology and even sociology.

Since the early 1960's many astronomers have been involved in serious thinking about extraterrestrial life. Many have concluded that there is a sensible chance that experiments with radio telescopes can give a direct answer to our question - by detecting a radio transmission from an extraterrestrial civilisation.

Both the original 85-foot telescope and the resurfaced 300-foot telescope at Green Bank have been used to search for possible intelligent transmissions at the 1420-MHz frequency of atomic hydrogen, on the grounds that hydrogen is the most abundant chemical element in the Universe and all astronomically-interested civilisations are likely to build equipment to study it.

A preliminary design study sponsored by Stanford University and NASA has been made for "Project Cyclops", a 3-mile diameter aperture to be filled with 300-foot telescopes whose principal objective would be a search for extraterrestrial life.

For myself, I have become convinced that several existing radio telescopes might usefully spend a small fraction of their available time on experiments to detect intelligent extraterrestrial transmissions, and I am now involved in a proposal to use the ARO 150-foot to search for such transmissions at the 1.35-cm water line. As this will be a rather unusual and speculative use of the ARO telescope, I thought readers of 'The Observer' might be interested in some of the background on which the proposal is based.

First of all, just what do we mean by "Is there life beyond the Earth?"

"Beyond the Earth" is specific enough, but what exactly is the phenomenon we call life? The scientific study of life is biology, but biologists themselves seem unhappy about an exact definition of just what distinguishes life from non-life.

It is easy enough to do this for most everyday purposes; the distinction between a living dog and the non-living slipper he chews presents us with few practical problems. But anyone who has seen the death of an animal realises how subtle the transformation from life to non-life can be. Indeed, in the human animal, the difficulty of making a scientifically and legally satisfactory definition of death poses an important social problem in this age of transplant surgery.

Just what property is it that makes a microscopic, structurally simple virus alive while a huge, structurally complex newly dead whale is not alive?

A biologist I know suggests the following empirical definition of life: "Life is the property of any quantity of matter which is structured in such a way as to be able to maintain itself in that structure, and to be able to duplicate itself". While this definition is usefully brief and covers everything we empirically describe as 'living', some non-living things such as crystals in the right physical and chemical environment could fit it.

It is a useful definition however because it pinpoints the most remarkable feature of life - its ability to preserve, enlarge and reproduce its structure.

This attribute of life is remarkable because it opposes a fundamental tendency

of all non-living matter to disorder itself. This tendency is expressed by physicists as the Second Law of Thermodynamics. Matter generally behaves in such a way as to reduce the total amount of order (structure) in the Universe, not to increase or even to preserve it. A dead fish will always decompose into a smelly heap, but smelly heaps never become live fish. An old building may collapse into a heap of rubble, but heaps of rubble never spontaneously assemble themselves into buildings.

All living organisms continuously defeat the general tendency of matter to disorder. They do so by first borrowing well-ordered energy (food) from a source, then manipulating that energy to preserve, enlarge or replicate their structure, and finally returning disordered energy (waste) to their environment.

The total system of energy source, life and waste tends to disorder, but the life itself does not. This tendency of life to aggravate the disordering of the rest of the world is possibly the ultimate reason for our growing pollution problems.

If life's unusual ordering ability were built on some very exotic or unusual mechanism, we could expect life to be rare in the cosmos. Looking at the enormous diversity of life forms on Earth - microbes, plants, insects, animals - we might suppose that a wide variety of mechanisms had appeared here, encouraging the conclusion that life was a property of very diverse states of matter and might therefore be widespread in the Universe.

But closer examination of Earth life does not allow us to jump to this conclusion so easily. It has been found that all Earth life, from the simplest microbe to a bull moose, has essentially the same chemical machinery for staving off disorder.

All living organisms on Earth base their energy manipulation on the chemistry of carbon, whose atoms can link up in long rings and chains to provide the "backbones" of enormous molecules. It is on these molecules that the energy-shuffling and structure-organising chemical processes occur in the ways characteristic of different types of organism.

There is a tremendous unifying pattern in the chemical functioning of all Earth life: the use of carbohydrates as an energy source, of fats for energy storage, of adenosine phosphates (ADP and ATP) for energy transfer within living cells, of proteins to define structure and to facilitate important chemical reactions, and of nucleic acids (DNA, RNA) to provide the patterns for protein synthesis.

In terms of the chemical elements involved, the essential mechanisms of all Earth life are based on compounds of carbon with hydrogen, oxygen, nitrogen, phosphorus and sulphur, magnesium in plants and iron in animals. The number of crucial compounds involved in the basic life mechanisms is small; the enormous diversity of Earth life is the result of widely differing ways of manipulating the same chemical basis to cope with different environmental problems.

Just one compound that is not based on carbon enters into the chemistry of Earth life in a fundamental way. That compound is water, which acts as a solvent for and as a structural component of a wide range of life processes. Water has a combination of thermal, electrical and chemical properties that allow it to act as a medium for a particularly wide range of chemical phenomena under an impressive span of ambient conditions. All Earth life requires water, and in particularly dry areas such as deserts almost all the available liquid water is inside living organisms.

There is no life on Earth that is known to be based on anything other than carbon-compound-in-water chemistry. Other bases could be imagined; for example, silicon could, with oxygen, provide large molecules (silicones) of complexity comparable to the carbon-based molecules of Earth life. Liquid ammonia could be a low-temperature substitute for water as a solvent, with some modification of other chemical detail in the 'life'. Fred Hoyle in his fantasy 'The Black Cloud' speculated on a low-density gaseous form of life that could exist in interstellar space.

But it turns out that the probability that life exists elsewhere is high even if we restrict ourselves to "Life As We Know

It" (LAWKI); there is no need to get involved in speculative, unproven biochemistry or biophysics in order to conclude that life is likely to be commonplace among the stars of our Galaxy. It is for this reason, rather than any lack of interest in other possible lifeschemes, that I shall consider only LAWKI from now on.

What is the probability that LAWKI exists elsewhere than Earth?

Obviously the probability would be small if the chemical constituents of LAWKI were rare in the Universe at large. But astronomical evidence shows that is not the case. After hydrogen and helium, carbon, nitrogen and oxygen are the next most abundant chemical elements in the Universe, with magnesium and sulphur not far behind. Iron is the twelfth most abundant, and phosphorus the sixteenth, of the over a hundred known chemical elements.

The chemical basis for life is both abundant and widespread in the cosmos; given this proliferation of the raw materials, what is the probability that there actually is the life itself?

LAWKI could not exist on the hot surface of a star, nor in the generally cold interstellar space. In fact LAWKI has to be pretty well confined to environments where water can be liquid at least some of the time, and it functions most efficiently on liquid-solid-gas interfaces. The surfaces of planets with atmospheres are thus the most favourable places for LAWKI to exist elsewhere in the Universe.

We must, therefore, ask two questions: what is the frequency of occurrence of planets in the Universe, and, given a planet with the right physical-chemical conditions, what is the probability that life evolves there?

The answer to the first question falls squarely within the competence of astronomy. Observationally, we have no direct evidence for the existence of any planets other than those orbiting our own Sun. Blurring of optical images by the Earth's atmosphere would frustrate direct ground-based attempts to observe the planetary systems of other stars, unless the supposed planetary systems were much larger in scale than our own Solar System.

Astronomers' statements about the probable existence of other planetary systems are, therefore, based on inference rather than on direct observation. Until recently, the strongest evidence for such systems seemed to be the fact that some stars appear to wobble on their paths across the sky, exactly as if affected by the gravitational pull of unseen planetary companions. But one of the best examples of this - the motion of the second nearest star to the Sun (Barnard's Star) - has recently been severely questioned as a purely instrumental error.

The most cogent argument for the existence of large numbers of planetary systems seems to me to be the fact that the formation of planets is understood theoretically as a necessary side-effect of the formation of certain commonplace kinds of star, of which our Sun is a typical example.

All of stellar evolution is understood in terms of the response of stellar material to the perpetual tendency of gravitation to squeeze it into a small volume. It is, therefore, natural to suppose that stars form by the gravitational collapse of diffuse clouds of gas. Certainly such diffuse clouds exist among the known stars, and some such clouds contain objects with properties suspiciously resembling those expected of very young stars or protostars.

But the interstellar gas glouds are not stationary; the interstellar medium is turbulent and it is both expected and observed that the clouds are generally rotating. When a rotating interstellar cloud is cooled enough or compressed enough to initiate gravitational collapse to form a star, this rotation becomes very important.

Just as a figure skater performs a fast twirl by picking up a slow rotation with limbs outstretched and then drawing them in to spin faster, so a gravitationally-shrinking gas cloud spins faster as it contracts to form a star. This inhibits shrinkage across the rotation, as the contracting cloud acts like a cosmic centrifuge. The objects formed by gravitational collapse of rotating clouds should be dense spinning disks, rather than spheres like the

Sun.

Observation shows that about half the stars in the sky are binary or multiple systems in which two or more stars revolve around a common mass centre. These can be understood as systems in which a flattening, collapsing cloud fragmented into a number of more or less equal parts which then collapsed separately into stars. The initial rotation of these clouds ended up as the mutual revolution of the stars.

Perhaps more puzzling are the single stars. The most massive of these are indeed deduced to be in rapid rotation, from the broadening of lines in their spectra; but most single stars spin only slowly, too slowly to be understood in terms of the formation of an isolated stellar object by collapse from a rotating prestellar cloud.

The Sun is an example of such a star, and the gross features of the motions in the Solar System provide a strong clue to what has happened here.

The motions of the planets around the Sun are very well organised. The planets all circulate around the Sun in the same direction and with the exception of the outermost (Pluto) their orbits lie within about ten degrees of a common place. The sense of the planetary motions is also the same as that of the Sun's rotation, and the mean plane of the Solar System is close to that of the Sun's equator. The satellite systems of the major planets are essentially miniatures of this organisation.

The motions of the planets around the Sun, not the rotation of the Sun itself, carry most of the angular momentum of the system. These features can all be explained if it is assumed that the planets condensed from a disc of material that formed with the Sun, and which carried most of the prestellar cloud's rotation; numerous theories have been proposed to account for the development of such a situation.

In all cases, these theories suggest that the formation of planetary systems should be the rule around slowly-spinning single stars, not the exception. This being the case, over a billion stars in our Galaxy alone are likely to have planets that could provide the physical and chemical environment for the development and maintenance of LAWKI.

Given these suitable, but inanimate environments, what then is the probability that LAWKI has actually appeared?

This is much harder to answer, as no human being has ever witnessed the appearance of life in a non-living object, except in horror movies. Our experience shows us that life today springs only from that which was previously living. We could put carbohydrates, fats, ATP, proteins, nucleic acids and water in a flask and still not have life because they would not be structured in the right way. The particular structures, organisations of molecules, that make up LAWKI can only be reproduced at present with the aid of LAWKI. So no experiment we can do today tells us directly whether or not life will always originate in a non-living environment that happens to have the right physical and chemical conditions to support it.

Our only clues to how life did originate on Earth come from the fossil record, which shows that life evolved from simple to complex structure very slowly indeed, over several billion years of the history of the Earth. The fossil record is prolific only in rocks up to about half a billion years old, going back to the beginning of the so-called Cambrian period. There are relatively few pre-Cambrian fossils. But this does not mean there was relatively little pre-Cambrian life.

Very old rocks have been subjected to changing temperatures and pressures during the geological evolution of the Earth's crust, and these tend to destroy fossils that the rocks may have contained when they were formed. Also, pre-Cambrian life most likely consisted mainly of gelatinous creatures that left few fossils.

The oldest known animal fossils are those of jellyfish-and worm-like creatures from the Ediacara Hills of South Australia, and occur in undeformed sedimentary rocks probably between a half and one billion years old. Stromatolites - discontinuous, hemispherical mounds of calcium carbonate typically several feet across and formed today by blue-green algae, are found in

rocks near the Great Slave Lake believed to be about two billion years old. Fossil micro-organisms and plant fragments have been found in the Gunflint Chert formation on Lake Superior, also dated about two billion years ago. Still older algae fossils may exist in the Rhodesian Shield, dated at about 2.7 billion years ago, but there is controversy over whether or not these are true fossil life or merely inorganic formations.

In any case, the fossil record shows that LAWKI took at least two billion, possibly three billion years to evolve from very simple (water-borne) organisms towards today's complex species. In considering the origin of life elsewhere we need only, therefore, consider the origin of very simple organisms, as complication to the intricate structures of today's life can evidently be accomplished by mutation, adaptation and selective elimination over a very long span of time.

Since the 1950's there have been numerous experiments to test whether or not the basic chemical fabric of life can be built up by simple processes involving only the likely non-living constituents of primeval planetary atmospheres. These experiments have all been very encouraging to the idea that the development of life is more or less inevitable given reasonable physical conditions and a large amount of time.

