NPL

NPL's History Highlights

NPL's History

Ask anyone if they have heard of the UK's National Physical Laboratory (NPL) and some may recall standard measures from their schooldays. But mostly we are immortalised as the place that tested the bouncing bomb. This is thanks to the war movie – The Dam Busters – partly filmed at NPL.

This publication highlights only some of the amazing things that have happened at NPL since opening in 1900.

If you wish to find out more about NPL we have two books, *A Century of Measurement – An illustrated history of the National Physical Laboratory and One Hundred years of photograph*s, both available for purchase.

1900 – NPL begins

On the 1st January 1900 the Royal Society appointed the first Director of NPL, Richard Tetley Glazebrook FRS.

At the end of 1900, the First Commissioner of Her Majesty's Works wrote to the president of the Royal Society that "Her Majesty, the Queen, has granted to the Commissioner of Works, by her Grace and Favour, Bushy House and Grounds for the use of the National Physical Laboratory under the direction of the Royal Society".

1902

1902 – Opening of NPL

The National Physical Laboratory was formally opened on 19 March 1902 by the Prince of Wales. The ceremony took place in a large bay of the Engineering Building.

The Prince said "I believe that in the National Physical Laboratory we have the first instance of the State taking part in scientific research. The object of the scheme is, I understand, to bring scientific knowledge to bear practically upon our everyday industrial and commercial life, to break down the barrier between theory and practice, to effect a union between science and commerce. This afternoon's ceremony is not merely a meeting of the representatives of an ancient world-renowned scientific society for the purpose of taking over a new theatre of investigation and research. Is it not more than this? Does it not show in a very practical way that the nation is beginning to realise that if its commercial supremacy is to be maintained, greater facilities must be given for furthering the application of science to commerce and industry?"

1906

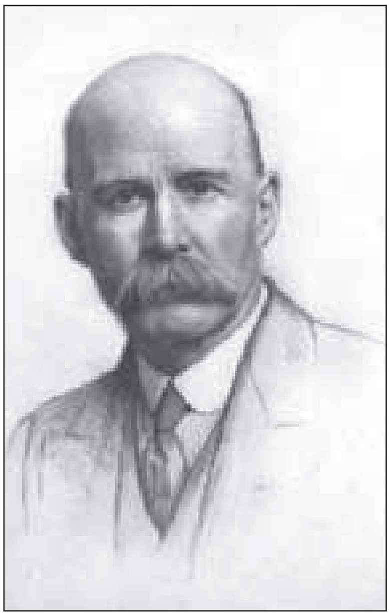
1906 – Department of Metallurgy and Metallurgical Chemistry begins

Walter Rosenhain joined NPL in 1906 and during the next 25 years held the position of Superintendent of the Department of Metallurgy and Metallurgical Chemistry. He was a brilliant investigator and gained for NPL the reputation of being one of the best equipped research laboratories in the world.

From the start it was Rosenhain's aim to undertake fundamental research with every precaution to achieve the highest possible degree of accuracy, and at the same time to meet the growing needs of industry.

1907 – NPL began testing taximeters

NPL began testing taximeters which continued for over 50 years. At its peak about 10,000 were tested each year.

