

WAVECRAFT: DESTINATION NORWAY

On a misty morning in November 1957 a small furniture van left Bristol, heading north. In the passenger seat was William 'Bunny' Warren, a former RAF radar technician who had dismantled, packed and secured the half-ton of kit the van carried. Known affectionately as 'Topsy', in the pre-digital 1950s that 'kit' was the most advanced brain investigation tool on the planet.

They followed a sedan, maybe a Humber, or Rover, in any event the sort of solid respectable car a senior hospital consultant would drive. Duggie Phillips was a brain surgeon, still a fairly rare bird in the newish National Health Service. Next to him was Harry Crow, an ironmonger's son from Aberdeen. After a war spent navigating Mosquito bombers over occupied Europe Harry had returned to his hometown to recover, play rugby, and train as a doctor. Once qualified, he travelled south again, to London then Bristol, pursuing an interest in the brain.

In back were the boffins: Grey Walter and Ray Cooper. Grey was public school and Cambridge, a physiologist whose hobbies included cybernetics, robotics and writing science fiction; the only member of the group with a YouTube clip to his name. It concerns a small self-steering robotic tortoise that featured in the 1951 Festival of Britain. Ray Cooper was grammar school and Manchester; a draper's son from Lancashire who never lost his accent, Ray graduated in physics at 19 and came to brain research via RAF radar and a PhD in astronomical optics. His snapshot and brief account will be the only enduring record of their trip.



Oslo, November 1957. Left to right: Harry Crow, Grey Walter, Duggie Phillips, Bunny Warren (courtesy of Ray Cooper, who took the photograph)

Their destination was RAF Fairford, in the heart of rural Gloucestershire, and as they near the security barrier my mind's eye shifts into '50s film noir. The car and van emerge from the mist, to be halted by an armed US soldier. 'RAF' Fairford had been leased to the US Air Force since 1950. They extended the runway making it the longest in Europe and able to take the largest Cold War bombers. Their silver bulk looms as the convoy clears security and makes its way to more modest transport: a US Air Force C47 Skytrain, the World War II Dakota. It would not be a comfortable ride. Cruising at only 160 mph their flight to Norway would take five hours, and a blanket of fog over Oslo make for an anxious landing.

They came from the Burden Neurological Institute*, a private research establishment on the outskirts of Bristol. Why was the US Air Force acting as taxi service for five UK brain scientists; how did a psychiatric hospital in Norway, then one of Europe's poorer countries, come to host one of the world's most advanced neuroscience laboratories? This essay addresses those questions.

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On 4th October 1957, a month before the Oslo trip, the Soviet R7 rocket successfully put an object into orbit around the earth. 'Sputnik' weighed as much as a small fridge and emitted a simple electronic 'beep' as it passed over the United States of America, four times a day. The following month the attempted to put their satellite into orbit. The rocket failed to clear the launch pad. In response Edward Teller, the father of the American atom bomb, went on national television and announced that the USA had lost a battle more important than Pearl Harbour: If the Soviets could put an object that size into orbit they could project a warhead between continents.

Earlier that year President Eisenhower had commissioned a US Senator to draw up a report on "Defence and Survival in the Nuclear Age". The 'Gaither Report', delivered on 7th November 1957, was leaked to the Washington Post. It recommended a major investment in missiles and shelters. "Only through an all out effort...can the US hope to close the current missile gap to counter the world wide Communist offensive in many fields and many lands". Missiles and shelters were only part of the response. Cold War paranoia, fuelled by Sputnik and the report, led to a funding windfall that spread to many fields, including, remarkably, neuroscience.

* For an account of the origin of 'the Burden', see the Appendix.

In fact the military had been looking over the shoulders of brain scientists since the late 1940s, and in that field also the Soviets seemed ahead of the game. Ivan Pavlov was the leading experimental psychologist of the first half the 20th century. Mid century the best-known neuropsychologist was another Russian, A.R.Luria. He learned his trade studying the brain-injured veterans, who were plentiful in the Soviet Union.

Understanding and controlling the brain became a major concern of the military and intelligence communities in the West during the Korean War. The sight of American soldiers denouncing their government and way of life only days after capture was truly shocking and could only be explained, so went the thinking, by some form of mind control. "Brainwashing" was the term coined by a C.I.A. operative, and picked up by the popular press.