If a simulated planetary atmosphere containing methane, ammonia, hydrogen, etc. but not oxygen, is provided with an energy supply adequate to break the bonds of these simple molecules, some rearrange into more complex molecules, provided the complex products are protected from being dismantled themselves by the energy supply. Such protection can be provided by dissolving them in water, simulating the conditions of an oceanic environment for the first life. The energy supply itself need not be very specific - ultraviolet light, electrical discharges and simulated cosmic-ray particles have all been shown to produce synthesis of aminoacids in lab experiments (aminoacids are a basic constituent of proteins).

The ideas of an atmosphere without oxygen and a watery shelter for the early chemical precursors of life fit in well with what is actually observed in the fossil record - that the oldest known organisms were simple marine plants. The oxygen-breathing animals did not evolve until several billion years after plant life (which produces oxygen as a waste product) first appeared on Earth.

Lab experiments lack, of course, effective simulation of the passage of time on a geological scale. But there have been attempts to overcome this at least partially by beginning new experiments with the concentrated products of previous ones. In this way, non-biological synthesis of simple carbohydrates, fatty acids, chains of aminoacids resembling proteins, and (in the presence of phosphorus) the energy-carrying ATP, have all been demonstrated.

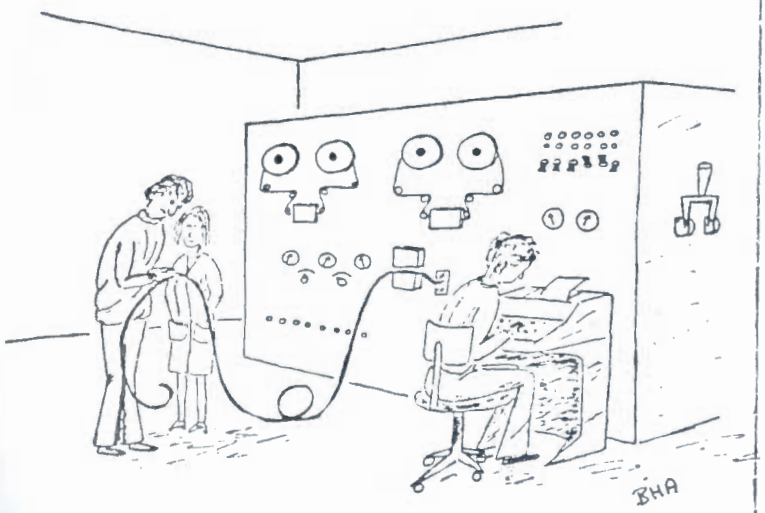
Of course, no living organism has yet appeared in such experiments. True "test-tube life" has yet to be created. A major hurdle still to be overcome is to demonstrate the non-biological synthesis of the nucleic acids with the blueprints for the molecular chemistry of organisms. But the trend of these chemical experiments is strongly towards the conclusion that, given a planet with the right kind of chemical environment, given an energy supply from a star, and given several billion years, the evolution of LAWKI is probably inevitable.

The requirement of billions of years does not pose an astronomical problem. The single, slowly-rotating stars like the Sun which are anyway the ones most likely to have planets are also capable of maintaining a fairly steady energy supply to permit the evolution of life over such a time period. So the odds seem strongly in favour of at least a billion possible homes for LAWKI in our own Milky Way galaxy. The nearest likely candidates are only about ten light years away.

Ten light years is a distance utterly beyond our society's capacity for travel, but well within its capacity for radio communication, if we imagine our bigger radio telescopes being used to transmit signals from our most powerful radars at one end, and similar telescopes with current state-of-the-art receivers being

used as detectors at the other. Indeed, in those terms, we might expect somewhere in the order of a hundred thousand possible sites for LAWKI to be within our present "radio communications range".

But on how many of those sites might there be an intelligent, interested civilisation transmitting a signal that we could detect at ARO? Exactly where should we look, and at what frequency? Turning the numbers that I have ventured above into a strategy for detecting extraterrestrial life involves many further questions, which I hope to explore in a second article.



It says, "NOT NOW, I HAVE A HEADACHE".

John Houseman, winner of the best supporting actor award, has long distinguished himself as a producer of the stag and screen. - The Ottawa Citizen

Art's all very well, but a guy has to make a buck too.

ETI ANYONE?

The Project Ozma and/or interstellar travel enthusiasts who eagerly await a communication from the twentieth-century version of the Great Beyond seem to be somewhat apprehensive about their ability to decode a message if it should appear.

It came to my attention recently that the magnetic letters scattered over my refrigerator door present a very similar sort of problem: seen in the early hours of the morning through the vapour rising from a strong black cup of coffee, they look exactly like the type of message one might expect from a zealous but slightly misguided nocturnal visitor anxious to establish communication with Planet Earth.

Purely in the interests of science, I would be willing to rent my refrigerator door, for a modest fee, to any individual interested in tuning in to the magnetic broadcast. The coding problem alone makes it worthwhile.

As a free sample I offer the following message, arranged silently, but deliberately, sometime in the early hours of Wednesday morning.

$$\mathfrak{G}_{X}$$

$$\text{FAAT} \div \text{U9}_{L^{1}}$$

followed by

MRS PQ = H

The last line undoubtedly represents a comment on the social conditions among the ETI. Apparently WL has not had any great influence on them yet.

C. Purton

The Observer would welcome an exact interpretation of these messages from any TI among the readership. The upper message, for example, seems to be some advanced form of postal code.

Going into Receivership

with Bill McLeish

LINE RECEIVER CALIBRATIONS

The nice part about automatic calibration is that one ceases to worry about the mechanics of converting voltage (or chart deflection) into input temperature. One is free to dream happily about the results of the experiment.

But there is always a nagging doubt - what does go on in there anyway?

Because we detect at a fairly high level (> 10 dbm) the output voltage of the spectrometer is proportional to (input power)$^{\frac{1}{2}}$. Therefore to convert the output to temperature in terms of calibration temperature, all the integrated voltages are squared at the end of each minute's integration.

Then

$$T_{out} = \frac{E_1^2 - E_2^2}{(5E_{cal})^2 - E_1^2} T_{cal} ,$$

where the factor 5 on E_{cal} accounts for the difference in time spent on calibration and the other switching phases.

Admittedly this is not the same result as squaring the voltages *before* integrating, which a square law detector would have effectively done, but for a random noise input the end result is practically the same.

With the above algorithm, each channel is individually calibrated, but there is a built-in nasty. If perchance the balance gets out of hand so that $E_1 - E_2$ approaches or exceeds $E_{cal} - E_1$ two things happen, both bad. First and worst the variance of T_{out} rises dramatically and second, errors due to non-linearity of the channels start to become significant, especially for long integration times.

But wait, there is hope. An algorithm tried by S. Weinreb and used on NRAO filter systems suppresses the errors by making $(E_1 - E_2)/E_1$ the critical ratio.

If we can assume the system noise is constant over the window, we can put

$$T_{out} = \frac{E_1^2 - E_2^2}{E_1^2} \cdot \overline{T_{sys}} ,$$

where $\overline{T_{sys}}$ = mean over 100 channels of

$$\frac{E_1^2}{(5E_{cal})^2 - E_1^2} \cdot T_{cal} .$$

The assumption about system noise seems to be valid and the method works. Just put switch 7 ON on the command console to get "Weinreb calibration".

All this was of casual interest while we were using Dicke switching because good balance was easy to get. On total power

the "balance" is really the value of $E_1-\overline{E_1}$, that is the roughness of the receiver response over the window. It was just possible to make it good enough for one frequency setting of the receiver but moving around the band ruined our delicate setup.

With Switch 7 ON that limitation has disappeared and the output noise level hold the line over full paramp tuning range.

Bill McLeish

WHAT WE NEED IS LESS PUFFERY AND MORE GOOD-ENOUGHERY

I believe it was Oscar Wilde, though it may have been another eminent Victorian, who first discussed the fine art of "puffery". Puffery consists of blowing up (or puffing up) any piece of work in order to make it sound or look more impressive.

We are all guilty of this to some extent; immediate examples which spring to mind include those of the tradesman who has "clients" rather than customers, the sewage worker who is "in Sanitation Engineering", and so on.

I do not propose, since I am not qualified, to describe astronomical puffery - this can be left to the guilty consciences of astronomers themselves. But I would like to bring up, from the world of circuit design, an absolutely stunning example, which is really so stupendous as to take one's breath away, and to offer a possible explanation.

It concerned the publication of a short paper which concluded with a series of computer-derived tables, the relevant entries in the table being plotted as a family of curves. It was explained that the computer had actually drawn the curves (through the medium of an interfaced analogue plotter) and the usual expression of gratitude for the use of the computer installation at the particular institution was added. The paper was published about five years ago when there were fewer computers and they were less accessible than is now the case.

The curves, which were the raison d'etre of the entire paper, made up a family with y plotted against x for several integral values of r, where 1/y is defined to be the absolute value of the function

$$\left[\sin\tfrac{\pi}{2n}+j(x+\cos\tfrac{\pi}{2n})\right]\left[\sin\tfrac{3\pi}{2n}+j(x+\cos\tfrac{3\pi}{2n})\right]\ldots$$

$$\ldots\left[\sin\tfrac{(n-1)\pi}{2n}+j(x+\cos\tfrac{(n-1)\pi}{2n})\right]$$

if n is even, and a similar function which ends in (1+jx) if n is odd.

"Very well", I hear you say, "what is wrong with that? Surely a legitimate use of the computer to reduce the arduous labour of computation and release the mind for more productive things?"

The answer is that the above function is simply a complicated way of putting $y = (1 + x^{2n})^{-\frac{1}{2}}$, the well-known Butterworth "maximally flat magnitude" function, which can be evaluated by slide-rule, pocket calculator, or even, on logarithmic paper, plotted at once from the "6 DB per octave per pole asymptote" rule with nothing more than a ruler and a good eye.

My explanation for this fantastic piece of puffery is that the author was forced to exist in a ruthless "publish or perish" environment and that the temptation to pull the wool well and truly over the eyes of the faculty committee on tenure was simply too strong to resist. Personally, I wish him well, and hope that he will go on to become at least a dean if not a president. He is well equipped for the struggle for survival.

After the above example anything else is sure to be an anti-climax. However, we are all familiar with technologists who

look with contempt on any piece of equipment, regardless of whether it performs satisfactorily or not, which does not contain the very latest medium scale integration of integrated circuits (MSI of IC's is the trade jargon).

By a steady extrapolation of this tendency, an engineer might easily manage to quadruple the cost of his equipment and gain some notoriety as the resident expert by steadfastly insisting that all new custom electronic equipment for which he was responsible would be built using thick film hybrid technology.

He would eventually become so busy shuttling to and from the nearest thick-film "house" that he would have little time left to do any work. This would be regarded as Progress, and his reputation as "the" expert would be secure. He would serve on many committees and be called in as a consultant by other institutions.

Of course, what is really in question here is the ability to discern that the two environments of design for high-volume production, and design of one or two units are fundamentally different, and that the gulf between them is growing wider. For some reason design "for production" is always felt to occupy a higher step on the ladder than does custom design and so the techniques appropriate to the former are often carried into the latter purely as a matter of snob appeal. One sees this just as much in small companies as in research organizations.

Astronomers and physicists seeking special equipment from engineers and technologists should always be on guard against puffery. They should always keep in mind that most of their requirements are for one or two units and should insist on the simplest solution, using parts and equipment that are available whenever possible. They should be prepared to resist arguments which suggest that newer techniques be used for their own sake.

Above all, they should remember that these newer techniques do make good economic sense, but only if you are planning volume production of your design.

R.S. Richards

RECEIVER NEWS ITEMS

At the moment the 2.8 cm paramp can be balanced only by injecting noise into the main beam channel. There is therefore an extra attenuation deliberately inserted in the reference channel. This extra loss adds about 20° of noise to the reference and ensures that the receiver can always be balanced.

The receiver is going to be altered so that balance noise can be injected into either channel. The reference attenuator can then be discarded and the system noise should decrease to 90 K or 100 K. Because of delays in the supply of parts, the estimated date of the alteration is late summer.

Why was the receiver not designed this way in the first place? You may well ask.

****

The date of completion of the new 4.8 cm, 50 K system temperature 400 MHz BW paramp is now August-September 1974. In November 1973 the target date was April 1974, but there have been four months of progress since then.

****

The 400 MHz receiver has been remodelled. It has a new wide band transistor preamplifier with a noise temperature of 175°. The receiver can now be used at any frequency between 250 MHz and 500 MHz with an instantaneous bandwidth of up to 30 MHz. The frequency is determined simply by the local oscillator setting.

****

The 9.4 cm paramp operates only with a single beam. The weather causes no

serious difficulties at 9.4 cm and there is not enough space inside the feed tube for two 9.4 cm horns side by side. In addition to that, the range of the nodder is not sufficient to cover a three beamwidth separation at 9.4 cm.

However, the main beam signal must be Dicke switched against something, and in the absence of a reference beam that something is a cold load. Unfortunately the cold load is 55 K warmer than the sky. We are going to introduce a second beam as an alternative to the cold load, thereby reducing the system noise by 55° to about 220°.*

This second beam will not be a duplicate of the main beam, because of the above restrictions, so it will probably be useless for observing, but it will provide a cold reference. It should also be possible to use the system in the hub.

