SIR ROBERT ALEXANDER WATSON WATT FRS

In the summer of 1940, the British stood facing an airborne opponent with the capability to knock the country into defeat, and based mere minutes away. However, thanks to the efforts of one Scottish scientist and engineer, the nation's defences stood firm, as **Steve Nicoll** explains.

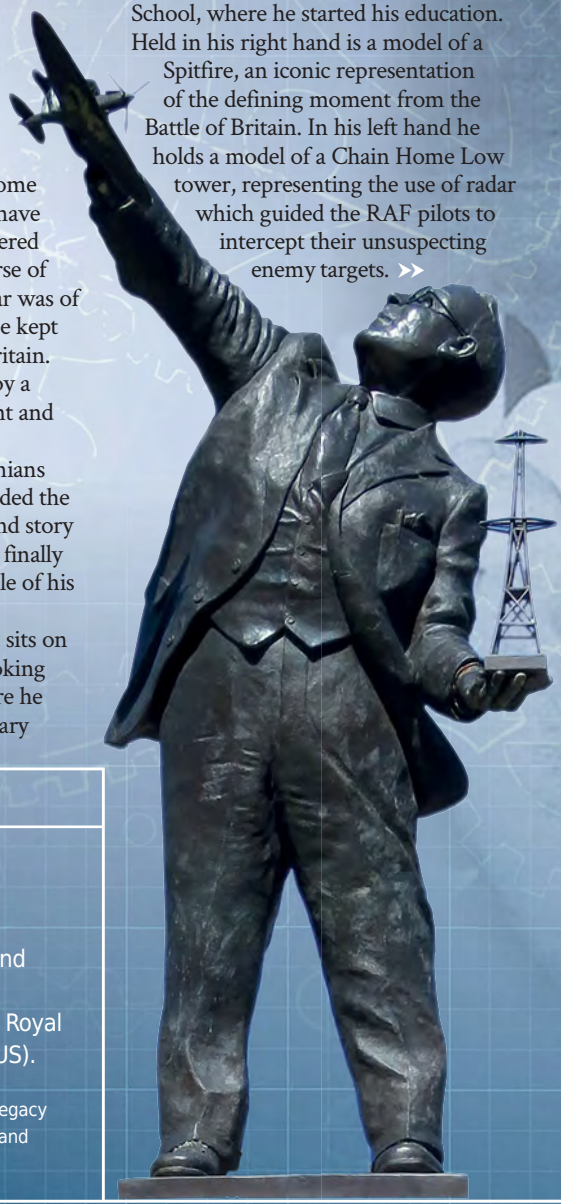
RIGHT
The statue dedicated to Robert Watson-Watt in Brechin.

On a gentle autumnal day in September 2014 the citizens of Brechin gathered in St Ninians Square to receive a very special royal visitor. The Princess Royal, Princess Anne was visiting to officially unveil the first statue in the cathedral city of Brechin. On the grassy square flanked by the Carnegie library on one side and the historic Caledonian railway on the other crowds began to gather in order to get a good view of the royal party and also to witness the overdue recognition of a world famous 'Brechiner'.

Sir Robert Alexander Watson Watt is internationally lauded for his pioneering work with radar which was so vital in providing the RAF with the technology to detect and intercept the German Luftwaffe during the Battle of Britain in 1940. Following that victory Churchill famously stated; 'Never in the field of human conflict has so much been owed by so many to so few.' Prime Minister Winston Churchill was right to applaud the skill and bravery of 'the few', but he knew all too well that without the input from the team of scientists let by Watson Watt the outcome of the Battle of Britain could have been very different, and delivered a disastrous effect on the course of the war. That work with radar was of course classified, and had to be kept to the shadows of wartime Britain. Watson Watt was knighted by a grateful monarch, government and country in 1942 for his work.

As the band played in St Ninians Square and the cameras recorded the day's events in 2014 the life and story of this pioneer scientist could finally be acknowledged by the people of his hometown in Brechin.

