Bulletin
of the Rutherford Appleton Laboratory 24 Mar 1986 No.3

# GIOTTO Wins Through

*After a journey of nearly 250 days in space, the GIOTTO spacecraft encountered Comet Halley last night. (Thursday 13 March/Friday 14 March).*

Halley is the brightest and most active of the short period comets and also possesses one of the best determined orbits so that an accurately planned space trajectory could be reliably expected to place the spacecraft close enough to the cometary nucleus to carry out its exciting mission.

Over the last month there has been an increasing level of activity at the European Space Operations Centre in Darmstadt, W. Germany as the experimenters checked out their instruments and carried out rehearsals in preparation for the short and hectic period of encounter. Two UK-led experiments were on board, both constructed and tested with help from the Space and Astrophysics and Geophysics and Radio Division at RAL. Professor Tony McDonnell from the University of Kent led the international team of scientists providing the Dust Impact Detection System (DIDSY). The purpose of this experiment was to measure the presence of the minute dust particles known to be emitted from the icy cometary nucleus as the heat from the sun boils off the surface layers. RAL scientists and engineers provided electronics and calibrated the dust sensors using lasers to simulate the fast impact speed of 68 Km per second. Dr Alan Johnstone from the Mullard Space Science Laboratory headed a large European team which provided the Plasma analyser. This instrument measured the energy and direction of charged particles in the cometary coma and close to the nucleus. RAL scientists and engineers designed and made the high voltage units for this detector and provided ground system support throughout the mission.

On Thursday, the day of encounter, experiments were switched on in groups, beginning at 0600 when the Plasma analayser was activated. By 11.30 the analyser was registering cometary ions, distinguishable from the fast flowing Solar Wind by their lower speed.

*Ray Turner explains the finer points of the GIOTTO dust-shield design to Patrick Moore. This encounter happended at the Laboratory on Wednesday 5 March at a Press Briefing held to provide extensive background information and for members of the press to meet a number of experts on the Mission.*



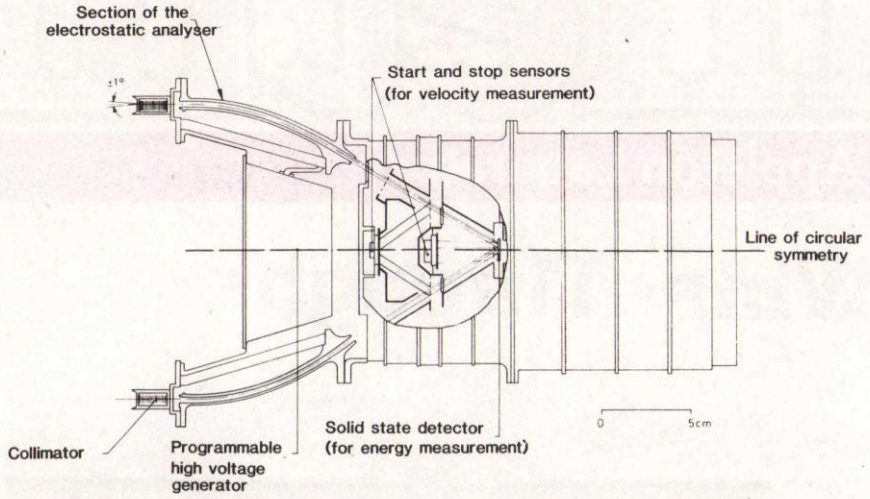
Information about the progress of the mission was relayed via starlink to the ASR Board which was in session at Swindon. At 19.40 the spacecraft crossed the bow wave where the cometary material interacts dynamically with the Solar Wind, and the charged particles in the wind could be seen with lower energy and travelling in a different direction due to the cometary interaction. These features were seen some 500,000 Km from the nucleus.

