RRS Newsletter

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

No. 37 May 1964

VISIT OF LORD BESSBOROUGH

Lord Bessborough, the Joint Parliamentary Under-Secretary of State for Education and Science, visited the Station on May 8th. During the short time available an attempt was made to give him an overall impression of the kind of things we do and of the way in which we do them. From our space research programme he saw the work on rockets and something of the circuitry and testing facilities. The analysis of ionosphere results was exhibited through the work of the topside sounder group. Space Science Services were represented by Minitrack and by the data processing equipment.

To represent the Station's field work, and work more directly related to practical communication links, we showed him the work with the differential radio refractometer and the tropospheric radar, and a model of the new radio telescope. Laboratory investigations were represented by work on ultra-violet absorption and on charge-exchange reactions.

Lord Bessborough has had considerable experience with the electronic industry and he told me that he found our work unusually interesting. He said he was impressed by the competent way in which people described their work to him.

A visit of this kind, involving the preparation and description of a series of exhibits, forms a small but valuable rehearsal for our Open Days. Its success augurs well for that more elaborate occasion.

J. A. Ratcliffe

THE RADIO TELESCOPE

Those members of the staff, at least, who have seen the model of the 82-ft diameter "Big Dish" which was shown to Lord Bessborough recently, will have realised that the telescope project is under way. In fact, it is now nearly four months since the contract was placed with A.E.I. by the Ministry of Public Building and Works on behalf of the Radio Research Station.

The instrument will be vastly different in appearance from that used by Jansky when he made his classical observations in the early 'thirties, which led to his discovery that the direction of arrival of radio noise was related to the motion of the stars. It is doubtful, even, whether the expression "radio telescope" crossed his mind at the time; he was an engineer employed by the Bell Laboratories investigating the effect of radio noise on communication systems. Jansky's work was taken up by Reber, who built in his back-yard in Illinois the first steerable paraboloid that bore any resemblance to a modern instrument, although it could not be steered in the horizontal plane, but moved only in elevation; it was, in fact, a meridian-transit instrument. With it, he plotted maps showing noise-sources in the sky. Reber was (and presumably still is) quite a character and an enthusiastic "ham". He must be one of the last of the string-and-sealing wax kind - or, perhaps, the first of the do-it-yourself school. He built a cavity-resonator from a paint-drum, and, when asked why he had decided on a particular form of construction for his elevation movement, said that he had got the idea when watching a cement-mixer disgorging its load.

The first fully-steerable aerial of large size constructed for radio astronomy purposes, was, of course, the 250 ft instrument at Jodrell Bank. Designed primarily for use at wavelengths not much less than one metre, construction had already commenced when the 21-cm hydrogen line was discovered. Hastily, the bowl was lined with solid sheets and the mount strengthened so that reception of the hydrogen-line could be undertaken. Ever since that time there has been a downward trend in minimum operating wavelengths, encouraged also by the desirability of installing higher frequency transmitters on satellites. The maximum economic diameter for a fully-steerable instrument now seems to be around the 100-ft mark. The Stanford Research Institute have, however, erected aerials of diameter about 140 feet - one in Scotland - but these have open mesh reflecting surfaces and are not suitable for the highest frequencies.

The R.R.S. telescope comes at a time when the use of satellite frequencies up to 10 Gc/s is envisaged. Consequently it must be designed to operate at frequencies as high as this value, which implies that the accuracy to which the profile of the reflecting surface must be constructed is 0.1" or better. In addition, the accuracy to which the instrument can be pointed must be about 2 minutes of arc. These factors present considerable problems in a reflector of diameter 82 feet, especially during windy weather. Those members of the

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staff who have seen the model will have noticed the rigidity of construction; the reflector and turning gear will weigh more than 200 tons and will be mounted on a hollow reinforced concrete tower itself weighing at least 800 tons. This tower will not twist by more than a few seconds of arc even when the reflector is subjected to 40 m.p.h. winds.

