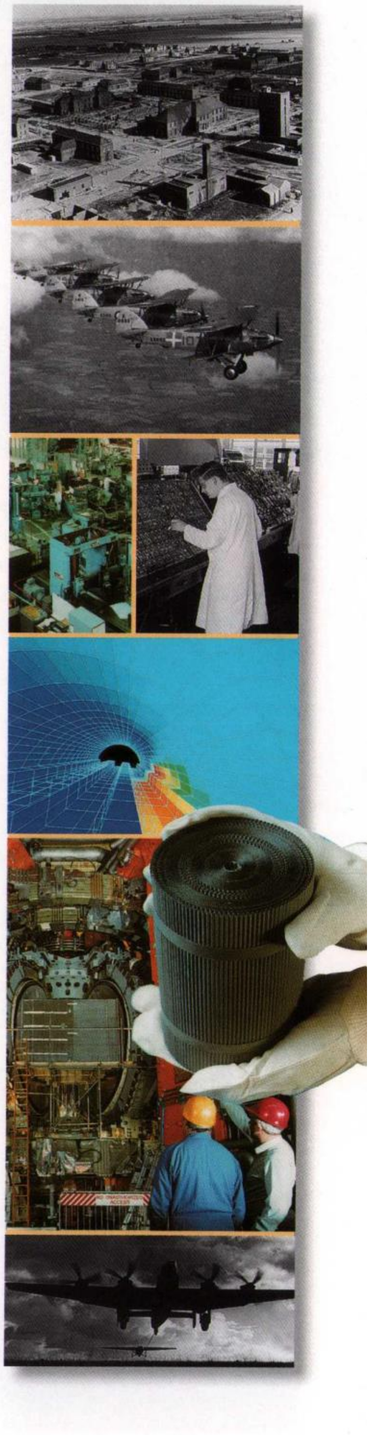
echo

Harwell 1946~1996 Special Anniversary Edition

50 years

Including the commemorative lecture given by Sir Alan Cottrell, FRS, F.Eng

pages 13-19



Aerial view of Harwell in 1989.

This special commemorative issue of ECHO takes a look at Harwell as it celebrates its 50th Anniversary year. Harwell has become part of the region's history, from its early RAF days, to today, as an internationally known centre of advanced science and technology.

Harwell lies some three miles south, as the crow flies, of Brunel's Great Western Railway and is situated at the foot of The Ridgeway — at c.2000 BC, Europe's oldest road. The Icknield Way footpath crosses the Harwell site from the East connecting to The Ridgeway.

Part of the 13th century Oxford-Hungerford road runs South-West through the site. Here William of Orange camped when making his way to London in 1688. This so-called 'Golden Mile' is marked with a granite stone and plaque, which is open to public view, situated at the end of Fermi Avenue.

RAF HARWELL

Bought by the RAF in 1937 for £11,650, the site — on greensand, chalk and clay strata, soil that produced excellent cherries for which local orchards were famous — was named 'Harwell' by order of the RAF Commanding Officer whose house, at the northern end of the site, happened to lie just inside the Parish of Harwell village.

RAF Harwell was one of the first of 66 RAF aerodromes to be constructed along similar lines by Sir John Laing's company. The extensive taxi-ways, runways and dispersal areas needed for military airfields led to his pioneering continuous concrete mixing plant technology.

1937, Hawker Hinds of 107(B) Squadron exercising over Oxfordshire. These were exchanged for Bristol Blenheims in 1938. (HR 94374)

In 1943 Laing organised the building of the Mulberry Harbour system, 16 miles of concrete caissons that were towed across the Channel to form an artificial harbour to help the allied liberation of Europe. He also built the Royal Ordnance Factory at Sellafield, Windscale nuclear plant, Berkeley nuclear power station, the M1 and Coventry cathedral.

Flying in the mid 1930s was in bi-planes with open cockpits and crews wearing flying helmets and goggles. The arrival of 105(B) and 107(B) Squadrons at RAF Harwell in 1937 heralded the introduction of new monoplanes such as the Fairey Battle and the Bristol Blenheim.

RAF Harwell became an Operational Training Unit (15 OTU) in late 1939.

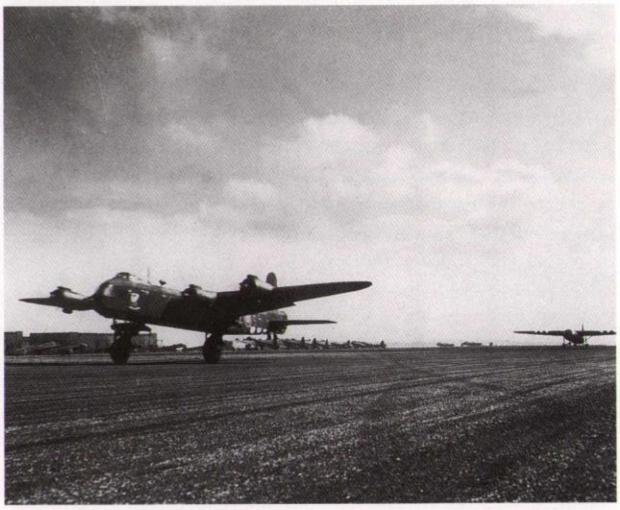
The three air-strips, initially grass, were lit at night by goose-necked flares. These strips required constant mowing and in the winter, the airfield became a quagmire. Concreting the runways was completed by MacAlpine in November 1941, when the station was deemed fit for much heavier planes — even the occasional Lancaster bomber!

On the evening of 5 June 1944, six RAF Albemarles were drawn up on the main runway. Just before midnight, the planes took off carrying 60 paratroopers whose mission was to mark the drop zones behind enemy lines on the Normandy coast. Later, planes took off from Harwell towing Horsa gliders packed with troops. These were the first British forces to land on D-Day.

Later that year, on 17 September, a total of 44 combinations from 38 Group of Stirlings towing Horsas took off from Harwell for Arnhem. For the next seven days Harwell continuously supplied men and equipment, suffering catastrophic losses.

Fifty years later, in June 1994, at the Jubilee Anniversary Dinner of D-Day held at Harwell, a framed extract from the 38 Group's Book of Remembrance was presented to Dr Brian Eyre (UKAEA) by Wing Commander H.E. Angell DFC. It names 1100 men who gave their lives in the D-Day campaign. In the mid-1950s a commemorative stone was erected at the end of the runway to mark this war effort and an open-air service is conducted there annually.

The RAF hauled down its flag at Harwell for the last time at 6 pm on 31 December, 1945.



A Stirling IV towing a Horsa glider westwards along the main runway, destined for Arnhem. (HR 93873)

(below) An early morning take-off by an Airspeed Horsa being towed by a Handley Page Halifax. (HR 15657)

AERE HARWELL

On 1 January 1946, Harwell became Britain's Atomic Energy Research Establishment (AERE), under the control of the Ministry of Supply, to provide the scientific basis for the UK's nuclear development programmes.

The Devizes firm of Chivers and Sons modified and added to John Laing's buildings — some 50 serviceable buildings and sheds, and four large aircraft hangars — at a further cost of some £20m to create the Establishment; the scientists and engineers were able to start working in them by April 1946.

At its peak, Chivers had over 1500 workers on site, requiring labour camps to be set up at the nearby airfields of Grove and Kingston Bagpuize, and a staff camp at Chilton.

The building requirements for nuclear research were new to civil engineering. The "hot lab" in B220 required walls of 10 ft thick concrete loaded with lead and steel. Chivers set up a special materials testing shop on site to test the integrity of the building materials. Research in the early years had to be carried out in the midst of a building site criss-crossed with trenches dug for piping mains services and radioactive waste effluent.

Chivers also constructed the Medical Research Council building, the Atlas Lab, the National Radiological Protection Board's HQ, the Chilton prefab site and the UKAEA housing estates at Abingdon and Wantage.

In 1947 Harwell had 1000 people working on the site; by 1953 numbers had tripled and then doubled to over 6000 by the late 1950s. These included just over 1600 qualified scientists and engineers. The mission and organisation continuously evolved:

- 1951 nuclear weapons work transferred to Aldermaston
- 1952 a committee under Lord Waverley devised plans to transfer atomic energy matters from the Ministry of Supply to a non-departmental body. Churchill's government later published a White Paper (Cmd 8986) that proposed a new public corporation, wholly funded by the Treasury.

Aerial view looking NE of the AERE site in 1947. The former Corporal's Mess, building 150, is in the centre of the picture, opposite the water tower, building 60. In the foreground is the station heating plant, building 58, and the open coal sheds, demolished when building 424 was built. On the former Parade Ground construction has started on the Metallurgy building, building 354 — demolished in 1993. Beyond the Parade Ground is the former NAFFI Stores. (HP 87550)

Work starts on the BEPO stack in November 1947. The Ministry of Works architects originally specified an eight-sided design, but a circular one was built for expediency. In the foreground can be seen the main air-duct for BEPO. The RAF's boiler house (top right) was demolished to make way for building 424. (HR 101572)

The Radiochemistry Laboratory B220, was completed in mid 1949 to a unique specification; air conditioning plant in the windowless upper storey cleans the entire volume of air in the building twice a second. One wing is used for alpha-emitting materials, the other for beta/gamma work.
Internal walls are made with rounded corners to avoid trapping dust particles and coated with strippable rubber paint to aid decontamination. Light fittings were recessed, windows hermetically sealed and the interior finished off to a hospital standard. Doors opened and closed automatically. (HPC 84853)

Radiochemistry on beta/gamma sources in a suite of B220 'caves'. Workers using manipulators are protected by shielding up to two metres thick. (HRC 14403)

The Atomic Energy Bill received the Royal Assent in June 1954 and the UKAEA came into being on 19 July 1954, taking up its duties on 1 August. Sir John Cockcroft was responsible for the UKAEA's Research Group and the Industrial Group was based at Risley, under Sir Christopher Hinton; Sir William Penney was in charge of the Weapons Group based at Aldermaston. The Authority's first Chairman was Sir Edwin Plowden.

• 1957 all fundamental atomic physics research transferred to the newly formed National Institute for Research into Nuclear Science (NIRNS) which became the Rutherford-Appleton Laboratory.

• 1960 Fusion and plasma physics research moved to the nearby Culham site, which ultimately became the host site for the Joint European Torus (JET) project in 1978.

• 1960 the Wantage Radiation Laboratory was created to exploit Harwell's work in radioisotopes and gamma sterilisation of medical instruments. It closed in 1970.

• 1971 the Radiochemical Centre (TRC) became a separate company although it kept a significant presence at Harwell for the next 25 years. In 1981 it became Amersham International and it was privatised in 1982.

• 1971 Staff from Harwell transferred to the National Radiological Protection Board, at Chilton, set up to study the human effects of ionising radiations, and in response to the Radiological Protection Act (1970).

• 1982 The Nuclear Industry Radioactive Waste Executive (NIREX) took over the former 'B' Mess building at Harwell to plan the National Waste Repository for Intermediate Level wastes.

• 1989 AEA Technology was launched as the commercial arm of UKAEA with its HQ at Harwell.

• 1990 The ending of major nuclear research projects and the closing of Harwell's remaining reactors coincided with many staff nearing normal retirement age. By 1996 staff within the security fence at Harwell numbered around 2500.