No dust impacts were recorded until 30 minutes from encounter when a few medium sized events were detected on the front shield. Gradually a steady stream of dust impacts built up on all sensors and in the last 2 or 3 minutes before closest approach, very large hits were detected in which all the sensors responded simultaneously. At this time the spacecraft attitude was beginning to be affected by the dust impacts and the telemetry was lost only a few seconds before reaching its closest approach.

This remarkable achievement by scientists, engineers and technologists means that GIOTTO has provided the first detailed study of cometary material at close range. The huge quantities of data recorded almost faultlessly by the experiments will transform our picture of cometary nuclei, as will the processed images of the nucleus. The mission could hardly have been more successful and the Operations Centre at Darmstadt was filled with delighted scientists when news came through some 30 minutes after loss of signal, that the spacecraft had survived and re-acquired the Earth. Some experiments have been damaged and may not record the exit from the cometary environment but several are clearly working and still providing good data.

The GIOTTO MISSION has provided publicity, drama and best of all, world leading science of the highest quality.

# RAL Collaborates with VIKING




One of the satellites successfully carried into space by the European Space Agency launcher ARIANE on 22 February includes a new instrument, a Magnetospheric Ion Composition Spectrometer - "MICS". The instrument has been developed by an international consortium which includes RAL and the University of Sussex. The consortium is led by the Max-Planck-Institute for Aeronomy, Lindau, West Germany, and the instrument is part of the first satellite to be designed and constructed in Sweden. The purpose of the satellite, called VIKING, is to explore the regions of space that are above the Earth's auroral-zones. A number of basic and universal plasma-physics problems can be studied in these regions, which contain the most accessible of all cosmical plasmas. The specific objectives of the Ion Spectrometer are to identify the ions that populate geospace and to determine the degree of ionization of individual ions. Another objective is to determine the extent to which the processes that produce the aurora are dependent on ion mass and charge. Information on the mass-dependence is necessary in order to distinguish the processes that are purely electrostatic from those which involve resonant interactions with plasma waves.

The instrument became operational during the week beginning 3 March and detected ions successfully for the first time on 4 March.

RAL is responsible for the collimator, electrostatic-analyser and programmable high-voltage-generator of the instrument. The electrostatic-analyser design ensures that the instrument is compact but still twenty times more sensitive than ion composition instruments that have been included in previous missions. The design is based upon techniques devised and proven during the UK programme of auroral-zone studies using rockets. The extra sensitivity is necessary for significant numbers of the major ion species to be detected over a broad range of energy (10 - 300 keV), and also, for the detection of the rarer ion species that may be present.

# Glazebrook Medal for Dr Geoff Manning

The Institute of Physics Glazebrook Medal and Prize for 1986 has been awarded to Dr Geoff Manning "for his wide-ranging contributions to the application of physics in the work of RAL, particularly in high energy physics, computing and the new spallation neutron source ISIS".

In congratulating the Director on the award of CBE in the New Year's Honours in the January *Bulletin*, we highlighted some of his achievements. This award is an example of the esteem in which he is held by the wider scientific community and the distinction he brings to RAL. We offer our sincere congratulations.

# and Rutherford Medal for Prof. Alan Astbury

Professor Alan Astbury (RAL 1963-82) has been awarded the Rutherford Medal and Prize "for his many contributions to high energy particle physics.

Best known for his leadership of the British UA1 group involved in the Nobel Prize winning discovery of the W and Z bosons, other aspects of his work in high energy physics have also been of great importance.

Alan joined RAL in 1963, dividing his time between the Laboratory and CERN, firstly working on Nimrod, then as leader of a UK collaboration on the CERN 25 GeV proton synchrotron, briefly as Chairman of the Nimrod coordinating team, later Chairman of the Proton Synchrotron Committee and finally joining Carlo Rubbia in preparatory work for the UA1 experiment on the CERN proton-antiproton collider. From 1976 he also developed close ties with the Canadians at TRIUMF which culminated in his appointment in 1982 as R M Pearce Professor of the University of Victoria.