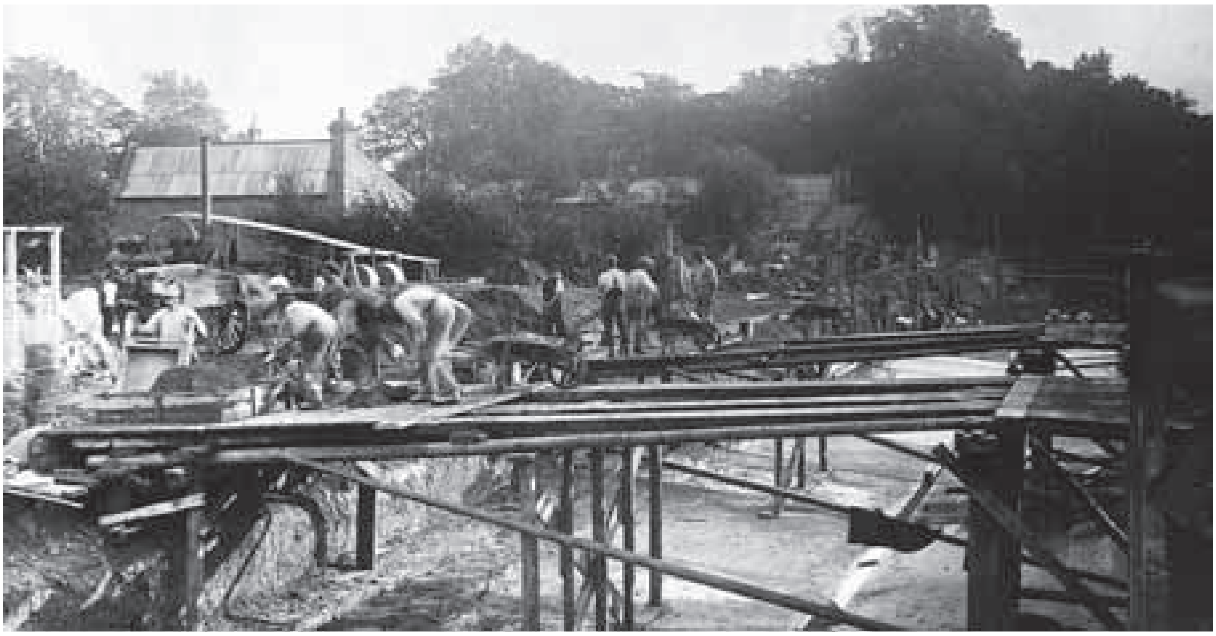


1908 – NPL begins testing on aeroplanes and airships

One of NPL's earliest areas of research after its foundation was in the magnitude and distribution of wind forces on structures such as bridges and roofs.

In 1908 these techniques were brought to the study of flight leading to rapid advances in the efficiency and safety of the aeroplane and to increased recognition of the general value of scientific research in its application to engineering problems.

Sir Thomas Stanton, Superintendent of NPL's Engineering Department was a pioneer in the science of wind tunnel testing, built at NPL in 1919.



1911 – No.1 Ship Tank opened

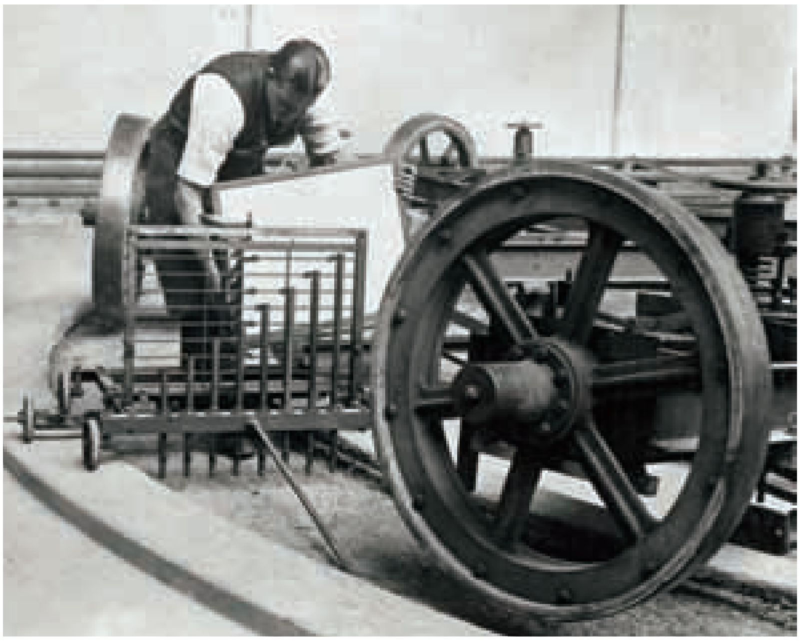
The first ship tank was completed and filled during September of 1910, and officially opened by Lord Rayleigh on 5 July 1911.

It was 150 m by 9 m wide and held 5000 tonnes of water with a centre depth of 3.75 m. It was initially known as “The National Experimental Tank”, later the “William Froude National Tank” or the “Yarrow Tank”. Later still, when the second ship tank was built, it became known simply as “No. 1 Tank”

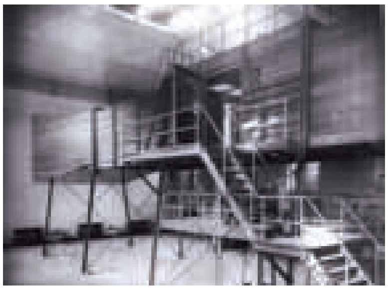
1911

1911 – NPL begins vehicle testing

From 1911 until 1933, NPL carried out various research into vehicles and transport, including: road surface testing, impact of motor vehicles, loudness of car horns, and the effect of skidding.