The reflector mount is of the altitude-azimuth kind, implying independent rotation in the horizontal and vertical planes, in fact, through 540° and 125° (0-125°) respectively. The maximum angular speeds are 3°/sec. and 1°/sec. respectively, with associated values of acceleration of 2°/sec/sec and 1°/sec/sec, so that satellites may be tracked and the aerial slewed at a reasonable speed. The amount of power required to do this is not great during calm weather, but, in strong winds, becomes considerable; 20-horse power electric motors will be necessary for the elevation motion and 60-horse power for the azimuth. The speed of these motors will be controlled by the "metadyne" system; those interested in electric traction will recall that this system was originally developed for producing uniform acceleration and regenerative braking on the London Metropolitan railway system.

The angular position of the paraboloid will be controlled by three main methods: firstly, by manual control, in which the operator turns control-knobs until the dish has reached the desired position; secondly, by "auto-follow", in which the dish tracks a beacon in a satellite automatically; and, thirdly, by a paper tape into which the desired position-programme has been punched. The last method will be used when following star sources.

The selection of a site on which to erect the telescope has proved troublesome, and has delayed construction considerably. Slough itself is unsuitable owing to the high levels of radio noise which prevail, largely due to the motorway and to the proximity of housing areas and the trading estate. Originally, a site was chosen in the large area of heathland and forest lying between Sandhurst and Ascot, but was later abandoned owing to the possibility of interference from a microwave radio-communication network which was being planned; unfortunately, many of the frequencies used for space research have to be shared with communications authorities, which makes siting a very difficult matter.

After an extensive search, made in collaboration with service, civil and local government departments, only two sites could be found which seemed suitable on all counts; they were on disused airfields at Foulsham (Norfolk), and Chilbolton (Hants.). The first was ruled out owing to distance from Slough, and Chilbolton was chosen. It is less than 1½ hours from Slough by road, and lies between Andover and Winchester, near to Stockbridge. About half the disused airfield remained in Air Ministry hands and, since the original owners (from whom the Air Ministry had purchased it using compulsory war-time powers) did not wish to buy it back, the land was transferred to Ministry of Public Building and Works on behalf of D.S.I.R. Of the total area transferred, a little over two acres will be used to site the telescope and associated control building; the rest will be re-let to local farmers on the understanding that

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no electrical interference is generated. An understanding has also been reached with the local planning authority by which R.R.S. is informed of any housing or industrial development which is proposed within a certain distance of the site, so, that, if necessary, objections can be lodged and a local enquiry requested from the Ministry of Housing and Local Government, following the usual procedure. This procedure should not often be necessary, however, since the site lies in an agricultural area which is not scheduled for development.

Since Chilbolton is fairly close to Slough, it is envisaged that the telescope can be operated by a small number of staff living locally, the installation and experimental work associated with particular projects being carried out largely by teams visiting from Slough.

The frequency range over which the instrument is expected to operate is 100 to 10,000 Mc/s. However, the directivity of an 82-ft diameter aperture is appreciable at frequencies lower than 100 Mc/s, and it is possible that there may be some applications in the HF band. Although suitable for radio astronomy, it is probable that the telescope will be little used for that purpose, since other organizations in this country are more directly concerned; but stellar noise sources will undoubtedly be used for calibration and reference purposes, and the radiometry techniques commonly used in radio astronomy will undoubtedly be used for detecting weak signals generally. Work which is allied to radio astronomy, such as investigations of the planets and of the sun, is, however, envisaged. Other applications will include investigation of tropospheric scattering phenomena at vertical and oblique incidence, tropospheric noise, absorption and scintillation at low angles of elevation, and studies of the ionosphere and high atmosphere. In addition to problems such as these, information on the performance of the aerial itself is required by designers, such as the deformation occurring during wind-gusts and errors brought about by differential expansion. The possibility of investigating a wide range of problems is being taken into account during the detail-design stage of the telescope.

At present, this detail-design stage is being undertaken by A.E.I. in close collaboration with the Ministry of Public Building and Works and R.R.S. The target date for completion of the radio telescope is Christmas 1965. Whether R.R.S. will be presented with a working instrument at that time remains to be seen; the history of contracts throughout the world for the construction of big dishes is not encouraging, but we shall all do our utmost to keep this date within the bounds of possibility.

