R.S.R.S. Newsletter

No. 73 May, 1967

UK-3 - THE FIRST ALL BRITISH BUILT SATELLITE

On Friday 5th May 1967 at 1600 hrs. G.M.T.

A new stage in British space science and technology was marked by the launch of UK-3, the first satellite to be ordered, designed, built and tested in the U.K. to carry five British experiments into space.

U.K.3 is the third in the series of our civil space research satellites.* It contains instruments, also designed and made in this country, for experiments devised at the Universities of Birmingham, Manchester (Nuffield Radio Astronomy Laboratory, Jodrell Bank) and Sheffield, the S.R.C. Radio and Space Research Station and the Meteorological Office. The project, which is part of a co-operative programme arranged between the U.S. and British Governments, is managed in this country by the Science Research Council and in America by NASA.

THE SPACECRAFT

The cylindrically shaped spacecraft (with a conical top) is 3 ft. long and $2\frac{1}{2}$ ft. in diameter. In orbit it weighs about 198 lbs. and, with the booms extended, measures $10\frac{1}{2}$ ft. across. The Royal Aircraft Establishment, Farnborough, where the spacecraft was tested in a special chamber to simulate the space environment, is the R and D authority for the project. British Aircraft Corporation is the main contractor with responsibility for the structure design and spacecraft assembly and testing. G.E.C. Electronics Ltd. is the main contractor for telemetry, command receiver and power supplies, involving some 10,000 components.

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* Ariel I, launched in April 1962 and Ariel II, launched in March 1964 were designed and built in the United States to carry British-built experiments.

THE LAUNCH

The satellite was launched by NASA from the Western Test Range in California using a 4-stage solid fuel Scout rocket.

The rocket travelled in a southerly direction until the 4th stage injected the spacecraft into orbit above the Earth's surface. Here a de-spin mechanism operated, the satellite's four booms were released and the 4th stage motor jettisoned, leaving the satellite orbiting at approximately 17,000 m.p.h.

THE ORBIT

An elliptical orbit, inclined at 80° and an altitude varying between 500 & 600 Km has been achieved so that the entire surface of the globe up to a latitude of 80° can have been traversed at all times of the day by the end of 3 months, at heights giving an effective compromise between the varying experimental requirements. This latitude coverage goes from Spitsbergen in the North to Antarctica in the South. The satellite orbits the Earth once every 95 minutes.

TRACKING AND TELEMETRY

UK-3 is tracked by the world-wide chain of NASA Space Tracking and Data Acquisition Network (STADAN) stations; one of these, at Winkfield, is operated by R.S.R.S. as a joint venture with NASA. These stations, together with our out-stations at Singapore and Port Stanley are used for recovering data from the satellite and commanding its operation.

Data from the experiments are obtained in two ways; either by direct radio transmission of the information in the form of frequencies varying between 5 and 15 KHz (Kc/s) as it is obtained by the sensors, or by recording it on the spacecraft tape recorder. This latter records continuously on an endless loop of magnetic tape and the data from it is transmitted at high speed on radio command from the stations referred to above, so that all information recorded in the satellite during one complete orbit can be transmitted to any ground station in about two minutes.

The telemetered information obtained in the two ways described above is recorded at the ground stations on magnetic tape and is later converted into digital form for ultimate analyses by the experimenters. The initial conversion process is carried out centrally at R.S.R.S. - to which are sent the magnetic tapes from all ground stations.

ATTITUDE DETERMINATION

In order to make the most accurate use of their data the radio experimenters wish to know the attitude of the space craft relative to the earth (as compared with the Meteorological Office experimenters who only need to know the spin axis/Sun line angle). The spacecraft incorporates a Sun angle sensor developed by R.A.E., Farnborough, and a further angular location is required to define completely the spacecraft attitude.

It was hoped to obtain this from a comparison of the magnitudes of the received telemetry signals with the spacecraft polar diagram (as for Ariel II), but at a late stage this was found to be impractical for UK-3, and an optical system was proposed.