NPL developed a machine for testing the endurance and wear of concrete and other road surfaces. The mechanism of skidding was explored using a motor cycle and special sidecar, the wheel of which had multiple movement and braking facilities.

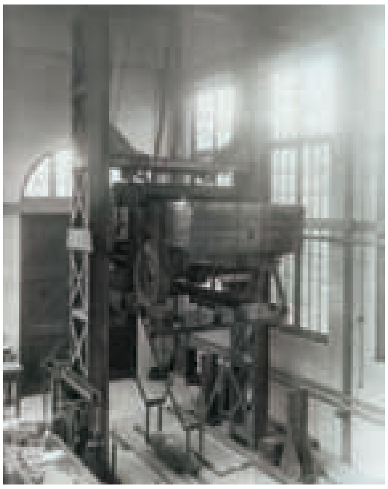


1919 - Duplex Wind Tunnel built

The Duplex wind tunnel was completed in 1919. It had a cross-section of 2 m by 4 m.

During the first world war, activity in aerodynamics expanded dramatically and NPL made major contributions to advances in theoretical and practical aspects of the stability of aeroplanes, airships, kite balloons and parachutes. Techniques had been developed for testing scale models of wings, ailerons, propellers and of complete models of aeroplanes in wind tunnels.

In 1925, the Duplex was used to test a 1/5 scale model of the Bristol Fighter aircraft, which until the Boeing 707 was the most tested aircraft of all time.



1920 – Introducing materials testing

The Engineering Department acquired many new state-of-the-art machines to test engineering materials. Properties that could be measured by 1920 included: strength, elasticity, ductility, hardness, abrasion resistance, fatigue resistance and impact resistance.

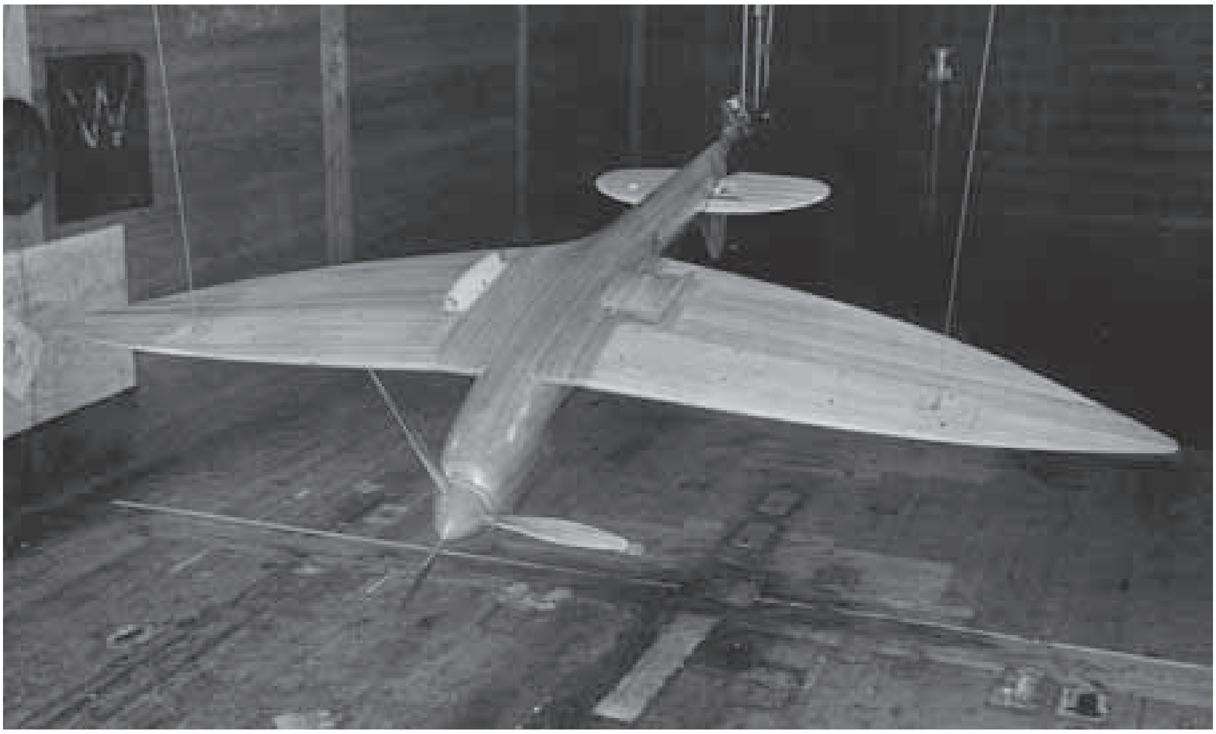
The mechanical properties of spring steels were investigated including the development of test methods for complete laminated springs fitted to lorries. The machine shown above was built to test the endurance of such springs.

