FOR STAFF USE ONLY

R S R S NEWSLETTER

No. 89 September, 1968

The Chilbolton Project : Work at Slough

Most people on the Station will know that, because of a mechanical failure, the Chilbolton aerial has been out of commission, partly or wholly, for the past fifteen months. It might be thought that with the aerial out of action, no useful work could be carried out in connection with the planned experimental programmes for the aerial. This is not so, and the Editor has asked me to describe what has been happening in the group at R.S.R.S. whose responsibility it is to develop radio and computing equipment - for use at Chilbolton.

One of the first operations to be carried out with the aerial will be to survey the reflecting surface to check how closely it conforms to a true paraboloid, and if necessary to re-adjust its component panels to bring it nearer to the paraboloidal shape. This is necessary because departures from the desired shape give rise to loss of aerial gain and to high sidelobe levels, which reduce the usefulness of the aerial as an experimental tool. The survey will be conducted with the instrument known as the 'parabscan', which is a glorified photographic rangefinder, somewhat overgrown, since it is about eighteen feet long. Although parabscan surveys were made prior to the original commissioning of the aerial, they are thought to have certain short-comings, and the seatings of the reflector panels are therefore suspect. This has emerged as the result of an exhaustive inspection of the parabscan carried out by the National Physical Laboratory. Our liaison man in this work was Bob Slater, who is assuming responsibility for directing the re-survey of the bowl, and the application to the results of the numerous checks and corrections recommended by N.P.L. The outcome of this work also has a wider interest,

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since the adjustment of reflecting bowls is a matter of importance to the manufacturers of satellite terminals and our experience could assist British firms in winning export contracts.

The Chilbolton aerial will be able to work over a wide range of frequencies up to some maximum which is determined by the accuracy and stability of setting of the reflector panels, and which is nominally 10 GHz. Whether the actual limit is more or less than this remains to be seen, but for the moment experiments are planned at various frequencies up to the nominal limit, and there exist firm proposals for work at 400 MHz (ionospheric and interplanetary medium) 2.7 and 4.1 GHz (tropospheric) and 9.6 GHz (tropospheric and radio-astronomy). It will therefore be necessary to have radio receiving equipment at each of these frequencies. At the moment limitations of space and weight on the aerial do not permit us to have more than one receiver on at once, so the different receivers must be interchangeable, and it is desirable to make the change-over as quick as possible to accommodate a crowded programme. A given receiver may also need to operate in more than one mode: for performance tests on the aerial using cosmic radio sources, the receiver must perform as a switched radiometer, receiving wide-band radio noise; for propagation experiments on a CW signal it may be needed as a narrow-band total-power receiver, perhaps with a logarithmic response. In designing the equipment, therefore, flexibility and inter-changeability have been the watchwords. The work of developing this equipment, which is still continuing, has been shared in varying degrees amongst all the group, Chris Boulton, Chris Comer, Bob Slater and myself; we were aided for a time by Colin Owen (sandwich student) and John Garratt (vacation student) and have lately been joined by Ken Tapping.

Receiving the radio signal is only part of the experiments. It is necessary to record and reduce data which may represent the power, polarisation, spectrum or fading properties of the incoming wave, according to the needs of the experiment. This may involve sampling and recording the output of one or several receiver channels at any rate from several hundred times per second to a few times per hour. Initially the facilities will be limited to some paper chart recorders and a six-channel digital magnetic tape recorder. This latter machine was originally designed by the late Chas. Fowler around an Ampex tape deck and has been developed by Chris Boulton and George Harris. It is capable of taking samples at rates up to 600 per second, and the tapes can be replayed on the decks of the 1905 computer at Slough.

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It is intended to expand these facilities,and to provide more flexible guidance of the aerial when the Argus control computer is delivered to Chilbolton early next year. The computer is capable of storing several programs at once, and operating on them in a sequence determined by the demands of the apparatus connected to it, so that, for example, it can simultaneously guide the telescope in a complicated sequence of movements, monitor the telescope to detect fault conditions, record and analyse the output of a receiver via an analogue-to-digital converter, change the telescope operation or the interpretation of the data according to the state of some other instrument (e.g. a clock or meteorological instrument) and finally print out a log of all its operations. The organisation of the machine to deal with a number of programs and control functions in this way itself requires a major piece of computer programming, and the writing of the 'executive' program to do this is being undertaken by Chris Comer and Ian Parkin, who have spent some time doing the ground-work for it. The connection of the computer to the various instruments which it will read or control needs a lot of work on digital electronic devices, the design of which is in the hands of Chris Boulton.

