RRS Newsletter

(For the Use of R.R.S. Staff Only)

No.29 September 1963

COSMIC RAYS AT R.R.S.

At the beginning of this century scientists working on the conductivity of gases found that however good the insulation the charge on their measuring electroscopes leaked away. Some mysterious agent was causing the gas to conduct. Since shielding the ionization chambers with lead reduced the gas conductivity by a large amount it was concluded that the leakage was due to charges produced in the gas by an external radiation of some sort.

It was probably natural to postulate that the radiation arrived from radioactive elements present in the earth's crust. In order to get further away from these radioactive sources the ionization chambers were carried aloft in balloons. Sure enough the ionization decreased as the earth was left below but at 700 metres to everybody's surprise it began increasing rapidly. In 1912 Hess and Kolhörster, who had been doing the balloon experiments, put forward the revolutionary hypothesis that an extremely penetrating radiation was arriving from outer space. Despite all the available evidence many prominent physicists rejected the idea even as late as 1928.

Hess flew his balloons at night and concluded that this mysterious 'γ-radiation' did not come from the sun since it was still present during darkness. The advent of the Geiger-Muller counter made measurements easier and in 1926 it was discovered that as atmospheric pressure increased the radiation reaching sea level decreased. A major advance was made when Clay in 1929, on a trip to the East Indies, discovered that the intensity of the radiation decreased as the equator was approached. The effect of the earth's magnetic field on the incoming radiation thus became evident, showing that in fact charged particles were arriving and not 'γ-radiation' as was previously thought. The discovery in 1933 that more of these particles reached sea-level from the west than from the east indicated that the majority of the particles were positively charged.

About this time, and with the discovery of the positron (+ve electron), the theory of the electron-photon cascade was developed. In this our

energetic γ-ray materializes into an electron-positron pair, which particles in turn may be accelerated by the field of a nucleus to produce further γ-rays. The process thus multiplies until a point is reached where the product γ-ray no longer has sufficient energy to form a pair. In 1938 Auger discovered that large showers of particles (Extensive Air Showers) arrive simultaneously over areas of several square Kilometres. When these were explained in terms of the above cascade theory it became clear that the parent particle initiating the cascade must have carried an energy greater than 10^{15} electron-volts. (The best man-made machines produce particles of about 10^{10} electron-volts and it is now known that some cosmic ray particles have energies of 10^{19} eV).

At this stage there was still an unexplained penetrating component in the radiation which could penetrate several hundred feet underground without trying very hard. Then examination of Wilson Cloud Chamber pictures revealed the existence of the mu meson. This particle has 207 times the mass of an electron, lives for about two millionths of a second and is extremely unsociable. The failure to interact with other particles before it decays (producing an electron and two neutrinos) enables the mu-meson to travel great distances without being stopped.

The discovery of the pi-meson (approximately 270 times as heavy as an electron) filled in a great deal more of the picture. The charged pi lives for about 10^{-8} seconds before decaying to a mu-meson while the neutral pi lasts only 10^{-16} seconds before giving rise to two γ-rays. These γ-rays initiate the dense particle showers described above. Most of the radiation at sea level consists of mu-mesons and the electrons into which they decay, the other components having been absorbed in the atmosphere. When the primary cosmic ray particle incident at the top of the atmosphere carries sufficient energy all components may get to sea level and we then have what is called an Extensive Air Shower.

Particles with energies of greater than 10^{15} eV should be little affected by fields in the solar system. Consequently detection of E.A.S. while the earth rotates so that we face different parts of the celestial sphere should give some clue as to where the radiation originates. In fact it appears to arrive isotropically so that we are still uncertain of the origin and how the phenomenal energies are reached.

The lower energy radiation does show marked time variations and in general these are determined by the behaviour of the sun. There is a solar day variation in which the intensity of the radiation increases with an amplitude of about 0.2% to a maximum around 13:00 hours local solar time. The amplitude of this daily variation itself often varies with a 27-day period, the time of one solar rotation. There is a seasonal variation and a particularly interesting sunspot-cycle variation. At maximum solar activity the cosmic radiation seems to be hindered from reaching the earth while at sunspot minimum, maximum intensity is recorded. In addition to these

periodic variations there are the fascinating short term changes recorded at the time of the solar flares and magnetic storms.

At R.R.S. we are particularly interested in sun-earth relations and associated ionospheric effects. Three projects have been embarked upon.