By this time, routine test work amounted to around 1000 to 1500 items per year and covered a wide range: strength of materials, tests of the efficiency of engines and gears, testing of agricultural tractors and implements, of steam pipe coverings, pressure gauges, lubricants, bearing materials, chains, fans, etc.

1923 – Ventilation of the House of Commons

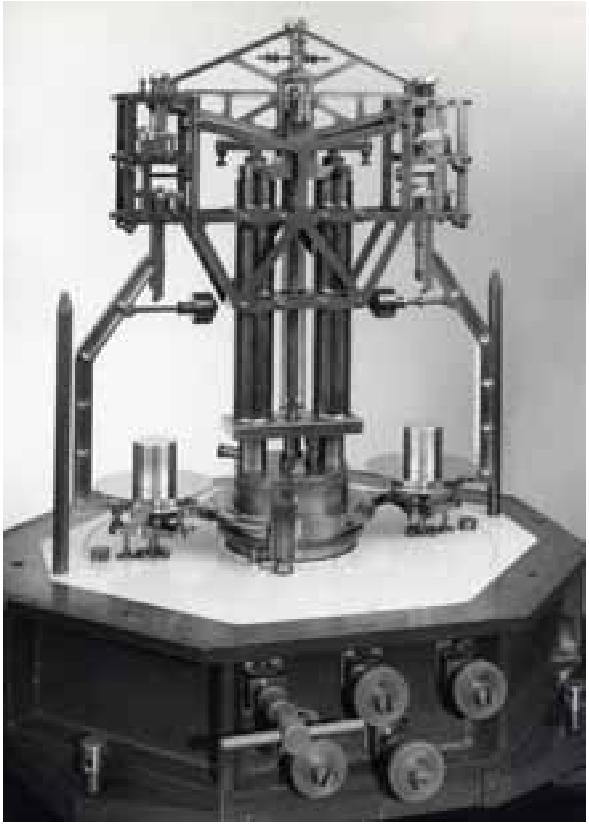
In the early 1920s the Engineering Department was asked to improve the ventilation in the debating chamber of the House of Commons.

Experiments were carried out at NPL on a 1/8 scale model and improvements recommended. The direction of air flow in the Chamber was demonstrated by observing smoke produced by a special firework.



1927 – Testing the Schneider Trophy winner

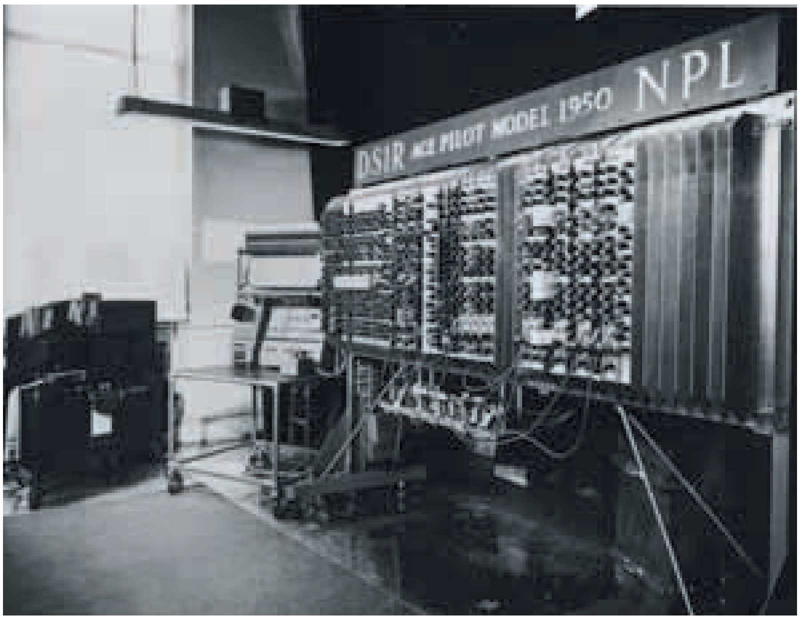
The Duplex wind tunnel ran all day and all night to resolve an instability in the Air Ministry's entry for the Schneider Trophy. The plane won the prize and then went on to retain it in 1929 and 1931. These planes were the forerunners of the later famous Spitfire.