• 1996 AEA Technology legally separates from UKAEA - both organisations having their HQs at Harwell.

HM The Queen and HRH Prince Philip are taken into building 220 by Harwell's director, Sir John Cockcroft, 1957. (AJ 413)

DIRECTORS OF HARWELL

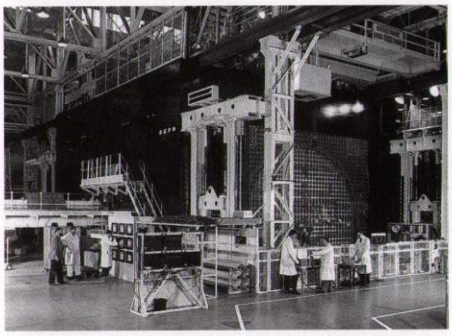
Sir John Cockcroft 1946 - 58

Sir Basil Schonland 1958 - 60

Dr Arthur Vick 1960 - 64

Dr Robert Spence 1964 - 68

RESEARCH FACILITIES AT HARWELL



The BEPO reactor in H10 showing, on the right, the aircraft carrier 12 ton hydraulic hoist which provided precision access to any part of the pile face for refuelling. (AJ 3980)

The "topping out" of BEPO's 200ft stack in 1948. BEPO required five tons of air every hour to limit the uranium fuel temperature to below 200 degrees Centigrade. The air exhausting from the stack pierced the densest fog. (HR 59797)

BEPO

The basic design of British Experimental Pile O (BEPO) was started by UK staff in Montreal during the war, and completed at the UK's Risley site. Construction started in H10 in June 1946 and criticality was achieved on 5 July 1948. BEPO provided valuable experience for the advent of Calder Hall and Britain's Magnox nuclear power stations. BEPO was the UK's major producer of radioisotopes in the 1950s. It shut down in 1968.

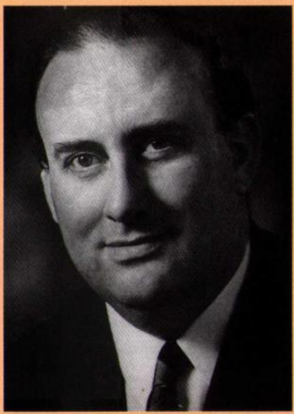
BEPO was a graphite-moderated, air-cooled pile that achieved 5.4 MW (Thermal) from a full load of 40 tons of natural or low-enriched uranium. Some 17,600 fuel elements were inserted into channels in 25,000 machined graphite blocks that weighed a total of 850 tons. Each graphite block was fabricated at Harwell to an accuracy of 0.0025in, and the resultant 26 foot high pile was built to within 0.03in of the designed figure.

Reactivity was controlled by four horizontal boron-carbide 2in diameter rods and emergency shutdown achieved in less than one second by vertical rods fired by compressed air.

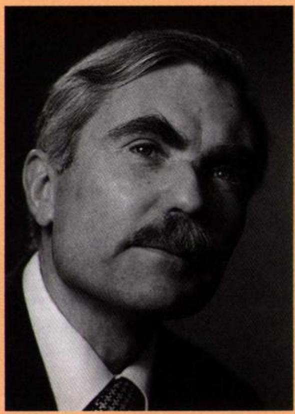
GLEEP

Built in Hangar 8, the Graphite Low Energy Experimental Pile (GLEEP), designed by Watson-Monro, was the world's longest running reactor. From a bare hangar floor to an operating 'pile' took only 15 months, and the basic

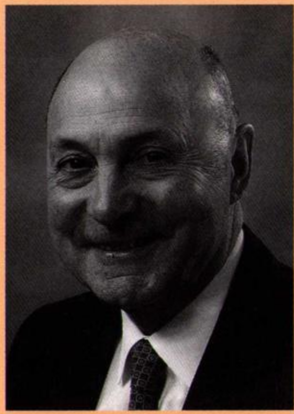
The GLEEP control desk remained largely unchanged throughout its 43 year lifetime. (HP 33965)



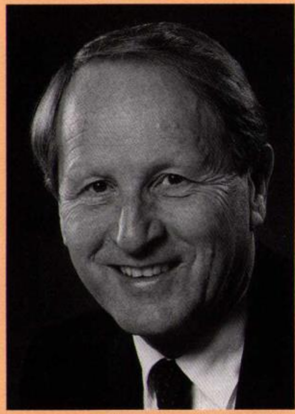
Dr Walter Marshall 1968 - 75



Dr Lewis Roberts 1975 - 86



Dr Graeme Low 1986 - 87



Dr Peter Iredale 1987 -90

John Baxter, head of Research Reactors Division, is interviewed by the media on the occasion of GLEEP's 40th Anniversary. (HRC 37430)

structure of the reactor was not altered until it shut down 43 years later in 1990.

It consisted of a 'pile' of chamfered graphite blocks in the shape of a 21ft cube surrounded by a large air gap and then a wall of barytes concrete 5 feet thick. Its fuel consisted of 30 tons of natural uranium dispersed among 660 channels formed into the core.

For most of its life GLEEP operated at a thermal power of 3kW — the same as a domestic kettle; but for isotope production in the late 1940's it frequently operated at 100 kW. Once, as part of a controlled experiment, it achieved 700 kW.

The consistency of its neutron flux, around 1000 million neutrons per square centimetre per second, over years of operation without deviation, made it the ideal neutron source for the calibration of ionisation chambers in the 1980's.

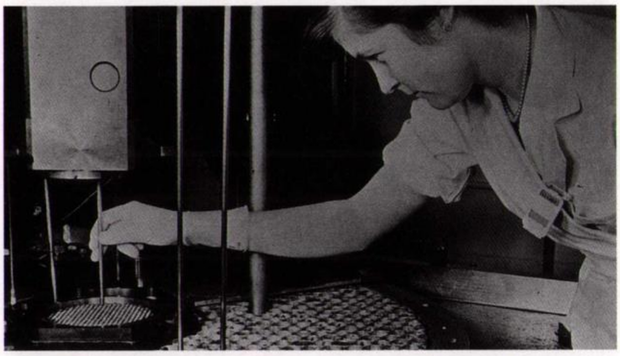
Fast Reactor research

As early as 1946, fast 'breeder' reactors dominated thinking on the future of nuclear power for electricity generation because of limited uranium resources. Fast reactors can convert non-fissile U238 to the fissile isotope of Pu239 faster than it is used up allowing such reactors to utilise 50% of the uranium fuel, compared to less than 0.5% for 'slow' moderated reactors.

Research at Harwell on heat and mass transfer in sodium, on the chemistry and metallurgy of liquid sodium and on reactor fuels contributed to the fast reactors to be built at Dounreay. Sodium boiling and sodium fire studies were done at Harwell in the early 1970s. And fuel studies resulted in a novel 'gel' process for making spheres of mixed oxides of uranium and plutonium.

ZEPHYR

Britain's first fast reactor, ZEPHYR, was assembled at Harwell in 1954. This zero energy device had a 15cm diameter core of clad plutonium rods surrounded by a blanket of natural uranium. Reactor control was by withdrawing some of the uranium rods to alter the number of reflected neutrons into the core.



ZEPHYR, the first fast reactor, had a breeding factor of x2. (HP 84900)

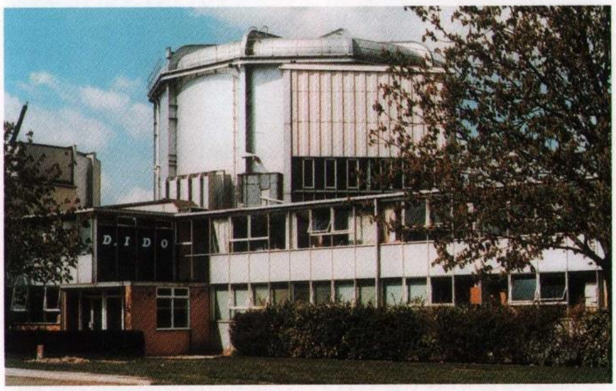
ZEUS

Measuring 60 cm across, ZEUS, built in 1955, was used to study the design of the core for the Dounreay Fast Reactor. From 1958 most of Harwell's reactor physics work was moved to the new Atomic Energy Establishment at Winfrith in Dorset.

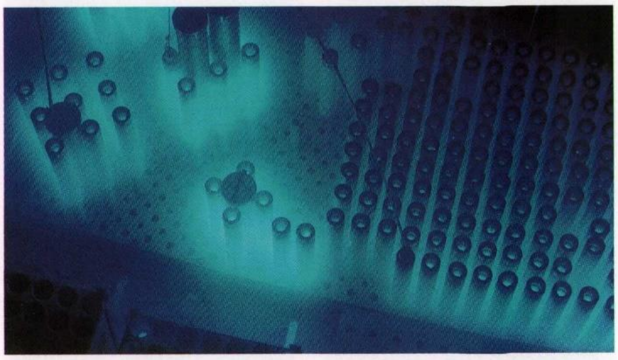
ZEUS, a larger zero energy fast reactor, whose enriched U235 fuel was ultimately used in the Dounreay Fast Reactor. (HP 84901)

DIDO, PLUTO *and* LIDO

The DIDO reactor was the first of Harwell's two high-flux materials testing reactors, and it went critical in November 1956. PLUTO was commissioned in 1957. They were moderated and cooled with heavy water and fuelled with uranium-aluminium alloy enriched to 80% U235. Their original design power of 15MW was progressively uprated to 30MW by the time they were shut down in 1990.



DIDO (HPC 31253)

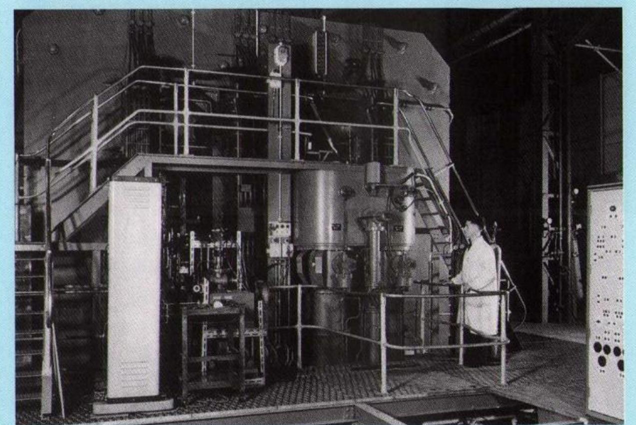


Spent fuel rods from DIDO and PLUTO 'cooling off' under 20ft of water before despatch to Dounreay for reprocessing. Gamma radiation travelling faster than the speed of light (in water) causes the glow of Cerenkov radiation. The pond also provided gamma sterilisation of hospital instruments. (HPC 83704)

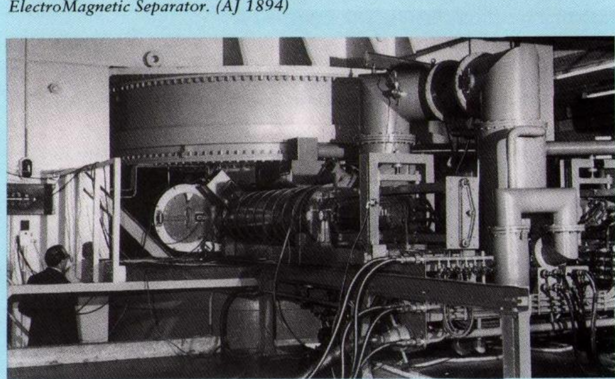
DIDO and PLUTO were designed for irradiation experiments, testing experimental loops for the design of other reactor systems and for isotope production. A substantial neutron beam programme grew in the 1970s and 80s for solid state physics research and neutron radiography.