This has been developed at the R.S.R.S. which assessed the practicability of the system, arranged for the manufacture of mirrors and assisted in their calibration and setting up and (in conjunction with NASA) organised the ground resources.

The idea is to monitor, from the ground, the spacecraft as it traverses the sky while the ground is in darkness but the spacecraft is still in sunlight, and to observe and record flashes of sunlight from reflecting surfaces of the spacecraft. This has already been done for Telstar using mirrors and specially developed tracking equipment, and for UK-3 it is proposed to use mirrors at known angles, supplemented by the reflecting surfaces of the solar cells to give the flashes. The flashes will be 'coded' by the fact that a different number will occur in any one rotation of the spacecraft in the different angular directions involved (except for the duplication of 4 flashes per rev. from both downward and upward surfaces of the boom solar cell arrays).

Ground recording is carried out by several different methods, as the proposed system has aroused considerable interest. In the UK the Royal Radar Establishment, Malvern, track UK-3 using their Schmidt camera, and the S.R.C. Royal Observatory, Edinburgh, use their kine-theodolite system. The Smithsonian Institute in Washington, which has a chain of Baker-Nunn cameras throughout the world, are co-operating, (and will probably be our main source of data, having cameras at the best latitudes for the purpose). Other cameras coming under Goddard Space Flight Center, will probably be used.

The data from these sources are reduced and combined with the Sun sensor information, so that the true attitude can be calculated at R.S.R.S.

THE EXPERIMENTS

The five experiments were selected for the satellite payload in consultation with NASA. They are :-

1. R.S.R.S. Terrestrial Noise Experiment

The aims of this experiment are to measure high frequency atmospheric radio noise received in the satellite and to deduce the distribution of the noise sources (mainly lightning discharges) over the surface of the Earth at different times of day and at different seasons. This information, apart from its general scientific interest, will be an aid in the design of radiocommunication circuits particularly those in which directional aerials are used. It will also help to show to what extent radio noise is a potential source of interference to satellite radio receivers and could be an important preliminary to later research into natural noise sources on other planets.

The satellite-borne equipment, during successive specified periods,

(a) measure the average voltage of the envelope of the noise received in three pairs of narrow-band channels in the standard-frequency bands near 5, 10 and 15 KHz and

(b) counts, up to a specified rate, the number of atmospherics with amplitudes exceeding a pre-determined threshold in these channels. (The two types of measurement should ensure coverage of the wide range of noise power expected from the intense thunderstorm areas of the tropics and the quiet regions at higher latitudes).

Two orthogonal, balanced, screen-loop aerials, each of effective area 0.12 sq. metre, are mounted on the upper cone section of the satellite. Noise received on these aerials is fed through filter networks to six narrow-band receivers in the satellite body. Data are recorded by a low-speed encoder every 27.92 seconds and stored on magnetic tape for later telemetering to the ground so that almost complete orbital coverage is obtained. Additional outputs are read every 1.745 seconds by a high-speed encoder for real-time telemetry transmission. The aerials weigh 3 lbs. and the electronics (including container, mounting and connectors) 5.5 lbs. with a volume of 200 c.ins. Power consumption is 460 mW.

In connection with the experiments, measurements of noise and the locations of thunderstorms are being carried out in the U.K. with the co-operation of the Meteorological Office and in Singapore.

(to be contd.)

Visit of His Excellency Dr. Gerhard Stoltenberg, Federal Minister of Scientific Research, Federal Republic of Germany

On Wednesday 3rd May the Station was visited by H. E. Dr. Gerhard Stoltenberg. Dr. Stoltenberg, who is 39, served in the war from 1944-45 and studied history, philosophy and social science at Kiel University. In 1960 he was appointed to the post of lecturer at Kiel. In 1965 he was made a director of Krupps and during that year appointed Federal Minister for Scientific Research.

The Minister's party arrived at 09.30 hrs. and after being received by the Director in the Entrance Hall, were conducted to the Board Room where Deputy Director and Divisional Leaders were introduced. The Minister then visited the following examples of the Station's work.

A model of the Chilbolton aerial, the Data Processing section, Topside sounder results and the Microwave Refractometer.