1932 - High precision balance installed

In 1932 a new precision balance of NPL design came into service. It was installed in a closely controlled temperature environment in the basement of Bushy House, where it remains to this day.

For highest accuracy, the weights must be interchanged on the balance planes without separating the knife edges from their bearing planes. This is done by steadying the beam after determining the equilibrium position. All operations are carried out by remote control from outside the balance enclosure.



1935 – Radar is invented at NPL

In February 1935, Robert Watson-Watt presented his report titled 'The Detection of Aircraft by Radio Methods' to the newly formed committee for the scientific survey of air defence. Robert Watson-Watt was the Superintendent of a new radio department at NPL.

A trial followed using the BBC's short-wave (about 50 metres wavelength) radio transmitter at Daventry against a Heyford Bomber. The trial was a success and resulted in the design and installation of a chain of radar stations along the East and South coast of England in time for the outbreak of war in 1939.

1946 – Work began on the worlds first Automatic Computing Engine (ACE)

Work begins on the worlds first Automatic Computing Engine (ACE) with the final improved version going into service in 1958. The total cost of developing the ACE was £250,000.

Alan Turing was part of a group being formed for the design, construction and use of a large automatic computing engine. During his time at NPL, he made the first plan of the ACE and carried out a great deal of pioneering work in the design of subroutines.

It was soon used for solving partial differential equations for use in applications including the design of aircraft, ships and electronic apparatus.

1947

1947 – NPL mobile acoustical laboratory launched

The measurement of noise was greatly assisted by the arrival of a new mobile laboratory - the first of its kind in the UK. This was said to have travelled more than 4000 miles in its first six months of operation, being employed in measurements of the noise from jet-engine, test cells and investigations of noise reductions in new post-war factories.

1953

1953 - Newton's apple tree planted at NPL

The tree was presented by Sir Edward Salisbury, Director of Kew Gardens in 1953.

It is derived from a graft taken from an old tree in Newton's mother's garden in Woolsthorpe, near Grantham in Lincolnshire.

According to accounts it was the fall of an apple from this tree which suggested to Newton that the force of gravity, which made the apple fall, was also the force that kept the moon on its path.

1953 – Filming of The Dam Buster movie

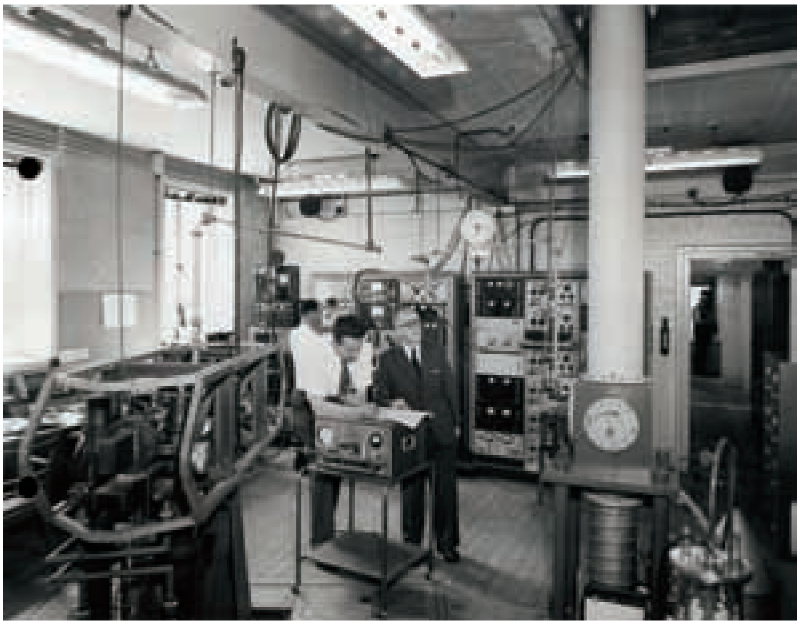
Part of The Dam Busters movie was filmed at NPL. Early tests of the bouncing bomb were undertaken at NPL in the ship tanks in 1942. The bombs were successful deployed in May 1943.