Harwell's reactors as the main tools for neutron cross-section analyses were supplemented by the Tandem Van de Graaff in 1960 and the Helios 136MeV linear accelerator in 1979. Harwell's research programme also required accelerators, chemical engineering buildings, and radiochemistry 'hot labs'. These were constructed in the 1940's and '50's. The success of the programme depended on the best support facilities possible. They included engineering workshops and design offices, metallurgy, electronics, specialist R&D laboratories and other support services.

Tandem Van der Graaff Accelerator. (HRC 59950)



ElectroMagnetic Separator. (AJ 1894)

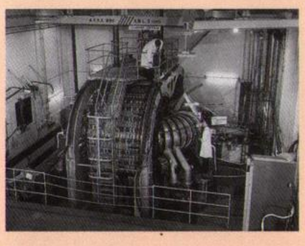


110" Synchrocyclotron. (HP 84879)

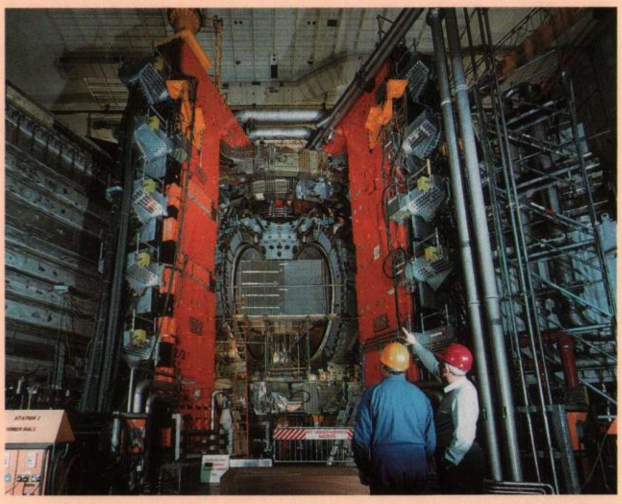
ZETA to JET - *Fusion Research*

On the 12 August 1957, a large experimental apparatus for studying the controlled release of energy from thermonuclear reactions was started up in Hangar 7 at Harwell. Scientists, led by Dr P C Thonemann, R Carruthers and 'Bas' Pease, heated deuterium gas to five million degrees centigrade inside the one metre diameter torus of ZETA (Zero Energy Thermonuclear Assembly).

Banks of capacitors delivered half a million joules of electrical energy every 10 seconds to the primary windings of a large pulse transformer encircling part of the three meter diameter torus. The deuterium gas ionised as it became the short-circuited secondary for the transformer. Peak currents of 200,000 amperes flowed in the resultant 'plasma' for several milliseconds and further 'pinched' the gas.



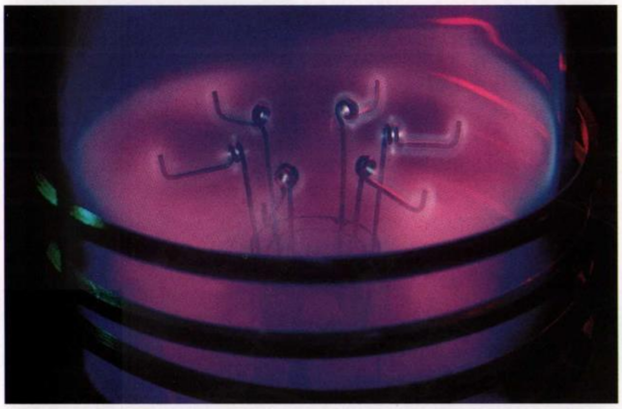
A net gain of energy required temperatures in the order of 100 million degrees centigrade. This was not achieved until research at Culham Laboratory, established in 1961 as UKAEA's fusion laboratory, culminated in the European JET project's success in the 1990s.



(above) The JET machine at Culham undergoing maintenance in 1990. (J90-66C)

(left) The ZETA device in Hangar 7. (AJ 1293)

Materials research



Plasma Activated Vapour Deposition (PAVD) of nitrides onto nylon thread guides used in a spinning mill. The threads travel at 750 mph causing rapid wear problems. PAVD treated guides last 100 times longer. (HPC 29101)

Materials developed for use in or near the core of a nuclear reactor had to function with consistent reliability under conditions of high temperature, high pressure and intense neutron and gamma fluxes. Harwell's materials technology research created hitherto unknown materials with exciting possibilities.

Examples of these included non-metallic materials for high temperature heat exchangers, electrodes in advanced batteries and porous heating elements in chemical processing plant. A range of composite materials were developed as substitutes for asbestos items; and gel processed powders with closely controlled particle size were introduced for ceramic spraying into intricately engineered shapes.

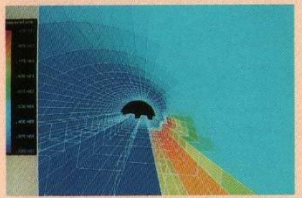
Coating technology and ion implantation techniques, developed from nuclear research, made it possible to reduce the wear rates of precision tools and machinery, from reducing the wear in car and lorry engines to strengthening the blades used to slice bread!

Metallurgical research investigated fabrication techniques and corrosion and fracture problems. Electrochemical studies led to novel battery fuel cell prototypes. Underlying research investigated superconductivity and microelectronic materials.

(right) A range of engineering items made from Harwell-developed metal matrix composites. They have increased stiffness, high temperature resistance and are lightweight. (HRC 13226)

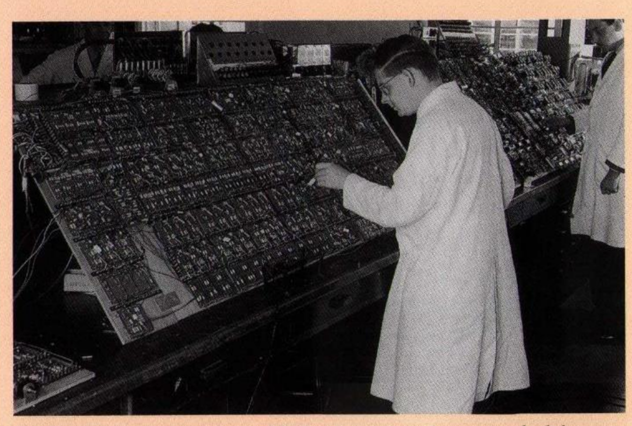
Computing and electronics

Harwell's site-wide computing service started as part of Theoretical Physics Division, under Klaus Fuchs, in 1948. Research demanded considerable numerical calculation, and data processing was initially done using hand cranked machines. In 1953 a Punched Card machine section was set up in B328 followed by a Ferranti "Mercury" computer in 1958, containing a room-sized one kilobyte 'fast' store of 1000 electronic valves. Mercury cost £80,000.



Computational Fluid Dynamics (CFD) was used to investigate the Kings Cross fire disaster and the resultant 'Harwell Trench Effect' changed the outcome of the Public Enquiry. The fireball that killed 31 people was proved to be due to chimney draught up the escalator and not to explosive combustion of paint. (HRC 46468)

Harwell's Electronics Division built KADET, the world's first all transistor computer in the late 1950s; but in 1961, a much larger Ferranti "Atlas" computer was purchased for £4 million, and shared with Rutherford Laboratory. Ion implantation, a nuclear physics technique developed and refined over many years, led to Harwell-designed implanters being used in the silicon chip industry world-wide.



Jim Stevens circuit testing the world's first transistorised computer, built by Electronics Division in 1958. (A 3733)

The demand for computer power in the 70s and 80s was met by IBM main-frame computers, culminating in the CRAY 2 super-computer in 1987. This performed 1,700 million calculations per second in a two billion byte random access memory, and cost £12 million.

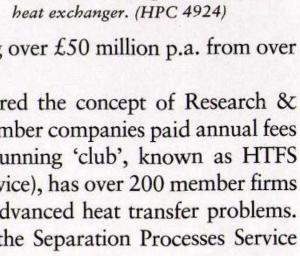
Technology transfer

By 1960 the concentration of talent and investment had established Harwell as a laboratory among world leaders in the development of nuclear power. With the end in sight of the pioneering stage in nuclear technology, it faced a dramatic reduction in size.

Fecralloy steel coated with platinum-based catalyst for car exhaust systems. (H 4817/180c)

The Science & Technology Act (1965) allowed Harwell to undertake non-nuclear work in response to ministerial requirement and so its objectives widened from being a single mission laboratory to include a wide range of work for Government and industrial customers prepared to pay for it.

Harwell's Nondestructive Testing Centre was set up in 1967 and eventually acquired 'National' status. Developed from the need to test nuclear plant, it sold industry a range of crack-sizing, defect location and materials characterisation services. It was awarded the Queen's Award to Industry for its work on improving the efficiency of Rolls Royce jet engines. Other centres included the Ceramics Centre and the Chemical Emergency Centre.



Laser beam investigation of a glass heat exchanger. (HPC 4924)

New materials such as FECRALLOY steels and REFEL silicon carbide, originally developed for the reactor materials programme, were patented and sold under licence.

By 1985, Harwell was earning over £50 million p.a. from over 1200 separate R&D contracts.

In the 1970s Harwell pioneered the concept of Research & Development 'Clubs' in which member companies paid annual fees for joint research. The longest running 'club', known as HTFS (Heat Transfer and Fluid Fow Service), has over 200 member firms worldwide financing work into advanced heat transfer problems. Other long term clubs included the Separation Processes Service and Bioseparations R&D Clubs.

Most clubs were set up to run for a fixed time but others were specialist units separately funded by Government. Examples of these were the Marine Technology Support Unit (1968) and the Energy Technology Support Unit (1974).

This diversification into non-nuclear, commercially driven activities led to the formation of AEA Technology plc, the world-wide science and engineering business, which as a separate organisation is now carrying forward this work in the private sector.

Redevelopment

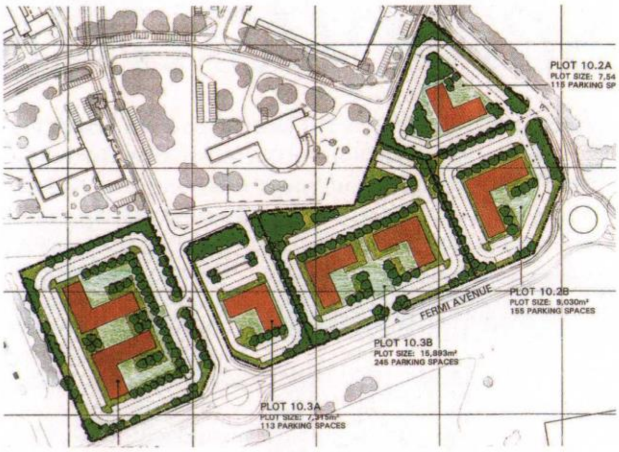
Harwell is now a multi-organisational centre for high technology business. It remains in the ownership of the UKAEA which is responsible for decommissioning its redundant nuclear facilities; while AEA Technology, now in the private sector having separated from the UKAEA, is its largest tenant. It is part of a larger Harwell/Chilton campus for science and technology which also includes the Rutherford Appleton Laboratory, the NRPB and the MRC.