1) The first is an experiment centred in Hut 26. This uses arrays of Geiger counters to record Extensive Air Showers. We are here interested in a solar time semidiurnal variation in the arrival rate of these showers. It is difficult to see how the sun can influence particles of such high energies. However, the atmosphere may vary in such a fashion that resultant changes in shower structure cause our apparatus to record a variation in arrival rate.

2) At Lerwick in Shetland a Neutron Monitor is being set up and should be operating in its basic form by December this year. Mr. R. G. Flavell, who will be responsible for running the monitor, has already gone to the Observatory at Lerwick. A neutron monitor provides a very sensitive means of recording variations in the low energy component of the cosmic radiation. It is particularly useful for studying effects associated with solar flares and magnetic storms.

3) It is planned to co-operate with two Scandanavian groups on the particle experiment for ESRO I. This small unstabilized satellite will be in a polar orbit between 300 and 1000 kms. above the earth. Although it is a far from ideal vehicle for the experiment we have been asked to do, our getting into the first European attempt provides considerable satisfaction. We hope to measure electron fluxes and energy spectra between 50 and 500 KeV. The Swedes will use a different technique to cover the range 1-30 KeV. Electron dumping into the atmosphere from the magnetically trapped radiation round the earth is particularly interesting in any attempt to explain auroral or storm time phenomena. It is also suspected that particle ionization may make a considerable contribution to the night time F region.

Cosmic ray studies and techniques can thus be used to look beyond the ionosphere and perhaps help explain what goes on in the ionosphere.

D. E. Page.

THE SECRET OF SPUR A.

For some time now, visitors to Spur A may have been puzzled by the appearance of the main laboratory. Newly-decorated walls and paintwork, air conditioning and accoustic tiles, highly polished floors and benches; all these improvements and yet the room remained almost empty. The answer to the puzzle came on August 22nd, when a huge lorry arrived, and crates of equipment were unloaded and unpacked. As a result of this activity, the lab. now looks very different. A row of smart two-tone grey cabinets is flanked at each end by an Ampex tape-recorder, while at right angles to these stands an impressive-looking control console. A team of engineers is

busy working long hours to make the equipment ready before the launching of the next British satellite, U.K.2. which will take place during the last quarter of 1963.

The equipment has been designed and built to RRS specification by the Plessey Co. (Great Britain) Limited at their West Leigh (Havant) Laboratories. Its purpose is to correct the information, telemetered in an analogue form from the satellite and recorded by ground stations, into a digital form suitable for feeding into a large computer on which the experimenters will analyse their results.

Descriptions of the equipment have appeared in earlier RRS Newsletters (November 1961 and February 1963) but I will briefly mention again some of the salient features.

Operation is intended to be automatic, and the operator should only be required to change tapes, start the machine and keep an eye on it. If the experimenters want to have a look at their results while processing is taking place, a two-channel printer and a five-channel pen recorder are provided. It is hoped that experimenters will take turns and not quarrel amongst themselves as to who should use this facility!

A separate tape recorder and console will be installed later for examining and evaluating the analogue tapes as they arrive from the tracking stations. In this way only the best tapes will be selected for digitising on the main equipment.

A feature of the design is the digital flywheel synchronizing circuit, which should automatically ensure continuous processing of the data when the signal-to-noise ratio falls due to fading of the carrier from the satellite. By this means, and with the comb-filter described previously, we expect to be able to recover information even when the signal is buried 12 dB or so below noise level. The digital fly-wheel works a number of coloured lights, arranged to flash in sequence, and when the equipment was first switched on, the lights flashed madly in a random fashion like some nightmare traffic -light system. I am glad to say that this part has now been made to function properly!

M. E. Farman.

FALKLAND ISLANDS NEWS

16th August.

The Editor,
R.R.S. News.

Dear Editor,

Recently your excellent Newsletter has carried some interesting letters from Cecil Clarke and these have put me so thoroughly to shame that I have managed at last, to write to you from this lonely Colony. Mind you, I must point out that apparently, unlike our colleagues in Singapore, we are really far too busy for such frivolities - but, of course, this may be just our story!

Well now, what is there to write about? Sitting here faced by blank sheets of paper and thinking about News Letters, I am struck by the large number of unfamiliar names they contain - most of them carrying the prefix Dr. After nearly two years away, RRS seems to have changed greatly and it occurs to me that all the new names are probably even more unfamiliar with us and our doings than we are with them, so it seems worthwhile to start by saying something about the work done at this Sub-Station.