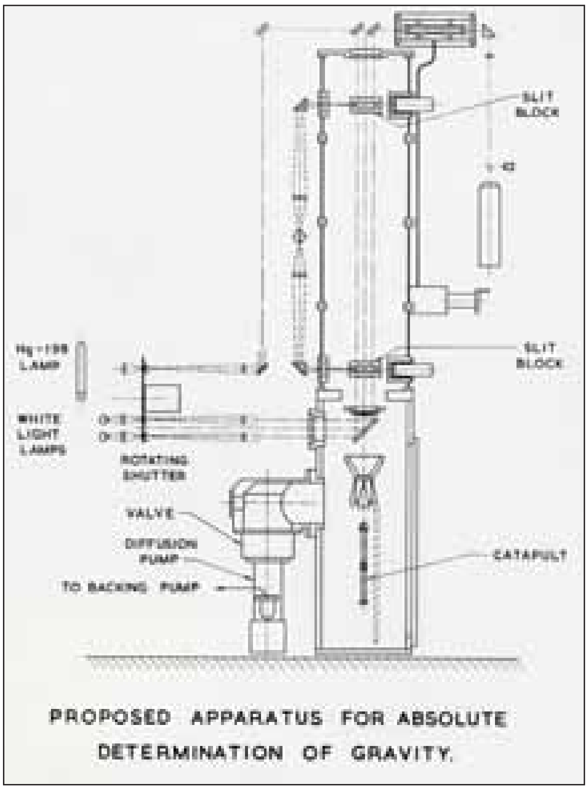
1955 – First accurate caesium atomic clock

NPL developed the first accurate caesium atomic clock in 1955, which led to the internationally agreed definition of the second being based on atomic time.

The clock was developed by Louis Essen, following a trip to America to see early versions atomic clocks, he designed and built one that delivered much greater accuracy and stability, based on the transition of the caesium-133 atom.

Successive developments of this have remained the fundamental standard up to the present day.





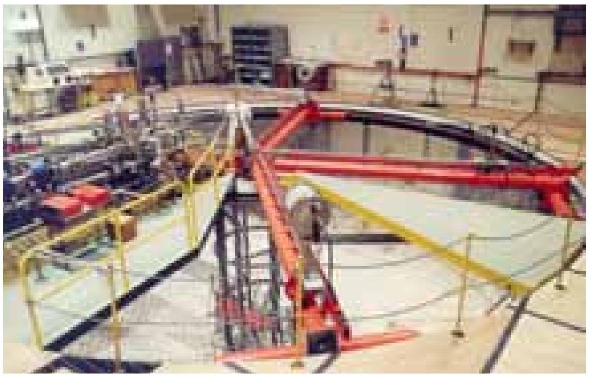
1960 - Absolute determination of g

In 1960 a new more accurate determination of acceleration due to gravity (g) was made by NPL.

A more precise knowledge of the value of the acceleration of free fall (ie the acceleration due to gravity) was demanded in various applications and the problem was attacked simultaneously by a number of scientific nations.

NPL's approach was a symmetrical free motion method, in which a glass ball was timed in upward and downward passages in a vacuum across two horizontal planes separated by a vertical distance of about a metre. The planes were defined by a pair of slits, the ball serving to focus light from one slit onto the other. Distances were measured interferometrically, and time measured by NPL's standard frequency service.

The new value for g was found to be 9.8118177 metres per second squared, lower than the previously determined figure.



1962 - 3.5 MV Van de Graaff accelerator installed

This picture shows the experimental area of the Van de Graaff accelerator facility.

The Van de Graaff is used to accelerate beams of protons or deuterons that are directed on to selected target materials on the end of an evacuated flight tube, thereby producing neutron fields by nuclear reactions. Voltages of up to 3.5 MV are generated, providing beam energies of up to 3.5 MeV (mega electron volts). A 3.5 MeV proton has a velocity of about a tenth of the velocity of light. The neutron fields, which have energies from a few keV to 20 MeV according to which nuclear reaction is utilized, are used mainly to calibrate monitors used for radiological protection.

1964 – Colour standards adopted

In 1964 the International Commission on Illumination published is data on standard observers, which is the basis of all colour measurements, still in use today. Dr Walter Stiles undertook this work at NPL.