In the work which I have described we have received much help and advice from the permanent staff at Chilbolton under John McGivney, with whom we keep close liaison. Our joint aim is to make the aerial into as powerful and flexible an experimental tool as is possible within its limitations. In this respect it would help if anyone who has even a tentative idea for a new experiment on the aerial would contact us as early as possible to discuss what apparatus would be needed, (especially if it requires instrumentation at a new frequency) and his needs can then be taken into account in planning the further development of the apparatus.

Mike Quigley

Colloquium on the Metrology of Large Radio Reflectors

Methods for accurately measuring the surface profile of large radio aerials have become of great interest to R.S.R.S. recently owing to the need for a good surface on the Chilbolton aerial. Greater accuracy is required as the frequency in use rises, and with ever-increasing frequencies being used in both commercial and military applications this subject is also of importance to a wide range of users. The idea of this colloquium was to provide a forum for discussing the usefulness of present methods and to stimulate ideas for better ones. It was hoped that British Industry might be stimulated, as a good method for measurement of dishes would have world-wide applications.

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The colloquium took place at R.S.R.S. on 12th September, and was attended by about fifty people. Government departments, industry and the Universities were all represented. Fifteen papers were read in the course of the day and much discussion took place, both formally and informally.

The subject matter of the papers varied from reports on methods already used to measure dish surfaces to suggestions for future methods. At present most people seem to employ either a theodolite method, or a range finding arrangement such as the 'Parabscan', which is at present in use at Chilbolton. These two methods were compared and contrasted, and most people seem to agree that they both have limitations, particularly in speed of operation. This is particularly important, since one wishes to know how the dish surface deforms for different attitudes of the aerial.

Most of the proposals for the future involve measurements of displacement at points on the surface of the dish, rather than an absolute measurement of its shape. One such method, depending on the change in phase of a reflected radio wave observed as the surface of the dish deforms, was proposed by R. H. Slater. This method can also be made absolute. M. J. S. Quigley proposed another method based on the same principle which would give a quick measurement of the surface at any attitude. Other methods proposed included a laser method which is to be tried out on the Chilbolton aerial.

Apart from these practical papers much discussion took place on the effects of a distorted surface on the performance of an aerial. Interest centred around the effects of non-random errors, which can cause a large increase in the level of the near side-lobes even when they are very small. It was agreed that this problem should be considered in future aerial designs, although no satisfactory method of laying down a specification for non-random errors was proposed.

An interesting paper from the University of Birmingham showed how a bad dish surface could be compensated with a feed system using several horn aerials and a phase adjusting network, similar to the principles employed in electronically steerable aerial arrays.

The colloquium proved very useful in bringing together the various ideas which people have on this subject. One had the impression, however, that people were clinging to their pet theories, and the discussion seemed a little inhibited, possibly for this reason. One or two people tried sticking their necks out, but the audience remained unresponsive.

The organisation of the colloquium was very smooth, and thanks are due in this direction to Mr. Meadows, R. H. Slater and the many people in the administrative sector who were involved.

C. R. Boulton

FIRE! FIRE! FIRE! FIRE!

WHAT SHOULD I DO?

It is frightening - the number of people who, in their own homes, are burned to death or suffer injuries from fire.

Have you ever given thought to the fact that you might have a fire in your own home, any day, any time, and what you would do if this did happen?

The general rules to follow if you find a fire are:-

Raise the alarm and rescue anyone in danger.

CALL THE FIRE BRIGADE. (The Brigade do not charge for attending fires).

Try to put the fire out by using whatever means you have available.

Circumstances will decide in which order you carry out these rules.

Never hesitate to call the Brigade even if you think that you have completely extinguished the fire. The Brigade will be only too pleased to send an Officer to make sure that everything is all right. (No charge).

Below are some types of fires which may occur even in the best run homes, and methods of attacking them whilst awaiting the arrival of the Fire Brigade:-

BED FIRES

If caused by an electrical blanket, disconnect the blanket or switch off the electricity. Do not disturb the bedclothes until you have buckets of water available. Extinguish with water.

CHIMNEY FIRES

Pull the rugs and carpet away from the hearth - prop the blower up on the front of the hearth to stop any fall of soot spreading into the room - extinguish the domestic fire by using cups of water ladled from a bucket - seal the throat of the chimney by pushing a wet sack or large wet cloth up from the fireplace - check to see whether the fire has spread into the bedroom or roof void.