The statue of Watson Watt sits on a plinth of local sandstone looking towards 5 Union Street, where he was born, and Damacre Primary School, where he started his education. Held in his right hand is a model of a Spitfire, an iconic representation of the defining moment from the Battle of Britain. In his left hand he holds a model of a Chain Home Low tower, representing the use of radar which guided the RAF pilots to intercept their unsuspecting enemy targets. ››



FACTBOX

- **Born:** 13 April 1892, Brechin, UK
- **Died:** 5 December 1973 (aged 81), Inverness, UK
- **Field:** Electrical Engineer
- **Principal Developments:** Advances in Atmospheric Physics, Radio Detection and Ranging (RADAR), Chain Home, Pulsed Radar
- **Awards/Honours:** Orders of the Bath, Fellow of the Royal Society, Fellow of the Royal Aeronautical Society, Hughes Medal, Elliot Cresson Medal (US), Medal for Merit (US).

(Note: Born Robert Alexander Watson Watt, there was no hyphen between Watson and Watt. Watson is a legacy maternal surname and Watt created the double-barrelled surname in his adult life. For historical accuracy and consistency the hyphen has been omitted.)

LEFT
Watson Watt in a characteristic pose looks straight through the camera lens with his direct, penetrating gaze.
(ALL IMAGES VIA AUTHOR UNLESS OTHERWISE STATED)

"AT THAT TIME IT WAS SAID THAT THE ATOMIC BOMB HAD ENDED THE WAR, BUT IT WAS RADAR THAT HAD WON IT." - IAN BROWN, NATIONAL MUSEUMS SCOTLAND.

ABOVE
One of the more advanced forms of sound detection, to warn and guide anti-aircraft batteries. Vastly more effective, radar represented a greater leap forward in technology and was later incoporated into AAA batteries. (BRITAIN AT WAR ARCHIVE)

Watson Watt's role in providing the RAF with an effective radar system was instrumental in deciding the eventual outcome of the struggle for air supremacy over Britain, it also forced Hitler to abandon his planned invasion, Operation Sealion.

How did a gifted schoolboy from Brechin manage to become the head of a team of ground-breaking scientists in 1939? And how did he manage to persuade the political and military leaders of wartime Britain that his untested technology could be deployed successfully? The story of Robert Alexander Watson Watt and his achievements are well worth recalling in 2017, the 125th anniversary of his birth in modest surroundings in 1892.

HUMBLE BEGINNINGS

Born in a modest red sandstone building still used as a family home today, into a working class family, Robert would have been expected to enter the family business of joiners. When he reached school age Robert attended the nearby Damacre Primary School and began a normal course of education, which continued at the local Maisondieu High School, where young Robert started to demonstrate he was a gifted and capable scholar. By the end of his time at Maisondieu he won the Smart Dux Medal and was earmarked for tertiary education, a first for his family.

Robert elected to study the emerging science of electrical engineering at St Andrews University. The faculty was based in Dundee and here Robert came under the guiding influence of Professor William Peddie who instilled in his student the desire to embrace this new, exciting and challenging world. In his 1957 autobiography 'Three Steps to Victory', Watson Watt pays repeated homage to his early teachers in Brechin for the educational insight they provided for his outlook on life. In fact whenever he returned to Brechin he would seek out Mrs Bessie Mitchell as recognition of her influence on his life. When granted the freedom of the city in 1942 he invited Mrs Mitchell to sit next to him on the stage. Her teaching and mentoring was remembered for the rest of his life.

In his autobiography Watson Watt also claims to be a descendent of James Watt, the famous steam engineer. It is the first known claim both men were related and has been repeated on numerous occasions, but possibly without the application of academic rigour any of their scientific achievements would have been subjected to. Genealogical research on both men's lineage fails to establish even the most tenuous familial link between them. It is unlikely Watson Watt invented this story, more probable he heard it at his mother's knee. Believing the family had a famous relation became something he accepted as fact instead of simple family folklore. Modern day technologies and genealogical websites make family history simple, easy and accurate to research, and there is no family link between these two Scottish engineering pioneers.