1966 – Packet-switching developed at NPL

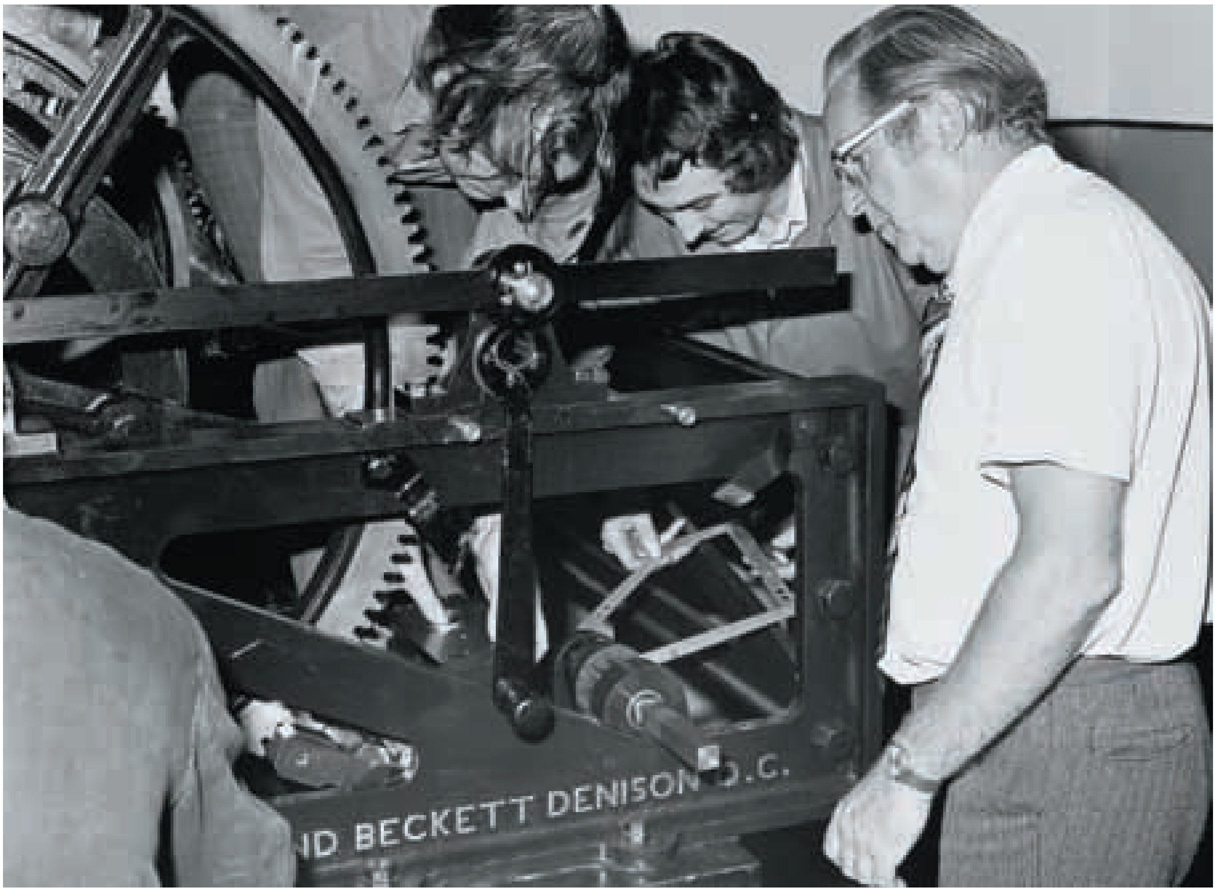
NPL begins development of a technique for transmitting long messages of data by splitting them into chucks and temporarily storing them at computer nodes, and still form the basis of the worldwide complex of computer communications systems today.

The technique, called packet-switching, was developed by Donald Davies. The first practical networks using packet-switching were introduced to the NPL local network, by the early 1970s this was providing a range of on-line services to some 200 users. This demonstration provided a much needed steer to the development of the Arpanet, which would evolve into the Internet we know today.

1974 - Laser wavelength measurement

Lasers are now used in many branches of modern metrology.

At NPL the metre is realised through the wavelength of the 633 nm radiation from an iodine-stabilised helium neon laser. Mechanical actions, for example the movement of a balance, are often measured using a technique called laser interferometry.



1976 – Fail-safe brakes for Big Ben

NPL designed and fitted fail-safe brakes for the chiming mechanism of Big Ben.

