



RSKS

# NEWSLETTER

No. 118

March 1971

## SPIN - OFF

At about one a.m. on December 14 1970 the first all British Satellite Ariel 3, re-entered the earth's atmosphere somewhere over the Atlantic and was destroyed. This spacecraft had been launched on 5 May 1967 from the Western Test Range, California, and carried into space the first of the five experiments that have now been designed and flown by the RSKS Satellite Group.

In Ariel 3, the RSKS Experiment was designed to carry out a global survey of atmospheric radio noise and consisted of loop aerials and three pairs of sensitive h.f. receivers tuned to frequencies close to 5, 10 and 15 MHz. Data received shortly before re-entry showed that, after  $3\frac{1}{2}$  years in space, the experiment was still functioning normally and that the gain of each receiver was within 1% of its value at launch. During its lifetime the experiment had generated more than 250 million data points.

Four particle experiments have also been flown successfully in the ESRO Satellites Aurorae and Boreas. These Satellites were launched on 3 October 1968 and 1 October 1969 and re-entered on 26 June 1970 and 23 November 1969 respectively. The short life of Boreas was due to its low orbit.

In September 1971 we hope that the second all British Satellite UK4 will carry into space an ionospheric noise-measuring equipment and a solar-sensor which form a joint experiment with Jodrell Bank and an impulse counter which forms part of a joint very low frequency propagation experiment with Sheffield University.

In addition an experiment to measure electron density and temperature will be provided by Birmingham University and for the first time there will be an American experiment on board a British satellite. This experiment will be provided by the University of Iowa and will measure the intensity and energy spectrum of energetic particles in the upper atmosphere.

For all the RSRS experiments we have had to prepare detailed specifications against which contractors could tender. These specifications could require the manufacture only of units to an RSRS design or could require the complete design, construction and testing of the various models required for a programme. These models usually are a,

Mass Model: having correct shape, fixing points, weight and connector positions.

Electrical Model: with all circuits complete and electrically and thermally tested. This model is used for compatibility and radio frequency interference tests.

Prototype: this is a fully modified, encapsulated and environmentally tested model for full spacecraft trials.

Flight )  
Flight spare ) constructed exactly as the prototype using highest grade components, encapsulated and fully calibrated. Environmental test levels are lower than for the prototype to avoid over stress.

To date too, all the experiments have been developed against constraints imposed by limitations on power, weight and volume. In Ariel 3 for example our experiment consumed only 480 mW, weighed  $5\frac{3}{4}$  lbs and contained over 1700 components in a volume of about 200 cu. ins.

During the past ten years different methods of constructing packages and interconnecting components have been investigated. The objectives have been to secure a high component density coupled with ease of construction and inspection and to ensure that the final product has the highest attainable reliability. At present the two most favoured methods both offer similar reliability and allow packing densities in excess of  $10^4$  components per cubic foot. One method uses soldered interconnections and is generally more suitable for r.f. circuits. The other method uses microwelded interconnections and is more suitable for the repetitive production of modules required in large logic assemblies. Printed circuit boards have been produced in the Satellite Group for special purposes but

their use for space work is not generally recommended because of the relatively high incidence of track failures. Even the way in which a component is connected to pins is of importance as great care has to be taken to minimise the stress which can be introduced into a component through its leads.

The past decade has also seen the cost of transistors reduced from £10 each to less than 50p. It has also seen the development of integrated circuits which, when quiescent, require only microwatts of power so permitting their use in satellite experiments and in turn resulting in reductions in power, weight and volume. In 1960 there was scarcely a component made in the U.K. which could be classed as reliable for use in space. Now, and mainly due to the manufacturers' realization that there are commercial dividends to be reaped from reliability, it is possible to buy about 70% of our requirements in the U.K.

Increased reliability and improved consistency in operation is also obtained by purchasing components to specifications with tighter tolerances on selected parameters and by the purchase of components which have been "burned in". This involves holding a large batch of components at an elevated temperature for perhaps 250 hours while they are operating at maximum power or voltage and then selecting those components which show the least change in their parameters as measured before and after the heat cycle. Any type of component used is normally required to have at least two manufacturers so that a programme will not be endangered by the loss of an only supplier.

Other factors such as radiation damage have also been studied and tests on semiconductors and materials have been undertaken with the help of AERE staff and facilities. One capacitor manufacturer improved his method of construction as a result of comments from the Station.