"THE BOMBER WILL ALWAYS GET THROUGH" - PRIME MINISTER BALDWIN TO COMMONS

RIGHT
The Swingate Chain Home station (Dover) under attack on 12 August 1940, taken from the French coast. Radar stations proved hard to bomb, and normally, only minor, easily repairable, damage was inflicted. (1940 MEDIA LTD)

LEFT
Another shot of Swingate under attack. Had the Germans realised the significance of such facilities, they certainly would have tried harder to destroy them and leave the RAF blind.
(1940 MEDIA LTD)

NAZI DEATH RAY?

On completion of his university studies in 1912 he sought employment in the world of meteorology and, once again, found himself at the beginning of a science that could crudely forecast developing weather patterns. This was needed, not to inform the public of emerging weather systems, but rather to support the newly formed Royal Flying Corps which was learning how to conduct warfare in the skies. By 1918 the single service Royal Air Force needed better and more accurate information for its pilots. Bad weather was the pilot's enemy and where possible they would prefer to fly over, under or around bad weather. To do so, they needed help and that was provided by the scientists based at Farnborough who used radio waves to detect approaching weather systems.

Working on this early, unsophisticated art allowed Watson Watt to continue his understanding of radio waves and their future potential applications. He left this field of work for the National Physics Laboratory in Slough and whilst there responded to a Government initiative that called upon the scientific community to respond to the searching exam question of 'is it possible to develop a 'death ray'?'

As surreal as it sounds, this the informed thinking of the time, in that Britain believed Germany had developed a field weapon which could kill personnel by the use of radio waves. It was something Watson Watt was well placed to respond to, and along with other scientists firmly concluded that it was not possible to kill anyone with a 'death ray'. A relieved Government accepted their fears had been allayed. One reason for their slightly nervous response to perceived threats that Hitler's Nazi Germany was already making ominous noises about military ventures. Looking over the English Channel it was all too easy to remember the dark days where Britain fought in 'the war to end all wars' not even two decades previously.

THE BOMBER WILL ALWAYS GET THROUGH

Advances in aerial warfare meant the skies had become an extension to land and sea battles, and potentially, equally as decisive. The RAF were still developing its strategies but realised there was very little it could do to stop enemy aircraft from attacking British cities, military and civil targets. Stanley Baldwin as Prime Minister made a speech in the House of Commons in 1932 that reinforced the established view; 'the bomber will always get through'.

This bleak acknowledgement represented a great risk to British military and political thinking. Therefore in the conclusion submitted by Watson Watt in response to the 'death ray' question, he added a clarifying statement that attracted attention. He found it was possible to use directional radio waves to detect incoming aircraft before they were seen or heard. Henry Tizard, Director of Scientific Research to the Air Force, reacted immediately and sought out the author of the report and asked if he could prove his claim by demonstrating it to witnesses. Watson Watt accepted and proceeded to make arrangements to determine the effectiveness of radio waves and chose a field near Daventry. It was chosen as it was adjacent to the BBC transmitter which was 'hi-jacked' for the experiment, which took place on 26 February 1935.

The receiving apparatus at the end of the experiment was a much more Heath Robinson affair. He had no way of knowing if it would succeed as his theory was paper-based and equipment had to begged and borrowed in order to create the correct set of circumstances for his experiment. History records the experiment was successful, but, it was a very close run thing. The Handley Page aircraft, Heyford K6902, ➤➤

LEFT
A young Watson Watt in his trademark glasses and three piece suit. This style of dress is faithfully replicated on the statue in Brechin. The sculptor dressed a friend in the same clothing to capture the accuracy of every fold and crease.