In summary - we operate an ionospheric observatory using a Union Radio ionosonde and we run a satellite data acquisition system.

The bottom-side sounding work has been carried out here since 1947 and before that the Navy did it, but the telemetry work only started in 1962. The staff of the Sub-Station has varied over the years from two to four (in IGY) and has now gone up to seven to cope with the satellite work. Actually, only three of these are from RRS, the other four being R.A.F. corporals on loan, from which you will see that there is logic on the side of the more facetious of our friends who address us as "RAF Stanley".

The data acquisition system uses a large steerable aerial like those at Winkfield but designed more robustly to withstand the notorious Falkland Islands wind. This aerial is driven hydraulically and, remarkably enough, has given very little trouble indeed which cannot be truthfully be said of the 9 racks of equipment containing the tape recorders, receiver, time standard and commanding equipment. Up to now this year has been used to record data from Ariel and Alouette, the recordings being sent away to various destinations for analysis. Some of this is done at Slough and I am told that the inhabitants of Spur "A" have already become quite familiar with the various accents and cadences with which 'The British South Atlantic, Port Stanley, The Falkland Islands" is announced. We must remember to send them Christmas Greetings later on.

Again, those of you for whom "Falkland Islands" is merely a name which crops up on notice boards, may like to be told something about the place. At the risk of being disagreed with by everyone who has ever been here (your Editor included), the first thing to say is that you shouldn't take any notice of anything anyone tells you about these islands - including me. If you were to come here yourself, you would find that nothing was quite as you had been led to believe it would be. This is partly because the place and its people seem to change rapidly but also, and more importantly, because how you like the place is quite frighteningly dependent on your own attitude.

Let me describe it as I see it.

Stanley is a small town (1200 people) built for about a mile along the northward-facing (sunny) slope of a low ridge beside a land-locked harbour at the extreme Eastern end of the islands. Some one thousand more people live in settlements ranging in size from a single shepherd's house to over one hundred at the Falkland Islands Company's centre at Goose Green. These settlements are scattered all over the two main islands of East and West

Falkland and many smaller islands which altogether occupy an area about 100 miles broad by 80 deep. The actual site of each settlement is usually due to the historical accident of what seemed to be a good site for a house to the original nineteenth century settler.

The countryside immediately behind Stanley is rather unpleasant, because it has a lot of very broken ground left where all the peat has been removed, and seems to contain an incredible amount of barren gooey clay and rock in amongst the coarse grass. The Sub-station itself is situated in just such country on top of the ridge at the south-east corner of the town.

Luckily all this cannot be seen from the town which looks out across the harbour to another grassy ridge, beyond which are visible a semi-circle of hills ranging in height up to 2000 feet, starting with the long ridge of Mount Low in the North and going round beyond the Two Sisters and Mount Kent in the West. To the East the land falls away to the sea in various bays, promontories and estuaries, ending with Cape Pembroke and its lighthouse clearly visible seven miles away.

To return to the mountains. The strata have a dip of about 45 degrees and vary greatly in their resistance to weathering, so giving the countryside a predominantly E-W grain with valleys separated by parallel ridges having the mountains as their highest points. These mountains are usually rather craggy with great bare tor-like outcrops of grey quartzite and only a little coarse white grass in between, but, down below, the grass becomes quite rich to give the standard "Camp" pasture of white grass with islands of diddle-dee and peat and shallow sheltered stream valleys carrying the best grass of all. There are no trees at all, and many people have compared the countryside to that of the Scottish Islands, but however bare it may look, it still manages to support over 600,000 sheep which are the islands sole economic resource.

To the visitor this land may look a bit uninteresting but it is not really so and anyone who likes fishing, climbing, shooting, bird-watching or just plain walking can find plenty to do. Admittedly it is often difficult to get to the more interesting places without special transport but this becomes, in itself, part of the interest. For example, a fishing expedition to the River Malo becomes quite an undertaking lasting 3 or 4 days with at least two vehicles going out in convoy carrying spades, ropes, jacks, pulley-blocks and all the other paraphernalia for de-bogging. But the result is well worth-while - beautiful tasty salmon trout weighing anything up to 16 pounds.