Thereafter, the military, and particularly the C.I.A. funded experiments on a wide range of subjects thought relevant to mind-control. Some, such as the work of Jose Delgado at Yale, was funded openly, and the results published in military journals. Delgado wanted to control behaviour by electrical stimulation of areas deep inside the brain, through inserted electrodes. It was Delgado who, famously, stopped, or at least diverted, a charging bull via electrodes inserted deep in the creature's brain and activated by a radio signal. In Delgado's vision of the 'brave new world' violent criminals, paedophiles and other 'undesirables' would be similarly 'psychocivilised'.

The C.I.A. favoured covert funding. Between 1955 and 1961 over 800 studies were carried out in more than 300 institutions as part of their MKULTRA programme. They included the use hypnosis and techniques used by magicians, but it was their study of LSD in interrogation that brought the programme to public attention. An employee jumped out of a high hotel window whilst 'tripping' in work time and his family looked for an explanation. When a Senate Committee sought information on this work in the mid 1970s they found no operational records. Richard Helms, the head of the C.I.A. from 1966 to 73, had ordered them destroyed before he left office. It was later found that he forgot to bin the accounts and his successor, Richard Colby was more open in his approach.

Another area of interest to the military was 'conditioning', the linking of stimulus and response much studied by Pavlov. In Richard Condon's 1959 novel 'The Manchurian Candidate' a 'brainwashed' Korean War veteran is conditioned to assassinate the president in response to a particular stimulus (a playing card) as part of a Communist plot to take over the US. The novel was made into a successful film starring Frank Sinatra, and released in

October 1962 during the Cuban missile crisis. A year later, when the president really was assassinated, Sinatra insisted the film be withdrawn from distribution. It was re-made in 2004, updated to Desert Storm, 'Manchurian' now referring to a multinational company with similar ambitions, and devices implanted in the brain as the agent of control.

In an unpublished memoir, written in the 1970s, Grey Walter describes how the Burden Neurological Institute became involved with the military:

My experience with supervision (private teaching) in Cambridge had established several 'professional' friendships with young men...One of my pupils had been a young American reading Medicine; we had swapped yarns about the states as well as discussing his essays. One morning I was sitting, wondering how the Institute would make ends meet, when he put his head around the door and said "Hi Grey!". He was in USAF uniform, a colonel, and told me he was head of the U.S. Air Force Research Centre in Brussels. Did I want any money?.

Ray Cooper elaborated in his later book on the Burden:

Experiments in conditioning had been done at the Institute since the beginning and much time had been spent in the middle and late 1950s (with the aid of the Air Research and Development Command of the US Air Force) looking with Topsy at the events in the brain that occur when a person uses one stimulus (S1) to prepare for action on receipt of a second stimulus (S2) a short time later.

Although Walter attributes his good fortune, in attracting US military funding, to a long-standing personal relationship, there was another reason why he would have been attractive to the military. After gaining a first in physiology at Cambridge he stayed on, carrying out research he hoped would lead to a fellowship. But after two years his project ran into problems and so he was offered a short-term research attachment. I.R. Rozental, one of Pavlov's associates in Leningrad, was visiting Cambridge carrying out a project supervised by his master, on the effect of drugs on conditioning in dogs. For several months Walter became his assistant and in a letter to Pavlov Rozental expressed his hopes for his new pupil:

'Barcroft found a very capable and knowledgeable young man named Walter for 'processing'. It looks like he has an interest in conditioned reflexes... if he will commit and throw himself into our cause then the future of the conditioned reflex is guaranteed. I am trying to enthuse him.'
(Letter dated March 1935, From the Pavlov Archive Leningrad, courtesy of Phil Husband)

At a time when the US military sought to understand all aspects of conditioning Walter's experience was unusual and of interest as they strove to catch up in a field that seemed key to communist brainwashing

techniques. In any event it seems likely Walter made the most of the experience. The flight to Oslo was part the resulting funding windfall. Incidentally, there is no record of the military projects undertaken in that decade in the Burden archive held by the Science Museum.