Old friends and colleagues at RAL offer their congratulations.

# RecSoc AGM

The Annual General Meeting of the RAL Recreational Society will be held in the R22 Lecture Theatre at 12.30 pm on Wednesday 23 April 1986. Committee volunteers or nominations are invited.

What next for your club? Your chance to offer or hear new ideas. Please come along.

PS. The Bar in R58 will be CLOSED for the day!

# Lifeboat Fund

RAL's contribution to the 1985 appeal amounted to £158.09.

Mr Barker, Hon Treasurer of the Fund conveys his gratitude to the Laboratory for their generous donation.

# Cricket Club AGM

The AGM of the RAL Cricket Club will be held on Wednesday 26th March in the R3 Conference Room starting at 12.45. Please come along and join the Club if you enjoy a game of Cricket in the evenings. If you are unable to get to this Meeting give me a ring on Ext 6136 with your name and ext.no. and I will make a note of it.

This year we will be running the "Dave Craddock Cup" a six-a-side competition and hopefully an eleven-a-side team playing friendlies on Tuesday and Thursday nights. I look forward to seeing you on 26th March.

Andrew Napper R9 M/Store

# Internal Events

GEOPHYSICS SEMINARS
all lectures start at 2 pm.

25 Mar. Dr J Powell/RAL
'Applications of Radar Altimetry'

8 Apr. Dr Chriss Watson/Harwell
Computer Modelling of Ocean Waves and currents.

22 Apr. Dr M Gunson/RAL
The Atmospheric Trace Molecule Spectroscopy Experiment.

# NASA Honours AMPTE

86RD1434.

Dr John Harries (Associate Director ASR) receiving a NASA Achievement Award for RAL's work on the AMPTE project from Gil Ousley (right) the NASA AMPTE project manager who also presented certificates to 41 other members of the UK team. The presentation ceremony followed a Press Briefing which was held at the Laboratory on Tuesday 18 February to present the media with the latest findings from the mission.

As well as the experiment teams from RAL, Mullard Space Science Laboratory, Sussex University, Sheffield University and Imperial College, honours also went to British Aerospace, the Royal Aircraft Establishment, Farnborough, Hartland Magnetic Observatory, Com-Rad Equipment and Spembly Technical Services for their contributions to the AMPTE mission.

Launched in August 1984, together with satellites from the USA and West Germany, to explore the regions of interaction between the solar wind and the Earth's magnetosphere, the UK satellite mission operated faultlessly for 5 months before unaccountably failing. In the event more data was obtained in that period than was anticipated for the original 9 month lifespan.

So far 70 papers have been written based on this data, and the results of the mission are expected to take years to clarify. The data have already added considerably to the current knowledge of plasma physics, which will benefit scientists such as those working on JET. The artificial comet produced as part of the AMPTE experiment also gave useful insights into conditions that are expected to prevail during the GIOTTO-Halley's Comet encounter.

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## RAL Lectures

The next lecture in this series will be held on 3 April 1986 at 3.15 p.m. in the R22 Lecture Theatre.

"THE INTERACTION OF SCIENCE AND THEOLOGY"

by

THE REVEREND JOHN POLKINGHORNE FRS

Science and theology share a comradely concern as they both seek to explore the truth about the way things are. Though they are concerned with contrasting aspects of reality, there are points of contact between them.

It is science's task to understand the occurrences of the world (such as the evolution of life) but the law and circumstance it has to assume themselves raise questions which go beyond science's power to answer. The intelligibility of the world and its delicate balance are matters on which natural theology has helpful things to say. In its turn theology has to consider the implications of science's perception of the role of chance in the process of the world and also the ultimate futility of the physical universe.

The lecturer hopes to show how it is possible to take seriously his experience both as physicist and as priest, without dishonest adjustment or compartmentalisation.