CHIP PAN OR FAT ON FIRE

Turn off the gas or electricity - put a lid on the pan by means of a long-handled spoon, piece of wood or poker - if no lid, use the bread-board- if the fire persists, get a damp towel and drape it over the pan and lid - if on an electric stove, slide the pan off the hot-plate. If the fire is in the oven, turn off the gas or electricity and keep the oven door shut.

NEVER USE WATER ON FAT ON FIRE.

CLOTHING FIRE

Approach the affected person holding a rug, blanket, coat or table-cloth in front of you for protection, wrap it round him or her and lay the person on the floor smothering the flames with the wrap. If alone, roll

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on the floor - do not run into the open air. Call the Ambulance or Doctor. Cover any burns (including burnt clothing) with sterile lint, clean bandages or freshly laundered linen - treat for shock. Do not use butter or oils on the burns. Treat any burn as serious.

ELECTRICAL FIRE

T.V. and wireless sets, radiograms, record players, refrigerators, cleaners, washing machines, spin dryers, cookers, electric irons, electric fires, tape recorders, electric wiring, etc., etc. Pull out the plug and turn off the supply at the main switch - in most cases where this is done the fire will go out. If the fire still persists, extinguish with cups of water ladled from a bucket. If the main switches, fuses or wiring adjacent are involved, do not use water for fear of receiving an electric shock. Call the Brigade.

FAULTY HEARTHS

Generally, the first indications of such a fire are wisps of smoke appearing up the sides of the hearth or a discolouration of the ceiling below the hearth. CALL THE BRIGADE. In the meantime, remove rugs, carpet, oilcloth and furniture from around the affected area and pour water from a tea-pot or kettle down any of the cracks through which the smoke is appearing.

GAS PIPE OR GAS ESCAPE FIRE

Do not attempt to extinguish the gas flame. Turn off the supply at the meter and extinguish any residual fire with water. CALL THE BRIGADE. If necessary, they will inform the Gas Board. Do not turn on the supply again until the fault has been rectified.

FIRE IN THE MIDDLE OF NIGHT

If you are awakened in the middle of the night by smoke or a smell of burning - ROUSE EVERYONE IN THE HOUSE AND TAKE THEM DOWNSTAIRS WITH YOU. Try to find the fire. Feel the upper parts of doors, if hot, the fire will probably be beyond your control - open cautiously, only an inch or so, as there may be a rush of hot air or flame. If the fire is beyond your control, shut the door and get everyone out of the house. DO NOT LET ANYONE GO BACK UPSTAIRS FOR CLOTHING, ETC., EVEN IF YOU THINK YOU CAN DEAL WITH THE FIRE UNTIL THE BRIGADE ARRIVES. CALL THE BRIGADE. KEEP ALL DOORS AND WINDOWS SHUT UNTIL THE BRIGADE ARRIVES.

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If, when opening the bedroom door, you cannot get out onto the landing for heat or smoke - shut yourself in the bedroom - bang on the walls and arouse all the other occupants in the house and the next-door neighbours. Everyone in the house should keep their bedroom doors shut and pile pillows, bedclothes, etc., against the doors to keep the smoke from percolating through the cracks - then open the windows and shout for help. Having attracted someone's attention, ask them to call the Brigade and get a ladder - if you are unable to escape, stay in the bedroom until the Brigade arrive; DO NOT JUMP. If, due to heat and smoke, you have to get out before the Brigade arrives DO NOT JUMP - climb over the window sill - lower yourself to the full extent of your arms - then drop.

Sit down now and devise a plan of action to meet such an emergency, utilising tops of bay windows, flat roofs and lean-to out-buildings, as possible escape routes.

OIL STOVES

Use buckets of water - pour over the whole of the stove - do not attempt to carry it outside before it has been completely extinguished.

GENERAL PRECAUTIONS

CONVECTOR HEATERS

Never block up the air vents by draping towels or clothing over same.

FIRE AND SPARKGUARDS

A 'must' where there are children and whenever you leave a fire unattended.

MATCHES AND CANDLES

Keep out of the reach of children.

MIRRORS OVER THE FIREPLACE

Ladies, it might be the warmest place for these aids to beauty, but it is also the most dangerous.

OIL STOVES

FOLLOW THE MAKER'S INSTRUCTIONS.

PORTABLE FIRES

Be very careful how you site these appliances; if put too near furniture or curtains, etc., they can soon cause a fire. Do not put them where they can be knocked over or in a draught.

SMOKING MATERIALS

The cause of many house fires. TAKE GREAT CARE - provide plenty of ash-trays and USE THEM.