ABOVE
A Chain Home Low (CH(L)) radar tower, a development of Watson Watt's Radar concept aimed at detecting aircraft flying at low levels.

piloted by Flight Lieutenant R. D. Blucke AFC, made several runs before the inscrutable Hugh Dowding and A P 'Jimmy' Rowe were able to witness that the screen was displaying the approaching aircraft ahead of any audible or visible detection.

Watson Watt and his colleague Edward 'Taffy' Bowen had proved it was possible to detect incoming enemy aircraft and that the bomber did not always need to get through. Watson Watt's letter outlining his initial findings is now regarded as 'The Birth Certificate of Radar' and a commemorative plaque outlining the events of that momentous experiment in 1935 now sits in the Daventry field where it took place.

Tizard approved funding and a tight timetable for further work. Watson Watt now had the herculean task of assembling a team of scientists, mathematicians, logisticians and RAF personnel to immediately start work on his primitive experiments. Looking back from today's perspective it is, perhaps, too easy to assume that events were proceeding to some sort of orderly plan. In 1935 there was no imminent threat of war with Germany and yet five years later in 1940 in the skies above England this embryonic technology was mature enough and capable of providing pilots with vital situational awareness unavailable to the German Luftwaffe. Five years is an incredibly short passage of time to develop any technology-led project and it was, amongst other contributing factors, the persuasive skills of Watson Watt that ensured progress was made at breakneck speed.

"THERE IS NO MORE IMPORTANT QUESTION BEFORE EVERY MAN, WOMAN, AND CHILD IN EUROPE THAN WHAT WE ARE GOING TO DO WITH THIS POWER NOW THAT WE HAVE GOT IT" - PRIME MINISTER BALDWIN TO COMMONS