Why was the receiver not designed this way in the first place? You may well ask.

****

The new dual bank filter spectrometer will be tested in June and should be working by the first part of next quarter. At first only the 30 KHz, 100 KHz and 300 KHz filters will be compatible with total power operation. The 10 KHz and 900 KHz filters will require Dicke switching. They will be converted to total power operation as soon as parts arrive, probably in late summer or early fall.

When the system is completed the observer will be able to use simultaneously any two 100 channel filter banks that have bandwidths with a three to one ratio.

****

More about 9.4. You may have thought that it is handy to have the 9.4 cm receiver in the hub, so that you can observe if it rains. At 9.4 cm, it is well known one is immune from rain. Ha! Not with our telescope.

If the 9.4 receiver is in the hub, it produces an impressive set of very large spikes in the output at very frequent intervals. These spikes are undoubtedly due to blobs of water cavorting on the milar window which covers the vertex feed horn. Looks like another minus for the Gregorian system (see page 28). Sorry about that.

****

The new super heppedupperodyne local oscillator system, which will be used for all receivers present and future, will be completed in late summer. It is again delayed by the non-arrival of parts.

When the device is finished all receivers will have a common computer-controlled local oscillator. There will be no further need to dash madly up and down the basement stairs, breaking nails on synthesiser buttons and twiddling rubber crystals, while at the same time calculating the frequency of the 225th harmonic plus or minus 26.5 MHz and going cross eyed watching the sine wave jump on the oscilloscope as you depress the lock box trigger button with your thumb and delicately turn the tuning control with your forefinger. Your left hand is free to play with your yoyo.

Be prepared for three weeks of chaos when the super hepperdupperodyne system is installed.

****

Yet more about 9.4. And 1.3. Someone, somewhere, forgot to mention to the astronomers a small detail about the 9.4 cm and 1.3 cm receivers. They do not have square law detectors. They have linear detectors that, paradoxically enough, produce a non-linear d.c. output. In short, the deflection produced by a source is not

*We hope

proportional to its flux density, but is a non-linear function of it.

It turns out that the effect is not important unless the antenna temperature produced by the source is greater than 10% of the system noise. This happens rather less frequently at 1.4 cm than at 9.4 cm, but if you have been observing strong sources with these receivers, you'd better check your results. Bill McLeish can supply you with graphs of the appropriate corrections. The receivers will be changed back to square law detection in late summer.

Why were the receivers designed this way in the first place? You may well ask.

B.H.A.

MEASURING UP

The Secretarial and Technical Support Staff of CRESS at York University are undergoing Job Re-evaluation. We reprint the following from the CRESS News without the kind permission of the Director.

PERFORMANCE FACTORS	FAR EXCEEDS JOB REQUIREMENTS	EXCEEDS JOB REQUIREMENTS	MEETS JOB REQUIREMENTS	NEEDS SOME IMPROVEMENT	DOES NOT MEET MINIMUM REQUIREMENTS
QUALITY	Leaps tall buildings with a single bound	Must take a running start to leap over tall buildings	Can only leap over a short building or medium with no spires	Crashes into buildings when attempting to jump over them	Cannot recognize building at all, much less jump
TIMELINESS	Is faster than a speeding bullet	Is as fast as a speeding bullet	Not quite as fast as a speeding bullet	Would you believe a slow bullet?	Wounds self with bullets when he attempts to shoot
INIATIVE	Is stronger than a locomotive	Is stronger than a bull elephant	Is stronger than a bull	Shoots the bull	Smells like a bull
ADAPTABILITY	Walks on water consistantly	Walks on water in emergencies	Washes with water	Drinks water	Passes water in emergencies
COMMUNICATION	Talks with God	Talks with the angels	Talks to himself	Argues with himself	Argues with himself and loses

THE NIGHT OF THE GUANO

by

Vic Gaizauskas

Anyone familiar with the kaleidoscopic activity housed in NRC's REED building should not be too surprised to find a group of optical solar astronomers squirreled away among the gnomes that tinker with antennas, receivers, computers, etc. To understand how they got there and what they are doing, we have to look back at the early history of astronomy in Canada.

Eclipsed

Even before the Dominion Observatory was founded at the turn of the century, some of its future staff were making daily sunspot drawings with a small instrument* located at a temporary observatory near Parliament Hill. This may come as a great surprise to those who have doubted that any light was ever usefully shed in that vicinity.

Soon after the Observatory opened its doors for business in 1905, a horizontal solar telescope of the coelostat form was acquired. The coelostat was one of the largest of its kind when it was built, and had a twenty inch primary mirror flat, and an eighty foot focal length concave telescope mirror.

Its first task was to photograph the total solar eclipse of 30 August 1905, at the Northwest River in Labrador. This eclipse expedition is a remarkable story in itself, but suffice it to say that despite ambitious and thorough preparations so characteristic of J.S. Plaskett, the effort was completely wiped out by clouds.

The coelostat was brought back to Ottawa for permanent placement at the new Dominion Observatory, and there a funny thing happened. Perhaps it was pique brought on by the failure of the eclipse project, or possibly aesthetic considerations prevailed over scientific common sense in a less hectic era. Whatever the reason, the coelostat was planted on the *north* side of the Dominion Observatory, thereby ensuring its near-total eclipse for three months each year.

At the International Solar Conference of 1910, the Observatory was one of several assigned the task of determining the law of solar rotation by spectroscopic means. For many years thereafter, the entire solar disc was photographed on plates daily (image size nine inches!) partly to provide backup data for the solar rotation program and partly to investigate the influence of solar activity on terrestrial phenomena.

Both the solar rotation project and the daily sunspot records came to an end with the retirement in 1949 of Ralph E. De Lury, Canada's first full-time solar astronomer.

The Modern Era

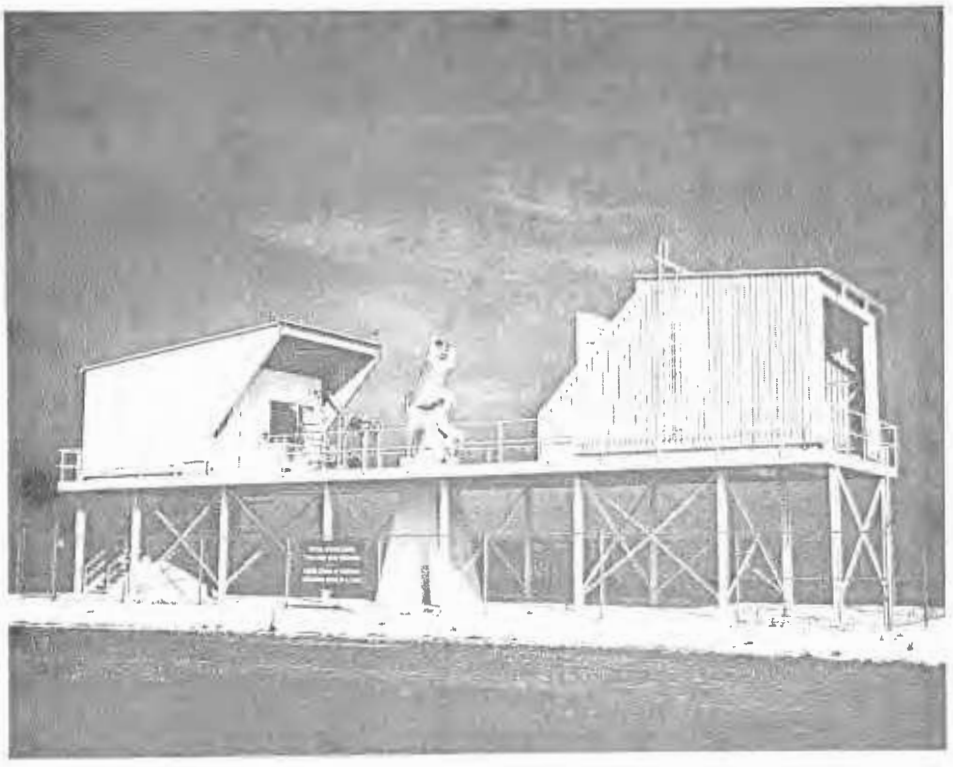
When Jack Locke took over the solar program at the D.O., the emphasis in solar activity research was placed on the chromosphere.

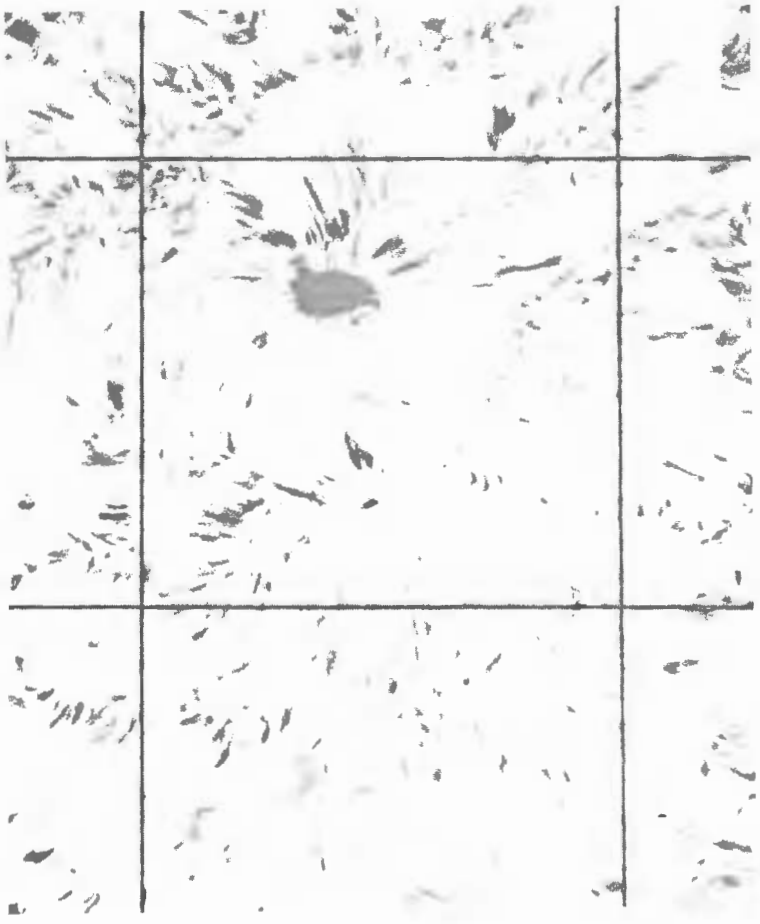
A Lyot narrow band filter was acquired in 1951 and with it the Observatory operated a hydrogen-alpha flare patrol from 1957 to 1966. Observations with small-scale images of the full disc on 35 mm film allowed rapid identification and simple classification of flares, but did not provide many useful clues about the physics of flares.

Experience gained on this project showed that a useful study of flare dynamics would require much larger images and elaborate cinematography.

The erection of the Sir John Carling

**commonly called a pencil*





Upper: the Ottawa River Solar Observatory. Lower: an ORSO picture of an active solar region taken in the red wing of the H-alpha absorption line.

Building on the Experimental Farm, a structure that overshadows the D.O. from the east, clearly signalled the end for serious solar observations at that location. Site testing for a new installation was carried out in earnest from 1966 to 1969 and culminated in the construction of the Ottawa River Solar Observatory on (and sometimes in) Shirley's Bay.

The ORSO site is on Department of National Defence property, 1 1/2 miles east of the radio quiet site operated by the Communications Research Centre, and about 2 miles northeast of the Connaught Rifle Range. The presence of water around the Observatory helps to stabilize turbulence in the lower air layers flowing over the site and leads to extended periods of good seeing. As an added bonus, the view of the Ottawa River is magnificent.

Exposed

The chief instrument at ORSO is a multi-compartment tube, usually called a spar, with provision for several optical telescopes to be trained on the sun at one time. A photoelectric guider locks the entire equatorially mounted assembly on the centre of the sun's disc to within 1/2 arc sec rms on calm days of good seeing.

The telescope sits on a solid concrete column about 15 feet above finished grade and is enclosed in a long steel clad shelter that rolls apart in two halves to create a large working area with free air circulation throughout.

This departure from conventional dome design eliminates seeing deterioration by entrapped air, but it leaves the telescope completely exposed to wind shake. In midwinter, it also leads to rapid observer deterioration that can be relieved only by frequent visits to the coffee jug in the control room, the consequences of which can be relieved only by frequent visits, etc., so that we can truthfully say the winter brings a continual flow of activity to ORSO.

We now have the major optical system of the spar in nearly full-time operation. This system is designed to photograph a single active region in monochromatic light at high time and spatial resolution in two wavelength bands simultaneously: a narrow band (0.25Å) that is stepped between successive exposures across the Hα profile to provide data on chromospheric features at different atmospheric depths; a fixed wide band (60 Å) that provides an image of the underlying photosphere for accurate registration on the chromospheric images.

A single 10 inch aperture f/40 folded refractor is used to provide the 4.2 inch diameter images for the two wavelength bands. All images are recorded with 35 mm cine cameras.