R. W. Meadows

JOURNEY TOWARDS THE QUIET SUN

Report on a Visit to Israel

To enjoy a foretaste of summer in the light of a spotless sun (IQSY) rarely obstructed by cloud and to return in time to witness the cautious unfolding of an English spring is a wonderful experience. But a visit to Israel is bound to be associated with miracles. Take the country itself: its past lies at the roots of Western civilization, its future is being shaped with the aid of modern science by a people multicoloured and multi-lingual but single-minded in its determination to see Israel live and prosper; it is a land holy to three world religions yet sadly divided, the paradise of fertile fields and the hell of barren deserts are found there side by side - and the Bible makes an excellent guide book.

Today I can only describe the journey there; my report on Israel will follow and, unless colour printing of the Newsletter is introduced soon, I will have to provide the illustrations in the form of colour slides later on.

A cold Slough in mid-March was quickly left behind as my wife and I sped southwards via the Alps to Marseilles in time to beat a rail strike. In the harbour M.S. Moledet (7,800 tons) of the ZIM Israel Navigation Company was waiting for over 600 passengers. There followed the usual hours of quayside queues and chaos involving passports, luggage, labels, customs, porters, tickets and passports again until, at last, passengers happily rejoined their own luggage in their correct cabins, and porters streamed off the boat pockets jingling (or rustling). Built in 1961 the 'Moledet' is an All Tourist Class liner; this makes for great informality, and its seven decks are open to all and provide the usual amenities such as a bar, cinema, synagogue, swimming pool, library, another bar and a hospital. Engine room and bridge were not so readily accessible, nevertheless I managed to check the operation of their radar equipment. This came into its own during a thrilling passage through the Straits of Messina at night when moon and stars vainly competed with the brilliant strings of light and flashing beacons along both coasts. Scylla and Charybdis having been safely negotiated the four-day non-stop journey continued at 17 knots with passengers engaged in various forms of inactivity until roused by the dinner gong. Boat drill was taken seriously by everybody - the recent 'Lakonia' tragedy had made a deep impression. Bulging orange-coloured clusters (life-jacketed passengers) formed at the various assembly points, boats were lowered and the captain made a tour of inspection.

Our links with home were not wholly severed. The news in English (by courtesy of the BBC General Overseas Service) was broadcast daily in the bars, and I could have listened to 'The Archers' and 'Family Favourites' from Cyprus on my transistor set while sunbathing on the boat-deck. Weird music and languages read from right to left, however, were the predominant sounds now uttered by the little loudspeaker - the East was all around us. Two hours of my precious leave were lost when the clocks were put forward - one of the

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traditional rites of long-distance travel. But even our familiar Sunday had suddenly shifted to the Saturday, the Jewish Sabbath and the day of rest. It was therefore on an ordinary working day, Sunday 22nd March, when we saw land again: to port the snow-capped peak of Mount Hermon in Lebanon, to starboard Mount Carmel and the spreading city of Haifa - our four weeks in Israel were about to start.

(To be continued)

W. S. Newman

"What, will the line stretch out to the crack of doom?" (Macbeth)

Because literature has been uppermost in many people's thoughts these past few weeks during the celebrations of the Quatercentenary of Shakespeare's birthday, it seems appropriate to glance at the vastness of literature and thus the quantity of information produced.

Did you know that in 1800 there were only 100 periodicals in existence? In 1900 there were 1,000, in 1930, 10,000 and by 1963 the number had reached 100,000. 40,000 of these are said to be Russian and contain 3¼ million articles per year.

To help combat this excessive amount of information, which continues to increase rapidly, there are 3,500 abstracting and indexing services throughout the world. Even so, as Michael Faraday himself said "It is certainly impossible for any person who wishes to devote a portion of his time to chemical experiment, to read all the books and papers that are published in connection with his pursuit; their number is immense and the labour of winnowing out the few experimental and theoretical truths which in many of them are embarrassed by a very large proportion of uninteresting matter, of imagination, and of error, is such that most persons who try the experiment are quickly induced to make a selection in their reading, and thus, inadvertently, at times, pass by what is really good."

