



Stafford Ellis Inventor and Engineer

By

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Stafford Ellis

Stafford Malcolm Ellis, known as 'Staff' was a most prolific and versatile engineer draughtsman and inventor. He progressed through mechanical design, hydraulics and finally optics. The technologies have a lot in common in the way he can visualise cause and effect with a few deft strokes of his pencil. Staff was capable of visualising a product in 3D. With his deep knowledge of products and operation he was a visionary. He is in fact credited with ten major inventions and more than fifty patents are in his name. He preached design throughout the 14,000 strong company and his text was '*All design is a compromise*'.

Staff was born in Melbourne Australia on 12th April 1917 and was educated at South Melbourne Technical College

He came to England in 1938 from Australia and worked for various companies such as Commonwealth Aircraft Corporation (The Commonwealth Aircraft Corporation (CAC) was an Australian aircraft manufacturer. The CAC was established in 1936, to provide Australia with the capability to produce military aircraft and engines.) and Napier (Aero Engines) before settling with Handley Page.

He was involved in aircraft design during the war including the installation of Hercules engines in the Halifax Bomber. (The Halifax suffered from a lack of power from its Merlins which adversely affected its bomb-carrying capability at higher altitudes and a restriction preventing Halifax's attacking more hazardous targets was imposed in September 1943 until improvements had been made. The B.III version was fitted with Bristol Hercules radial engines which allowed an increase in altitude of some 2,000ft and the restriction on targets was lifted in February 1944.)

It was at Handley Page that he met his wife, Thelma, who worked in the Drawing Office.

In 1946 he worked for the AJS Motorbike Co. where he designed a unique box frame. He found that hydraulic valves were expensive and developed a zero-lap valve built as a series of sleeves. This company was absorbed into the Amalgamated Motor Cycles (AMC) group around 1937 and Staff worked on the AJS 7R 350cc 'Boy Racer' which was produced post war. This motorcycle won the British and European Championships. Staff admitted that he had had no interest in and knew nothing about motorcycles, but they needed a Mechanical Designer to design an engine which would give the level of power required to outclass Nortorn and Velocette.

He joined GEC's predecessor Elliott Brothers at Borehamwood in 1949 to 'get away from aircraft'. It was at this time that he met with Jack Pateman and Elliott Brothers was establishing a small team to break into aircraft automation. His first design work was on the autopilot for the Lightning, the

world's first supersonic fighter. When Elliott Automation set up an Aviation Division, he naturally joined that group as Chief Designer. Together with Jack Pateman he patented an integrated power control system for the English Electric Lightning. He was also responsible for the design of the prototype autostabiliser hydraulic actuation equipment for the Lightning.

Through 1950 to 1955 he was involved in the design of the early TRIDAC 3D analogue computer which used multiplying servos. This was designed in conjunction with the RAE and used for missile simulation particularly on the Blue Streak programme. He also designed the GPI 6 analogue Navigation computer.

In 1955 Staff led the mechanical design team on the V Bomber Master Reference Gyro and he did much development of gyro systems.

His extensive engineering skills were challenged by designing much of the Blue Steel inertial guidance platform. Blue Steel was a Mach 3 cruise missile deployed in the 1960s, carried and launched by V-bombers with a standoff range of 100 nm. It was conceived by the RAE and designed by AVRO. Elliotts designed and manufactured the inertial platform; this had to fit in the space behind the warhead so there was no choice on the available volume.

He went on to design the benchmark E3 platform series as well as the E5. The basic mechanical configuration chosen was a novel 'inside-out' gimbaling system with separate azimuth axes for the individual gyros and accelerometers coupled by a unique 'boomerang' linkage mechanism. The design owes much too to RPG 'Dick' Collinson. This series of inertial platform has seen service in aircraft (such as Jaguar NAVWASS and Nimrod), missiles and torpedoes. His skill in packaging was evident again in the way he managed to fit three Kearfott gyros into the platform

In the early 1960's he worked in the Elliott Flight Automation Research Laboratory and was Divisional Manager from 1966 to 1969 preceding John Bussell. Staff spent most of his time and energy assisting Airborne Display Division on the 'ILAAS' Head Up Display programme. This development project eventually led to the Company winning the A-7 Corsair HUD programme.

Staff was a first-class mechanical designer and during this period his design interest in hydraulic actuation extended to develop single axis hydraulic flight control systems and eventually multiplex failure survival systems. The basic mechanical concept of the Quadruplex Actuator originated from Staff and in 1965 he designed a more compact version which culminated in the quadruplex fly-by-wire actuator adopted in 1970 for the Tornado flight control system.

It was in this era that Staff Ellis collaborated with Markowski on the design of 'vertical tape' aircraft instruments following the US fashion which was a feature of the OR946 requirement. Elliotts made a

range of these but the principle proved to be wrong and they were not as good as round instruments dynamically. Only one of the Elliott units remained in service, the TAS/Height; this was used on Buccaneer and possibly on a navigation system for a transport aircraft.

Staff worked on a mechanical computer for the Navy (ship-borne, deck-mounted radar). The housing/turret was built by Lanarkshire Welding Co. to hold the dish made by Elliotts. During testing in the yard at Boreham Wood, Joe Lubbock climbed onto the top of the housing to get an accurate fix on a radio mast about 2-3 miles away. The next test was carried out in a similar fashion, but much to Staff's frustration, Joe could not repeat the fix – when he looked, the radio mast had been dismantled and was no longer available!