The camera exposure rates, the sequential wavelength tuning of the narrow band birefringent filter, and numerous other functions are controlled by a PDP-8L processor housed in a control room on the same level as the observing platform.

Future additions to the spar include a 6 inch aperture vacuum telescope for granulation studies, and a 4 inch aperture full disc flare patrol telescope.

Unwanted Visitors

Scientific visitors are always welcome at ORSO and need only make their interest known to one of the staff members. Because of its isolated location, transportation has to be arranged about a day in advance.

The site is not open to the general public. However, we are frequently plagued by unauthorized visitors.

The most offensive type are the sturnus vulgaris (sub-species: Lamontagniae) who infest every nook and cranny of the building in early summer. Somehow their common name, starling, drops far behind in describing the odious habits of these foul mini-fowls. The most belligerent activity on our part has so far failed to discourage them from gaining entry to the Observatory. By mid-summer, ORSO is one of the main guano repositories in the Ottawa Valley.

Anyone wishing to avail themselves of this rich source of plant nutrient is welcome to do so. We cannot deliver, but will let you pick up what you need at any time.

Some people put a lot of effort into

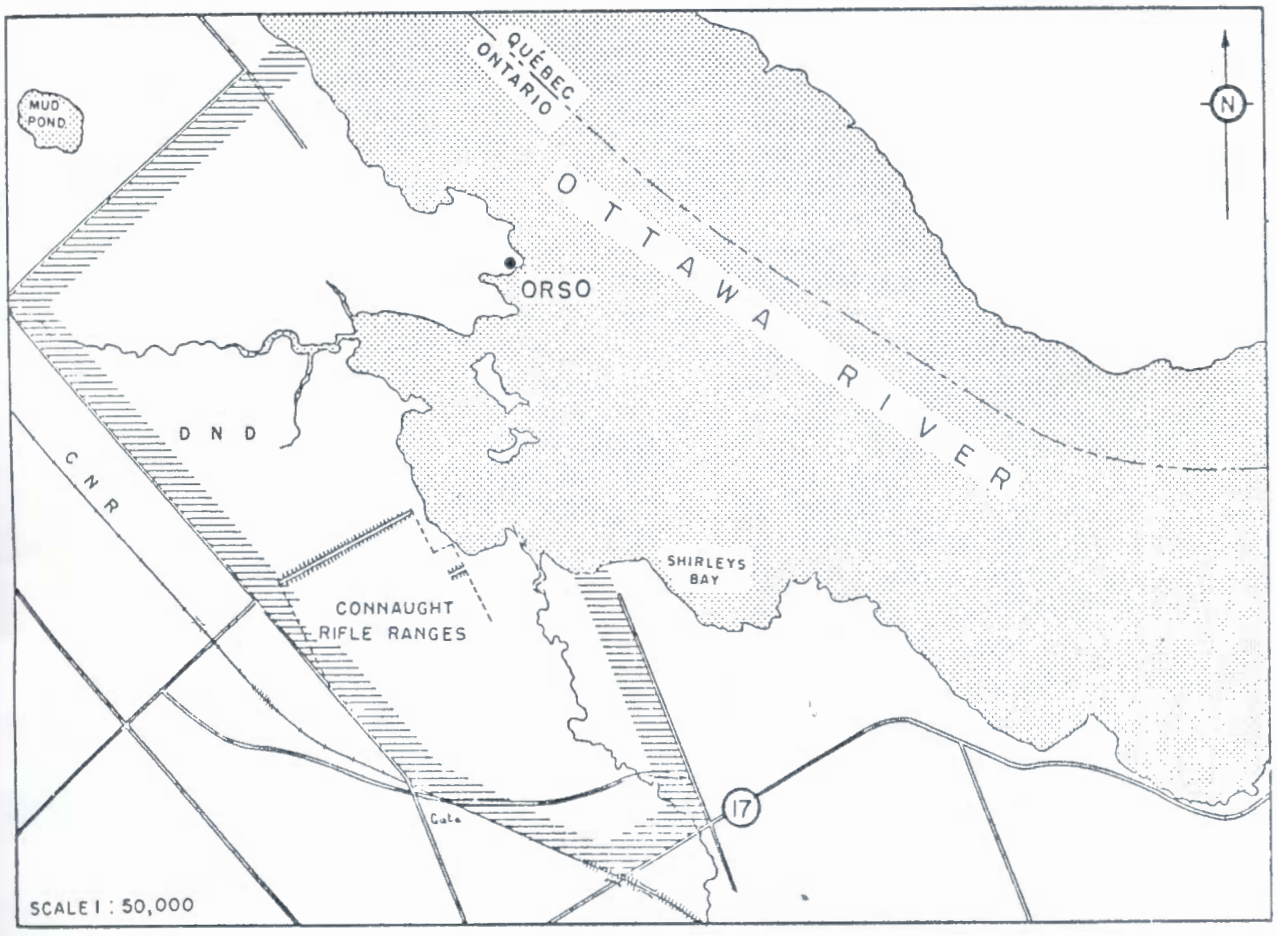
debugging their systems and programs. We have to demice ours. This species of unwanted visitor has created havoc more than once by committing hara kiri inside power supplies or even nastier deeds all over the logic circuit boards.

As for unwanted humanoid visitors, the kind who are given to snide remarks, we don't turn them away. Instead we encourage them to take a self-guided tour of a fascinating archaeological site about 2 miles southwest of the Observatory.

After a mildly strenuous tramp through swamp and forest they will come across many narrow mounds erected by an earlier civilization in a perfectly rectilinear array. This site is best visited in early August when it is the scene of a bizarre religious celebration marked annually by a mysterious cult that decks the mounds and its encampments with a blizzard of gaily coloured flags and pennants.

If one presses close and watches carefully, one will see the devotees prostrate themselves before the mounds and actually bark at them in savage, angry tones. The scene is so unusually exciting that anyone we've sent on the tour has been unable to tear themselves away from it.

Or at any rate, they've never come back.



THE NUMBERS RACKET

by

Lloyd Higgs

With the long awaited hiring of a programmer now a reality, future plans for the computer support group (consisting of myself and our new numbers man, Milan Javor) can be formulated.

We have a few works in progress plus, of course, the major project of making the computer control system of maximum usefulness to anyone who wishes to use it. Also, there are a few minor jobs that may be of interest to no one but which we feel may be fun to do.

In this latter category, I feel we might start a small reference system which stores (for retrieval) details of objects (or areas) of which maps or spectra have been produced at ARO or DRAO. (This is what attendance at one conference on information retrieval can do to a person.)

In more detail, some of the tasks which face us, along with a few notes on current progress, are:

(1) An immediate revision to the line receiver on-line program. This revision is underway and a new system tape should be available by February.

The major change is that magnetic tape dumps (in floating point format) of the ONSO, OFSO and SPECTRUM buffers will be possible, using the PSPC command. This will permit complete off-line processing of data for anyone desiring it. In addition, dumps of this sort can be read back into the system by the LDSP and AVSP commands. To support this facility, logging commands have been added to the system so that one can log the data on a magnetic tape.

Minor changes are:

(a) The SPCR command will put the regression spectrum in the SPECTRUM buffer.

(b) Comments (for magnetic tape dumps) can be entered during observations.

(c) The RCVR command is withdrawn.

(d) All reference to "operational notes (SW23)" is removed.

(e) The commands, BASE, RMSN, FITB and SPCR all use the same defaults for channels to be omitted. This has made it necessary to change the RMSN and BASE commands somewhat. In any case, the user is always told which channels have been deleted.

In connection with this (which we hope will be the last) revision of the Mark I line receiver system, a revised manual is in the works. It is an attempt at an up-to-date manual, including reference to total power operation. In order to make further revision less arduous (for the Mark II system, see below), it is being computer type-set and should appear around May 1974. Details of the features of the new system will be outlined in a "Computer Newsletter" in the near future.

(2) The Mark II line receiver system, which will control the new double bank spectrometer,† should soon enter the design stage.

If feasible, we would like to change the command repertoire as little as possible (perhaps only with the addition of a BANK command which designates the filter bank to be inspected and/or processed). We plan to start work on this system in February. A meeting of spectrometer users was held in late November to discuss design concepts.

(3) Improved IBM 360 software has been developed to read the magnetic tapes from the spectrometer system.

A "logging program" is now available which lists telescope and observational parameters for all the spectrometer dumps on a tape.

(4) The mapping package written a year or so ago by myself, which has been used

†*See ARO Observer, No. 2, p. 13.*

with qualified success by brave souls at York, Queen's and Toronto, will be undergoing some improvements.

These improvements stem from modifications made by D. Steer (who worked with Norm Broten for the past two summers) and modifications made by myself for a similar package at DRAO. They include such things as:

(a) The partial elimination of the broad borders (over which the user had little control) on maps of ARO data.

(b) The indication of depressions on contour maps.

(c) Improved lettering (larger).

(d) Gaussian fitting procedures for the derivation of source fluxes.

(e) The choice of either a side or a front view for ruled surface plots.

(f) Plus many other goodies.

In addition, an effort will be made to write a manual describing the package and how one uses it.

(5) Support software for the ARO control system will be a continuing project.

At the moment, the AQ routines available for control applications are few in number and documentation is sparse. Clearly, if the control system is to be used to its full potential, a lot of effort must go into new routines. In particular automated polarization routines and automatic pointing and focus determinations are needed.

One of the first tasks for our new programmer will be the organization (with the cooperation of the ARO computer group) of the documentation of the existing software at ARO. We have become rather lax in this respect in the past two years.

In this connection, it might be noted that the new manual for the ARO computer control and data acquisition system is ready. (By the time this is published, it will probably be on many of your desks.)

If anyone reading the "ARO Observer" wishes to have a copy of this latest masterpiece from Jim Wolfe's pen, they may obtain one by contacting him or myself.

Since my return from B.C.,* the only control support which I have tackled has been the elimination of an error (spotted by Andy Woodsworth) in the pointing error correction routine in the control system. I think the modification which has been implemented is successful.

In addition, a new off-line module, designated PCRV, has been written for the ARO computer and may be of interest to some of our users.

This program, given the current values of the four telescope pointing errors, produces a list of corrected dial positions, zenith angles, parallactic angles, etc. for a given source and a range of hour angles. The module will be placed on the System B tape and may be run when the control system or spectrometer system are not in use.

(6) It is hoped, as stated above, that we will be able to devote some time to the development of a cataloging system for ARO observational data, if only on an experimental basis.

It would appear that we have a busy year ahead of us but we would like to hear from users about the control software they would like to have written and also any suggestions as regards the Mark II spectrometer system. We can't guarantee that such suggestions will always be followed but we would like to have a feeling for the desires of the user community.

*see: *Winkle, Rip van, vol. 1, p. 33.*

'What dost thou mean, "don't call us, we'll call you"?

ALOHA AU GRAND KAHUNA DU MAUNA KEA

par René Racine *

lexique hawaiien;

ALOHA: salutations, allô! au revoir, meilleurs voeux; mot employé à défaut de toute autre connaissance de la langue indigène.

KAHUNA: prêtre, sorcier (généralement bénévolent), protecteur; symbole de la superstition indigêne des îles Hawaii.

MAUNA: colline, montagne, massif volcanique.

KEA: blanchi (par la neige), brumeux, nuageux. Peut être appelé à devenir une mise en garde universellement reconnue chez les astronomes.

L'un des caractères les plus frappants de la mentalité indigène Hawaiienne, ou de ce qui en reste après les mains-mises américaines et nipponnes sur ce territoire, est une grande tendance à la superstition.

Pour un Hawaiien tout est chance ou malchance et l'issue de telle ou telle aventure sera heureuse ou malheureuse selon la disposition des dieux. Il est nécessaire pour assurer un bon dénouement de tenir compte de nombreux taboos et, surtout, de s'assurer de l'intercession du plus puissant Kahuna disponible.

Il ne fait aucun doute que le triste sort que le capitaine Cook a rencontré aux îles Sandwich et qui a coupé court à ses expéditions astronomiques (?) vient de sa négligence à prendre les précautions rituelles nécessaires.

Or il est bien évident que cet aspect magique est complètement négligé dans le projet du télescope Canada-France-Hawaii et l'on peut se demander si toute une armée de Kahunas ne devrait pas être mobilisée pour protéger cette entreprise.

Lors de ma récente visite à Hawaii j'ai pu repérer certains taboos dont les astronomes devraient tenir compte et j'ai même pu vérifier la justesse de certaines croyances indigènes qu'on insiste à qualifier de superstitieuses.

La légende indigène veut que la vallée entre Mauna Kea et Mauna Loa, les deux grands volcans de l'île d'Hawaii, soit hantée la nuit et que tout individu qui s'y aventure entre le coucher et le lever du soleil risque de s'attirer l'ire des dieux.