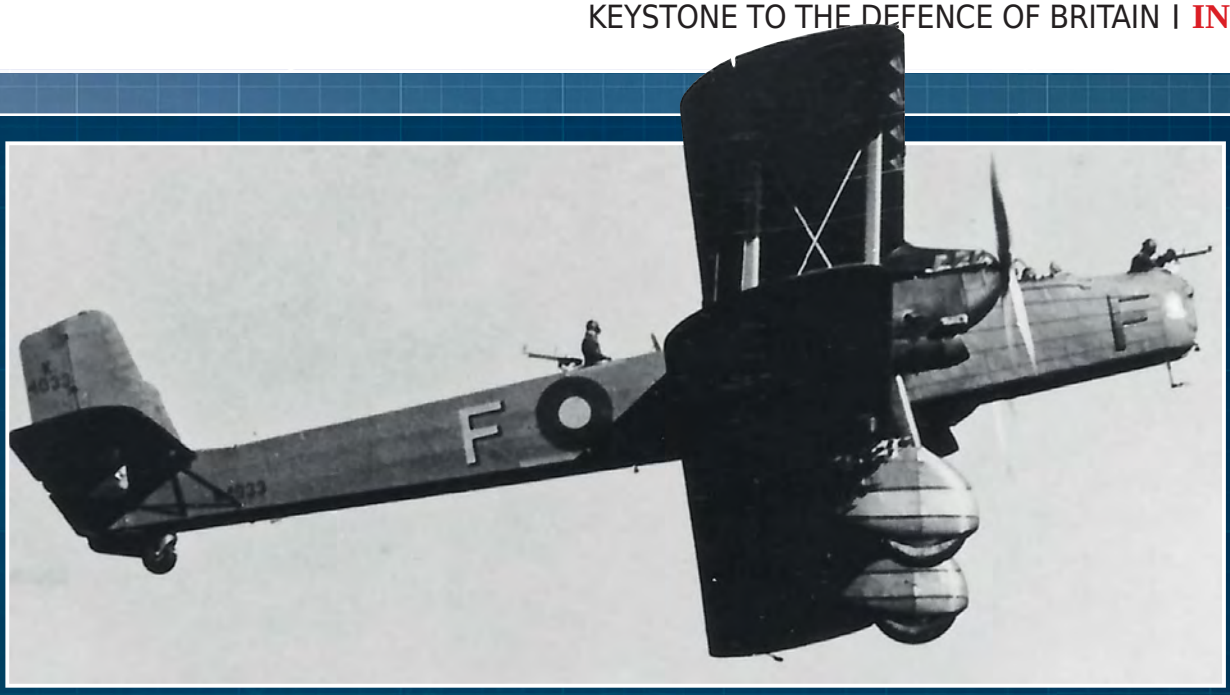
BAWDSEY MANOR

The team first assembled at Orford Ness on the English southeast coast, where a nearby airfield and available buildings overlooking the English Channel provided the basic ingredients to further develop the concept of radar. Over a short period of time it became obvious the location was no longer suitable for the complexity and scale of the project. Newer and bigger premises were required. Watson Watt assembled around him a team of brilliant scientists who ensured he was free to lobby the government and RAF into understanding that it wasn't just a case of providing a box of electronic tricks for their use. In order for it to work effectively it needed several additional projects to run simultaneously. Watson Watt was a skilled and highly persuasive negotiator, a point not always readily understood by his team back at their new location, Bawdsey Manor.

Watson Watt also knew that it was too easy to confuse laymen with complex scientific jargon and his intuitive senses knew he had to nourish and exploit goodwill. Watson Watt coined the abbreviated word radar which is now every day common parlance. He also was keen to keep the project driving forward and impelled his team to accept that their strange work was vital. His appreciation of the end user, the RAF pilot, and that the man-machine interface was absolutely vital to succeeding, led him to develop a technique of understanding the big picture when pilots were required to respond to radar intelligence. This comprehension of what was expected of a fighter pilot became a central consideration and by sitting alongside operational pilots when airborne was he able to appreciate their unique set of circumstances.

Emerging from this understanding was the application of 'operational research' to ensure that the end user was also a stakeholder in the development of this new piece of equipment. This research became a fundamental part of all work carried out by the team at Bawdsey Manor.

RIGHT
Watson Watt poses in front of laboratory equipment on a visit to Holland after the end of the war.



LEFT
An example of a Heyford bomber used in the Daventry tests. Heyford K6902 helped validate Watson Watt's concepts. (BRITAIN AT WAR ARCHIVE)

In 1936 this was unheard of, normally the last consideration was for that of the pilot. Operational research is now a core element of modern day equipment development internationally and that is largely down to Watson Watt and his team.

On his team was Robert Hanbury-Brown who described Watson Watt as follows: "When he was on form, you couldn't resist R W-W. He was the most persuasive person I had ever met, and the fact the Britain had defensive radar system in time to fight the battle of Britain owed a lot to his powers of persuasion. (R Hanbury-Brown, (2016))

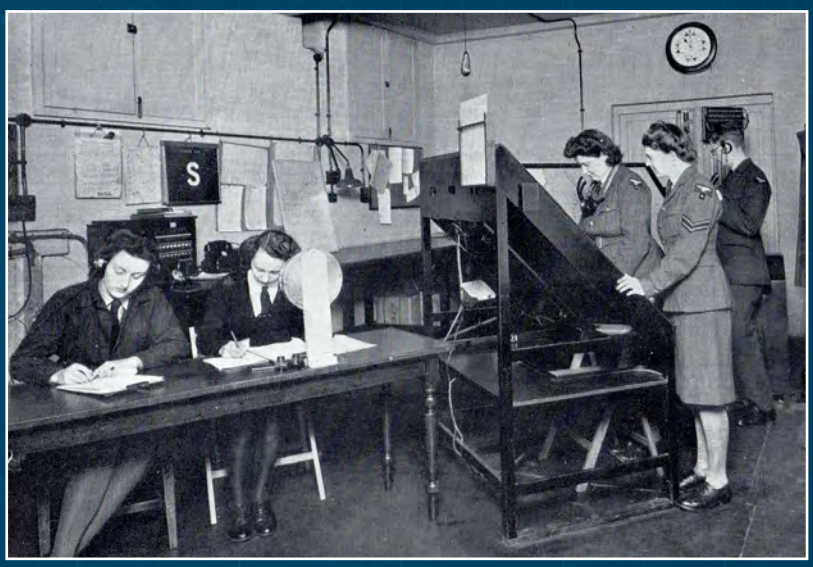
His final demands of government and the RAF was to create a national network of stations that would transmit and receive the radio waves and for the RAF to reorganise to respond to this radar intelligence. Fighter Command was restructured and the massive civil engineering project undertaken to construct these radar sites was funded and started in very short order. But Watson Watt knew his operational research had concluded the most important element of the whole radar jigsaw was the timely and accurate passage of information to the pilot. His research also concluded women operators were particularly adept at processing this information quickly. The RAF set about an expansion of the Women's Auxiliary Air Force (WAAFs) to provide command and control centres with trained female personnel who were capable of carrying out this particularly demanding task.