There is another story of the Astro Reference Unit which was commissioned by RAE at Farnborough: to line up a star with a standard spotting scope, 1 inch in diameter. During testing at night on the roof at Elliotts, a technical hitch was resolved by using a matchstick – several types were tried, but only Swan Vestas worked. Staff was faced with the problem that this solution could not be included in the Specification.

Staff was involved in some of the equipment that Elliotts designed for Concorde in the 60's. There were many discussions about the shape of the central knob on the Flight System Control Panel. Staff came up with the solution by squeezing a lump of 'Plasticene' in his hand, telling the Model Shop to "*make one like this*".

It was probably around this time that he designed the bellows assembly used in the Pitot-Static Capsule Unit, the basis of all the Elliott electro-mechanical Air Data Units. The story is that he was in the Gents toilets at the 'Flying School' with Vic Shelley from the Model Shop and he sketched the design on the painted wall above the urinals. Vic had to keep coming back to properly copy the design!

At some time in his career at Elliotts he shared a house called 'Lamorna' with Ron Howard, Glyn Thomas, Dick Collinson and Peter Kaye.

He showed his breadth of design by his work on optical systems. In 1965 he turned his attention to the design of optical mechanical aspects of Head Up Displays. He has been involved in two of the company's biggest HUD export runs, first for the Vought A-7 Corsair and then for the F-16A/B and C/D fighters. He played a major role in designing aspects of the A-7 optical system particularly the split standby sight.

Staff designed the LANTIRN optical system building on the concepts developed in the company research centre. This revolutionary design was compact and highly producible and because of this the company won the contract with some 900 units manufactured. His design was exhibited at the Design Centre.

In 1973 he had designed the v slit camera tracker system for use with Helmet Mounted Displays. The miniature Mono HUD used in helicopters is one of his designs.

In 1974 he designed the LED Helmet Mounted Sight which was used in the Point Magu trials with John Campbell in 1976.

His other work involves designing the Cats Eyes night vision goggles. This design was a runner up in the Prince of Wales award. His facility with optical design enabled him to turn the ideas of Farnborough's scientists for integrated night vision and attack into the GEC system evaluated by the US marines at the Naval Weapons Centre in California. In Sept 1984 he showed at the Farnborough Air Show an integrated night vision system for aircraft, combining thermal imaging, the head up display and wide-angle night vision goggles. Many of his patents are for HUD designs, NVG, Helmet systems and integrated HUD and HDD. He even has a patent for a supermarket trolley! In a totally different area, he designed a fly-by-light control system which was incorporated in the Airship Industries airship.

He left in FARL in 1970 to join Joe Harmady (Harlady?) who was a colleague of Alf Harrison and worked in the Drawing Office. It seems that Staff was appointed Quality Control Manager in about 1974 but when he felt he had solved the main problem he became bored. Staff was often heard to complain that "there are not enough problems to solve". He then left to set upon his own to design machines for cutting grooves in roads and runways. Staff was commissioned to design a machine which would cut grooves in the surface of the Los Angeles Freeways to allow surface water to disperse. This machine was manufactured and put into service.

Marconi then employed him as a consultant from about 1976 onwards. He did a lot of work with Colin Marshall.

He was awarded the MBE in 1984 for services to export. He was quoted 'I was pleased about the honour, but I thought at my age, after all I'm 67; I wasn't in line for such accolades. It does show designers have a chance! My wife, Thelma, will enjoy going up to collect it and see the grounds of Buckingham Palace'.

On the 1st May that year he was awarded the prestigious Lord Nelson Medal of GEC. The medal was introduced by GEC's former Chairman when he retired, as a distinction for engineers, scientists and technicians throughout GEC whose individual performance has shown outstanding technical merit and who are continuing to do highly creative work.

In July 1984 the first presentation ceremony took place at Goldsmiths' Hall in London, when Staff and four other GEC people received their medals from Lord Nelson. This occasion was the latest formal highlight in Staff's career with the company and provided an opportunity for a review of the many contributions made by him - his role has been quoted elsewhere as a "wholly owned subsidiary of Jack Pateman".

His job involves taking the initial concept and making it practical — for example, making a Head Up Display fit a given aircraft. Staff led the teams designing installations for a wide range of aircraft. Staff was involved with the Phoenix programme and worked on the Pod.

His activity during 40 years in the UK Aerospace Industry has resulted in many patents and has significantly influenced the product line of the Company. It is estimated that at one time he had in aircraft service throughout the world more than 10 distinct designs of equipment in 20 aircraft types covering electromechanical units, including, in addition to the above mentioned, air data system sensors, mass flowmeters and many ancillary devices.

Staff left the company in 1989 and died on 22nd March 2002.

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* AJS had been bought by Matchless's owners, the Colliers, in 1931 and Sunbeam was added in 1937 from Imperial Chemical Industries.^[1] The name of the Matchless Motor Cycles company was changed to "Amalgamated Motor Cycles Ltd" in 1937 and "Associated Motor Cycles (AMC)" in 1938. AMC was not a manufacturer in its own right, but rather the parent company of a group of motorcycle manufacturers which included Matchless, AJS, Norton, James, Francis-Barnett, Sunbeam and others.



Stafford Ellis in 1967