MULLARD SPACE SCIENCE LABORATORY

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"POINTERS" FOR THE PRESS

Quick Facts and Figures

The UCL Space Group is the largest in the UK and undertakes about 25 per cent of space research.

Staff at the Mullard Space Science Laboratory include 22 scientists, 7 research students, 26 laboratory and workshop technicians and 11 administrative workers.

Space science is a young man's occupation. Average age of the scientific staff is 28 years.

Mr. and Mrs. J. C. Timothy are thought to be the only husband and wife team working together on space science projects.

The unifying effect of science enables two of the research students, an Israeli and an Egyptian, to work together in complete harmony.

Despite the continual exposure of British space scientists to associated activities overseas there has been no "brain drain".

The work is supported mainly by the Science Research Council with a grant averaging over the current three year period about £150,000 per year, an enviable sum by British standards. It is hoped that the figure will increase to £200,000 per year in the near future.

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Day-to-day running costs of the Laboratory and maintenance of the buildings and grounds amount to £22,000 per year.

The Mullard endowment of £65,000 enabled Holmbury House to be purchased in 1965. The Mullard Space Science Laboratory came into full occupancy and operation in October 1966.

Experiments are necessarily long-term. It may be from five to seven years from inception of a project to final analysis and publication of results.

Next year an IBM 1130 computer will be in operation at the Laboratory and will be linked directly on-line with the large IBM 360 computer at UCL, London.

<u>Co-operation with NASA and Others</u>

Unquestionably, the offer of co-operation by NASA in 1959 gave a great fillip to British Space Research and the UCL and other British Groups have taken full advantage of the facilities provided.

Today, British universities are offered facilities equal to those afforded to their American counterparts. The British contribution to international space research is fully acknowledged throughout the world.

The criteria for inclusion of an experiment on NASA satellites are as follows:

> The experiment must be timely and not likely to be overtaken by events.
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> It must have scientific objectives within the pattern for the particular satellite involved (for example, a satellite in elliptical orbit would probably only carry magnetospheric experiments).
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> It must have the general support of the scientific community.
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> It must be capable of working in the given environment.

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NASA are fully co-operative in supplying comprehensive details of power supply available, telemetry and command links, mechanical details and other matters affecting the physical design and construction of experiments.

Members of Mullard Space Science Laboratory play an important part on committees of the Science Research Council and of the European Space Research Organisation.

The Technology of Space Science

The main innovations are in the development of more refined detectors and measuring instruments and in their pre-flight calibration. The principal hazards of space instrumentation are in slow deterioration of performance, radiation damage, and extreme temperature cycling.

Experiments must be devised within the capacity of the power supply available on the satellite and UCL have done pioneering work on ultra-low-current engineering. The complexity of design is such that on Ariel 1 the encoder sub-systems package alone had 1575 components including 520 transistors and 59 diodes.

The electronics packages are generally designed using only proven components and, therefore, are not quite so "state-of-the art" as may at first be imagined. The reason for this, however, is simply that failures are catastrophic in time and money once an experiment has started. Nevertheless, integrated circuits are under evaluation and when a proper confidence level has been established they will be used. The problem of reliability and stability is analogous to having to watch a television receiver drift slowly out of adjustment over a year or more and yet be unable to reach the controls.

On the larger and more complex scientific satellites more command channels are becoming available so that radio-active sources can be carried and used as datum points for calibrating detectors. On command from the ground the source is exposed to the detector and calibration takes place.

As with the electronics, so the general mechanical construction and materials used lean towards the proven rather than the exotic. In both fields,

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however, there are notable exceptions and some of these are listed in the following paragraphs.

Relationships with Other Sciences

The work of the Mullard Space Science Laboratory is purely in research of the physics of the ionosphere, the Sun and the stars. It complements visual and radio astronomy and provides a valuable contribution to our total knowledge of the Universe.

Although the work is not directed in any way towards practical ends there are considerable "spin-offs" of great value in other fields. One example is that further knowledge gained of the ionosphere has improved our understanding of the mechanics of radio communication.

Another example is the solar X-ray experiment, designed jointly by UCL and University of Leicester, which was carried on a stabilised Skylark from Woomera last year and contributed new knowledge on X-radiation which is of value to those working on flight hazards associated with high-flying supersonic transport aircraft such as Concorde.

All basic studies can, of course, have some practical end use but many of these remain obscure. In the scientific sense, the acquisition of new knowledge is an end in itself.

At the technological level the "spin-off" is more apparent and while no revolutionary techniques are claimed it is nevertheless true that many existing techniques have been refined and pushed to limits which would not have been achieved but for the impetus of space research.

Many industrial firms have co-operated with the Laboratory and have gained in experience and new methods which are capable of exploitation in other fields. Among these are:-

Electronics: Micro-miniature digital and electronic modules. The development of channel photomultipliers. Improvements in telemetry systems.

Detectors: New techniques in vacuum sealing lithium fluoride windows. Soft X-ray detectors using a large beryllium window.

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Optics: New experience in precision engineering of mandrels from which parabolic X-ray mirrors are made by electro-deposition. Grazing incidence gratings on gold film. New knowledge on the importance of ruling direction (i.e. whether the tool progresses left to right or vice versa). New methods of grating construction such as the "etched" grating.

Mechanics: Experience of bearing-life in ultra-high vacuum. The construction of mechanical components for satellite astronomical observatories with special consideration to stringent optical alignment under extremes of vibration and temperature. Small electro-mechanical devices for repeated operation in a space environment.

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