Radio frequency interference is often difficult to trace and eliminate and so, recently, and in addition to screened room tests, a model of the Jodrell-RSRS experiment for UK4 has been taken to deep caves so that tests involving the use of an electric dipole could be conducted without interference from broadcast stations.

The requirement that all experiments shall be thermally tested, be exposed to high humidity (as a safeguard against unfavourable ground storage conditions), sinusoidally and randomly vibrated and subjected to prolonged thermal cycling in high vacuum has resulted in the installation at RSRS of a wide range of environmental test equipment. These facilities are used by an increasing number of other Groups on the Station and in addition, are offered to University experimental groups.

As experiments increase in complexity, means of reducing the time taken by tests and subsequent data analysis also become increasingly important. To this end, on-board calibrator circuits are included in experiments and ground test equipment is custom designed with the experiment. Ultimately this will lead to computer controlled ground check-out of experiments and of spacecraft.

V. A. W. Harrison

STAFF NEWS

Congratulations to:

Margaret Thompson and Michael King on their marriage  
Roy Adlam and Ann Holmes on their marriage  
Elizabeth Zbikowska and Florian Tkaczyk on their engagement

Mrs. L. M. Brindle	now Machine Asst. P/T
P. J. Bannister	now A.E.O. (Acting)
A. J. Lucas	now A.E.O. (Acting)
Miss J. Roy	now D/Shift Leader
Miss R. Ford	now D/Shift Leader
Mrs. E. M. Watson	now Leading hand cleaner P/T
Mrs. L. R. Loudonsack	now Supervisor i/c (Canteen)
W. R. Guthrie	now skilled labourer

Welcome to:

Mrs. M. V. M. Newsome	Clerical Officer
Mrs. J. Ryder	Clerical Asst. P/T
Miss H. K. Obhrai	Sandwich Course Student
S. C. Lloyd	Sandwich Course Student

Resignations:

Mrs. P. Vincent	Cleaner P/T
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Other changes:

D. W. Hardy	(A.E.O.) Left Falkland Islands
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STATION NEWS

The First European Earth and Planetary Physics Colloquium will be held at Reading University from 30 March - 3 April.

Dr. Croom will present a paper on "Millimetre Wave Temperature Probing from Satellites" to the Symposium on European Space Research Studies of the Earth and its Environs; this Symposium forms part of the Colloquium and is being organised by Dr. King and Professor H. Bondi.

The Second European Regional Meeting on Ionospheric Research, which also forms part of the Colloquium, will foster discussions of co-operative and interdisciplinary problems and projects. Dr. L. Thomas will lead the discussion on current D-region problems, Mr. Piggott will lead the discussion on the role of ionospheric physicists in improving the future of radio communications and Dr. King will lead the discussion on the International Magnetosphere Survey.

The Director has agreed that delegates attending the Second European Regional Meeting on Ionospheric Research, organised by Dr. King, will be able to visit the Station on 29 March, and it is expected that scientists from several countries will call in on their way to Reading.

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Staff will be pleased to learn that our former Director, Mr. J. A. Ratcliffe, has been awarded this year's Guthrie Medal and Prize of the Institute of Physics and the Physical Society.

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Library Notice

We now hold in the Library a new book entitled "Electronic Design Data Book" by Rudolf F. Graf.

This book contains much useful information, in particular to experimental staff. As it is a reference book it cannot be taken out on loan, but it is available for you to read in the Library.

SPORTS AND SOCIAL CLUB NEWS

BRIDGE CLUB

Following the strictures in my last report, I am very pleased to report increased attendances at both the club evenings held since. At the second we were able to play four tables - the most for several years. This increase is not only caused by the welcome return of Dr. and Mrs. Bain after more than a year's absence, but also by interest shown by existing and new members of staff.

Because the next scheduled match has been postponed, the next club evening will be held either on Tuesday, 30 March, or on Thursday, 1 April. The postponement mentioned means that our remaining matches will be played in almost consecutive weeks, the matches being: vs ICI(A) on 15 April, NPL(H) on 22 April and RRL(H) on 6 May.

Robert Pratt

CRICKET

The AGM of the cricket section will be held in the Board Room at 1 p.m. on Tuesday, 6 April. All who played last year, and any newcomers with minimal cricketing ability, are welcome to attend. Nominations are required before the meeting for the five committee posts, and these should be made on the list on the notice board.