LETTERS FROM OUTSTATIONS : FALKLANDS

Those members of the staff who have journeyed to the Falkland Islands on either R.M.S. Darwin or her predecessor R.M.S. Fitzroy, will be pleased to learn that Captain F. White, O.B.E. has been appointed an Elder Brother of Trinity House. By the time this appears in print, he will be on his way to England to take up his new appointment.

Freddie White has been a well known and popular figure in these parts since the war and we shall be sorry to see him leave although wishing him every success in his new job.

R.M.S. Darwin now sails under the command of Captain Nigel Miller whom many of you will have met when he was first officer on the same ship.

D. MORTIMER

LETTERS FROM OUTSTATIONS : SINGAPORE

THERE ARE DUCK EGGS AT THE BOTTOM OF MY GARDEN

Most readers of the Newsletter will know little of R.S.R.S. activities in Singapore. Well, we are engaged in B2, D6, A4, C28 etc. and also apparently on research into hatching duck eggs!

Addressed to the Officer-in-Charge, Central Research Station, Sembawang, Singapore we received the following letter from the Officer-in-Charge, Demonstration Farm, Singapore:-

> 'Re : Duck Eggs for Hatching from Dem. Farm:
> 132 Peking duck eggs are sent from the Demonstration Farm to determine the hatching percentage of the eggs. Please acknowledge receipt of the eggs.'

This was shortly followed by another letter saying, 'Adding to the first batch of 132 eggs sent on 23. 9. 66, the second batch of 277 eggs is hereby sent for determining the hatching percentage of Peking duck eggs. Please acknowledge receipt of the eggs.'

The eggs have not arrived at Sembawang yet and the Officer-in-Charge is worried about the progress review.

U. YILMAZ

"REFLECTIONS IN BLUE"

Let me weep, and let each tear be a sorrow gone.
Let me sigh, and let each sigh be a grief forgotten.
A fresh start, a new beginning, the past to kill,
The future - on towards a new era - fresh in it's very birth,
Untainted by corruptness gone, virginal and pure.
Sweet as a child in innocence yet to go astray, as go astray she must if she is to remain part of this eternity.
Oh for a satisfied mind - even if only in it's blindness - or perhaps for love? and the respite it can bring in it's engulfing stream.
For a soul to share the burden of guilt - for are we not all guilty?
Should love not be of the mind?
A union of souls?
An entwinement of intellect, eternal in it's strength.

ANON

STAFF NEWS

Congratulations to :

Frank Bale on winning a Music Festival prize with his composition 'A Comedy Overture'.

Dr. Henry Rishbeth on his marriage to Miss Priscilla Davis at St. George's Parish Church, Weald, Kent on 22nd April, 1967.

Welcome to :

Mr. P. Fulcher	Sandwich Course Student
Mr. D. A. Cowcher	P/E.O.
Mr. P. J. Harrison	Sandwich Course Student

Resignations :

Mr. D. A. Chifford	P/A.E.O.

SPORTS AND SOCIAL CLUB NEWS

The Officers of the Club for 1967-68 are :-

Committee

Dr. E. Dunford	Chairman	Room 2
Mr. G. Thomas	Vice Chairman	Spur D, Room 48
Miss C. Seabrook	Secretary	Spur C, Room 33
Mr. R. Slater	Treasurer	Hut 6
Miss E. Buckner	Minutes Secretary	Library
Miss B. Greenfield		
Mr. K. Slater		
Mr. R. Butler		
Miss M. Stacey		

SECTION REPRESENTATIVES

Bar	Barbara Greenfield	Old Building
	Ken Slater	Room 4
Cigarettes	Bob Butler	Photographic
Sweet Shop	Veronica Lovell	Spur D, Room 48
Blood Donors	Tony Lowe	Spur A, Main Lab.
Badminton	Malcolm Chivers	Spur A, Main Lab.
Billiards & Snooker	Ken Slater	Room 4
Bridge	Martin Bowman	Spur A, Room 18
Camera Club	Henry Rishbeth	Hut 18
Chess	Albin Zavody	Spur B, Room 26
Concerts & Theatre Outings	Veronica Lovell	Spur D, Room 48
Cricket	Brian May	Hut 19
Darts & Shoveha'penny	Barmen	
Football	Roger Lucas	Spur B, Main Lab.
Motor & C.S.M.A.	Ted Golton	Spur A, Room 18
Radio Society	Derek Thorpe	Spur C, Room 38
Tennis	Richard Smith	Spur D, Room 48
Table Tennis	Rodney Knight	Spur B, Room 23
By-Prox	Barbara Greenfield	Old Building
Alec Brooks Sports Equipment	John Juleff	Spur C, Main Lab.