'2ND RATE PHYSICIST, 2ND RATE ENGINEER'

It is important to reflect of how much concurrent, complex work was being carried out and the speed that accompanied it. At the centre of all of this activity, in a fatherly co-ordinating role was Watson Watt who shuttled between Bawdsey and London to keep everything on track and to maintain pressure on the Government to continue with its support to his work. Although remembered as a scientist when he wrote his autobiography in 1957 he openly challenged the view of this stereotyping by describing himself as follow: 'I am 56, five foot six, an unlucky 13 stone, tubby if you want to be unkind, chubby if you wish to be a little kind, fresh complexioned, organically sound and functionally fortunate if fat after 30 years war of resistance to taking exercise. A 6th rate mathematician, 2nd rate physicist, a 2nd rate engineer, a bit of a meteorologist, something of a journalist, a plausible salesman of ideas, interested in politics.' (Sir R A Watson-Watt)

In this short passage penned by Watson Watt it is possible to understand to the range of complementary skills that helped him to be much more than just a scientist. He is remarkably frank about his personal attributes and yet it is the total sum of those attributes that had him at the heart of a project that needed more than the application of science to succeed. It needed a champion, a man who knew his way around the corridors of power and how to argue, lobby and persuade senior officials to provide their support and understanding.

Remarkably, by the outbreak of war with Germany in 1939 everything ➤➤



LEFT
RAF personnel process information in a CH(L) reciever room. (BRITAIN AT WAR ARCHIVE)

RIGHT
Plotting a distance and range on a map in the area of north Wales and Liverpool. Most of the Chain Home sites were sited on the south and east coasts of Great Britain, facing the most likely direction of attack from occupied Europe.

was in place and ready for an operational baptism of fire. When the Luftwaffe began their attacks RAF pilots took to the skies equipped with radar and it quickly became the strategic difference between the two opposing air forces. When the Battle of Britain ended and the threat of invasion receded Winston Churchill acknowledged this victory with his famous speech. 'The gratitude of every home in our Island, in our Empire, and indeed throughout the world, except in the abodes of the guilty, goes out to the British airmen who, undaunted by odds, unwearied in their constant challenge and mortal danger, are turning the tide of the World War by their prowess and by their devotion.' (Winston Churchill, 20 August 1940.)