## RAL Wives

We continue to meet monthly at the Cosener's House, Abingdon from 10.30 am until noon. Our future dates for coffee are:

Wednesday 16 April
Thursday 15 May

Pre-school children, babies, newcomers and visitors are especially welcome.

Due to the success of last year's social evening with husbands; we are happy to annouce that we have arranged a

Spring Buffet Supper
on
Friday 18 April
at
The Cosener's House

from 7.30 pm (supper at 8.00 pm).

Tickets are on sale at £9.50 per head inclusive of wine and a sherry reception. Numbers are limited, so to avoid disappointment do book early! Please contact Celia Lockwood before 31 March.

For any information about our gatherings, please phone:

Celia Lockwood
6 Long Barn
Sutton Courtenay
Tel: Abingdon 847266

Zoe Patrick
3 Bosley's Orchard
Grove
Tel: Wantage 68809

## Missing

The following items are all (yes all) the subjects of loss reports. Please contact enquirer with information.

Avometer Model 8 Mk2.
Ser. No. 105921-C-460
Avometer Model 7
Ser. No. 51005-A-1054
V. Cloake, R2, Ext. 5480

Gould OS255 Rack mounting double beam oscilloscope was labelled AMPTE
Alan Smith, R68, Ext: 6480.

Avometer Model 8
Ser. No. 63302-767
M Clarke-Sayther, R2, Ext: 6133

Tektronix plug-in amplifier - type 7A18
V011921
Tektronix spectrum analyser
Type 7L12. V012207
Avometer 8, V004296
" " V004685
" " V002939
Prinztromic Micro calc, V007587
Polaroid Land camera
Model 180, V005416
Crown Cassette recorder
Type CTR 300, V009216
Hewlett Packard teleprinter
Type 2752A, V007623
Tektronix oscilloscope
Type 7603, V011919
Tektronix plug-in time base
Type 7B53A, V011920
B V Ayling, Ext. 5694.

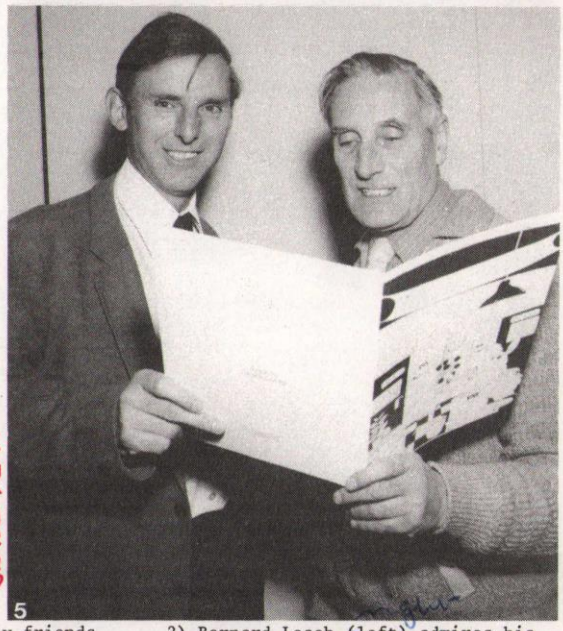
86 RC 1049

# It Has Been a Pleasure

86 RC 1096

85 RC 5790

86 RC 1201



86 RC 1271

In the past few weeks the Laboratory has lost five more of its early pioneers. Each has made major contributions in his chosen field of endevour. Bob Taylor in computing, Bernard Loach in documentation, computing support and grants, Peter Smith in sun-spot analysis, John Stenning in satellite monitoring and control and Robin Elliott in magnet design and public relations.

All will be sorely missed by friends and colleagues, as they will be well aware, if they were paying attention at their farewell ceremonies where these photographs were taken.

We wish them the very best of luck for the future.

1) Robin Elliott (right) receives a token from Director Geoff Manning.

2) Bernard Loach (~~left~~) admires his certificate of appreciation with Bob Hopgood.