In 1994, building 354 was demolished and the former RAF Parade Ground was made into a car park. Four veteran cars paraded at the opening ceremony. In the background, right, can be seen the former RAF NAAFI which is now a Social Club. (HRC 97476)

The UKAEA is determined to maintain the site's reputation for excellence in science and technology and is preparing for the next 50 years by regenerating its infrastructure, by planning for new development, by giving first class support to present business occupants and by attracting new high technology business.

During the 1990s about £25 million is being spent to improve the infrastructure. In scenes reminiscent of the 'Chivers' 1946-50 era, the site has on occasion once again become home to hundreds of contractors and their machines.

RAF buildings of the 1930s, such as Hangar 9, and many 'temporary' buildings put up in the 1950s, have been demolished to create new open green spaces. Electricity, water, gas and heating supplies have been renewed and ownership transferred to public utility companies. The site's shortage of car parking spaces is being met by the creation of new car-parks — notably on the former RAF Parade Ground behind B150. Longer term plans to improve site access and traffic management schemes were started in 1996, by creating a new roundabout at the end of Fermi Avenue.

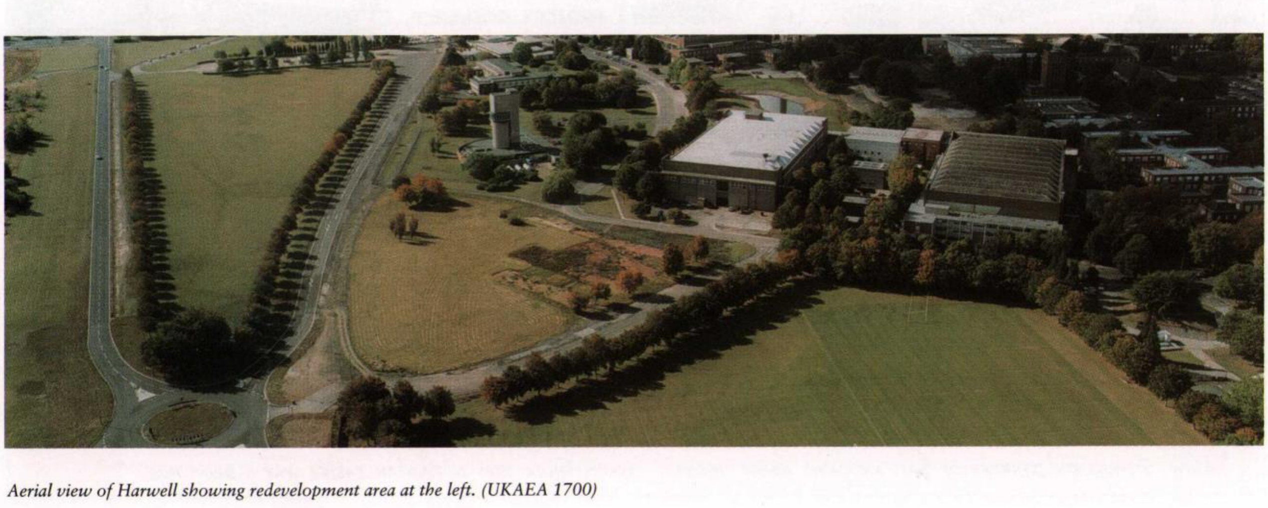


Phase One planning application for Harwell, illustrative site layout

Two new lagoons have been dug, one on the old Hangar 9 site, and the other at the Reactor site. These are designed to manage surface water drainage problems, and provide emergency fire fighting water supplies as well as creating an environmentally attractive location for staff and wildlife.

The former Chilton and Aldfield prefab sites have been cleared and agreement reached with the local planning authority to allocate up to 275 dwellings on the Chilton site in the District local plan. In September 1996 the UKAEA obtained outline planning approval for 28,000 square metres of business development at the south-east side of the main site along Fermi Avenue and on the site of the former RAF A-Mess, Ridgeway House.

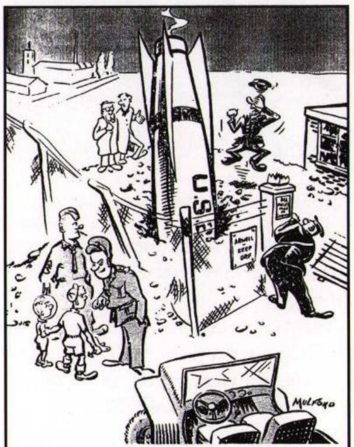
In the 50th anniversary year of Harwell, the redevelopment plans aim to create a pre-eminent high technology centre for the next 50 years.



Aerial view of Harwell showing redevelopment area at the left. (UKAEA 1700)

Distractions
serious and humorous

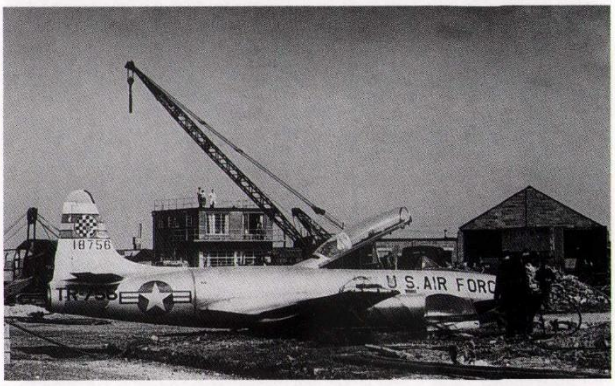
On 22 April 1957, a T33 Starfire jet of the USAF, lost on a flight from Kent to Dorset, mistook Harwell for RAF Abingdon and landed safely on Fermi Avenue, coming to a halt outside the Rutherford Appleton Laboratory's building R12.



"Say — here's a buck! Ask if we can have our rocket back!"

During lunch time the next day, and watched by hundreds of staff, it attempted to take off in an easterly direction assisted by temporary rocket pods fastened to its wings. As it rapidly approached the A34, the pilot attempted a steep climbing turn at the moment when one of the rockets malfunctioned. The jet slewed to the left and its wing touched the ground. It headed along the ground in a plume of smoke and sparks, its undercarriage collapsed, and it ploughed through the perimeter fence heading for Hangar 8 and the GLEEP reactor.

It came to a halt at the edge of the pit being dug for the Tandem Van de Graaff building. The pilot escaped unharmed but the jet was later cut up into sections and taken away by a low-loader transporter. As a consequence of this incident, Harwell's former runways were covered in top soil and many trees were planted.



The T33 jet, minus its undercarriage, rests among Chivers sheds near the former Control Tower B6. (HP 84827)

HARWELL - THE FIRST FIFTY YEARS

50th Anniversary Lecture

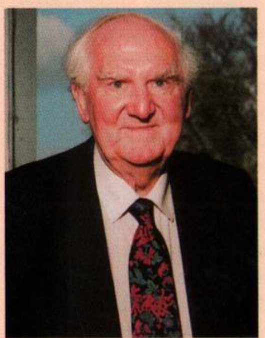
given on 10 May, 1996 in Harwell's Cockcroft Hall by

Sir ALAN COTTRELL, FRS, F.Eng

Department of Materials Science and Metallurgy, University of Cambridge

In The Beginning

We are here to celebrate a jewel in Britain's crown, the Atomic Energy Research Establishment, Harwell, on the attainment of its 50th birthday. What has made it such a brilliant jewel are its outstanding scientists and engineers, from the early heroes of the United Kingdom's atomic energy project through to today' s resourceful entrepreneurs. Harwell is a powerhouse of advanced science which has driven many of Britain's postwar developments in physical science and engineering technology.



Sir Alan Cottrell

It began at a chance meeting between Cockcroft, Chadwick and Oliphant, in a Washington hotel in November 1943, when Cockcroft agreed to take charge of the Montreal Laboratory of the Anglo-Canadian Atomic Energy Project. A year later, the same line of thought led to the idea of founding an atomic energy research establishment in Britain, with of course Cockcroft as its founding father and grand designer. It would have general responsibility for providing the scientific basis of Britain's intended atomic energy projects. Mr. Attlee, the Prime Minister, announced in the House of Commons on 29 October, 1945, that the Government had decided to set up a research and experimental establishment covering all aspects of atomic energy. From the outset Cockcroft's concepts of what was needed were clear and firm. As regards choice of site, he insisted that the proposed laboratory had to be near a major university and within easy reach of London. This seemed to narrow the choice down to somewhere near Oxford or Cambridge. But there were other conditions to be satisfied. It should be sited in fairly remote, empty, countryside — and Cockcroft insisted here that it should also be in pleasant country — and should be near to a good supply of cooling water. All of this pointed to the R.A.F. airfield, with its large hangars and good roads, on the Berkshire downs near the village of Harwell. It was an ideal choice. To quote what an American visiting scientist wrote about Harwell, a few years later: Harwell was "two hours by car to London, the south coast and Wales. Possibilities for exploration, entertainment and intellectual stimulation are endless: theatre in Oxford, Stratford-on-Avon, London: abundant archaeological sites from all periods: cathedrals, churches and Oxford colleges."

Cockcroft was appointed Director in July 1945 by Sir John Anderson who said that "the Director should have the utmost measure of freedom in the control of the Establishment." What wisdom was shown in that directive! And how strange those far-sighted words sound, today. The airfield was handed over 50 years ago, in the Spring of 1946, and so it all began. The conversion of a wartime RAF establishment into a huge laboratory of the most advanced kind, with great nuclear facilities, took a strenuous ten years in which everyone waded through mud and stumbled on builders' debris. But there was a great enthusiasm, a young staff mostly imported from the British team at Chalk River, Canada, and a real pioneering spirit which swept everyone along. Accommodation was a severe problem, partly solved by the urgent construction of a large village of prefabricated bungalows nearby. These were intended to last only ten years, but of course remained in use until quite recently, 43 years later. Later, several estates of good houses were built in Abingdon and nearby villages for the rapidly growing Harwell staffs and their even more rapidly growing families.

Cockcroft had an equally clear concept of what the character and style of Harwell was to be. Above all, it was to be a great research establishment in all aspects of nuclear science, a kind of post-graduate University, able to attract outstanding people and provide them with excellent and unique facilities for their research. But, of course, it had as its primary duty the requirement to provide the basic scientific data and understanding needed to launch and underpin Britain's atomic energy projects. The most urgent needs were for nuclear data, to design reactors, and for chemical processing techniques for the extraction and purification of uranium and other nuclear materials; and for separating the constituents of irradiated fuel. Hence there was a strong early concentration on building up the Divisions concerned with nuclear physics, reactor physics, chemistry, chemical engineering, metallurgy and materials. Health Physics was also obviously important.