The Bristol group travelled at the invitation of Dr Carl Sem-Jacobsen, a Norwegian physician and brain scientist formerly based in the US. He had worked in a programme at the Mayo clinic that involved inserting electrodes deep into the brain and leaving them in place for weeks and months. Such electrodes could be used to electrically stimulate targeted brain areas, or at higher voltage, coagulate brain tissue. Electrophysiological recordings could also be taken. Patients with epilepsy and psychiatric disorders were the main groups investigated and treated and the last paper Sem-Jacobsen published before leaving the States was an account of 'depth electrode' studies of 93 psychotic patients. Most, if not all of those 'subjects' would have been long-term residents of psychiatric hospitals, many incapable of giving informed consent. By current standards such work seems jaw-droppingly unethical, but in the 1950s few would bat an eyelid. The paper was presented in the author's absence at a Scandinavian psychiatric congress and followed by comments from Ørnulf Ødegård, one of Norway's most senior psychiatrists and the long-serving superintendent of Gaustad Hospital, Oslo. After the paper had been delivered he comments that the work 'may mark an entirely new era in psychosurgery' and goes on to express the hope that Sem-Jacobsen would 'continue these experiments on his return to Norway'. The following year he provided facilities in his hospital, and on-going US funding was promised. The low level of medical litigation in Norway, compared to the US, made the country especially appealing.

Sem-Jacobsen had extended the invitation to Walter and his team when they met at a conference. The group included Walter, a physiologist, a physicist, electronics technician, neuropsychiatrist and neurosurgeon. Their aim was to learn the technique of electrode insertion, deep brain recording and coagulation and begin their own series back in Bristol.

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In the middle years of the last century damaging the front of the brain as a way of treating mental illness, 'leucotomy', became popular in many countries, but Norway's experience of the operation deserves particular comment. Before off shore oil was discovered and extracted in the 1960s Norway was one of Europe's poorer countries, particularly after the German occupation in World War 2. Brain surgery of any type was expensive and in short supply. When the low cost 'transorbital approach'

was developed by Walter Freeman in the US Ødegår at Gaustad became one of its most enthusiastic proponents. In consequence, by 1957 several hundred patients had undergone the procedure in his hospital. In all about 2,500 patients in Norway received leucotomies of one sort or another before the fashion for leucotomy began to die off in 1960s.

The approach Ødegår supported took 10 minutes, and didn't require an operating theatre or specialist neurosurgeon. A pulse of electricity, powerful enough to cause an epileptic fit, was applied to the scalp and rendered the patient insensible. An upper eyelid was then raised and a sterile steel spike hammered through the roof of the eye socket to a depth of about 2 inches. It was then waggled from side to side, removed and the 'operation' repeated on the other side. In Norway this was carried out by any available surgeon and sometimes by psychiatrists. In the most careful hands the mortality from leucotomy was around 3%. In Norway 18 of the first 35 women operated on in this way died.

In 1996 the Norwegian government issued a public apology to everyone who had been "leucotomised" in state hospitals and on 20th August that year allocated Kr100,000 in compensation to each survivor. In 2001, following allegations made in the newspaper Dagblat and a TV documentary, the Norwegian government appointed a commission "to investigate medical research with LSD, electrodes and radioactive rays in a vulnerable group of people without their consent". Carl Sem-Jacobsen's work, at Gaustad, and that of others funded by the US, formed part of that investigation.

The media suggested, correctly as it turned out, that the US funded such research in Norway because they could get away with things that would have led to litigation at home. They also suggested that Sem-Jacobsen had particularly close links with the CIA, and was even a friend of William Colby, C.I.A. station head in Sweden in the early 1950s and C.I.A director from 1973-76. On the face of it the story looked promising.

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Carl Sem-Jacobsen was awarded his medical degree in Oslo in 1941, the second year of German occupation. He was born and raised in the north of Norway, the son of an early aviator. On qualification he returned to the North to work as a doctor for a mining company and became an active member of Milorg, the Norwegian resistance movement. Milorg carried out intelligence gathering and sabotage, in collaboration with the UK's Special Operations Executive, and also aided Norwegians who wished to escape to

'neutral' Sweden. Over 40,000 of his countrymen made that trip during the war. In January 1945 Sem-Jacobsen was forced to join them, his activities having been uncovered by the Gestapo.