The weather here is always a point of dispute because it varies so much from year to year. In the six seasons I have spent here so far, only two of them have had anything approaching bad weather - and both of these have been summers. The winter of 1962 was exceptionally mild and we almost believe it was drier and sunnier than the summer you had in England. The spring which followed gave us two months of perfect weather with little wind and hours and hours of sunshine, so that the Sub-Station's handyman grew quite ecstatic about his "lovely country".

Its variability means that visitors in different years get quite different impressions of the weather. When we arrived we were greeted with stories of the rotten summer and worse winter they had had, but my own impression has been of a bracing climate with beautiful fresh clean air and a brilliant sun.

The notorious wind is there, but you cease to notice it after a time (especially if you have a car!!) and it rarely blows all day. Summer evenings are often beautifully calm with warm, red tones on all the hills followed by a brilliant moment of sunset as the rays bounce off the ocean to the west onto the bottoms of the newly formed evening clouds. Then the colours are magnificent.

Mind you, many gentlemen of considerably more renown than I have held very different views, and I might quote Dr. Johnson as asking why should Britain go to war for "the empty sound of an ancient title to a Magellanick rock .... an island thrown aside from human use, stormy inwinter, barren in summer, an island which not the southern savages have dignified with habitation; where a garrison must be kept in a state that contemplates with envy the exiles of Siberia ...."

Of course he had never been here and was writing for the Government of the day with a very blunt political axe to grind, but it is sometimes suspected that these often-quoted remarks have coloured people's views about the Islands ever since.

Just to complete the picture, Sir Ernest Shackleton described Stanley as "a place of one street with the slaughter-house at one end and the cemetery at the other". He should have known, because he was spending his time pacing up and down this one road trying to persuade someone to go to the rescue of his men marooned on Elephant Island.

At that time there may have been considerable justification for Shackleton's comments because except for this one paved road along the sea front, all the roads were merely rubble-filled peat bogs with all sorts of rocks and muddy pot-holes to snag the incautious rider or pedestrian. In recent years most of the roads have been tarmac'd and sodium street lighting has been installed, which gives the town a very neat and familiar appearance and reminds me strongly of parts of the West Middlesex suburbs.

From the distance Stanley looks just like a doll's town. At first it seems depressingly small and lost in the surrounding countryside, but on closer approach, the place looks neat and colourful with all the streets either parallel to the sea or running straight up to the top of the ridge and the houses with yellow or silver walls and corrugated iron roofs painted green or red.

Some of the towns 380 buildings stand out prominently. The most obvious is the red-brick cathedral with its squate spir but also noticeable are the rambling Government House, the fortress-like Town Hall and a long white building proudly carrying a banner notice-board saying "Falkland Islands Company".

After discovering the huge number of shops, the next impression you receive is of the immense and involved social life which is available. This aspect of Stanley life leaves even more differing impressions than the weather. The basic outward structure of clubs, pubs, churches and dances remains the same but within it are threaded any number of large and small social circles of a more or less unofficial nature. Above all, except for a few indigenous sports like football, darts, rifle shooting and whist drives, the influence of the migrant U.K. community is very powerful. There must be about 200 of these people in Stanley and the popularity of any activity depends largely on whether enough of them are interested. For just this reason we have seen revivals recently in amateur dramatics, badminton, squash and cricket.

There is something going on to suit everyone's taste.

People who want to get drunk every night can - and frequently do - but if you prefer to stay quietly in your home and entertain your friends, then you will be joining in something equally popular. There are any number of sports to pursue, whilst there is an average of one dance a week if that's what you want. You are almost certain to find yourself involved in some programme on the local radio and it is almost as certain that you will become a keen photographer - if only to take back snaps of the penguins.

Just now we are in the middle of winter and there is a layer of snow on the ground. The hills stand out white against the grey skies and the cold south wind seems to blow straight off the Antarctic ice-cap. But we have a nice warm office and are far enough away to treat the rest of the world as the idiot it really is, whilst we argue about the new decorations in the Town Hall or grumble about the ash-can collection. We plan for the Photographic Club's spring exhibition or prepare for the Badminton Club's Fancy Dress Dance, so, speaking as an ex-Sports and Social Club enthusiast, it feels just like home - and we hardly ever notice the weather.

Any volunteers!

Yours sincerely,

John Pearson.

NEW EQUIPMENT

Keeping up to date with commercially made products is a never ending task and staff will be interested to know of the way in which this Station tackles the problem. A comprehensive set of catalogues and price lists, which are added to daily is stored in Room 6 and the staff of this room will be pleased to assist you in finding the nearest instrument to your needs. Also from time to time new items of general use will be described in these columns.