There was one feature of Britain' s general atomic energy policy which had a decisive influence on Harwell and in which Harwell, in turn, then had a decisive influence on the further development of this policy: it was the choice of nuclear reactors. The imperative in 1945 was to develop a British nuclear deterrent and to do it quickly. This meant that it had to be based on plutonium; hence the requirement for nuclear reactors. Again, for quickness, these reactors had to be fuelled by natural uranium. Enrichment would have to wait until later. The two candidate moderators for natural uranium were graphite and heavy water. Whereas Britain had easy access to sources of graphite, there was little heavy water available. Finally, there was the problem of cooling. Light water cooling of a graphite reactor was seen to be hazardous (as was tragically demonstrated, many years later, at Chernobyl) and so the choice was gas cooling. Hence the UK embarked on the system of natural uranium, graphite moderated, gas-cooled, reactors, starting with the first Harwell ones, GLEEP and BEPO; a system which was to dominate British atomic energy for many years. Initially, the gas cooling was chosen to be of the simplest kind, merely unpressurised air along cooling channels through the graphite and out into a chimney stack.

GLEEP and BEPO were constructed as experimental reactors, still known as 'Piles' in those days, mainly to provide nuclear data and prototypes for the Windscale reactors and to test graphite and uranium for impurities. But they also had other uses. A heat exchanger was fixed to the air exit of BEPO, to provide the Harwell site with hot water, surely the first peaceful use of atomic energy. BEPO, particularly, was also used for research into radiation damage. Importantly, both reactors were used from the earliest days to produce radioisotopes for medical applications. The small radium business of Thorium Limited at Amersham was taken over, in mid-1946, to become the Radiochemical Centre, later Amersham International, the commercial outlet for Harwell's isotope production. This was the first example of what was later to become a familiar feature of Harwell's evolution: the launching of separate activities, outside the Harwell 'fence', initially as external subsidiaries but later to become independent, self-standing, activities and businesses.

The Golden Age

There was one feature of the earliest days of the British atomic energy programme, including Harwell, that many people thought unsatisfactory. It was under the control of the Ministry of Supply. The general impression was that the Civil Service was not the right organisation for running such a new, adventurous, enterprise; and a general campaign was mounted, led by Lord Cherwell, to create a separate and more independent organisation for atomic energy. On 4 June, 1954, the Atomic Energy Bill became law. It introduced the Atomic Energy Authority as a semi-autonomous body with three main groups, Research, Industrial and Weapons, led respectively by Cockcroft, Hinton and Penney, together with a London headquarters, under the Chairmanship of Sir Edwin (later Lord) Plowden. With this new-found freedom, British atomic energy — and with it, Harwell — rapidly expanded into its golden age. It brought Harwell's manpower up to a peak of about 6000 by 1962.

There was a second reason for this golden expansion and one which brought about the first great change within Harwell itself, beginning in about 1950. Ever since the earliest days people had dreamt of a civil application of nuclear energy, that of producing electricity. In Britain these thoughts were sharpened by the bitter winter of 1946-47, when the great fuel and power crisis led to an almost total shutdown of all national activity, other than shivering, for several weeks.

Honour

It was decided to build upon existing British experience, and a design study was completed at Harwell in 1952 for a gas-cooled, graphite-moderated, natural uranium reactor which would have the dual purpose of producing both plutonium and electrical power. Known initially as PIPPA — ie. pressurised pile producing power and plutonium — it later became known as a MAGNOX reactor, in honour of a notable Harwell contribution. Up until then uranium fuel rods had been encased in aluminium cans. But aluminium reacts disastrously with uranium at temperatures above 250 degrees Centigrade; and the power reactors have to operate at much higher temperatures than this. A research programme at Harwell developed an alternative canning alloy based on magnesium and named as magnox. It has proved very successful for the British natural uranium power reactors.

Starting from BEPO and Windscale experience it was hoped that the development of the PIPPA/MAGNOX reactors would be a relatively simple matter. This might seem to be true since the first of these, the Calder Hall reactors, were built in only three years, to be formally opened by HM The Queen at a famous ceremony in October 1956, when the first nuclear electricity entered the national grid. But the development turned out to be very far from simple and the effort on it produced great changes at Harwell, as well as in the Industrial Group at Risley, Springfields and Windscale. Although BEPO and the Windscale reactors had involved sophisticated nuclear physics in their design and advanced chemistry and chemical engineering to produce their input materials and deal with their irradiated fuel, in all other respects they were extremely simple, undemanding, constructions. It was an entirely different matter, however, for power reactors.

Operation at higher temperatures introduces difficult corrosion problems. Operating the coolant gas — now carbon dioxide — at high pressures brings in the need for pressure vessels, either steel or prestressed concrete, with all their immensely complicated technology and new safety problems. Operating the fuel to higher burn-ups means controlling the ghastly effects of radiation damage which occur in heavily irradiated material. An immense range of new scientific and technological problems thus challenged Harwell and these were problems mainly outside the then traditional areas of Harwell expertise, nuclear physics and chemistry. And so large R & D Divisions had to be developed in these new areas, particularly to do with materials science and metallurgy, with an importation of a second wave of scientific and engineering staffs, more experienced in the newly required disciplines. All this was further enhanced by a correspondingly large research and development effort, on the Fast Reactor and also the Advanced Gas Cooled Reactor (AGR), which again involved new sciences and technologies, such as ceramic fuels, different fuel can materials and liquid metal coolants.

Launched

Harwell at that time was also in a fever of excitement over the invention of new power reactor systems. The Magnox reactors were obviously only a first step in the nuclear power programme. And, while the fast reactor was seen as the ultimate step for fission power, it was clearly realised that much better thermal reactors than Magnox could, and would, be developed. There were many candidates and each had its champions, around which small pioneering design teams formed in an almost ad hoc manner. Harwell's task here, in the reactor field, was to make first studies of possible reactor types and evaluate them. It was also realised that the Harwell site could not accommodate all these embryonic new reactor types, especially as it was already adding to its existing facilities two major materials testing reactors, DIDO and PLUTO. As a result, Harwell launched a second research establishment, at Winfrith on Thomas Hardy's Egdon Heath in Dorset, where the experimental High Temperature Reactor (DRAGON) and Steam Generating Heavy Water Reactor (SGHWR) were built and operated.

Another strongly growing activity at Harwell was thermonuclear research, with the long-term goal of producing a commercial fusion power reactor. Despite the setback of the premature Zeta project this activity flourished so much that it also was eventually hived off to another site, at Culham, a few miles from Harwell, which later became the home of the international JET project.

Through all this flurry of activity on new reactor projects, Cockcroft' s other ambitions for Harwell — that it should also be an academic centre and engage in such pure science as springs from its primary roles — were also satisfied. Two major teaching ventures, the Isotope School and the Reactor School, were set up and, over the years, trained large numbers of students in these new sciences. As regards pure science itself the contributions were many. To mention just a few, the forces between nucleons were determined and the shell model of nuclear states developed, the chemistry of the actinides was worked out, the problems of plasma stability studied, solid and liquid structures were analysed using neutron diffraction and scattering, the basic processes of radiation damage were unravelled, especially by high-resolution electron microscopy, fluorine chemistry was developed, the Mossbauer effect was applied to the theory of general relativity, radioisotopes were used to elucidate the mechanisms of atomic movements in solid-state diffusion; and fundamental work on electronic interactions in solids, which defined the transition between metals and non-metals, threw new light on the basic processes of magnetism. Harwell's large experimental facilities, its reactors and accelerators, were opened up to university groups for their fundamental researches and this led in 1957 to the setting up of the National Institute for Research in Nuclear Science (later to become the Rutherford High Energy Laboratory) alongside Harwell.

This period, from about 1950 to 1965, was truly a golden age. I was fortunate enough to have been there during part of this time (1955-58). An enlightening description of the establishment at that time was given by a visiting American scientist, A. Langsdorf (Atom, July 1961): "Harwell itself is steadily becoming more attractive to the eye, thus better matching the pleasant countryside around it as the original airfield and early temporary buildings are obscured by landscaping and replaced by new construction. Most of the buildings lie in a mile-long crescent which follows the old airstrip. They are tightly grouped and it is usually a surprise to learn that they house about 6000 people. Four large hangars... are conspicuous... they were the first buildings converted to research purposes. The most recent construction has burst from the confines of the crescent on to the open airfield, giving a clear impression of booming research. Beyond this is a group of buildings dominated by two steel shells, each housing one of the twin heavy-water reactors, DIDO and PLUTO. They are at the edge of the level field close to the open rolling downs which ring the area."

New Roles

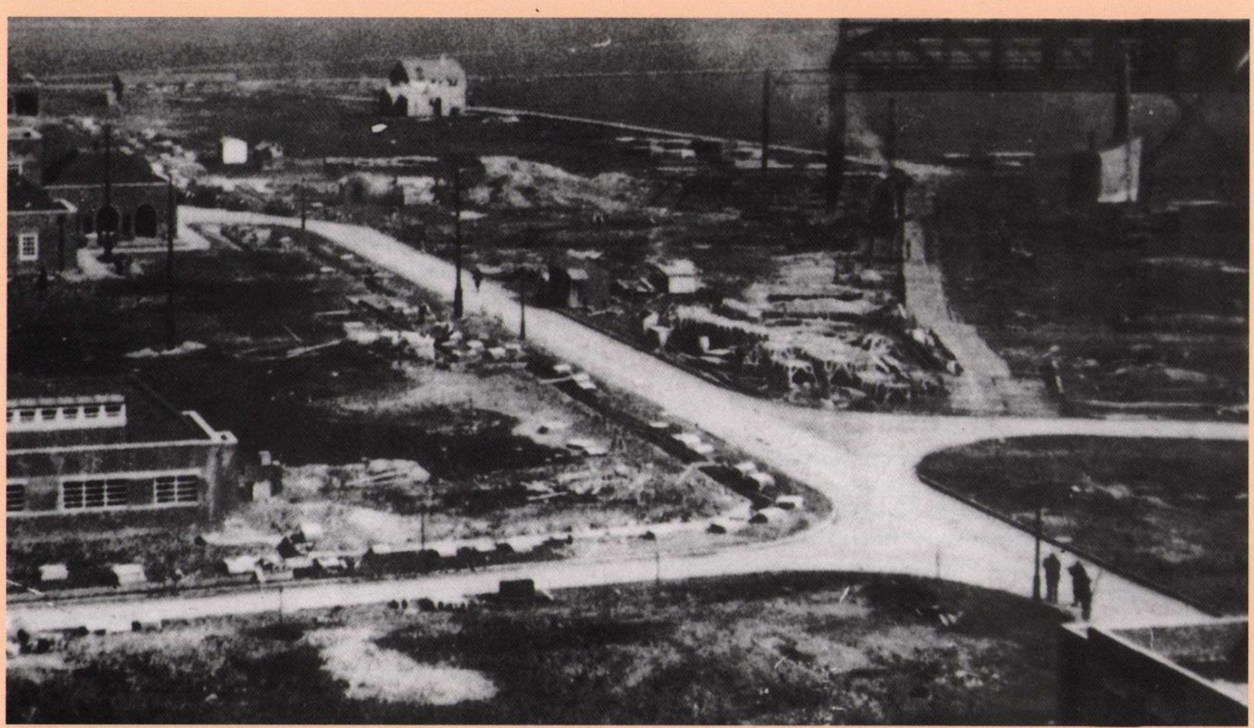
After about 1965 Harwell faced a new problem. It seemed that its initial work, which was to provide the scientific basis for Britain's atomic energy and nuclear power programmes, was approaching completion. Actually, this was not true, as I shall argue later. But in 1965 the later problems of nuclear power were barely visible and the substantial and successful solution of most of the initial ones meant that Harwell had to seek new roles. The Moses, then to lead Harwell towards a new land, was Walter Marshall who became Director in 1966. What enabled him to do this was the Science and Technology act of 1965 which required the UKAEA to undertake certain non-nuclear scientific research. Marshall reckoned that the demand on Harwell for research in support of the nuclear power programme would drop to about one-third of that at the peak. He also clearly saw that to reduce the Laboratory by this amount would effectively destroy it; and so he decided to offset the nuclear research run-down by a major new initiative, ie. non-nuclear research based on Harwell's existing expertise and directed towards helping British industry increase its technological and economic performance. Harwell thus set out to become a contract research organisation, selling high technology as a spin-off from its work for nuclear power. Marshall also recognised that if a technological innovation was to survive its vulnerable infancy and grow into a commercially successful venture it had, usually, to be attached to a single industrial company so that this had a commercial incentive to develop the innovation exclusively for its own benefit. This was the frankly realistic basis of what became known, inappropriately in my view, as Marshall's 'policy of maximum unfairness.' Underlying this was an even more basic policy, which defined the aim of Harwell at that time in Marshall's own words as "to use our scientific knowledge, people and resources, to the maximum national advantage."