He made his way to one of the refugee camps operated by the Swedish government, and took on the role of medical officer. American Special Forces (the fore-runner of the CIA) were active in Sweden, and particularly in those camps, gathering intelligence on occupied Norway. Sem-Jacobsen, as a member of Milorg, would have been of great interest.

William Colby was a law student when the US joined the war. He volunteered for Special Forces, soldiers dropped behind enemy lines to work with resistance movements and was chosen for his first mission, in occupied France in 1944, because he could speak French. Parachuted into France after D-Day he joined up with the French resistance and helped coordinate sabotage. He was chosen for his second mission because he could ski. The plan was to parachute into Northern Norway, at the beginning of 1945, along with 10 exiled Norwegians and meet up with Milorg. He would then assist with the destruction of rail links with the far North.

Finland was an ally of Germany during World War 2. When the Soviet Union invaded in force in 1944 over 100,000 German personnel escaped North to Finnmark, the most northerly Norwegian province. They then travelled south with the aim of reinforcing resistance to the allied advance in France, hence the importance of breaking the rail link. As a member of the resistance Sem-Jacobsen might well have encountered Colby, had his mission not been delayed by bad weather. In the end it was April before Colby and his men parachuted in, three months after Sem-Jacobsen flight to Sweden.

Despite Sweden's professed neutrality there was much sympathy for their neighbour, and contact with the Norwegian Government in exile. Through that link they agreed to train 'police troops' to cope with the immediate post-war period. Police troops were trained with weapons in secret camps and in 1945 assisted in the liberation of Finnmark and later in the rounding up of collaborators. Carl Sem-Jacobsen also worked in those camps and at the end of the war moved back into Finnmark, and continued working with former refugees. In 1950 he moved to the United States and secured a research post at the Mayo clinic in Rochester, Minnesota. He was trained in the use of EEG, the technique for recording the electrical activity of the brain from the scalp, but also became part of a pioneering research programme.

The Mayo Clinic was and is one of the USA's foremost centres of medical excellence. It is difficult to see how a fresh Norwegian émigré with no neuroscience background would secure such a post, and not unreasonable to suggest that his work with the US Special Forces may have opened doors.

The programme in which he worked involved drilling holes into the skull and inserting electrodes deep into the brain, initially in people with epilepsy. The aim was to find precise areas of abnormality, electrically overactive or unstable, that might be put out of action by coagulation. That work was soon extended to include psychiatric patients. In the 1956 paper the summarized that work it is clear that he hoped to find similar abnormalities in people with psychiatric illness. From the mid 19th century many doctors overseeing mental hospitals believed that when sensitive enough tools became available, brain abnormalities would be found in people with the common and disabling mental illnesses, and some were. In 1892 Arnold Pick, a Prague psychiatrist, identified a form of dementia associated with a particular abnormality of brain cells. In 1911 Alois Alzheimer in Munich described another. In 1905 Shaudinn and Hoffman in Berlin discovered the bacteria that causes syphilis (*Treponema Pallidum*). The later stages of that disease were referred to as 'general paralysis of the insane' (G.P.I) and many infected people ended their life in an asylum.

But the brains of most mentally ill patients, including those with schizophrenia and manic-depressive illness, to the naked eye and under the microscope, appeared normal. When the EEG was developed as a clinical test in the 1930s and 40s it was greeted enthusiastically by psychiatrists. It involved recording electrical signals originating from the brain from electrodes stuck to the scalp. They believed that this more dynamic test would at last reveal physical differences in the brains of people with severe mental illness. By the mid-1950s, none had been found. The work of Sem-Jacobsen at the Mayo clinic took that electrophysiological search deep into the brain, and, judging by his 1956 paper, it is clear he thought he was onto something.

Inside the frontal lobes he found small areas that produced waves of electrical pulsation slower than the surrounding brain. Viewing them as a source of abnormal 'traffic' within the brain his surgical colleagues destroyed them. The people to whom this was done are described as 'rather difficult, un-co-operative and incoherent active patients in great need of care', and judged mostly improved by the operation. He goes on to describe yet another electrical change that seemed to occur when patients

seemed to be hallucinating. One, for example, 'argued rather loudly with President Eisenhower' as seemingly aberrant waves appeared deep in their brain.