Our first fixture is in the first week of May, but lunch-time sessions should begin fairly soon. Some considerable effort will be required to get the wicket into a reasonable condition before the start of the season, so the more people who lend a hand the better.

Graham Thomas

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Dear Observer,

hear this plea -  
We like to know just what you see  
But please - it's quality that counts,  
Not observations in large amounts.

For when it's time to utilise  
What you saw before your eyes,  
Most orbit analysts agree  
The essential thing is accuracy.

So when you are out at night  
Timing in space your satellite,  
Remember the computer later  
Likes to feed on accurate data.

With grateful thanks, we beg to be,

Your humble servants,

S. O. G.

(Satellites Orbits Group)

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LETTER TO THE EDITOR

329 Franklyn Ave.  
Indialantic  
Florida 32903  
U.S.A.

16 March 1971

The Editor  
R.S.R.S. Newsletter

Dear Sir

I wonder if you appreciate how efficient the private R.S.R.S. postal services were during the U.K. postal strike.

I was awakened at my home before 6.0 a.m. one morning in February by my local postman and handed a letter from RSRS posted in Italy and marked for "Express delivery". Anxious to find out why Dr. Saxton was sending me an urgent letter I tore open the envelope to find a vacancy notice for a Health Physics Foreman at the Chatham Dockyard!

Best Regards

Rodney B. Bent

SPORTS CLUB

The competition season has now ended but the table will always be available during the lunch hour and at other times. The team has had what has turned out to be a successful season after the shaky start mentioned last month. In fact we finished second in Division 3 to Centre Hunters, and so will be promoted to Division 2 next season. The difference in the standard of play will be quite marked! Centre Hunters are of upper Division 2 class and have a 100% record in Division 3 with 32 points, whereas R.S.R.S. obtained 20 points (32 points possible) from 16 games. Hunters beat R.S.R.S. 9-1 and 10-0. However next season is yet to come.

P. Muzlish  
Hon. Secretary

LETTER TO THE OUTSTATIONS

Dear Colleagues

What can only be described as non-Board-Room type noises emanating from that sanctum caused your ever enquiring Editor to poke his nose in, as usual.

It was an act worth the doing; a group of staff stood within, enraptured, gazing upon a floor covered with bright patterns of coloured paper. It must be admitted that the phrase about the lunatics having taken over the asylum presented itself in the mind's ear for an instant but it soon dwindled and gave place to visual pleasure.

There lay this polychrome sea of separate entities visibly united by a regular overall pattern, with hints of subtler submerged design only waiting to be revealed to the appreciative layman by any of a number of expert interpreters. See, recollection even makes me write like a TV ad.

This was however no neo William Morris effort - or was it? Here, after all lay the end product of many individual artist-craftsmen and women, some indeed being part-time workers in the best cottage industry tradition. This was, in fact, a collection of coloured maps of electron density derived from an Ariel III experiment, and the Board Room floor the most suitable place to line them up and gaze down with Olympian detachment. They were indeed attractive even to the uninitiated; but should any decorator think of using these originals for a one-off wallpaper job he would do well to consider overall production expenses. Thus: design and launch of satellite and experiments, initial acquisition and processing of data, more computing, finally individual interpretation and hand colouring. I don't know how much all that is, but it makes even yer actual hand-blocked Morris wallpaper come at the rough end of the trade and lies well outside modest incomes of such as

Yours sincerely

The Editor

March 1971

List of Reprints

- E. N. Bramley      Influence of directional fluctuations on the gain of horizontal  
rhombic aerials for high frequencies  
Proc. I.E.E. 1971, 118, 281-286
- P. A. Bradley      Measurements of transmission loss at high frequencies over  
960 km temperate-latitude path  
Proc. I.E.E. 1971, 118, 64-78
- L. Thomas          The Lower Ionosphere  
J.A.T.P. 1971, 33, 157-195
- R. Rüdster         The relative effects of electric fields and atmospheric  
composition changes on the electron concentration in the  
mid-latitude F-layer  
J.A.T.P. 1971, 33, 275-280

Internal Memoranda

- I.M./339            Radiometric Probing of the Atmosphere by Millimetric  
Infra-red Techniques  
(Summary of Colloquium contributions)
- I.M./340            C. R. Boulton  
Notes on the AGARD XXth Technical Symposium  
Istanbul, Turkey, June 1970