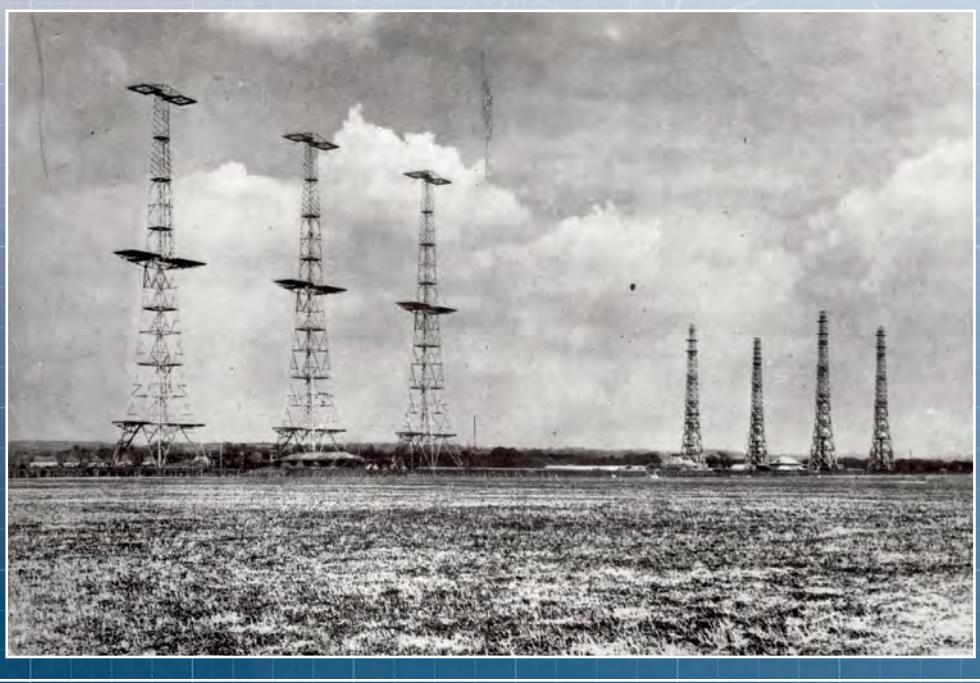
'SAVIOURS OF THEIR COUNTRY'

History records this as a turning point in the war for Britain and it is difficult to comprehend what the outcome may have been if the RAF had not been able to use radar so effectively. To fully appreciate how this was regarded it is useful to learn of how the Germans considered the impact of radar: 'The enemy knows all our secrets and we know none of his…the scientists who created radar have been called the saviours of their country. Next to the Atomic bomb radar was the most decisive weapon of the war.' Admiral Karl Doenitz (1891-1990) (C-in-C German Navy and head of state after Hitler's suicide on 30 April 1945. After forming a new government he negotiated Germany's unconditional surrender on 8 May.)

Watson Watt was knighted in 1942 although his entry in the London Gazette is notably short of detail about his classified wartime work. Although Britain had been spared it also meant that the work on improving radar had to continue as the coastline stations had done their job. However they were large, static first-generation pieces of equipment that were now combat proven but largely redundant. Some of the existing sites were used to track incoming V2 rockets in an attempt to provide early warning. Now radar systems had to be improved and made available on-board aircraft and ships. They had to be smaller, faster, easier to operate, more reliable and after the events of 1940 there was considerable political support, and finance, for this research.

Watson Watt had gathered a team of brilliant electrical engineers who now continued their work in the knowledge that the leadership, guidance and intellectual insight of Watson Watt had ensured that their work was ready in time for one of the most decisive, and defining, battles in British history.

BELOW
The metal reciever and wooden transmitter towers of a Chain Home station. Such facilities were viable until the late 1940s.



ENDNOTE:

Watson-Watt married on 20 July 1916 in Hammersmith, London, to Margaret Robertson, the Scottish daughter of a draughtsman from Perth. They later divorced and he remarried in 1952 in Canada where he was living and working. His second wife was Jean Wilkinson, who died in 1964. He returned to Scotland in the 1960s. In 1966, at the age of 74, he married for the third, and final time, to Dame Katherine Trefusis-Forbes. She was 67 years old and had also played a significant role in the Battle of Britain as the founding Air Commander of the Women's Auxiliary Air Force, which supplied radar-room operatives. They lived together in London in the winter, and at 'The Observatory' – Trefusis-Forbes' summer home in Pitlochry, Perthshire. They remained together until her death in 1971. Watson-Watt died in 1973, aged 81, in Glen Feshie near Inverness. Both are buried in the churchyard of the Episcopal Church of the Holy Trinity at Pitlochry. There were no children from any of the three marriages.