Il ne fait aucun doute que l'épaisse brume qui, chaque nuit, envahit la région n'est guère propice à la circulation. Je sais quatre astronomes qui, tout récemment, ont bien failli disparaître dans le décor de flore tropicale et de coulées de lave à un virage serré et glissant de la "Saddle Road". Heureusement qu'un Kahuna en maraude sut réveiller à temps le conducteur sinon le Conseil Scientifique Consultatif s'eut vu privé (libéré?) de certains de ses membres les plus réactionnaires.

La croyance locale veut aussi que le sommet du Mauna Kea soit maudit et que le cône volcanique le plus élevé du sommet, le plus haut de l'archipel, soit la résidence de l'esprit du Grand Kahuna.

On sait qu'il est défendu d'installer quoi que ce soit sur le plus haut sommet et que la construction du télescope de 2.2 m de l'Université d'Hawaii, sur un pic inférieur, a dû être accompagné de rites appropriés pour satisfaire aux coutumes locales.

Le Bureau de Direction du 3.6 m a-t-il songé à ce propos à réserver les servi-

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* *Brillant jeune astronome français de l'université de Toronto.*

Sotto voce: Mais s'il est si brillant, pourquoi est-il à Toronto?

ces d'un sorcier compétent? Ou faut-il que le Conseil Scientifique s'en occupe? Je doute que le couvre-chef d'un certain grand opticien canadien le qualifie pour ce rôle mais les Hawaiiens verraient peut-être d'un bon oeil l'installation d'un réseau d'autels de sacrifices au sommet du volcan.

Les astronomes canadiens sont, comme on le sait, des individus tout a fait raisonnables qui ne sauraient être impressionnés par rien d'autre que des arguments logiques et qui n'ont que faire d'histoires de bonnes femmes. Peut-être devraient-ils quand même tenir compte d'une autre superstition hawaienne selon laquelle tout objet ayant déjà été lié à un mauvais sort porte malheur avec lui.

On peut citer à l'appui de cette opinion l'histoire de la fameuse tour météorologique que le Bureau de Projet a installée sur le site en juillet pour mesurer les turbulences microthermales. Jusqu'à présent (novembre) aucun résultat significatif n'a été obtenu soit parce que les thermocouples sont détruits par des poussières portées par grands vents, que l'électronique soit en panne ou que les vents "dominants", présage de ciel clair, refusent de souffler depuis que la tour a été érigée.

Certains auront déjà deviné qu'il s'agit là du même équipement qui décorait autrefois un autre fameux site, canadien celui-là, proposé pour le grand télescope et qui, lui aussi, aurait eu besoin de l'intervention la plus efficace du Grand Kahuna (l'auteur ignore le nom donné au Kahuna en Colombie Canadienne *).

J'arrête ici mon essai sur les besoins de sorcellerie dans le projet du télescope de 3.6 m et je me hâte de dire qu'il est écrit "avec la langue dans la joue". En terminant je suggère une incantation que devrait réciter tout astronome en route pour Mauna Kea:

O Grand Kahuna du Mauna Kea
Let the trade winds blow
Arrête, du volcan, le flot
Rappelle moi que 1 plus 2 font 3
Et garde mon dîner dans mon estomac.

---

* *Wacky*

AT THE TOP OF MAUNA KEA,

13,700 FEET ABOVE SEA LEVEL

"Disorientation is a good way to describe it, but it is not easy to be specific.....I found it difficult to concentrate on what was right before my eyes - it was as if everything was being seen with peripheral or averted vision. At the beginning I experienced a feeling of nausea quite likely associated with my disoriented sense of the vertical. The latter made me walk with a peculiar gait when I first set out for the site. I had a tightness or mild ache between my temples." - D.A. MacRae, in the David Dunlap Doings

My advice is to lay off the fruit punch at those luaus.

"The road winds around and between ancient cinder cones and is now being regraded and paved as far as Halepohaku which, as the name implies, is simply a stone house to shelter hikers and campers at about the 10,000 foot level." - D.A. MacRae, in the David Dunlap Doings.

And if you don't speak the language, it's a long way to the next one.

SOLID STATE DRIVES FOR 46m RADIO TELESCOPE

For all those astronomers and others who may have wondered why it was necessary to generate "all that noise" upstairs in the 46m radio telescope - well, you can forget it!

The "noises" - two 50 HP motor-generator sets - have been removed and in their place two solid state converters now perform the same basic functions, one for each telescope axis. The change-over was made during an extended "Maintenance and Development" period from 2-19 November 1973.

Each drive system is essentially a DC power supply which provides sufficient output for the DC Servomotors to drive the telescope at all speeds up to the maximum rates for either axis under normal loading conditions.

DC power is derived from a dual converter, controlled thyristor bridge arrangement which is supplied with 340 VAC 3 phase 60 Hz via an isolating transformer.

Thyristor firing is controlled by servo error voltages of up to 30 VDC via a differential input amplifier and logic control circuitry. Four quadrant operation of the dual converter allows forward or reverse motoring, or regeneration at the maximum rating for an indefinite period.

The dual converters are based on the Westinghouse RAPCON 70 system, but with modifications for our specific requirements. The output of each unit is rated at 400 VDC, 250 ADC, but operating limits are set at lower levels in this application.

Protection of the dual converters and the servo drive motors from malfunctions, overloads and power failures is provided by a combination of magnetic overload breakers, thermal trips, shunt trips, bridge fuses and logic monitoring devices. A failure in either unit will automatically remove power from both and apply the telescope brakes in both axes.

The new solid state drive systems, depicted in skeleton line diagram at fig. 1, were jointly developed for this application by ARO technical staff in cooperation with Westinghouse Canada Ltd., Hamilton. Installation of the two systems was carried out by ARO Site 3 technical staff.

If the new solid state drive systems do essentially the same job as the original motor-generators, the layman may well ask "why change"? The answer is that the old systems were too prone to catastrophic failure.

Each motor-generator set comprised a 50 HP synchronous AC motor driving a Metadyne Exciter and a main DC generator, all coupled to a common drive shaft rotating at 3600 RPM. This six-bearing arrnagement - i.e. 12 bearings total - averaged one bearing failure per year; every second failure caused extensive damage to armatures, poles and bearing housings such that repair times took from one to six weeks. Latterly we had been operating without essential spares, so repair times could have been much longer.

In these circumstances change was not only necessary, it had become imperative. Hopefully, we are now less likely to experience such catastrophic drive failures.

Apart from expediency, other advantages have been gained by the change-over to solid state drives:-

(a) A full range of servicing spares are now held.
(b) Spares now cost much less.
(c) Noise and vibration are greatly reduced.
(d) Lower level input drive signals to the converters will facilitate later replacement of the main servo-amplifiers with solid state units.

In order to maintain the specified stability of the new solid state converters, it has been necessary to install an air conditioner and insulate the old "Machine Room" - now re-christened "Drives' Room".

The air conditioning equipment, insulation and panelling were all installed by ARO technical staff.

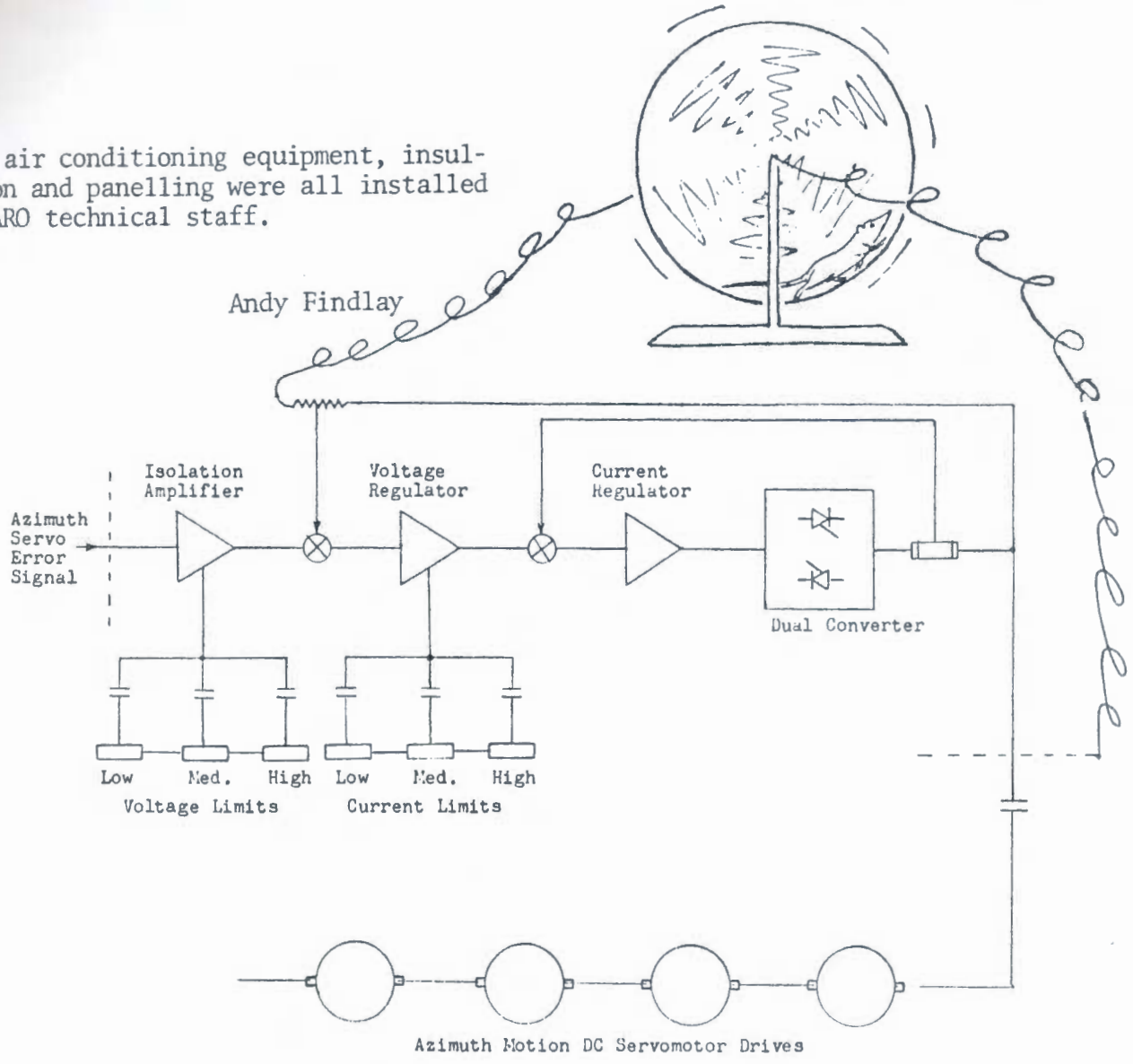


Figure 1 - SOLID STATE DRIVE SYSTEM - Skeleton Line Diagram

(Note : Zenith Angle Drive is similar)

ENERGY CRISIS

The following message was relayed to us by John Galt. It appeared mysteriously in a page of printout of pulsar interferometer fringes made a few years ago at ARO. It has just been declassified by the Canadian Government, which has just been declassified by the CIA.

1452 1378 1587 1772 1635 1582 1678 1662 1581 1518
1395 1353 1582 1452 1450 1468 1427 1655 1461 1451 1451 1451 1451 1
ATTENTION EARTHMEN THIS IS AN IMPORTANT MESSAGE PHOR MORE THAN TWO
YEARS NOW YOU HAVE BEEN USING OUR POWER OUR SUPREME COMMANDER
TRNDOW IS ANNOYED HE HAS BEEN MOVING OUR BELOVED HOME ALL OVER
NEARBY SPACE AT HIGH SPEEDS IN THE HOPES THAT SOME OF YOUR SCIENTISTS
WILL GO NUTS TRYING TO PHIND OUT WHAT HAS HAPPENED TO THEIR PHRINGE
FASE OUR CITIZENS ARE PHED UP AT BEING MOVED AROUND LIKE THIS
PLEASE STOP LOOKING AT US GRVNYCH HEAD OF CITIZENS GROUP CP3329
F 1452 1378 1353 1333 1428 1351 1423 1561 1542 1586

SPREADING THE WORD

by

C.B. Cragg

In Canadian university circles, the teaching of science to students whose main interests are in such things as literature, economics, and theatre appears to be a madly progressive enterprise, to be viewed with enthusiasm or suspicion according to the temperament of the viewer. But it would be more accurate to think of it as deeply conservative.

The place of astronomy and mathematics among the liberal arts taught in the first universities during the middle ages could be quoted, although the more immediate ancestor of our present efforts seems to be the liberal arts tradition established in the first American universities during the 18th century. That this ancestry is not obvious in the Canadian context seems due to two factors.

(1) The strongest influence on the English-language universities in Canada has been British, and something very queer seems to have happened to British intellectual life around the end of the 18th century: the sciences appear to have been co-opted on the liberal side in the ideological debate between conservatism and radical liberalism.

In Britain, conservatism won, giving rise to the "Two Cultures" situation which is really an extension of the British class war.

(2) Canadian universities arose at a period when the "vocational" ideal of education had high prestige: the "liberal arts" ideal of education started out in a very weak position.

Thus when Canadian university education became established in the last century, the safest justification for the inclusion of science was its usefulness as a training for professionals. The Natural Sciences, *taught as Liberal Arts*, had a dangerous tendency to drift near the subversive.