Target

Although new research contracts began to be won by this means at an impressive rate, it was nevertheless inevitable that some reduction in staff numbers at the Laboratory should occur; and in fact by 1973 the total employed at Harwell had dropped to about 4500. This difficult run-down had to be combined with the equally difficult conversion from a traditional, government-funded, laboratory to one that would live partly or wholly on contract research. Marshall's target, here, was for Harwell to give about half of its total effort to nuclear power, one-quarter to contract work for government departments and one-quarter to British industry. It is a tribute to the late Lord Marshall's leadership and to the resourcefulness and adaptability of the Harwell staff that this difficult transition was achieved so well and smoothly.

Pressure

Looking at the published figures for the change in professional manpower and financing of Harwell, over the period up to about 1974, I find one surprising feature. Despite the statement that the conversion was necessitated by the near-fulfilment of Harwell's initial role — that of providing the scientific basis for Britain's



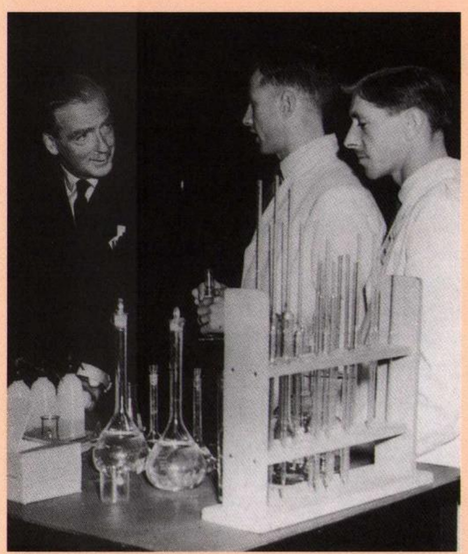
Harwell airfield under construction, 1937, with Hangar 7, top left. (HP 84899)

Cockcroft, third from right, and early Harwell heroes, 1946. (HP 84898)

The Hot Lab, building 220, 1949. (HP 84855)

Bulganin and Kruschchev visiting Harwell in 1956. (HR 102818)

Cockcroft and Henry Seligman opening the Isotope School, 1951. (HP 84842)



Anthony Eden, left, visiting Harwell in 1957. (HP 84985)

Harold Macmillan, right, visiting Harwell in 1957. (HP 84811)

Winston Churchill, seated centre, visiting Harwell in 1954. (HP 84983) nuclear power programme — in fact over this decade there was remarkably little run-down in the annual resources given to this nuclear role.

It declined by only about 20 percent. The big cut back was in the underlying programme of fundamental research into all aspects of atomic energy. This was reduced by nearly two-thirds, which suggests to me that the real external pressure put upon Harwell at the time was not due to a drop in the needs of the nuclear power programme but came from a campaign simply to cut government expenditure on research. All subsequent government actions abundantly confirm this impression.

Under the new policy, Harwell's all-round expertise in all sciences related to atomic energy, together with the resourcefulness and imagination of its staff in identifying new applications, led to a remarkable set of commercial initiatives. I will mention merely a few. The need to run nuclear reactors with complete reliability for many years had led to the development of excellent non-destructive testing (NDT) techniques. Many new commercial programmes grew out of these, such as the radiography of engines, while in rotation, for Rolls-Royce. In other areas the desalination of water, liquid chromatography and the production technology of carbon fibres were also major ventures for Harwell. Yet another was the Ceramics Centre, based on Harwell's work on oxide and carbide fuels for the nuclear power programme, which anticipated the modern trend towards the increasing use of ceramics in engineering. Chemical analytical techniques, instrumentation and control systems in medicine and industry, computer programming and chemical engineering have generated further applications. And of course, radioisotope tracer techniques have been applied very widely, not least in the monitoring and protection of the environment and the assessment of natural resources. Another venture, set up in 1974, was the Energy Technology Support Unit, to serve the (then) department of Energy in the assessment of national energy supplies and technology.

Excellence

All this represented the new face of Harwell. In admiring all of this, done under the new directive, we should not overlook Harwell's continuing excellence in its more traditional fields. The effort it could put into these, although severely reduced in quantity, remained of highest quality. As just one example of this, there was the brilliant work done to understand and control the formation of voids by point defects and inert gas atoms, in fast reactor materials.

Continuing Research Needs of the Nuclear Programme

I mentioned that the expected run-down in the need for research on nuclear power may have been over-estimated in 1965. The Fast Reactor programme of course generated a large programme of research for many years after this. But in addition there were two other developments, perhaps overlooked in 1965. The first was the need to assure everyone, particularly the general public, that nuclear power was safe and environmentally acceptable. The second was to increase the economic gain from nuclear power by first developing longer-lived fuel elements and then extending the working lives of the Magnox power stations. All this led to a second wave of researches for the nuclear power programme.

National Opinion

The question of safety has of course grown into a major public issue over the past twenty years. It has not been a matter of real risks, in Britain at least, for these have been extremely well controlled in the wake of the Windscale accident in 1957. It has been one of imagined risks, imagined by a general public sensitised by highly vocal national opinion formers. There has of course long been an intrinsic public fear of radioactivity, which was seen to be a new form of medical hazard, silent, invisible, insidious. Furthermore, its awful effects had already been demonstrated at Hiroshima and Nagasaki. But in the early years of the nuclear power programme the public were generally willing to accept assurances from both within the nuclear industry and external experts that it was all safely under control.

Then the anti-nuclear lobby got to work. I do not believe that safety against radioactivity was their driving motive — which was probably partly nuclear disarmament and partly a general opposition to industrial society — but they recognised, in the easily aroused public fear of radioactivity, an irresistible opportunity to raise anti-nuclear opposition to fever pitch.

They were skillful propagandists, entrancing large sections of the media who found in their dire pronouncements an easy source of sensational headlines. The result has been an intense concentration in recent years on safety issues, waste disposal and decommissioning, culminating in the massive public inquiry into the proposal to build a pressurised water reactor (PWR) at Sizewell. It has also raised expenditure on safety in the nuclear industry to £20m per life saved, more than 25 times that in other areas such as safety against road accidents.

Trend

One consequence has of course been a large recent growth in safety-related research, in which Harwell has participated fully in many ways. Interestingly, it has become closely linked with the other modern trend that I mentioned, the drive to extract more electricity from fuel elements and power stations by extending their working lives. As regards fuel, the research work has achieved remarkable successes. For example, the life of magnox fuel elements has been stretched from 0.4% burn-up, initially, to 0.9 percent now, which gives great economic benefit.

The working lives of the Calder Hall, Chapel Cross, and Magnox stations have also been extended. Of the various re-searches that made this possible, perhaps the most prominent have been directed at ensuring the safety of the steel pressure vessels against brittle fracture. This has proved to be a fascinating problem which combines the fundamentals of material behaviour with mechanical engineering in the most complex and intricate ways. Much brand-new basic science has been generated as a necessary spin-off from this applied programme with a directly economic motivation. Such research is in the classical tradition of Harwell which has of course played a key role in it, shared with other strong contributions from Risley, the Central Electricity Generating Board, Nuclear Electric, industry and the academic world.

This last point illustrates another feature of the history of Harwell. In the beginning Harwell was THE research centre for the nuclear power programme. Everything started there. Then the Northern Group of the AEA had need to do research and development, mainly in the field of mechanical engineering, so that scientific facilities grew at Risley, Springfields, Windscale and Culcheth. Next, as the civil nuclear programme got under way the (then) CEGB saw the need to have its own laboratories and a scientific force to deal with the on-going problems of operating nuclear power stations. Harwell has thus increasingly come to share its research role with other establishments.

The Present and Future

A big further trend began in 1989 when AEA Technology was created, converting part of the AEA into a commercial organisation to market itself as a science and engineering business. The other part of the AEA was to become a Government Division, dealing mainly with the decommissioning of nuclear plant and the disposal of nuclear wastes. In a sense, the creation of AEA Technology was Marshall's Harwell doctrine writ large, now applied across all of the AEA in the form of nine AEA-wide businesses. A key feature was that these businesses were not individually confined to single AEA establishments but spread as networks across all of them, claiming staffs and facilities from each as appropriate. This of course has had an effect on Harwell; its site and facilities have to some extent become a condominium in which parts of these networks have lodgement.

Applied

The present work of Harwell, on behalf of AEA Technology and the UKAEA (Government Division), extends over an impressively wide range of activities, including the decommissioning of nuclear reactors, research into the disposal of nuclear waste including fundamental groundwater studies, non-destructive testing methods particularly of steel pressure vessels, radiochemistry, electrochemistry, environmental technology, remote handling, advanced materials development and engineering software. One cannot but admire the resilience, resourcefulness and fortitude of the AEA staffs as they have adjusted to these profound changes in their organisations, and worked hard and skillfully to make them a success. All these qualities will surely be exercised to the utmost as privatisation takes effect, now that AEA Technology plc has been established as a publically-owned company. I find it particularly encouraging that the originality and grasp of fundamentals, so characteristic of Harwell's scientific work, is now being applied to the science of the management of commercial innovation. A good account of this has been given recently by Professor Stoneham in his recent Royal Society Zeneca Lecture, to be published in Interdisciplinary Science Reviews.

Assumptions

The drive behind these changes stems from two strategic assumptions, in my view both dubious. The first is that Government should divest itself, as far as possible, from funding applied science and technological development. The second is that nuclear power is now fully developed, at least as far as thermal fission is concerned. For example, Government annual funding for nuclear technological development has declined from some £200m in 1988 to below £30m today.

The national mission to develop nuclear power-generating systems has thus been almost totally abandoned, leaving only the UKAEA (Government Division) fusion projects at Culham as remaining examples of the exciting, far-sighted, reactor research and development philosophy which once motivated Harwell. This withdrawal from reactor development cannot be right, if only because there is no nuclear power system yet available at a capital cost low enough to attract unsubsidised private investment. The Sizewell PWR is a magnificent piece of engineering but also costly and complex. Unfortunately a 'mind-set' seems to have developed, to the effect that it is finality in thermal reactor development. It is not; only another stepping stone, the Magnox of the 1990s.