SMOKING IN BED

The quickest way to a very short life.

PETROL

Keep it out of the house - petrol is a high explosive - you would not keep Dynamite in your home, why keep Petrol?

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TO CALL THE BRIGADE

By 'phone - DIAL 999 or, if a manual exchange, get the operator and ask for 'FIRE'.

By Police Pillar - open the public side and ask for 'FIRE'.

PLEASE give the NUMBER of the house on fire and the ROAD or STREET.

KEEP CALM - SPEAK CLEARLY.

I. Eyre - Station Fire Officer

STATION NEWS

Visit of Dr. B. H. Briggs

Staff will be pleased to welcome Dr. B. H. Briggs who is visiting the Station for a period of two months. Dr. Briggs, formerly of the Cavendish Laboratory, is at present at the University of Adelaide. He is an authority on ionospheric drifts.

Tropospheric Wave Propagation Conference

At the I.E.E. from 30th September to 2nd October there will be a conference on the various aspects of tropospheric propagation. This meeting will be attended by experts in the subject from many parts of the world. Dr. Saxton, is Chairman of the Organising Committee, and other R.S.R.S. staff who have made considerable additions to the study of this subject will be contributing to the programme of the conference.

Dr. L. Thomas and Dr. J. Hall are going to a Conference at the University of Illinois from 23rd to 27th September. It is concerned with D-region studies.

A rocket is to be launched from Andoya, an island off Norway, and is attended by several people from R.S.R.S. Dr. P. G. Davies has gone to fly a magnetometer during the aurora, and Mr. G. Webb has gone to make optical observations with a T.V. system.

Dr. Bryant and Mr. Mason are also present in Norway for their experiment on detection and measurement of energies of the electrons in the aurora.

ESRO I is due to be launched on 2nd October from the Western Test Range. Messrs. Thorpe and Carter are both in the States making final checks before launch.

The Chilbolton aerial is now working again, and a programme of tests has commenced. A symposium on the metrology of large aerials was held in the board-room on 12th September and was attended by some fifty people from industry, the universities and government departments.

STAFF NEWS

Retirement of Mr. C. W. Spencer

Mr. C. W. Spencer recently retired from the Station after a scientific career lasting some forty years. Originally joining the N.P.L. he has been associated with radio and meteorological studies for most of the period, particularly with the development of the radiosonde and the investigation of meteorological factors affecting radio propagation. Throughout his career he has been very active in the sporting field, particularly in hockey, where, latterly, he was well-known as a referee. In recent years he has become well-known to new entrants in his capacity of Training Officer where his guidance and long experience have been of great value. The following recollections of his career have been received from colleagues.

C. W. Spencer joined the staff of N.P.L. as a Junior Observer in 1928. When I began at the Radio Department , as it then was in 1936, we were all working in the "wireless hut" on the way to Cannon Gate. I found Spencer working under Dr. H. A. Thomas in developing and subsequently operating equipment for the measurement of radio frequencies over a wide band. This was a bulky but beautifully-engineered job; I believe the team was Thomas, Spencer and Murfitt (a friendly mechanic with a sharp tongue); perhaps Haxton was involved too. Soon after, this same team took on the job of designing the first radiosondes for the Meteorological Office. Gradually my own work in VHF direction finding came into close association with the radiosonde work, since it became clear that a network of direction finders taking bearings on radiosonde transmissions would enable wind speeds and directions to be measured as a function of height. So by 1937 or 8 Radio Department were able to provide an operational system to the Meteorological Office for radiosonde and wind measurements. For some years all routine radiosonde transmitters were ordered by Radio Department, accepted from the manufacturer and calibrated there. Spencer was heavily engaged with this work; heavily in the literal sense, because the massive steel chamber in which the aneroid pressure elements were calibrated had an equally massive horizontal lid some 2 ft. in diameter which had to be manoeuvred on and off with a block and tackle. In the course of the 1940 blitz; to me, mysterious,extra work descended on Spencer. He started playing with radiosondes to which were attached small bags of ballast and coiled up pyrotechnic fuses. It turned out that this work was for the Boom Defence Department of the Admiralty. Mills bombs (or similar) were attached at the end of long lengths of piano wire. The ballast bags in some way enabled the balloons to fly at a pre-set constant height while I suppose the fuses were used to arm the device by uncoiling the wire after release. At any rate

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the balloonatics as Spencer and his colleagues were known used to go off each night downwind from London with a large R.A.F. convoy equipped with hydrogen cylinders and let off clouds of these devices set to fly at the heights of the incoming bombing raids. I was involved in setting up temporary direction finders in marquees around London so that we could plot the course of the cloud, I well remember one clear night, when the cloud was overhead, seeing ominous flashes from the sky; presumably the bombs were exploding of their own volition and not by hitting bombers. As the war went on Spencer and his fellow balloonatics became involved in further mysterious activities and expeditions. The arrangements they had developed for flying balloons at constant height were used for distributing literature over enemy territory.