3) Peter Smith (centre right) equipped for a bright future, colleagues Angela Vernon, Rita Blake, David Ramsden and Duncan Bryant in attendance.

4) Bob Taylor with text for the future.

5) John Stenning (~~left~~) and Eric Dunford admire the card.

right

Bulletin

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# The Magnetic Storm of 7/9 February

On the evening of 8 February a bright aurora (Northern Lights) was seen in the skies over Southern England and was widely reported on TV and radio. This auroral display was the visible manifestation of an intense magnetic storm. Such storms are the most dramatic phenomena observed in the field of solar-terrestrial physics, that is the study of the Earth's upper atmosphere, ionosphere and magnetosphere, and of the effects of solar activity on these regions.

The progress of this storm, and of the causative activity on the Sun, were monitored by RAL staff working in the World Data Centre (WDC), a section of G&R Division, which collects and supplies data about the solar-terrestrial environment. Figure 1 shows data extracted from regular daily telexes which are received from the USA, France and West Germany. The solar activity (curves b & c) began to rise around the beginning of February, whereas the magnetic storm, which is indicated by the narrow peak in curve a, followed a few days later.

The effects of the storm were recorded by the two ionosondes, operated by RAL at Slough and South Uist, which monitor the state of the ionosphere over the United Kingdom. These two observatories supply data to the WDC every day. During the daytime hours of 7 February the ionosondes observed an enhanced ionosphere with electron densities at 250-300 altitude up to nearly double the usual values. After dusk on 7 February the electron densities rapidly decreased and remained very low for the following two days; therafter the densities rose slowly and returned to normal by 12 February. This pattern of behaviour with high electron densities on the first day followed by a period of low densities is very typical of ionospheric storm effects.

The low electron densities in the later stages of a storm have important practical effects. They may restrict or even prevent the use of High Frequency (3-30 MHz) radio links. The WDC regularly provides data to aid engineers operating such radio links. To give one example, data on solar and geomagnetic activity are sent each working day to the BBC World Service; this helps them to determine whether weak signals arise from faults in their transmitters or from poor conditions in the ionosphere.

The storm conditions on 8 February produced very large variations in the geomagnetic field. Preliminary reports suggest that some observatories in the USA observed their largest ever variations of the field (changes of 12% in the field strength and 18 degrees in direction). These large perturbations can induce significant electric currents in long metal structures on the ground and cause problems with sensitive equipment (e.g. telephone networks).

The storm raised the fluxes of energetic charged particles in near-

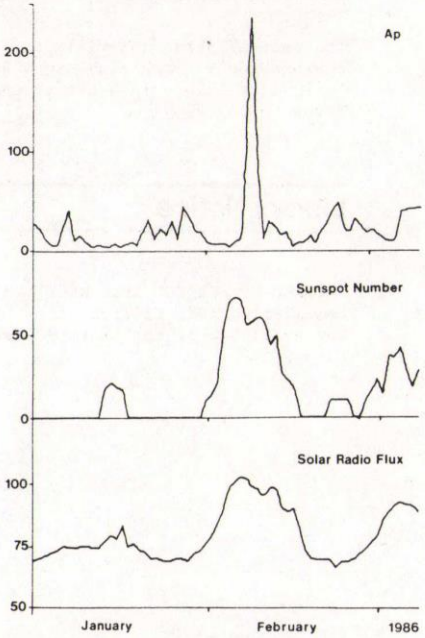


*Fig. 1 a) The estimated geomagnetic activity index Ap b) The sunspot number determined at Boulder, USA c) The solar 10.7cm radio flux measured at Ottawa, Canada.*

Earth space. One consequence of this was the auroral display, which was produced by collisions between energetic electrons and atmospheric molecules at heights of 100-200 km. A more practical consequence was the increased occurence of problems in the operation of satellites. To give one example of how this may occur, energetic particles striking the satellite will deposit electric charge. Different parts of the satellite may charge up at different rates, which can result in large potential differences (>1000 volts) across the spacecraft. These voltages may discharge by arcing, which is thought to produce electric pulses that may be interpreted as 'phantom commands' by the satellite's control system. This is an effect by which a satellite executes a command without that command have been transmitted. Reports from colleagues in the USA indicate that many anomalies of this and other types occured during the recent storm.