(We do not have to go to California to see modern examples: the students I meet believe that Biology is a less theoretical subject than Physics, because the central theory of Biology, which is absolutely required to make any intellectual sense of the subject, is not taught in our schools except as a "specialty".)

I would contend that the sciences are Liberal Arts. Therefore, when I argue that it is in the interests of the scientific community to teach students who are not prospective professionals, I am not going to claim that it is mainly as an exercise in flacking for research money. Indeed, some of our students may conclude, sometimes rightly, that our endeavours include some featherbedding, logrolling and messing around.

Rather it is my conception of the nature of science, and of the scientific community, that it requires as part of its task the communication of the most important and significant results to the wider community.

The business of science is discovery, and that is why we have taken it up. A great scientific discovery is a marvellous and delicious thing: it is really a new phenomenon in the world, and for those who can understand it everything looks different than it did before.

The map of the world does not look the same, for example, now that we have heard about sea-floor spreading and continental drift.

Now, it is perfectly possible to imagine science carried on by a sort of secret society, a Pythagorean brotherhood, in which only the initiated are told what is going on. (It might even get public money by pretending to be a company for the invention of gadgets.)

C.B. Cragg is the Director of York University's Division of Natural Sciences.

But I think that many of us would feel that such an arrangement would be a betrayal of one of the strongest appeals of science, that it is not the property of a privileged group or class, that it is open to whoever will take it up wherever he might be. Galileo wrote the "Dialogue on the Two World Systems" in Italian to make it as accessible as possible, because he felt that the nature of the solar system was important to everybody.

If we agree that the scientific community has an obligation to communicate its results to a wider public, is teaching courses to captive Arts students in universities the right way to do it? It may well not be the best way, and certainly should not be the only way. The immense popularity of science museums, such as the Ontario Science Centre, even when they are not terribly well done, should be food for thought.

On the other hand, the efforts of the newspapers to handle science subjects has been unimpressive, and the efforts of television abysmal. This may not simply be sloth and cowardice on the part of these media: perhaps they are inherently unsuited to any material requiring sustained attention.

The decline of science, along with practically everything else, in the High Schools, is a dismal portent, since the High Schools were the most probable place to reach large numbers of students at an age where some of our stuff would be accessible to them.

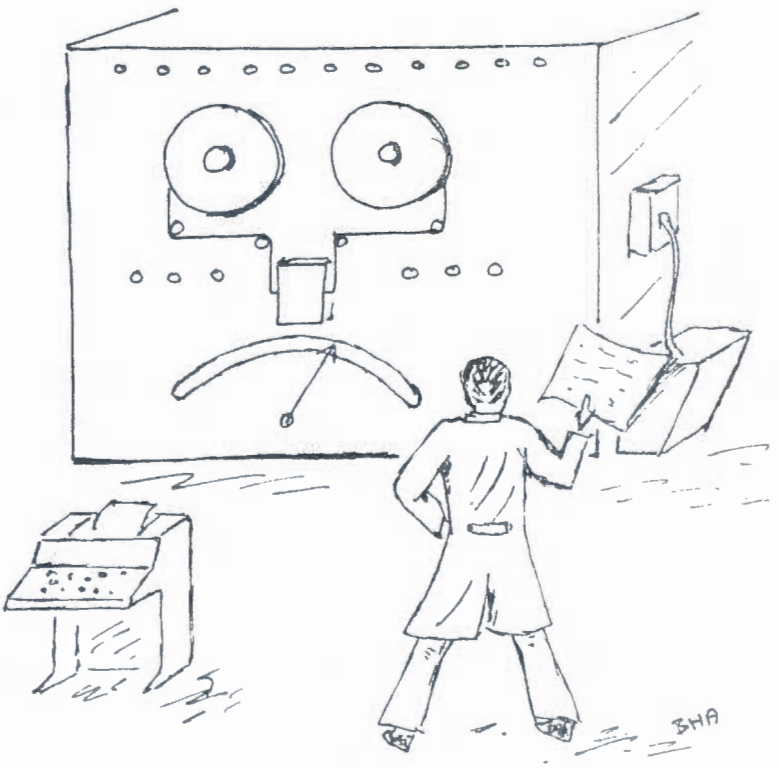
Thus, faute de mieux, there is some point to our touting our wares to university Arts students. There are an awful lot of them. I find them to be cheerful, tolerant, and often very good-looking. The questions they ask are intelligent, if primitive. They are conveniently located to meet scientists, who are also to be found at universities.

I have the impression that when the Arts students meet the university scientists, the two groups like each other more than they expected to. Given a reasonable chunk of teaching time, we have a chance to persuade some of the brighter spirits that the pursuit of science is something that human beings might find enjoyable and significant.

Perhaps as important, we have a chance as scientist-teachers to remind ourselves what, aside from our salaries and pension funds, our institutional politicking, the pleasures of impressing our friends and enemies, the pride of publication and the pursuit of fame, we find enjoyable and significant about science.

I cannot believe that scientific knowledge consists of a batch of handbooks of data and computer programs, however useful these may be. Scientific knowledge must say something about what kind of place the world (or the universe) is, and how we got to be here.

It seems to me that if we cannot tell anybody but our professional colleagues what we have found on these matters, then we have missed the point somewhere, we have not really understood it.



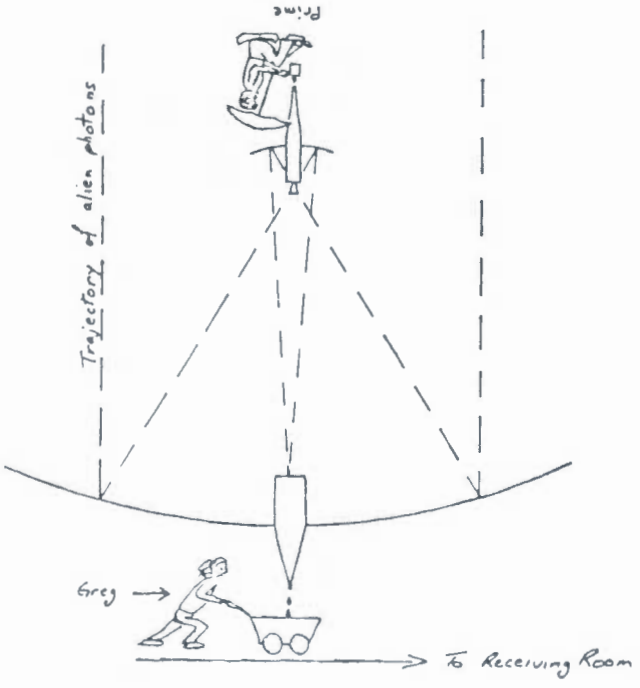
'So what if you did beat Bobby Fischer at tic-tac-toe, you still blew my integral.'

FIX IT OR FORGET IT

The operation of the ARO telescope in the Gregorian system has always been a disappointment. The Gregorian system is unsatisfactory for line work because of a large ripple component in the spectrum,* it is unsatisfactory for polarisation work because of a large spurious polarised signal, and it is unsatisfactory for continuum work at high frequencies because no beam switching is available. And that pretty well covers the field.

In practice the sole use of the Gregorian system has been to provide a standby receiver for secondary observations or in case the prime focus receiver breaks down. Nobody would use the Gregorian system at all if they could have receiver changes in the prime focus which took, say, half an hour or less.

**See 'The Ups and Downs of the Spectrometer' by Bill Lavrench, ARO Observer No. 2, July 1973, p. 6.*



The ARO 150 ft photon catcher

This situation is far from the one envisaged when the telescope was being designed. At that time it was thought that the Gregorian system would be the work horse of the telescope.

The gain of the telescope was to be greater in the Gregorian mode than in prime focus operation. The system noise temperature was to be less because the spillover past the sub-dish falls on the cold sky rather than the warm ground.

The installation of receivers in the spacious hub room offered, and still does offer, the advantages of easy access and comfortable working conditions, not minor considerations when working with voluminous test equipment or handling such unfriendly substances as liquid helium or liquid nitrogen. It also afforded the opportunity to have several receivers running in the hub, ready to be brought into play simply by connecting them to the feed horn.

No one foresaw, understandably enough, the advent of beam switching, that magical ingenious technique which gives us, in one simple device, immunity to all but the most atrocious weather, a reduction in system noise temperature through the substitution of a reference beam for a cooled load, and a factor of two increase in signal to noise ratio for measurements of flux density. Long live BS*!

Beam switching in the Gregorian mode is, of course, denied to us because of the battleship sized feed horns needed to illuminate the subdish. Only one feed was designed into the system. To drill a hole in the surface large enough to accommodate another feed could have disastrous consequences on the structure. After all, those quarter inch steel plates help to hold the thing together.

We might have expected that the Gregorian system would at least live up to its promise of better performance, all other things being equal, but of course it

**Beam switching.*

has not, as anyone will attest who has tried to make polarisation or line observations from the hub. Nobody yet fully understands why, but some recent tests by Lorne Doherty and Bill Lavrench have begun to define the problem.

Their results are summarised in the Table. The prime focus, as expected, is the superior location in all respects except that of beamwidth. What is surprising is that the gain in the hub is worst when one uses the horn specifically designed for the frequency of observation. The gain improves with the use of horns designed for longer wavelengths.

The beamwidth in the hub location is independent of the feed horn used, so apparently a change of feed horn does not result in a change in the illumination of the main reflector. The changes in gain must come from changes in the spillover.

Based on the ratio of the observed beamwidths, the gain in the Gregorian mode should be larger by a factor $(2.66/2.55)^2 = 1.09$, yet it is actually smaller by a factor of $1/1.3 = 0.77$. In short, the gain is only 70% of that expected, and 30% of the incident power is being lost in spillover.

The measured contribution of ground radiation to the system temperature at the

Observations at 2.8 cm

	Observing from hub using feed horn designed for use at			Observing from prime focus
	2.8 cm	4.6 cm	9.4 cm	
Relative gain	1.00	1.02	1.14	1.30
Beamwidth (arc min)	2.56	2.55	2.54	2.66
Ground contribution to T_A(K)	18°	22°	25°	18°
Off-source ripple (K)	0°.40	1°.01	0°.45	0°.25
Intrinsic ripple (% of source)	1.0	1.4	1.7	0.4

Observations at 4.6 cm

	Observing from	
	hub using 4.6 cm feedhorn	prime focus
Relative gain	1.00	1.13
Spurious polarisation (% of source)	2.9	1.3

zenith (third line of table) does not depend greatly on the feed system or location of the receiver. If there were a 30% spillover past the main reflector onto the ground, the contribution of ground radiation to the system temperature would be 80K to 100 K. So the spillover must be past the subdish rather than the main reflector.

The observations of the ripple in the spectrometer output have so far served only to confirm what we already knew. It's worse in the hub. The ripple is, of course, the unsolicited and unwelcome sinusoidal wave which appears across the bandwidth of a theoretically flat spectrum. It has a large amplitude, often very much larger than the amplitude of the expected signal (fourth line of table).

The ripple is a fundamental feature of the system, and is generated in some mysterious way by background radiation and multiple reflections, but the addition of an absorbing material on the main dish had a negligible effect on the amplitude of the ripple using the 2.8 cm horn. However the attachment of a scattering cone to the edge of the 4.6 cm feed horn produced a reduction of the ripple by a factor of about three. The scattering cone halves the ripple when the telescope is used in the prime focus mode.

The amplitude of the ripple does not depend on whether circular or linear polarisation is used. On the other hand it can change for unknown reasons by a factor of two or more in the space of a day.

Off-source ripple amplitudes measured at 9.4 cm were a factor of three higher than those measured at 2.8 cm as might be expected. The incident power is proportional to the area of the feed, so the ripple amplitude, which depends on voltage, is proportional to the wavelength if similar feed horns are used.

Fortunately the effects of the ripple can be removed almost entirely by observing a source, repeating the observation off-source but over the same range of hour angles, and subtracting the off-source from the on-source observation. There is, of course, some residual ripple due to imperfect cancellation of the on-source and off-source components because the ripple is derived from the background temperatures, which in turn depend on the weather, the ambient temperature, the position of the focus, the position of the telescope, the time of day, and for all we know, the phase of the moon.

Obviously the amplitude of this residual ripple will be related to the amplitude of the initial ripple, so the prime focus is clearly the best site for the receiver.

No matter how perfectly we align the hour angles of the on and off source observations, there is going to be one fundamental and irrevocable difference between them. The source itself. So there is always a component of the ripple that is proportional in amplitude to the intensity of the source. Again the effect is much smaller at the prime focus.

The only way to get rid of this intrinsic ripple and the residual ripple is to fit a sinusoidal wave to the output using the part of the spectrum not "contaminated" by line emission from the source. When you get to the point where you can't identify what is ripple and what is line, you've had it. Other observatories have success in cancelling the ripple by adding together two on-source observations taken with the feed successively $+\frac{\lambda}{8}$ and $-\frac{\lambda}{8}$ from the focal point. We don't.*

The other way round this problem is to understand the cause of the ripple, and then, if possible, eliminate it. Don't hold your breath.