H.G.H.

Following the war, Spencer turned his attention to more peaceful pursuits, first on the measurement of radio noise, and then studying the effects of the weather on the propagation of radio waves, the effects which at times lead to interference to television programmes. On his transfer to Slough, with the rest of the Radio Division, he again took up work on the radio noise emitted by lightning discharges, a task which involved more travelling around the country, visiting installations. It is, however, in his latest duties that he has become best acquainted with his colleagues at Slough. He has combined the duties of training officer with others concerned with welfare and with planning exhibitions of work and demonstrations to visiting parties. His wide experience and unflappable disposition have been invaluable in these activities.

His strictly official duties have still left time for him to play an active part in staff association matters, and he has been Chairman of the Slough I.P.C.S. Committee for several years.

F.H.

Congratulations to:-

Peter and Marion Davies on the birth of their son, Christopher Gwynne on 18th September.

Mike James and Maureen Silvey on their marriage at Iver on 21st September.

/Welcome

Welcome to:-

P. R. Cook	H.E.O.
Mrs. J. E. Berry	P/T Clerk/Typist Singapore
Miss L. M. Thomas	Photoprinter II
Miss E. M. Bambridge	S.A.
J. M. Woodroffe	E.O.
Mrs. R. V. Chapman	Machine Operator
A. D. Hart	S.A.
K. C. Roberts	S.A.
N. J. Hillsdon	Engng Apprentice
M. S. Guest	Engng Apprentice

Resignations:-

W. S. Newman	S.E.O.
K. W. Starr	A.E.O.
J. S. Winchester	S.A.
N. E. Meer	S.T.O. Transfer to D.E.S. Darlington
P. P. Power	Gardener I
E. Taylor	Labourer (Retired)

SPORTS AND SOCIAL CLUB NEWS

"COMEDY OF ERRORS" at Pendley Manor, Tring.

This year the R.S.R.S. party attending the Shakespeare Festival at Pendley numbered six. We enjoyed a most amusing performance of "A Comedy of Errors", staged in an open air setting that makes good use of the landscaped garden. The audience crowded into a covered stand, are fortified at intervals with coffee and soup. Rugs are essential for a typical "summer" evening!

Thanks are due to Bob Fitchew for organising the outing.

Henry Rishbeth

CRICKET SECTION

After much preparation of the pitch, some practice in the nets and some sterling work by Jack Savage's department on the outfield, we were fairly well prepared for our last match of the season, against R.G.O. on September 8th. After our defeat at their hands earlier in the season we were eager to get our revenge. The elements were kind, for a change, although the pitch was a little damp.

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The Astronomer Royal won the toss and elected to bat. R.S.R.S. had an early success when Purcell was run out in the first over, from an excellent return by Hussain. Moosajee and Eccles bowled well, keeping the runs down, but R.G.O. got to 36 for the loss of only two wickets. At this point R.S.R.S. removed Hobden (21) with a brilliant catch by Dunford. The Astronomer Royal went two balls later, and two further wickets fell at this score. The tail-enders tried hard, but R.G.O. were eventually all out for only 47. Moosajee took four wickets for 15 runs, and Hussain bowled very economically to take 1 for 4 in six overs. In their innings R.S.R.S. started well. Bellchambers was going well, but unfortunately was given l.b.w. for 5. Martin (19) and Hussain (13) took the score to 42, before both were out trying to hit the winning run. Hopkins and Dunford completed what had become a mere formality.

This success showed what we can do, and obviously we could well have a good season next year. The bowling was very steady, even without Davies and Flynn, and the batting performances show that the talent is there. Let us hope that next season brings more success.

As this is the last report of the active season it seems appropriate to thank the many people who have ensured the continued revival of R.S.R.S. cricket. We could not manage without the gardeners' continual help on the outfield. The appearance of the ground on September 8th was a tribute to a lot of very hard work on their part. Also in respect of this particular match we would like to thank Mike Johnson for umpiring throughout the day, a somewhat thankless task, and our thanks too to the ladies who made the tea. More generally, thanks are due to other 'tea-makers', particularly Veronica Lovell, and umpires who have helped so nobly. Finally, thanks to members of the section for help with the pitch, and inadequate thanks to Eric Dunford without whom nothing would have been done.