These words were written in 1826! Extrapolation is a technique frought with risks; but it is evident that at the present rate of increase in output, something will have to be done. Shall we see the learned journals applying ever more stringent criteria before accepting material. Will abstracts of abstracts; second, third and fourth derivatives; be prepared before the first typesetting?

Faustus entered into compact with the devil. It is not for nothing that the luckless doctor is sometimes identified with Johann Fust, a fifteenth century printer, and Marlowe makes him end his days with the hopeless shriek .... 'come not Lucifer, I'll burn my books'.

Eds.

STAFF NEWS

Congratulations to:-

Mr. and Mrs. R. Murray (Judy is a former member of RRS) on the birth of their daughter, Beverly.

Betty Turner (also former member of RRS) on her engagement to Brian Bradey.

Welcome to:-

New Staff

A.J. Chipperfield	College Based Sandwich Course Student
E.G. Coles	T/Carpenter
N.C. Coe	T/Laboratory Mechanic

Resignations

Mrs. H.M.R. Hale	T/S.A.
R. Barnett	T/Carpenter's Mate
S.H. Khan	T/C.A.
N.P. Bates	T/Laboratory Mechanic
B.D. Parley	T/S.A.

Other Changes

Mr. J.K. Oatley was transferred on promotion to the Geological Survey and Museum.

John Beynon would like to express his gratitude to all those members of the staff who contributed to the cheque presented to him on the occasion of his marriage. A very useful - and very elegant - coffee percolator has been purchased with the money.

HOPE SPRINGS ETERNAL

It has lately been shewn that a gun-barrel may be connected with a high-pressure steam-boiler, in the same manner as with a chamber of condensed air; and as the steam may be supplied as long as water remains in the boiler, if bullets be allowed to fall into the barrel fast enough, a hundred or more may be thrown out every minute, with the same force and precision as if each issued from a common piece of artillery. The rapid succession resembles the issue of water from a jet pipe; and if such an engine could be used in a field of battle, its barrel of death, made to point gradually along a line of men, would mow them down like cornstalks before the scythe - none could escape. The horrible idea and proposal have been excused by saying, that to prove the possibility of such carnage must have the effect of putting an end to war altogether.

Treatise on Natural Philosophy 1829

SPORTS AND SOCIAL CLUB

As a result of the elections held recently, a change of committee has been effected. The new committee is as follows:-

Dr. Fooks - Chairman Dr. Page - Vice Chairman
Mr. D. Thorpe - Treasurer Mr. J. Juleff - Secretary
Mr. A. Lowe, Miss M. Peart, Miss A. Jones, Mr. C. Lovett

Messrs. J. Hancock and M. Edwards have been co-opted to the committee for the purpose of running the bar.

The names of the section representatives are to be seen on the club notice board, together with their occupation.

With the large amount of effort that the Open Days require, it is very much regretted that we shall not be able to hold our summer dance until the end of the summer.

J. Juleff

Smith-Rose Cup

The Smith-Rose Cup will once again be competed for this season. For the benefit of new staff the activities include tennis, cricket, motor rallies, badminton, table tennis, bridge and snooker.

Watch the notice board for details.

A.B. Lowe

Tennis

Tennis on the hard court has already commenced for the new season and your attention is drawn to the main corridor notice board where the booking sheets appear every week. Players are invited to arrange and book games in addition to the regular evenings we have on Mondays and Wednesdays. Mondays are for those keener on competition tennis with Wednesday for the not-so-serious players but do not let this put you off, some people come to both sessions. Newcomers are most welcome especially as we have some matches and tournaments to come later in the year. It is hoped that the bar will normally be available on the regular evenings.

P.A. Smith

Badminton

Once again the last cup of tea has been drunk and the last game of solo played until September - the badminton season has come to an end. Many fast and furious games of badminton have been played but, unfortunately, the number of people to play them was not sufficient to prevent the club from making a loss. I can assure all non-members that Thursday evenings are too enjoyable to miss so join us in September.

Our thanks go to Margaret Peart who has organized the evenings and, most important, made the tea for the past seven months.

L. Baker