The polarisation picture is similar to the ripple one. There is a large sinusoidal output generated when the linear polariser is rotated off-source that can be removed, more or less, by subtracting an off-source run from an on-source run. There remains a spurious polarisation of amplitude proportional to the strength of the source, i.e. there is an apparent polarisation which is measured when observing a source that is actually unpolarised. This spurious signal must be sub-

*News flash:- Lorne Uchert has discovered that if you move the feed-tube and the subdish, it works!

tracted vectorially from the results when making observations of linear polarisation.

The spurious polarisation maintains a fixed orientation relative to the surface of the telescope, and presumably results from the feed horn having unsymmetric flooding patterns in the two modes of polarisation. As the second part of the table shows, the spurious polarisation is much greater when the Gregorian system is used.

Lorne Doherty has written a report on the tests and most of the above data and conclusions are taken from this report. He summarizes his report by saying, "In total, the retention of the Gregorian system must be questioned."

He may have a point there.

B.H.A.

EAT YOUR HEART OUT, OGDEN NASH

BUTTERFLIES

Margarine
on the other hand
just lies there
and sogs

POME

If you please
say Betelgeuse
but if you choose
use Betelgeuse

AN UDDER POME

I like milk in bottles
cool and white and clean
I don't want to think about
where it's been

YET AN UDDER POME

If a cow had quintuplets
the last of the litt
er
couldn't even look forward
to sucking hind tit
er

If a cow had quintuplets
one wouldn't get fed
but nor would the others
the cow would be dead

LULLABY

Flush-a-bye baby
on the tree top
when the wind breaks
the cradle will rock
If the wind changes
you'll need a friend
or you will come to
a sticky end.

B.H.A.

Found in the control room at ARO, early January 1974

Comet, Comet in the sky
Who has greater need than I
To know the makeup of thy halo
Before the guys at NRAO

Anon McL?

AN ASTRONOMER IN CZECHOSLOVAKIA

by

Bruce McIntosh

Why didn't I come to Czechoslovakia for a year?

I could think of a thousand reasons - my wife's work, the children's schooling, a slight language problem. But it was tempting, this proposal made by the director of the Slovak Astronomical Institute.

She commented that the exchange program between their Academy of Sciences and NRC was highly valued but that it seemed mostly a one-way street with their people coming to Canada and little traffic in the reverse direction. My association with astronomy in Czechoslovakia began in 1966 when our Section had two PDF's from that country, both interested in meteor studies. They became not only esteemed professional colleagues but also my good friends.

With the encouragement of their director, the other members of their staff began to "lean" on me and we compromised on a four-month period: June to September- the maximum time I felt my children could be out of school without a great outcry.

Our first month was spent at Ondrejov, the location of the Astronomical Institute of the Czech Academy of Sciences. (If you are surprised that I continually make a Czech-Slovak distinction, you should understand that Canada is not the only country with a B and B problem.† A Czech colleague commented that I, as an English-speaking westerner, would probably encounter politer treatment in Slovakia than he sometimes did as a Czech. On the other hand, we overheard a young Slovak in Prague complaining bitterly that the display captions in a museum were in Czech, Russian, German, and English but not in the Slovak language.)

†*Note for British readers: This does not mean bed and breakfast despite your thinking that anyone who eats pancakes and maple syrup in the morning has a problem. It means bilingualism and biculturalism and is associated with bifurcation rather than bicarbonate. - Ed.*

The Observatory sits on a hill, in Medieval times the hangman's hill, about 30 km south of Prague. The village of Ondrejov lies halfway down the hill, and the small chalet, made available to guest scientists, right at the base of the hill. The daily climb to the observatory probably contributed the 15 pounds I lost in four months!

The chalet was quite comfortable for a family of five. A refrigerator normally used to cool film was scrounged for us, as was anything else we thought necessary. The chalet overlooked rolling hills and hayfields typical of the area. In a walk down the valley one evening, the children picked 20 different kinds of wildflowers.

The Ondrejov Observatory has a staff of about 150. The main fields of research are: stellar astronomy - with a two-meter telescope; solar physics - both radio and optical observing equipment; meteor physics- radar and optical observations; a recent, but very active, field is satellite tracking for geophysical purposes using laser radars as well as standard radio methods.

Ondrejov is only about 40 km from Prague, known as the city of 1000 spires. One's first impression of Prague may be that it is a shabby, dirty city; but one soon accepts this as a patina of age and looks beneath at the fascinating history and culture of this city. It is good for many weekends of browsing. For an evening in Prague, dinner at one of the delightful old wine cellars in the old quarter costs no more than five or six dollars including wine and liqueurs. One could follow this with a stroll through Prague after dark with complete safety.

Ondrejov is centrally located for weekend tours - to see the castles of south Bohemia, for example, an area where the major crop is fish, cultivated in large artificial ponds. Or to Karlovy Vary (Carlsbad Springs), for many decades considered to be *the* European spa. There are

12 different mineral springs with reputed remarkable powers when used either externally or internally. Many people, my wife and I included, prefer the 13th spring, a delightful liquid which comes out of a green bottle.

The Astronomical Institute of the Slovak Academy of Sciences has a staff of about 43, fragmented among four locations. The administration headquarters is in the mountain town Tatranska Lomnica just below the stellar and meteor observatory at Skalnate Pleso (1783 m) and the solar observatory on Lomnicky peak (2634 m).

The Interplanetary Matter group, with which I spent three months, functions in Bratislava, 350 km southwest of the Tatra mountains. The work here is of necessity theoretical and analytical. Any program of observations on meteors, comets and asteroids requires commuting to Skalnate Pleso. The staff have access to a relatively large computer facility on an "external user" basis - a CDC 3300 at the United Nations economic research branch. But red tape being what it is, nearly one month went by before I could be accredited as a user.

Working hours were flexible but a 42 hour week was expected. During the summer months, many of us started at 7 a.m. in order to leave "early" - at 4 p.m.

Since Bratislava is a city about the same size as Ottawa, we felt much at home. The accommodation provided for us was the lower floor of a private house in the old quarter of the city. Since the landlady was an avid gardener, it was a pleasant spot. Conversations with her were in an amusing mixture of German, French, Slovak and English, in about that order of usage frequency. Her sons, by the way, are olympic calibre equestrians.

For shopping, this is still a country of specialty stores; the supermarket and department store are coming, but slowly. In general, food must be purchased at the grocer, the butcher, the vegetable store, and the milk store. Since the shopper will usually have to wait in line in these stores, the shopping process consumes much time.

Our local store was a newer one which combined groceries, milk and bread. (Beer and wine occupy a good deal of space among the "groceries".) My wife quickly adopted the local custom of being at the store shortly after opening at 6 a.m. to buy fresh bread and milk for the day. Since bread is unwrapped and milk unrefrigerated, this is as much a necessity as custom.

Automobile servicing, too, has problems. I was surprised to find, when I took my car in for its 10,000 km checkup, that the service establishment would not rotate the wheels; that was a specialty job for the tire shop. Furthermore, to have the oil changed, I had to provide the oil.

Slovakia has a great variety of places and terrain for the sightseer: from sunny valleys to snowcapped mountains, from once-magnificant castles to remote villages where thatched-roof log houses and tiny wooden churches indicate that time has stood still for centuries. On the slopes of the low mountain ranges flourish many varieties of grapes that result in excellent wines - mostly whites. Unfortunately, none are imported by the L.C.B.O.†

The annual wine festival for the area near Bratislava was one of the most interesting events of the summer, with its carnival atmosphere and parade in traditional Slovak costumes. For those who had the money and the stamina there were 289 varieties or vintages of wine to be tasted.

For me, this was a profitable period professionally; for my family, a rewarding experience in a new social and cultural milieu. For the little automobile that carried us over 7000 miles of the back roads of Czechoslovakia, it meant having to have her belly washed and scrubbed three times before the Canadian Department of Agriculture was satisfied that the contaminating soil of Czechoslovakia was gone.

†Liquor Control Board of Ontario

We hear Marlon Brando is making a movie about the final days of an aging French streaker. It's to be called *Last Dangle in Paris.*

A WORM'S-EYE VIEW OF ARO

[or, *Is there a Light at the End of the Baseline?*]

"You'll be working with the Chilbolton dish, they're setting up a radio interferometer between Chilbolton and Canada", said the important voice on my first morning at work.

"Good grief, how on earth can it work, don't you have to bring the two signals together and produce interference fringes or something like that?"

I learned later that others had been struck by this same thought. They had, so they said, found the solution; you record the signals on magnetic tapes, and you don't bring them together until after the observing session. In that way you can observe with a clear conscience, not knowing if the tapes contain incoherent rubbish, and knowing that you can't know until afterwards anyway.

Still, what a topic for cocktail party conversation it turned out to be.

"Oh, I'm working on an experiment using radio telescopes in England and Canada."

"Lucky you, lots of trips to Canada at the taxpayer's expense, I suppose."

"Well, no, not yet...but I did have to go to London airport last week to meet a clock."

With the clock, of course, came two Canadian scientists. They ate with the fork in the right hand and they couldn't manage to use the antique tin-opener at Chilbolton. But they were really nice chaps, and they handed round attenuator pads like Americans handing out food parcels. And then there were all those nice people at the other end of the telex line.

"Just off for a warm-up.", they used to say whenever there was a break in the observing schedule. We've all heard about the Canadian winters, but why do they need to warm up during the summer months, and why is their spelling so atrocious when they return with fingers warmed, yet somehow slipping to the wrong keys?

More Canadian Scientists came and went, leaving behind even more sophisticated equipment. More topics for cocktail party conversation.

"A hydrogen maser clock takes a million years to gain or lose a second."

"Oh yes...my watch gains two minutes a day, that's progress for you, ho, ho, ho...."

Well, she soon killed that little conversation.

The interferometer did work, of course (leading to an unfortunate rash of puns about "fringe benefits"), and since those happy summer days of '72, has been churning out fringes at regular intervals. Now that we can synchronise clocks remotely, we no longer have to meet Canadian clocks at London airport. ("What's wrong with British clocks, anyway?" as my cocktail party friend said.)

Our Canadian Scientists still keep coming; they stay in our most expensive hotels, they drive on the wrong side of the country lanes, they delight in our English pubs, they bring us duty-free whisky, and we love them all. We sometimes wonder what they think of *us*. Perhaps one day they'll tell us in the pages of the "Observer".

Pete Barber

GOOD GRIEF, WHAT HAVE I DONE?

I recently received a letter which began as follows: 'We acknowledge the receipt of reprints mailed by you on 11 Jan. 74 and we announce the death of the Director of this laboratory and the closing of the lab.'

I didn't feel they were all that bad, but if they're going to be like that about it, I won't send any more.

B.H.A.

WHERE THE HELL IS CHILBOLTON?

by

L.K. Hutton
University of Maryland and
Goddard Space Flight Center

This is ridiculous!

Or so I told myself, as I sat on the floor in the reference section of McKeldin Library at the University of Maryland, with every conceivable world atlas, including the New York Times Atlas and the Rand McNally, spread on the floor in front of me. Arbovale, West Virginia is in them both, so why not Chilbolton? All I could do was settle for Slough, only slightly comforted by the fact that both atlases seem to agree on *its* position.

How did I get into a wild goose chase like this one, anyhow? (Perhaps an apt comparison, but the wild geese do not belong on that end of the baseline!) All I had wanted to do was check a model for the structure of 3C 84! Innocently enough, I set out to check it against the visibility function published this summer by Our Northern Neighbours.

The hang up came in finding the baseline. Not to mention getting the source map inverted and sideways, having different data points on the two diagrams of the visibility function, and quoting position angles of up to 369° (see Fig. 1), it appears that they have also managed to use a station that cannot be found in any references available to a poor graduate student in the United States.

I finally did my check, however. Working from the fact that someone I know remembered seeing a dish from the bus on the way from Brighton to Stonehenge, I located Chilbolton 50 km west and 25 km south of Slough, and of course it didn't make any difference at all (I could have used downtown London as the other station and reasonably reproduced the uv track!). The model still doesn't work very well.

But there is a certain challenge in absurdity like this! If someone doesn't tell me where this place is pretty soon, I may do something crazy, like assume the Goldstack structure for 3C 84 and try to solve for the location of Chilbolton!

FIG 1

CANADA

AS VIEWED BY INHABITANTS OF SEYFERT GALAXY 3C 84

MOTIFATION

Now that the Canadian Astronomical Society has come up with its brand new spirally galactic logo (available as a lapel pin on demand), maybe we NRC types should acquire our own heraldic device if we want to preserve our image.

The Observer is willing to receive suggestions. In the meantime a suitable coat of arms might be composed of an ivory tower on a field of gold, surrounded by intertwined red tape and surmounted by crossed memoranda bearing the inscription *'Inertia Omnia Vincit'*. We would, of course, have professors rampant on either side.

B.H.A.