Chris Boulton

BRIDGE CLUB

The first bridge evening of the 1968/9 season will be held on Wednesday 2nd October in the canteen - for further details see the Sports and Social Club notice board. It is expected that these meetings will be held every two-three weeks, depending on members' wishes.

Lunch-time bridge is played most days in E127 when new members of staff and those wishing to learn will be welcome.

Robert Pratt

/Coming

COMING EVENTS IN OCTOBER

Friday 4th: Theatre Party to "Irma la Douce".

Saturday 12th: Discotheque Evening

Friday 25th: Theatre Party to "Patience".

Further details will be given on the Sports and Social Club notice board.

Bob Fitchew

BONFIRE NIGHT

The annual Guy Fawkes celebrations will soon be upon us again. May we make a plea now for assistance with wooding and bonfire building in the lunch-hours, loan of saws, old engine oil, old clothes for the guy, and drivers willing to ferry children from local homes to and from the Bonfire? Any offers of help would be much appreciated - even the odd ten minutes makes quite a difference.

Paul Dickinson
Veronica Lovell
Eric Dunford

BADMINTON CLUB

The R.S.R.S.S.S.C. Badminton Section starts its 1968/69 season on Thursday 3rd October.

The venue is the Austen Leigh and Baldwin Institute which is just off Eton High Street. The hours of play are 1900 hours to 2230 hours and the cost is 3/6 per night (inclusive of a cup of tea).

Beginners, county players and all grades between are welcome.

For further information contact one of the following committee members:

Barbara Greenfield
Mahboob Hussain
Alan Smith

Letter to the Outstations

Dear Colleagues,

Summer in much of southern England has, as you will no doubt have read, been swilled away on a tide of overflowing tributaries. Strangely enough our own part of the world, though wet enough, has not seemed much more sodden than usual; in some mysterious way the Thames, locally, and the drains, locally, have coped. It has been within the building that hydraulic problems have occurred. The spirit of rebellion overtook some of the upper corridor plumbing and as well as providing tidal troubles aloft, it descended the walls into the darkrooms below. There, staff carried on, showing devotion above and beyond the call of duty by working beneath, if not the sword of Damocles, at least a bucket full of drips suspended by a string.

Over the last few weeks R.S.R.S. has witnessed the departure of two well-known members of staff. Of Mr. Spencer's forty years' skilful service you will read elsewhere, suffice it to say here that, from one who has had some association with him in recent years, his humour, experience and courtesy have been much appreciated. May his new career as a gentleman of leisure in the West Country long prosper.

The other gentleman who has recently left our happy home and circle can scarcely be said to have left for a leisurely life. Yet, with all his cosmoplitan travels, Simon Newman finds time to cultivate the arts with balance and humour. We hope he and his wife will enjoy their spell in Switzerland while he is attached to C.E.R.N. His absence is a great loss to communication at the Station. We shall be forced to go through the usual shame-making meeting with foreigners who speak good English, without being able to counter with more than the mangled fragments of schoolday French or German or a few unsuitable phrases in Italian dealing with seduction, blood, betrayal and vengeance, part of opera libretti enjoyed by such as,

Yours sincerely,

The Editor

Reprint List

H. Rishbeth and C. Kervin
Seasonal changes displayed by F1 layer ionograms
J.A.T.P. 1968 30 1657-1665.

H. Rishbeth
Solar eclipses and ionospheric theory
Space Science Reviews 1968 8 543-554.

J. W. King, G. L. Hawkins and C. Seabrook
The seasonal behaviour of the topside ionosphere
J.A.T.P. 1968 30 1701-1706.

J. W. King and D. Eccles
The effect of a solar eclipse on the development of the ionosphere equatorial anomaly.
J.A.T.P. 1968 30 1715-1718.

J. W. King and P. A. Smith
The seasonal anomaly in the behaviour of the F2-layer critical frequency
J.A.T.P. 1968 30 1707-1713.

J. W. King, H. G. Rix and C. Seabrook
The behaviour of the topside ionosphere at middle latitudes at night
J.A.T.P. 1968 30 1605-1613

L. Thomas
World-wide disturbances in the F-region accompanying the onset of the main phase of severe magnetic storms.
J.A.T.P. 1968 30 1623-1630.

Internal Memoranda - nil