The effects of increased solar activity were also seen by the GIOTTO spacecraft which was, by good luck, carrying out instrument tests during this period. The GIOTTO plasma experiment recorded a shock wave in the solar wind early on 8 February. At the request of Mullard Space Science Laboratory, who operate this instrument, we looked to see if this could be matched with effects measured at the Earth. The passage of a shock wave can be detected as a sudden increase in the geomagnetic field due to the compression of the magnetosphere by the shock wave. A preliminary check has failed to link terrestrial effects with the GIOTTO observation. This suggests that GIOTTO, which was a considerable distance from the Earth, was sampling a different part of the solar wind to that reaching the Earth.

The enhanced solar activity in early February originated in two "active regions", which had rotated over the Sun's western limb and out of our sight by 15 February. One region decayed completely while out of sight, but the second region reappeared over the eastern limb on 1 March. We were monitoring incoming data to see if this region was expected to produce another magnetic storm in early March. This was of particular interest as there was a UK EISCAT campaign at that time, and so the WDC was providing information about the predicted levels of geomagnetic activity to aid scheduling of experiments during the campaign.

*For further information on the work of the World Data Centre, please contact Mike Hapgood Ext.5620 or Cathy Doidge Ext. 6579.*

## RAL TECHNOLOGY LECTURES

The next lecture in this series will be held on Thursday 17 April 1986 at 3.15 pm in **Conference Room 12 Building R68. PLEASE NOTE CHANGE OF VENUE.**

FOCUSSING SOFT X-RAYS

by

PROFESSOR P J DUKE
DARESBURY LABORATORY

The undulator beam line at the SRS Daresbury offers a copious source of collimated, polarized soft X-radiation. This radiation can be focussed using a Fresnel micro zone plate (produced at King's College, London) to produce an intense beam with sub-micron dimensions. The lecture will describe how this focussed beam is produced, how the microzone plates are generated and how this combination can be used to generate scanned images of thick, wet, biological materials. Some examples of these will be shown.

**FOR YOUR DIARY:** The next lecture in the series will be held on Thursday 29 May 1986 by Dr R J Nicholas of Oxford University, and will be entitled "The Quantum Hall Effect".

## Film Badge Notice

It is period 4 Colour strip BROWN.

Please be sure you are wearing the correct dosimeters. Please do NOT return your beta-gamma film in the same envelope as the fast neutron badge!!!

## Radio Control Model Club

Well here we are in 1986. I just hope this year the weather will be kinder.

Last year was a bad year for radio controlled planes, either raining or high winds. When the sun did show its face and the wind dropped, up went the car boot and out came our models - Mr Smith with his powered glider or Mr Goodchild with his aircraft doing some aerobatics.

I am holding three 'Fly for Fun' days this year.

Sun 20 April 1400-1800 'Fly for Fun'
Sun 15 June 0900-1900 'Model Tattoo 86'
Sun 10 Aug 1400-1800 'Fly for Fun'

There will also be some lunchtime displays but no dates have been fixed for these as yet.

Well, modellers, dust off those models and let's hope the weather will be on our side this year. My ROBOT will soon be ready for the air. I am changing the radio gear to 35 MHz. I also hope to get my Sopwith Pup into the air this year.

Hope to see you on the Sports field - happy landings!

P C Marchant-Angell
Ext: 5545/5505

## Sales to Employees

The sale of scrap materials to employees will take place on 4 and 8 April from 1200 - 1230 hrs in the R24 Scrap Compound.

## Library Notice

'PICKED UP FOR YOU THIS WEEK'
Compilation 1985 Edition
Now available at the Library Desk.