TENNIS

The warmer weather has brought about a welcome increase in numbers on club evenings and the need for a grass court has become apparent. Chris Boulton, who has undertaken the task of restoring the old grass court, will need plenty of assistance, particularly during the next fortnight. Volunteers can contact him in Spur B.

Saturday afternoon sessions, starting at 2.15, are now a regular feature, but we would like to see more players turning up. Light refreshments are available.

R. W. SMITH

ROWING EVENING

An expedition will cast off upstream from Cookham Bridge at 18.15 hrs on Tuesday 6th June - destination : Bourne End? Crews should assemble at Turk & Sons Boathouse at 18.00 hours, equipped with supplies. All volunteers should sign on with Miss Seabrook or Dr. Dunford. (If weather inclement expedition will be postponed till 13th June).

CRICKET

We are now the proud posessors of a 14" motor mower which was purchased with a grant of £15 from the Sports and Social Club and a generous gift of £10 from an anonymous donor. It has already been used in preparing a pitch, and is also being used by the tennis section for the grass court.

The first internal match was arranged for May 4th, but was cancelled due to rain. It will now take place on Thursday May 18th.

It has been decided to levy a charge of 1s. per person per match for all organised matches. This should result in an income of about £10 per season, and will be used to purchase equipment.

GRAHAM THOMAS

BRIDGE CLUB

The D.S.I.R. cup tournament was held at this station on April 23rd. Our first team consisting of Dr. and Mrs. Bain and Mr. and Mrs. Gordon-Smith established a crushing lead in the first half of the competition and managed to hang on to most of this through a rather flat second half. The final scores were :-

R.S.R.S.	23 points
N.P.L.	4 "
Road Research	3 "
Warren Springs	- 3 "
N.P.L.	-12 "
R.S.R.S.	-15 "

Our thanks are due to all those who helped with organising the match and to our first team for retaining a notable item of refectorial ornamentation.

MARTIN BOWMAN

ENJOYING THE INEVITABLE?

Request to a lady in Registry :

'Please submit to Nature'

LETTER TO THE OUTSTATIONS

Dear Colleagues,

An orbiting Ariel 3, carries with it an R.S.R.S. radio noise experiment. This seems a fitting way to mark the half-century that has gone by since Watson-Watt's original thoughts on the 'Cathode Ray Direction Finder' and his experiments at Aldershot with a rotating loop direction finder and coherer lightning flash recorder. Let us wish good luck to this new approach to the study of our old familiar 'atmospherics'.

Interest has been aroused by the coming of a paved path leading to the car park. A set of concrete posts of strategic height and spacing, linked by spiked chains, guards the sides of this path. First impressions are that M.P.B.W. are going to make a formal garden of West Park, but a second study reveals a deeper drive than desires to vie with Versailles or outshine Schönbrunn.

Consider: Pegasus went out, Ariel 3 went up and so did the path posts. There are 18 posts, sufficient to mark ten degree intervals of a semi-circle (doubtless a link with the equinoxes here). Mysterious arithmetic harmonies can be found, for instance 34 spikes per chain and 17 spaces between posts. Examination of path angle with the ecliptic and equinoctial noon solar shadows cast by the posts on the wall of the reproduction room will reveal much. Who can doubt that the thing is not a path but an analogue computer for calculating satellite orbits, pay increments and overtime rates. In time certain anomalies will resolve themselves and when a cos χ relation can be shown, all will be convinced and amazed at our Masters' forethought; not least,

Yours sincerely,

The Editor