It has long been accepted that the U.S.A. leads the field in the advanced oscilloscope but of course they are only calibrated in metric units. Britain

has at last won through in this field with the 545 AB marketed by Livingston Laboratories. It has the advantage that it is calibrated in everyday British units.

545 AB Oscilloscope. Specification

Mechanical.

Length $1\frac{1}{4}$ cubits

Width 1.1/12 feet

Height 4.3/16 hands

Weight 2 quarters, 11 pounds.

C.R.T. area 3.1/8 micro-acre.

Power consumption 2052 B.Th.U per hour.

Vertical Amplifier.

Risetime $3\frac{1}{3}$ pico hours.

Max. deflection 21.1/11 millifathoms

Sensitivity. 9 calibrated steps from 11/1160kV/fathom to 3.23/29 kV/fathom.

Signal Delay. 55.5/9 pico hours.

Timebase A.

24 sweep rates from $4\frac{1}{8}$ microfortnights/furlong to $206\frac{1}{4}$ fortnights/furlong.

Sweep length 1/11 yard.

Timebase B.

Similar to timebase A but with 18 calibrated sweep rates from $82\frac{1}{2}$ microfortnights/furlong to $41\frac{1}{4}$ fortnights/furlong. Provides sweep delay variable to a maximum of 317 nanoyears.

Horizontal Amplifier.

Calibrated magnifier provides effective sweep length of 1/10 perch and extends maximum sweep velocity (timebase A) to 967,000 knots.

Although this first newsflash is lighthearted it is hoped that other items will arrive which merit a more serious treatment.

L. A. Bonvini.

A Volunteer?

Oh to be in the Falkland Isles now that summer's near,
Or Singapore or Halley Bay, or somewhere far from here.
No wonder the staff from this station go,
'Cos the weather is good and the life is slow,
And the summer climates really sizzle
And they've never heard of English drizzle.
Oh joy, Oh bliss, sweet paradise,
Oh, give me penguins, drains and ice!

S. Naylor.

STAFF NEWS

Congratulations to:

Mr. David Bedford and Miss Angela Burgess who were married at Maudlam near Porthcawl on 31st August.

Dr. D. Brooks on his gaining the degree of Ph.D.(Sheffield). (With the Editor's apologies for the delay in recording this).

Welcome to:

New Staff

Mrs. S. R. Gawan	T/Clerical Officer Secretary.
Mr. P. G. Davies.	Scientific Officer
Mrs. E. G. Gomez.	Secretary/Clerk (Singapore).
Mr. A. W. Hudson.	T/Specialist Teleprinter Operator
Mr. W. N. Rees.	T/Instrument Maker.
Miss A. Arman.	T/Shorthand Typist Grade II.
Miss J. D. West.	T/Typist Grade II.
Mr. M. Gough.	T/Labourer Messenger.
Mr. P. H. Miller.	T/Instrument Maker.

Vacation Students

Mr. R. J. Dodd	at R.R.S. until 13th September
Mr. R. F. Wheaton	at R.R.S. until 4th October. —

Resignations

Mr. W. Campbell	T/Semi-skilled labourer (Inverness)
Mr. J. C. Warkentin	T/A.E.O.
Mr. W. D'Souza	T/Specialist Teleprinter Operator
Miss L. A. Pickin.	T/Clerical Assistant.
Mr. V. A. Hughes.	P.S.O.
Mr. C. W. Cleversley.	T/Semi-skilled labourer.
Mr. E. J. Hopgood	T/Labourer-Messenger, who although retiring from his full-time appointment will remain at R.R.S. on part-time duties.

Overseas Transfers

Mr. A. Rodgers leaves for Port Stanley, Falkland Islands on 13th October.

Messrs. R. J. B. Champion and M. Pender returned from Inverness on 14th August on the closure of the Sub-Station.

Mr. J. F. Gaynor returned from Singapore on 18th August.

British Antarctic Survey

Mr. Barry Murton has joined the station for training prior to leaving for Argentine Islands in October. He will be responsible for the Vertical Incidence and Whistler programmes during I.Q.S.Y.

Messrs. E.W. Grimshaw, Mike Bethel and Barry Peters have now left following the completion of 1961/62 record reduction. Barry Peters will be going to Royal College, Nairobi, to assist in the East African I.Q.S.Y. programme and Mike Bethel is returning to Manchester University.

W. H. Bellchambers