RECOLLECTIONS OF A SUMMER STUDENT

The personal, tax deductible, memorabilia

of

Geoffrey J.R. Wyght

The summer students of 1973 at the ARO were university or college students with scientific backgrounds and interests. We were the lowest on the totem pole but did various jobs to ease the work load of others. For instance, we made the surrounding area of the ARO more attractive looking.* Sometimes, however, we kept Mr. Duston and Mr. Findlay on their respective toes.

I had been looking forward to working in that part of Ontario even though I did not know what it looked like or how the conditions were. Also, because of my active interest in astronomy I relished the thought of spending hours examining countless numbers of radio telescopes.

However, it was not quite the way which I just described. There were weeks of working in bug-infested bushland. It was a great way to get in good physical shape; so much so that Dr. B.H. Andrew asked one day, "How are things down at Muscle Beach?"

Little by little with the help of the visiting astronomers and technicians from M-50 and the universities, the drivers and technicians at the sites, I became familiar with some of the operations. Most of the astronomers took time to explain what they were doing. Of the technicians, Joe Fletcher comes to mind. He gave us a thorough description of the hydrogen maser during the L.B.I. experiment and explained why or why not it was working. The drivers told us what every switch on the control panel, which we were about to flick, did.

I would like to thank Ken Davidson for helping me learn some auto mechanics and instructing on how to use the fire fighting equipment. Fortunately, we only had to use it once. Fighting the small fire at the Pembroke Lumber Company site was probably the most exciting job that I had to do. My childhood dream was to be a fireman and here I was at the nozzle end of the hose; scampering for cover when the Department of Lands and Forests aircraft skimmed the treetops to dump its load of water; telling the lumberjacks to grab a shovel and put out an isolated fire or clear this or that out of the way so that we could get right into the fire.

Just as exciting was painting the dish of the site 3 telescope. This gave us a chance to climb the feed legs up to the receiver for a breathtaking view of the countryside around us. How the cameras clicked with abandon!

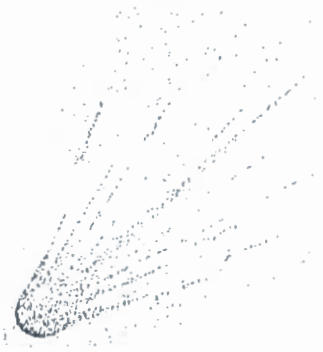
Since I was a city slicker, I also kept the camera on hand for a shot at any wildlife. To me the rush hour traffic by the bears at the dump was more relaxing than the city rush hour..

My stay at the ARO was a welcome change from city life. Where else could you finish a hard day's work by jumping into a warm but refreshing lake then sitting down in a relaxed atmosphere to one of Fred's excellently cooked meals? Yessir, if a hard day at the office let you down then Fred's cooking picked you up.

Although I have only named a few who now come to mind, I would like to thank everyone who helped make my summer of 1973 interesting and worthwhile.

Well, I don't know, I always thought the chipmunks added more to the scenery.

The Comet's Tail



IF YOU CAN'T STAND THE HEAT, STAY OUT OF THE KITCHEN

The ARO Observer has come of age. (You, of course, may have been thinking that it had died, it's been so long since the last issue, but here we are, resurrected). Mark this. We have received our first indignant letter (well, sort of) from an irate reader, the ubiquitous Eugene Epstein. Someone is out there listening!

Such an event is tremendously flattering for myself as author of the offending article. Not only has somebody been reading my stuff, he actually took it seriously enough to think it worth rebutting. Nothing is more deflating to a self-appointed offensive article writer than to be completely ignored.

The letter begins 'Bryan' (softening me up before it socks it to me). It continues

"The Comet's Tail column entitled "In Defence of the Flat Earth Society" contains the following sentence: "Abortion on demand is touted, yet abortion on demand is basically a denial of one's accountability for the foreseeable consequences of one's own actions." (Emphasis added.)

In the course of my extensive volunteer efforts as a problem pregnancy counselor at a local free medical clinic, I have spoken to approximately 900 women, most of whom decided, either individually or in concert with their partners, upon abortion as the solution to their problem pregnancy. The overwhelming majority were motivated toward this choice by considerations of responsibility to the potential child and to themselves.

The pregnancies were problems because the women realized that they and their

partners were not in a position to assure that the potential child would be well-born and lovingly and responsibly provided for. Many also realized that they preferred a child-free life, or that they were not yet capable of being the emotionally mature parent(s) to which every child should be entitled.

They were also responsible enough to know that the failure of a contraceptive or the failure to use a contraceptive should not be the reason for such an important process as the passing on of life to a new human being.

My observations therefore indicate that the above-quoted sentence would be consistent with reality if it were slightly altered to read: "Abortion on demand is basically an acceptance of one's accountability for the foreseeable consequences of one's own actions."

Eugene E. Epstein
Radio Astronomy Program
The Aerospace Corporation

My reply is simply that none of the arguments advanced above are reasons for abortion, they are simply rationalisations of a decision already made.

I suggest that Eugene, in his role as a counselor, is not helping the women to arrive at a decision. They have already done that, though they may not admit it, even to themselves. What he does, by his advice and sympathy, is to allow them to acknowledge that decision. His acquiescence, perhaps even encouragement, permits them to allay their sense of guilt or to transfer the blame to him.

My point is that such decisions are not arrived at logically but emotionally. Abortion is a purely emotional issue and it is useless to argue for or against it on rational grounds. A question as fundamental as the taking (or prevention if you will) of human life is bound to be an emotional one to all but the most dehumanised of persons.

Barring the deliberate act of abortion the foetus will, in normal conditions, be born, grow up, and live out its three score years and ten. Barring the deliberate act of, say, pulling the trigger, a victim, in normal circumstances, would continue to a ripe old age.

In both cases the action taken results in there being one human life less in the world than there would have been if no action were taken. Yet one act is a crime, the other a medical procedure. There's no logic in that.

The execution of a murderer, rapist, hijacker or political terrorist is the elimination of a person who has at least demonstrated his incompatibility with society. Society decides that he is not worth the trouble of keeping alive. The unborn foetus must be regarded as an innocent, unless you believe in original sin*. The mother-to-be decides he is not worth the inconvenience of bearing and bringing up.

Yet curiously the people who favour abortion on demand tend to be the same people who favour the abolition of the death penalty. There's no logic in that, either.

The woman who has an abortion has one because she does not want a child, for her own reasons.† Even an apparently altruistic devotion to the child's welfare is her own reason. 'Don't do me no favours,' quoth the child, unconsulted.

An abortion is the easy way out. It is the facile solution, and in today's emotionally immature society the facile solution is the favoured solution in all things.

It is emotional immaturity that Eugene mentions in his letter. It was emotional immaturity that I was decrying in my article. On the same subject and from the same observations we reach opposite conclusions.

And there's no logic in that.

****

I hope you were all struck by the piquancy of the above paragraphs. Note their symphonic reiteration of previous refrains. Observe how the symmetry of the

*Boo to original sin.

†I am specifically discussing normal pregnancies, in our [illegible].

prose obscures the shallowness of the thoughts.

If ever a sentence screamed 'End here - stop - finish - beautiful, baby, beautiful, wind it up', it's that last one, and if I had any sense I would quit while I can still feel the literary ecstasy. But I started out to tell a story before I got sidetracked into the diatribe, and tell it I will.

When I was a student at Glasgow University (here it comes again, Ole Andrew's boyhood reminiscences) one of the highlights of the year was the Medical Society's film show. Actually the Medical Society had monthly, perhaps even weekly film shows, but there was only one that anybody went to. That was the one on contraceptives and it paid for all the others and probably for a booze-up for the Medical Society types as well.

The hall was always jammed, upstairs and down, young men sat in the aisles, hung over balconies, perched on radiators and window sills, and probably would have swung Klute-like from the lights had they been within reach. The air was foetid with smoke, sweat, and ribald humour, and the temperature soon rose to about ninety degrees. (In Glasgow, that's something.)

The organisers, with a true sense of the theatrical, kept the feature attraction till the end, so we all had to sit through a couple of nauseating little numbers on surgical techniques. The first of these opened with a close up of an unidentifiable expanse of human flesh. The flesh was left there, filling the screen with its empty unstructured smoothness just long enough for us to ascertain that it was, in fact, living, warm, slightly quivering, still attached flesh.

A strangely disembodied hand appeared from one edge of the screen, scalpel poised. It drew the scalpel delicately and lightly across the flesh, like a gentleman apportioning a slice of English-thin roast beef. At first nothing seemed to have happened, except that there was a thin, scarcely discernible white line across the skin. Then a drop of blood squeezed through, and hung there, then another, and another, and slowly the flesh split apart into a sharp-edged red crevasse.

At this point the person in front of me screamed and collapsed in a dead faint. Overcome, I thought, by the apparition before him. But it turned out that he had had his foot wedged beneath the tip-up chair in front of him, and a latecomer, clambering in, had dropped into a chair, crushing the foot.

The faintee's friends carried him out and deposited him in the corridor somewhere, then, aware that chivalry shrivels quickly in the harsh environment of self-interest, they hurried back lest someone stole their seats.

After sitting through another hour or so of bloody enlightenment, we were more than ready to abandon the intestinal rummagings. We greeted the main attraction with perhaps more joy than it deserved.

The film was by any standards unimaginative. It was one of those documentaries so common about fifteen years ago wherein the expert stands in some vaguely academic surroundings and lectures the camera in monotone. But it quickly got to the point. The camera scanned a table littered with an array of what appeared to be medieval torture instruments of astonishing number, variety and inventiveness. There were hooks, curves, clips and rings of all and any imaginable sort.

'Here we have a number of contraceptive devices', intoned the lecturer. 'From my personal collection', hollered the Voice in the Gallery.

The Monotone then selected a few of the more common species for demonstration. (Remember that I was unfortunate enough to spend my youth before the Age of the Pill.) Our ears pricked up. Did he say demonstration? He did, indeed.

The screen was again filled by an expanse of flesh, but this time everybody recognized it. A raucous cheer went up. It was, after all, the only thing identifiably female in the room.

The disembodied hand once more appeared and went about its clinical business (wearing a rubber glove, of course). It brought in implement after implement, all of which were quickly swallowed up. Rings

followed domes followed syringes in bewildering succession until the Voice in the Gallery, doubting the capacity of even the seemingly indefatigable catch-all confronting him, bellowed plaintively, 'Hey, is there room for anything else in there?'

The film continued in the same vein for a few more minutes, and then we found ourselves outside, reflecting that the film show had been a pretty effective contraceptive device in itself. None of us felt interested in sex for at least fifteen minutes afterwards.

But what sticks most in my mind is the opening sequence. It consisted simply of the lecturer standing beside a long, long scroll which he had unrolled and hung from the wall. The scroll contained a list, in alphabetical order, of all the known contraceptive methods. It was a long list. "Only the first of these is one hundred percent effective", said the lecturer. There it was, at the top of the list, in all its glory, the only sure way. Abstinence.

I recommend it to those who feel they are absolutely unable to accept the risk of having a child.

B.H.A.

This article was typed over the vociferous objections of our secretary and every female within hailing distance. I wearily acknowledge, even demand, that the father has an equal responsibility to his unborn child. So in the above you may, if you wish, read 'their' for 'her' and 'the parents' for 'the woman'. Unfortunately the biological facts are that men neither bear children nor have abortions, so the final veto must be and is the woman's. I therefore direct my opinions toward her.

Now that women rightly insist that they not be treated as objects, as personal possessions, it seems only fair that parents extend the same consideration to their children, born or unborn.

BLACK IS WHITE

There are some people who will argue that black is white. I'm one of them. The argument goes like this:-

An object that absorbs all wavelengths of light equally is said to be black. An object that reflects all wavelengths equally is white. Those are our definitions of black and white.

But no object is a perfect absorber, so the black object reflects some of the light incident on it. Indeed if it wasn't for the light reflected from it we would not be able to see it, for we see things by the light leaving them and entering our eyes.

Now because the black object absorbs all wavelengths equally, the reflected component of light must also contain all wavelengths equally. In other words we see the black object in the light reflected by it, and that light contains all wavelengths equally.

But that is just the definition of white, so the black object is really white. Right?

B.H.A.

LATE NEWS - BROTEN TO CAPTAIN TITANIC

Norman W. Broten has been appointed Head of the Radio Astronomy Section of the Astrophysics Branch of NRC. His appointment became effective on April 1, 1974. We are assured that no significance should be attached to the date.

He succeeds Dr. J.L. Locke who has given up the post to concentrate on his duties as Chief of the Astrophysics Branch.

Parting Thought

If you can keep your head when all about you are losing theirs, you'll be about ten inches taller than everybody else.

The ARO Observer is produced by the Astrophysics Branch of the National Research Council to serve as a forum for the Canadian astronomical community, and in particular for those members of it who use the Algonquin Radio Observatory. The views expressed in these pages are those of the individual writers. They do not in any way represent the official opinions or policies of either the Astrophysics Branch or the National Research Council.

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Nous sollicitons des articles, en anglais et en francais, s'adressant aux personnes qui s'intéressent à l'astronomie.