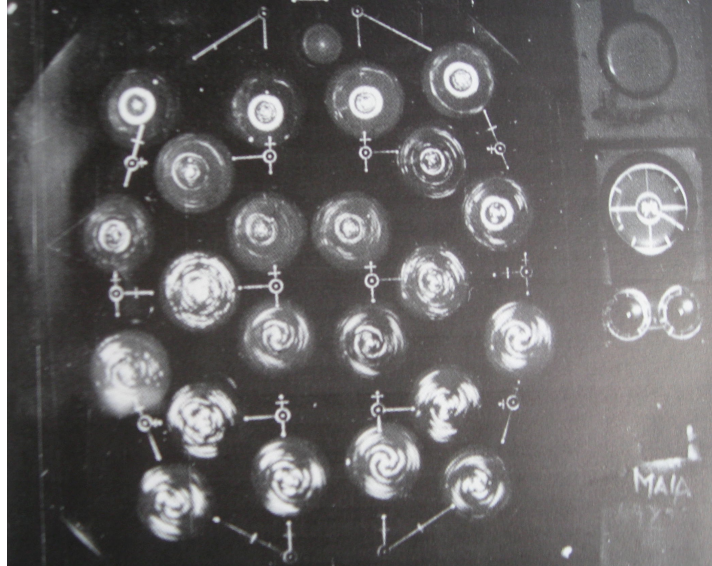
In the long run, neither observation was confirmed, but back in 1957 the visitors from England were keen to learn his technique. They also wanted the opportunity to take their own recordings from deep inside brain. Enter 'Topsy'.

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At the end of World War 2, hundreds of radar technicians left the RAF and joined the job market. Harold Shipton, an RAF technician had spent much of the war in South Wales developing and improving aircraft based radar. It was important work. Airborne radar enabled spotter planes to detect U-boats in the Atlantic and gave bombers early warning of fighter attacks. By the end of hostilities 'Shippy' had risen to Sergeant and was highly skilled in a field he likely thought had few applications in civvy street: the detection and display of weak electrical signals. However, he saw possibilities in the emerging field of bioelectrics and before demobilization visited the Burden with the aim of persuading them to take him on. Grey Walter built his first radio with his father when aged 9, an experience that kindled a life-long interest in electronics. Unfortunately his ambition sometimes outstripped his knowledge. Shipton had just the expertise he needed to realize a new idea – the toposcope, soon nicknamed 'Topsy'. He got the job and also persuaded his new employers to take on his former assistant, Private 'Bunny' Warren. In 1957, before the Oslo trip, Shipton moved to a new post in Iowa.

The electrical pulsations that pass through the skull from the brain are tiny, around fifty millionths of a volt. Electrodes attached to the scalp pick them up and feed them to amplifiers that boost their voltage so that they can be recorded, displayed and measured. Records were generally made, from the 1940s to the beginning of this century, by pens on moving paper. Thus rhythmic electrical pulsations, picked up by two or four electrodes back in the '40s, were transformed into measurable wiggly lines. The electrical signature the 'normal' brain had been mapped, pretty much, by the 1950s when recording from 6 or 8 electrodes became common. 'Topsy' was a step change. The signals from 22 electrodes were boosted and sent to 22 miniature screens: cathode ray tubes, the sort used in TVs before LEDs. Grey Walter described himself as a 'visualist'. His idea was to create a vivid real time visual display of brain activity, the array of screens revealing electrical pulsations as they spread spreading over the surface of the brain

in real time, like clouds over a planet surface.. By 1948 Shipton and Warren had created a working prototype of the 'toposcope'. She was to undertake a range of research projects during a decade of refinements funded by the US Air Force.



The toposcope was a marvel of analogue technology, but the messages it displayed were highly complex and, in the end, amenable to only the most basic interpretation. The depth electrode studies in Oslo, and in Bristol where over 150 patients underwent such investigation and treatment, revealed little of lasting value. When digital technologies arrived in the early 1960s Topsy was abandoned; in the end, she was perhaps more much avant garde artwork than useful scientific tool and in one of his final comments on the subject Grey Walter seemed to acknowledge as much.