Achievement

In the great programme for civil nuclear power, what has been so far accomplished is the controlled release of nuclear energy and its conversion to useful electricity on a large scale in a fully safe manner. This has been a fine achievement but the last part of the task, which is to provide all these features in a system of low capital cost, still remains to be done. This part of the remit, set all those years ago, has yet to be fulfilled.

Challenge

The scientific and technological challenge is to retain today's standards of safety and efficient energy conversion in a system far simpler than anything available today. The need for simplicity, which must surely lend to lower capital costs, has I think been greatly under-emphasised. To give it prominence and priority means freeing ourselves from existing concepts of reactor systems and looking at the problem completely afresh, this time with simplicity as its starting point. For example, it is likely to lead to systems based on natural safety features involving gravity and convection, instead of engineered ones. Needless to say, there is already forward thinking of this kind, not surprisingly in the USA where new generations of simplified advanced light water reactors are being designed and developed. The Westinghouse version, for example, uses 60 percent fewer valves, 75 percent less pipework, 80 percent less control cable, 35 percent fewer pumps and 50 percent less building volume, than the corresponding nuclear core of a conventional PWR. I believe that even the AEA was interested in a corresponding project, the Safe Integral Reactor (SIR), a few years ago.

Getting back into advanced reactor design, almost certainly in an international collaboration, would be a magnificent challenge for Harwell, one in accord with its great traditions of scientific and technological originality, one aimed at completing the great programme of nuclear power development implicit in its remit of 50 years ago; a task to take Harwell forward for the national good.

Acknowledgement

I am grateful to Dr. Brian Eyre and Dr. Richard Judge for substantial help during the preparation of this lecture.

Congratulations to Harwell
from its tenants and neighbours

AEA Technology plc

Since its formation in 1954, the United Kingdom Atomic Energy Authority has had a base at Harwell. From the work here at Harwell, and at other sites, sprang the skills, knowledge and technologies which have led to the creation of the science and engineering services business, AEA Technology plc.

Harwell remains one of AEA Technology's principal sites. At Harwell, for example, AEA Technology has developed innovative lithium battery technology and advanced software for modelling fluid dynamics.

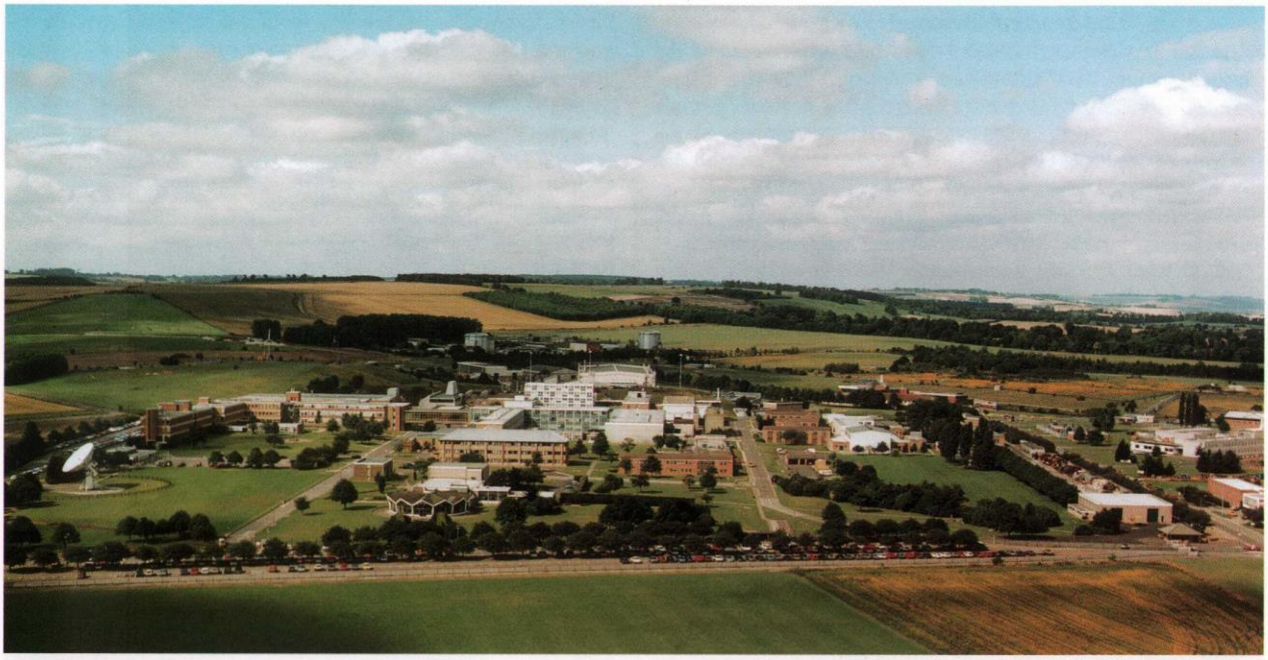
AEA Technology has now been successfully floated on the Stock Exchange. This is the first step in the process of creating from the work of the UKAEA a competitive private sector business capable of providing technical, safety and environmental solutions to industries and governments in the UK and overseas.

The privatisation process saw the formal separation of AEA Technology from the UKAEA on 31 March 1996. But AEA Technology has drawn from UKAEA a rich heritage of independence, integrity and innovation. These, combined with a commitment to the highest standards of science and engineering, are the foundations of our competitive strength.

AEA Technology is active at all six UKAEA sites, as well as having a number of overseas offices. At Harwell, as at all its other locations, AEA Technology is committed to being a good employer, neighbour, supplier, tenant and purchaser.

We value our relationship with UKAEA highly. Harwell has been a centre of excellence for 50 years; as a major presence on site we will be playing our full part to help ensure it remains a centre of excellence in the future.

AEA Technology plc's HQ at Harwell



The Rutherford Appleton Laboratory

Rutherford Appleton Lab

"It gives me very great pleasure on behalf of the Council for the Central Laboratory of the Research Councils to congratulate Harwell on achieving its Jubilee.

The history of our largest laboratory, The Rutherford Appleton Laboratory (RAL), is, of course, intimately linked with the history of Harwell. The Rutherford High Energy Laboratory was established as an independent organisation in 1957 so next year we will be celebrating 40 years of independent existence on the campus. RAL's programmes are now very diverse encompassing space astronomy and remote sensing, microstructures, large scale computing, particle physics, lasers, super conductivity, electronic and mechanical engineering and materials science. It is interesting, following Harwell's leadership in nuclear reactors, that RAL is now the leading international player in pulsed neutron scattering though our world-leading ISIS facility.

Some of our core technological capabilities can be traced back to our early years in the fifties, when Harwell's influence was very strong, but, like all children, we have grown up and developed our own skills and reputation which I believe complement areas of Harwell's expertise.

CCLRC congratulates Harwell on its fine record and for being the catalyst that initiated the development of Science and Technology based industries in South Oxfordshire. The Harwell/Chilton campus is still a key player and I am proud that RAL has played its part in this story."

Paul Williams, Chairman and Chief Executive, CCLRC.

UK Nirex, a tenant company at Harwell.

Nirex

The Nuclear Industry Radioactive Waste Executive was formed in 1982 and incorporated as a limited company — United Kingdom Nirex Limited (Nirex) — in 1985, to provide radioactive waste disposal services. The Company is pursuing the development, design and construction of an underground repository for disposal of intermediate-level, and certain low-level, radioactive wastes.

The Company's principal activities at present are site investigation and the provision of advice concerning waste packaging and transport. All Nirex's research, development and design work is directed to providing and managing a deep facility for the safe disposal of radioactive waste. UKAEA will be a major customer.

Currently, Nirex is awaiting the outcome of a local public inquiry into its application to develop a Rock Characterisation Facility (RCF) at Longlands Farm near Sellafield, which is a potential site for the repository. The RCF is planned to be sunk to a depth of 735m below the ground surface and is essential so that Nirex can obtain a firmer assessment of the potential of the site's suitability for radioactive waste disposal.

Nirex would like to take this opportunity to congratulate Harwell on its 50th anniversary, and looks forward to our continuing association and co-operation.

The Medical Research Council

"The Medical Research Council have had a presence on the Harwell site since 1947 and we are very pleased to be able to congratulate Harwell on their Jubilee Year, coming as it does just one year before our own! In those early days the Unit was at the forefront of helping to establish the effects of radiation on man and the importance of genetics for human disease and carried out pioneering work which led to some modern life-saving medical procedures, such as bone marrow transplants for leukaemia patients.

In October 1995 the Radiobiology Unit was replaced by two new related and complementary Units, the Mammalian Genetics Unit headed by Bruce Cattanach and the Radiation and Genome Stability Unit headed by Dudley Goodhead. In January 1996 the new UK Mouse Genome Centre also became operational headed by Steve Brown, creating an expanding and integrated campus with the MGU for molecular genetics, genomics, mutagenesis, transgenesis and informatics. There is particular emphasis on genomic imprinting, induction and use of chromosomal deletions, mutagenesis, the characterisation of deafness genes, developing complementary programmes in neurogenetics and on strengthening existing scientific links with human genetics programmes at Oxford. The Radiation and Genome Stability Unit studies the mechanisms of genetic and medical effects of radiation exploiting the evolving knowledge on induction of genomic instability (research pioneered at the Unit) and cell signalling processes.

We look forward to continuing to work with our colleagues at the other establishments on site to take Harwell into the next 50 years!"

Bruce Cattanach, Dudley Goodhead and Steve Brown, Directors, MRC Harwell Unit.

The Medical Research Council, Harwell

Procord

Procord is delighted to offer its congratulations to Harwell on reaching its 50th Anniversary.

Procord's association with Harwell began in 1995 with the acquisition of the Facilities Services Division (FSD) of the UKAEA when nearly 1000 staff joined us across all six locations.

Since then our relationship with both the UKAEA and indeed AEA Technology has developed, particularly here at Harwell.

Procord's commitment to the Harwell site is demonstrated by its decision to base the UK Headquarters of its entire Government & Technology Business Unit at building 344. Several members of the senior team are based at Harwell including Procord main board director, Stewart Wood.

Commenting on the relationship with the Harwell site, Stewart said, "Harwell is an exciting and changing facility enjoying significant development. Within this framework I am delighted that we have built, in partnership with our customers at Harwell, a relationship based on mutual trust and support to deliver key services to a world class facility."

Procord itself is enjoying an anniversary. It is five years since the Business was created as part of a Management Buy Out from IBM. Now a wholly owned subsidiary of US based Johnson Controls, Procord is a significant player providing quality facility management solutions as part of a truly global business.

Procord's relationship with Harwell provides a "best in class" case study now used world-wide.

Our association with everyone at Harwell is one which everyone at Procord is justifiably proud of.

Happy anniversary Harwell.

