

R. S. R. S.

Newsletter

No. 48

April 1965

RADIO AND SPACE RESEARCH STATION

When the Russians launched the first artificial satellite the Radio Research Station immediately set to work to track it and to investigate the Faraday rotation and the Doppler shift of the waves which it emitted. Soon afterwards, in 1959, the Research Council of the D.S.I.R. decided that the Station should devote half its effort to space research; the construction of a radio telescope was authorised; agreements were made with the U.S.A. for the operation of the Minitrack Station, and with Canada for the Station to have direct access to the results from the topside sounder; and experiments were started in rockets and satellites. While these new activities were getting underway the older work, of investigating the propagation of waves of all frequencies, and of trying to understand the fundamental nature of the ionosphere and the troposphere through which they travelled, continued.

Although to those at the Station it was clear that the two activities, of Space Research and of Radio Research, overlapped to form a coherent single programme of work, it often happened that those outside the Station, being interested only in one or other of the two activities, would suppose that the Station did only Radio Research or only Space Research. It became clear about two years ago that the name "Radio Research Station" did not properly describe the work and the desirability of changing it was discussed. Just at that time, however, the "Trend" Committee suggested a reorganization of the D.S.I.R. and it was decided to postpone the change of name until their recommendation was implemented.

On 1st April when the Committee's recommendation was followed and the Station came under the new Science Research Council, the opportunity was taken to describe the Station's work more precisely by altering its name to "The Radio and Space Research Station". There is every indication that, under the new Council, and with the new name, we shall have increased opportunities to carry out our unified programme of work, including both radio and space research. Let us make full use of this opportunity to show what the Radio and Space Research Station can do to enhance its repute still further in both aspects of its work.

J. A. Ratcliffe

COMMUNICATIONS IN UNUSUAL MEDIA

Part II (continued from February Newsletter)

3. ULF EARTH MODE COMMUNICATIONS

In recent years there has been considerable interest in the possible use of ULF currents induced in the earth for reliable short range low data rate communication. Current is injected into the earth at the transmitter between the two buried terminals and the induced conduction and induction fields are detected at the receiver by measuring the potential difference between two further buried electrodes. The technique is similar to that which has been used for long by geophysicists for determining the electrical resistance of the upper crust of the earth. Geophysical data already collected has been useful to determine whether earth currents can be used for communication.

The apparent resistivity between the transmitter and receiver may be considered as an average resistivity to a depth which is related to the separation between the stations, the frequency of operation, and the actual resistivity profile of the ground. In general, the characteristics of the earth will be far from uniform and the apparent resistivity will vary with the separation depending on the underground layering structure. Measurements made in many areas show that the apparent resistivity of the earth varies widely but that it generally lies between the limits of 100 and 10,000 ohm metres.

A choice of frequency is necessary for communication purposes as the background or natural noise of geomagnetic origin, caused by micropulsations of the earth's magnetic field which induces a voltage on the receiving electrodes, is dominant at frequencies below 1 c/s. Above this frequency, the noise is atmospheric in origin and depends on thunderstorm activity. It is therefore desirable to operate with this mode of communication at a frequency of around 1 c/s where the background noise is minimum.

At this low frequency the data rate, even for transmission over a distance of only a few miles, will be severely limited. By using large electrode spacings and sensitive detection techniques, contact between transmitting and recovery terminals can be effected to distances of more than 100 miles, but such communications will have only fractional bit data rates.

Because of the great variations in the apparent resistivity and noise level in various locations, every case must be considered separately. The earth current communication method does offer the advantage of extremely simple transmitting equipment consisting merely of a power source, a rectifier to produce D.C., and an SCR switch. The electrodes must have a low resistance so that most of the power is dissipated in the path between them. They must, therefore, be large in area and the weak resistance at the terminals should be lowered by soaking the soil with salt water. At the receiver, the signal from the buried electrodes passes through a narrow band-pass filter to reduce the noise, and then to an amplifier and detector.

/In

In an actual experiment carried out in Texas, using 15A in the transmitter between electrodes 0.75 km apart, signals were received at a distance of 30 km with an amplitude of the order of μV . Typical data rates for transmission distances of 5, 12, 19 and 32 km, were 30, 12, 2.5 and 0.1 bits per second respectively.

Other advantages of the method include security, reliability, the possibility of extreme "hardness" and the survivability of the propagation medium.