A dramatic example of NPL service to the community happened in 1976, when the chiming mechanism of the Great Clock of the Palace of Westminster (Big Ben) disintegrated after almost continuous service since 1854.

The shaft of the fly-governor failed, the driving weights fell 50m to ground level and so accelerated the chiming mechanism.

NPL identified the cause of the failure and designed a fail-safe device for the quarter-chiming mechanism to prevent similar disasters in future.

1979 – NPL weighs Concorde

NPL took on the challenge of weighing Concorde to enable it to pass air safety certificates before going into public service.

1984 – Environmental measurement

NPL's mobile laboratories for environmental testing take to the road in 1984.

In the early 1980s, NPL developed mobile laboratories capable of remote, range-resolved or integrated-path measurements of a wide range of trace gases at distances of up to several kilometers.

1987 - Cryogenic radiometer

In the 1980s, NPL developed the first cryogenic radiometer.

This was the best experimental realisation of the Stefan Boltzmann constant and remains the accepted experimental value to this day.

1989 - NPL colour standards receive Queens Award for Technological Achievement

The Ceramic Colour Standards were first produced in 1969 in collaboration with industry, trade associations and academic partners to check instrumental accuracy of colour measuring instruments.

By 1983 over 1,000 sets had been issued worldwide and improvements to the standard results in the Queens Award in 1989.

1992 – 1.2MN deadweight force testing machine

In 1992, the 1.2 MN deadweight force standard machine was installed at NPL.

One of the largest such machines in the world, the 1.2 MN deadweight force standard machine replaced the old 500 KN machine in 1992. NPL's facilities were significantly improved by its larger capacity, ability to perform hysteresis testing, and uncertainty of applied force of only +/- 0.001 %

Features of this machine include its 55 stainless steel weights, split scalepan, and the ability to be computer controlled.

The photograph shows only the very top of the machine - it is more than 3 stories high (not including its foundations).

1995 – Paul Vigoureux produces his last NPL Report

Paul Vigoureux joined NPL joined the Electricity Division of NPL in 1925. His scientific career, at NPL and with the Admiralty Scientific Service spanned seven decades.

It was his contributions to the units of magnetism and electricity that are most notable, particularly to the shape and introduction of the International System of Units: the SI units. Vigoureux, through his work, helped greatly the process of reaching agreement as to what the SI should be, both in the decisions and in translating key documents between French and English.

1998 – Work starts on NPL's new laboratory

In 1998 the foundations are laid for the world's largest and most sophisticated measurement facility. Almost 100 years of sporadic growth and demolitions have resulted in a mixture of buildings spread over much of NPL's existing 82 acre site. The new scheme is an opportunity to consolidate the laboratory and provide more up-to-date, efficient facilities whilst greatly improving the setting of the laboratory.

2000

2000 – NPL starts biotechnology research

Responding the changing demands on measurement, NPL opens a new biotechnology laboratory to support measurement challenges experienced in the biomedical and pharmaceutical industries.

2000 – Europe's largest underwater Acoustics Pressure Vessel arrives at NPL

A facility of strategic importance at the National Physical Laboratory provides vital measurements demanded by manufacturers and designers of sonar equipment used in the oil and gas, oceanographic and defence industries. The facility also strengthens fields as diverse as the identification of fish stocks, seismic measurements and the location of buried artefacts under the seabed.

The purpose-built unit is the only such commercially available testing facility in Europe. It can simulate sea conditions at depths of up to 700 m and at temperatures of between 2 °C and 35 °C. Previously, trials and acceptance tests had to be undertaken in the USA or involved expensive sea trials.

2002 – NPL helps Formula One racing

NPL provides materials expertise to the Federation Internationale de L'Automobile (FIA) to ensure teams respect the rules of F1 racing without compromising the safety and competitiveness of the sport.

2004 – New method for measuring time developed

NPL announces results for a new technique to measure time using optical frequency, which could provide a ten-fold improvement in time measurement accuracy.

The technique involves freezing single strontium atom to about -273 °C by bombarding it with billions of tiny packages of light. The atom then moves precisely between two energy states, like the ticking of a clock. A laser beam is then locked onto this 'ticking', which provides an optical frequency which the scientists can measure.

2007 – NPL time signal moves

The antenna that broadcasts the time throughout the UK on the behalf of NPL is moved from Rugby to Cumbria in a change of contract.