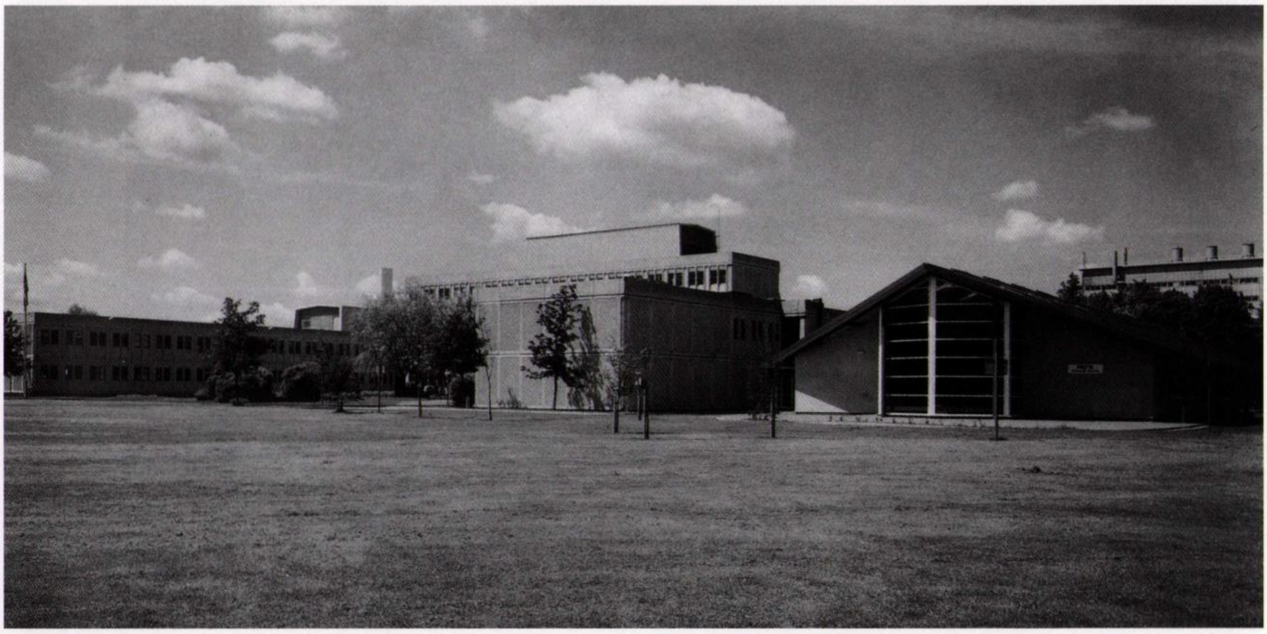
Stewart Wood, Director

National Radiological Protection Board

"NRPB was set up in 1970, to give advice, conduct research, and provide services and training in radiation protection. It has been on the 'site' since then and over the years it has become well known nationally and internationally. It acts as a focal point for organisations with responsibilities in radiation protection, especially government departments, local authorities, general industry, the European Commission, and various professional groups. Its work includes non-ionising radiation (eg. UV, lasers, mobile 'phones, power lines) as well as ionising radiation.

Some 275 people work at its headquarters and southern centre at Chilton, about 25 at its northern centre, Leeds, and 15 at its Scottish centre in Glasgow. The Department of Health provided about 45% of its £14.5 million revenue in the last financial year, the remainder being earned through the supply of technical services and research under contract to a variety of organisations.

NRPB congratulates Harwell on reaching its Jubilee Year and hopes that it will continue for many more, maintaining the very high standards of science and technology for which it is famous."
Mike O'Riordan, Board Secretary



The NRPB building.

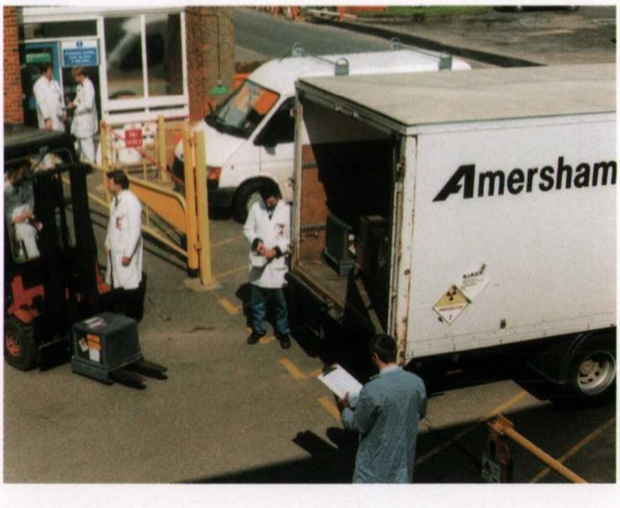
Amersham International

"Amersham International's association with the Harwell site has been long and close. The Radiochemical Centre — later to become Amersham International — was part of UKAEA until 1982 when it became one of the first government privatisations.

The Harwell reactors were the main source of radioisotopes for Amersham until their closure in 1990. The Amersham Isotope Production Unit (IPU) formed in 1959 and based in building 10.23 provided an essential link between the Harwell reactors and the chemists at Amersham Laboratories. The relationship forged by IPU and reactor staff was a model for co-operation and effectiveness. The success that Amersham currently enjoys has to a large extent been built upon the foundation of the service provided by the reactors and the UKAEA staff.

The closure of the reactors has forced a change of emphasis in the way that Amersham operates at Harwell. Currently on the Harwell site, Amersham operates two major businesses. The first, *Sentinel*, is at the forefront of the non-destructive testing market. The business supplies iridium-192, ytterbium-69 and cobalt-60 sources, together with sophisticated equipment to radiographically examine mechanical parts for defects. Typical applications would be in the examination of oil pipeline and aircraft engines. The second business, *Puridec Technologies*, supplies large cobalt-60 sources for use in industrial gamma sterilisation plants. The plants are used primarily to sterilise medical devices.

Amersham would like to congratulate Harwell on its 50 years of invaluable contribution to the nuclear field and to thank everyone in the organisation, both past and present, for the excellent relationship that exists between our organisations."
Gary Beynon, Site Manager, Harwell
Amersham International



Harwell Dosimeters Limited

"We congratulate Harwell on surviving fifty years by continuing to evolve in a rapidly-developing environment; and we wish it a successful future as a home to both large and small companies.

When AEA launched us in 1995 from the nest it had provided for so long — almost thirty years for some of us — we were clear that we should retain the name 'Harwell'. 'Harwell' had become a brand name, and in much of the world-wide radiation-processing industry which developed from Harwell's short-lived sister, the Wantage Research Laboratory, our products are known as 'The Harwells'.

To our customers, 'The Harwell' is not an institution or a village: it is a product and every pack bears the word Harwell . . . and our logo!"

Roger Bett, General Manager.

Aldfield Nursery

"Aldfield Nursery shares the anniversary celebrations this year with the Harwell site in hosting its summer Birthday fun day.

The nursery was set up six years ago by Kids Unlimited to meet the parental demand for workplace day care of the highest standard.

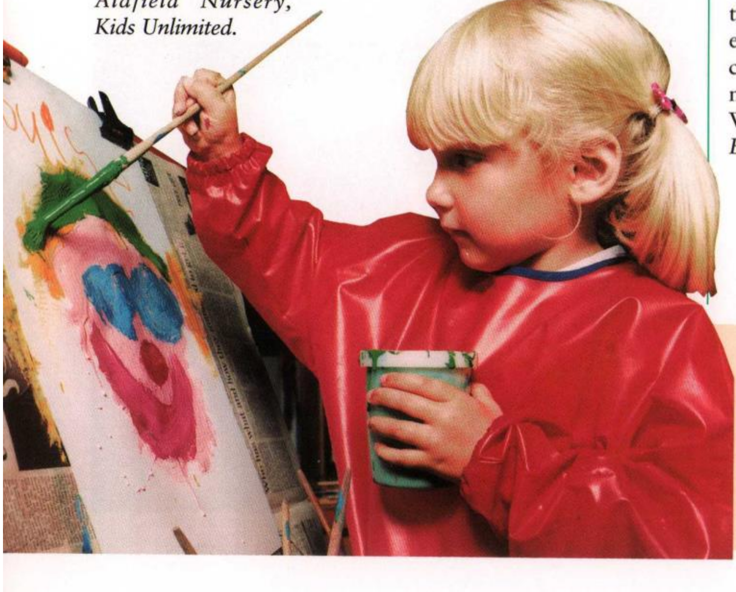
The nursery caters for babies from three months old to pre-school children in their nursery class and has continued to provide an extended homely environment. Not only does the nursery provide flexible child care between the hours of 7.30 am - 5.30 pm, but also offers a baby-sitting service, charity projects and educational visits.

This year Kids Unlimited acquired ISO 9002:1994 Quality standards recognition. We are also committed to training and Investors in people, so double celebrations are justified.

For the past six years I have managed the nursery and worked to build excellent community links with the site including visits from the fire service and Police, singing carols in the Harwell restaurant and project work involving site services.

The nursery has recently been re-decorated, many thanks to the Harwell/training/conference centre for accommodating us in a temporary home. The nursery has recently been given a garden face-lift which enhances the curriculum that we provide."

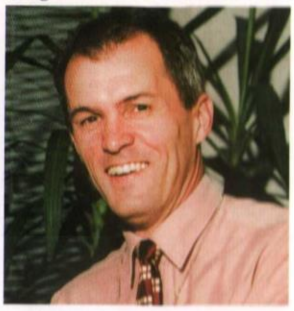
Liz Ashwin, Manager
Aldfield Nursery,
Kids Unlimited.



A message from Harwell's Head of Site

"Over the 50 years since the Atomic Energy Research Establishment began work at Harwell, I cannot believe that there has ever been a dull moment. The scientists who arrived on 1 January 1946 built GLEEP in less than 18 months and blazed a trail which has left the area with one of the highest densities of technological brainpower in the world.

Having established the scientific basis for the UK's nuclear power programme, Harwell became an engine for technology transfer diversifying into new technologies for new customers and spawning new laboratories and organisations. This has left us today with a thriving community of high technology organisations which include AEA Technology, UKAEA, Nirex, Amersham International, MRC and, our neighbours on the wider Harwell/Chilton Campus, NRPB and the Rutherford Appleton Laboratory. A number of smaller companies now add further diversity to this community.



Stephen White Head of Site, Harwell

For the future, we are committed to developing Harwell as an international centre for high technology business, building upon its reputation for excellence in science and technology. Our programme of infrastructure renewal, the demolition of redundant buildings and the upgrading of roads, footpaths, car parks and landscaping are laying the physical foundations for the next 50 years. Amenities and support services will also be matched to the changing requirements of the companies which work here. The local councils and community are backing us and we have just obtained outline planning permission for the first phase of commercial development.

We can be proud of the achievements of the past 50 years. The next 50 years are going to be just as exciting."

Stephen White

Vale of White Horse District Council

The Vale of White Horse District Council is pleased to join with everyone else in congratulating Harwell on its achievements over the last 50 years. During that time the Vale and Harwell have enjoyed a cordial and fruitful relationship. We look forward to that continuing into a new high-tech partnership which will do much to maintain and enhance prosperity and employment in the Vale of White Horse.

Bob Johnston, Chairman of Council

Researched by Nick Hance of
Corporate Communications, UKAEA.
Compiled and edited by Top of the Q Publishing 01865 864190
Designed by The Image Works (UK) Ltd 01865 721213
Photographs supplied by
the Imaging Centre of AEA Technology plc.
Published by UKAEA