H. K. Bourne
(U.K.S.M., N. America)

An Alphabet

- A for analysis, first on the list
Of subjects whose purpose is usually missed.
- B is for body, an object most rigid
Which even in heat waves stays perfectly rigid.
- C is for conic, oh common of curves
It crops up so often, it gets on your nerves.
- D is for delta, for div and for det,
And several others we try to forget.
- E is for that which is greater than nought,
This magical symbol will save us much thought.
- F is for field, not where buttercups grow
But where magnets and charges bring currents in tow.
- G is for gravity, clear to us all
Or what else would happen to Newton's old ball.
- H is for hydromechanics, a study
Of sources and streams - not the kind that are muddy.
- I for infinity, mythical place
Where circles and parallel lines show a face.
- J for Jacobian, a pleasant device
For making the nastiest integral nice.
- K is for Kepler, who left us some laws
Of planet'ry motion, effect but not cause.
- L stands for so many things, that, in doubt,
I've chosen the limit that's always about.
- M is for Matrix, a mighty array -
If we didn't leave blanks we'd be writing all day.
- N is for normal, a misleading word,
A "non-normal" normal's not even absurd.
- O is for orbit; we'll readily trace
The path of a body that's moving in space.
- P is for particle having no size;
It's wonderful what it can do when it tries.
- Q is for quadric, the conic's big brother;
What's true for the one may be true for the other.
- R is for rank; but the Major is out,
For here it's the Minors we're worried about.
- S is for sign, that's often mislaid,
Explaining mistakes that should never be made

T is for trip; how I wish that implied
A journey by car or a char-a banc ride.

U for uniqueness, important I'm sure,
But the proofs of the theorems are rather too pure.

V is for vector; all lecturers say,
That the sum is the same if you take it each way.

W must obviously stand for a wave.
The problem arises 'How does it behave?'

X, Y and Z, from their own point of view
Are complaining 'We have far too much work to do.
'It seems that for axes we're much better than
'All others; they use us whenever they can.
'Though mathematicians may do as they like,
'Beware! We may yet go on strike!'

(With acknowledgements to "Eureka", the Archimedean
Journal)

STAFF NEWS

Congratulations to:-

Dr. E. Dunford on having gained his Ph.D.

Miss E. Barnes on her 1st class pass in the Typing Proficiency
examination

New Staff

Welcome to:-

Dr. J. E. Geisler

T/S.S.O.

Mr. D. R. Owen

T/A.E.O.

Resignations

Mr. C. D. Lovett

T/S.A.

Mr. R. F. J. Edwards

T/S.A.

Mr. E. J. Hopgood

Part-time semi-skilled labourer

Mr. F. Kift

P.S.O. transferred to Ministry of Aviation

R.S.R.S. SPORTS AND SOCIAL CLUB

A dance ran jointly by the A.C.O. and R.R.S. was held in the canteen here
on 26th March. Music was provided by Wynne and her Rhythm from Langley and
the bar was organized very ably by the "Stag" at Datchet.

By the time this appears in print, there will be but a short time before
the Annual General Meeting of the Sports and Social Club, on Thursday 29th April
at 5 p.m. in the canteen, when it is hoped to introduce the new committee.

J. Juleff

R.R.S., A.C.O. Dance

The dining-hall looked normal, save for tables at the sides;
No fairy lights were there to make a show;
Support from here was sorrowful, eight came in all, besides
An hundred and twenty came from A.C.O.

At first our hearts were saddened by the prospect of a flop,
But 'twas not long we sat there feeling sad,
For Wynne's great rhythmic band played well and all began to bop,
And we enjoyed the best dance ever had!

Smith-Rose Cup

It has been rather a disappointing year with only three out of the seven activities played off.

The London team had to scratch due to lack of support, so the fight has been between North and South, with an overall win for the North team.

Please help to make the forthcoming year more successful.

YOUR SUPPORT IS NEEDED!

Chess

Monthly chess evenings will be resumed in the Autumn.

A. B. Lowe

Bridge Club

A club evening was held on 23rd March and the last, on 5th April, took the form of a Joint Pairs Tournament with the Road Research Laboratory. Fifteen pairs took part and the result was a win for Mr. and Mrs. Gordon-Smith as N-S players and for Messrs. Matthews and Buglass as E-W players.

While still R.R.S. we played against the Road Research Laboratory, on 15th March, and won by 46 International Match Points. Our team was

Dr. Bain and Dr. Bramley
Dr. Dickinson and Mr. Zavody
Dr. and Mrs. Fooks
Mr. and Mrs. Gordon-Smith.

We started life as the R.S.R.S. Bridge Club on 2nd April with a decisive defeat by the National Physical Laboratory by 80 International Match Points. Our team was

Dr. and Mrs. Bain
Dr. Dickinson and Mr. Zavody
Dr. and Mrs. Fooks
Mr. and Mrs. Gordon-Smith.

Two more matches in the N.P.L. Inter-divisional League have been played during the last month. Dr. and Mrs. Fooks and Mr. and Mrs. Gordon-Smith played on 9th March and were placed first; Dr. Bain and Mr. Venables and Mr. and Mrs. Gordon-Smith played on 30th March and were placed third. The next match will be on 13th April and the final one on 11th May.

Jean Fooks

LETTER TO THE OUTSTATIONS

Dear Colleagues,

Our heading has gained an initial. Various formats were considered; R^2S^2 , $(RS)^2$ or even $(RS)^n$ in case of future alliterative additions to our title. Finally we settled for the obvious.

Time (Easter leave) and Space (remainder on page 5) conspired to delay this issue and curtail my offering; my apologies. 'For this relief much thanks' may, however, be your sentiments on having less than usual to bother with from,

Yours sincerely,
The Editor