The mating of science and art too rarely achieves any progeny, but the strange assemblies of whirling patterns in chiaroscuro generated by our latest display systems suggests a gay pastiche of sunflowers and distant galaxies. We hope that they reflect in some way the order and beauty of vital thought.

(W Grey Walter, Preface to the 1961 Penguin Edition of *The Living Brain*)

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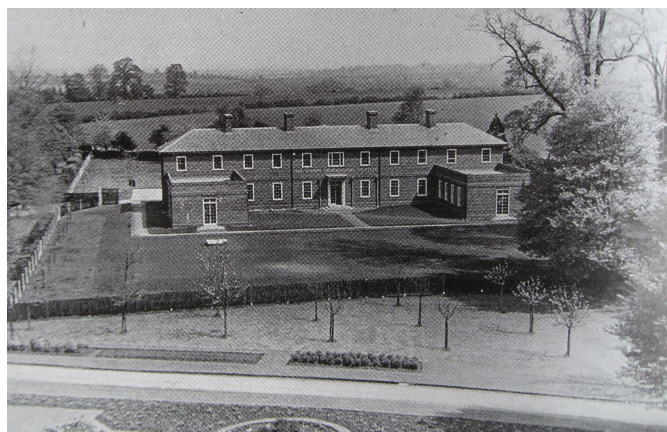
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Appendix

The Burden Neurological Clinic first opened its doors on 12th May 1939. Funded by a charitable trust it comprised wards, laboratory, library, offices and a specialist neurosurgical operating theatre. When war was declared on 3rd September that year the 'Emergency Medical Service' immediately requisitioned the theatre and wards to provide specialist facilities for the West Country.



The chain of events that led to the creation of 'The Burden' began half a century before, in Canada. In November 1891 the Rev. Harold Burden, a 32-year-old Anglican priest, and his wife Katherine, boarded a steamer

bound for England. They had spent the last 3 years as missionaries to the Ojibwayo, a native Canadian tribe who lived by the great lakes. In the last 18 months Katherine had given birth to a girl and boy. Both had died within days. After their son's demise they both became unwell and on medical advice returned to England. They were to have no more children.

On their return Harold took up a curacy in the East End of London, followed by another in Cambridge, before being appointed chaplain to Bristol prison. Continuing to work as a team, they were shocked by the home conditions of inmates, and the drunkenness of female offenders. They had found their next mission.

Their concern for 'female inebriates' was shared more widely at the time, and so their effort to establish specialist facilities was quickly rewarded. By the turn of the century they had created three 'care centres' for inebriated women, in Bristol, Norwich and Lewes. Their work also put them in touch with people judged "feeble-minded", the next group to receive the Burden's attention.

In 1904 the UK Government set up a "Royal Commission on the Care and Control of the Feeble-Minded" in order to "consider the existing methods of dealing with idiots and epileptics, and with imbecile, feeble-minded, or defective persons not certified under the Lunacy Laws". Harold Burden gave evidence. The commission didn't report until 1908 and it was another five years before the "Mental Deficiency Act." came before parliament. It recommended that the "mentally deficient" (a category that extended from the most impaired to "moral defectives") should be taken out of asylums and workhouses and placed in specialized, licensed colonies, a proposal that mixed a more humane approach to care with a eugenic sequestration of the genetically unfit. The first person to obtain such a license was Rev. Harold Burden.

The Burdens created the "National Institutions for Person's Requiring Care and Control" and started "Stoke Park Colony", on the former estate of Lord Beaufort in Bristol, just north of Frenchay village. The hospital included the Dower House, an impressive four storey Georgian pile that still sits on an escarpment overlooking the M32 into Bristol. Their venture was successful and within a few years they had opened two more 'colonies' in the area, also in redundant stately homes. When Rev. Burden died, in 1930, his estate was worth £150,000, a fortune for the time. After Katherine passed away in 1919 he had married Rosa Williams, superintendent of Stoke Park Colony and in 1933 she set up the "Burden Mental Research Trust" in Harold's memory. The Trust funded the creation of Burden Neurological

Clinic, a new build on the Stoke Park campus. 'The Burden' closed in the 1990s, research and clinical activities moving to the nearby Frenchay Hospital. The Burden Trust later shifted its funds to an existing neurology research group in Bristol and a housing estate built over the site of the old clinic and institute. There is no blue plaque.