THE SECRET VALLEY

Hidden in a narrow valley amidst a very scenic stretch of north-east Wales is a site which was once one of the most highly classified locations in the whole of the United Kingdom. As David Smith reveals, during the Second World War its buildings and underground tunnels not only sheltered a poison gas factory and storage complex, but they also played it had a key role in the development of the atomic bomb.

In the late 1930s the British Government, in association with ICI (Imperial Chemical Industries), planned that in the event of war the United Kingdom should be capable of retaliating in kind if the Germans, or indeed any potential enemy, utilised chemical weapons.

Such fears were far from unfounded. The Italians began using chemical weapons in their Ethiopian campaign of 1935. They dropped mustard gas in bombs, sprayed it from aircraft, and spread it in powdered form on the ground. It is said that 150,000 casualties were reported due to chemical agents, mostly from mustard gas. The Japanese also began using chemical weapons in 1937 during their invasion of China.

Of even greater concern in the years before the outbreak of war in 1939 was the news that the industrial giant I.G. Farben, which had produced much of Germany's chemical weapons in the First World War, had been turned over to the German Army Weapons Office. Specifically-trained chemical warfare troops had been set up as early as 1934 and delivery methods developed.

Plans, therefore, were made to construct the required infrastructure in Britain, the Government having decided to manufacture both chlorine gas and mustard gas. As part of this work, three mustard gas factories were to be established – one in Wales, another at Randle in Cheshire, and the third at Springfields, Lancashire. They would be supported by three plants that would provide the constituents for the mustard gas factories. At the same time, two phosgene gas factories were to be opened at Rocksavage near Runcorn and Hillhouse near Fleetwood.

ABOVE: Looking down the main entrance tunnel, one of the three access tunnels, at the former Ministry of Supply Valley Works at Rhydymwyn near Mold in Flintshire. The main entrance tunnel is roughly 250 yards long and is concrete lined for about half of its length. Work on the construction of these tunnels, and the chambers to which they ran, began in October 1939. (All images courtesy of the author unless stated otherwise)

BELOW: An aerial view of the Valley Works at Rhydymwyn that was taken in August 1945. The Danger Area, located at the southern end of the site, can be seen at the top of the image.

With its chemical name of dichlorodiethyl sulphide, at room temperature mustard gas is actually a liquid, rather like diesel oil in appearance, which evaporates to produce a gas whose smell resembles that of the plant garlic mustard, hence the name. It is a vesicant or blistering agent, affecting the skin, lungs, eyes and other organs and can lead to a painful death. Mustard gas does not decompose and will remain active in the ground or on materials it has contaminated for many days, in fact months

MAIN PICTURE: The Danger Area at Rhydymwyn as seen from the south. This area was so-called because it was in the buildings here that the charged and bonded munitions were fitted with explosives and fuzes. A number of the structures in this area still show evidence of the wartime camouflage paint, particularly on the more sheltered eastern sides.

BELOW LEFT: A view of the Valley Works at Rhydymwyn, looking roughly northwards, as they are today. The Danger Area is nearest to the camera. The tunnels run under the hills to the left of this shot. The two large buildings towards the top of the site as seen here are buildings Nos. 50 and 59, the latter being the furthest from the photographer.

BELOW RIGHT: Building No.45, or P6, the ultra-secret Tube Alloys research building.

or even years. This makes it completely different from the effects of chlorine or phosgene which, as gasses, are readily dissipated in the atmosphere.

Mustard gas is comparatively easy to manufacture given a supply of raw materials which are mostly readily available chemicals and there are really only two effective ways of decontaminating material or ground; one is by the application of bleaching powder and the other by burning.

There were two types of mustard gas. One was Runcol, which was produced by reacting thiodiglycol (known as "Syrup" during the war) with hydrochloric acid. The other was Pyro, manufactured by combining ethylene with sulphur dichloride. Runcol, which was invented at Sutton Oak in 1932 using methods developed by the Germans in the First World War, was the more expensive to manufacture but was necessary for charging airborne sprays because of its lower freezing point.

In 1937 work began on the first mustard gas plant at Runcorn, Cheshire. Initially considered a low priority, in 1939 the factory rapidly expanded to having two Runcol plants capable of producing 100 tons per week, and three Pyro plants capable of producing 216 tons per week.

However, it was considered that if the Germans did intend to use mustard gas they would attempt to bomb the UK's production capability to preclude the British from using gas in retaliation. There was, therefore, an urgent need to find concealed and bomb-proof storage in a remote local area where mustard gas could be stored in bulk and where some charging and manufacturing could take place.

Between April and June 1939 the Alyn valley adjacent to the village of Rhydymwyn, about three miles to the north-west of Mold, Flintshire, was surveyed by the Department of Industrial Planning on behalf of ICI and the Ministry of Supply (MoS). The site consisted of a narrow valley about one-and-a-half miles long with low hills on the east and west sides. There was an area of about sixty acres of level ground on the valley floor which was suitable for the construction of chemical and charging plants.

It was on 27 August 1939, that the Treasury approved the £546,000 development of this chemical weapons plant. Work on the site began in October 1939, the initial structures consisting of storage tunnels dug into the western limestone hillside. Storage capacity for 3,120 tons of toxic material in bulk was provided by forty-eight tanks, each

ABOVE LEFT: Building No.50 – note the traces of wartime camouflage paint that can still be seen.

ABOVE RIGHT: A section of the interior of one of the Pyro buildings. Although virtually gutted, they are still in excellent condition. The construction is of reinforced concrete and brick.

holding sixty-five tons. These tanks were situated in two underground chambers in the hillside on the west side of the site, about 140 feet below ground. Access was provided by three tunnels driven 900 feet into the hillside at right angles from the level of the valley floor. The location chosen was such that the roofs of all tunnels would fall within a bed of solid rock and for this reason no additional reinforcement was required. A local mining contractor with the necessary expertise was employed to do the work. The Valley Works, to use the Rhydymwyn site's cover name, which was to manufacture mustard gas, received its first transfer of vesicant from Randle on 19 June 1940.

Two Runcol plants, R3 and R4, were then constructed at the Valley Works. Between them they could produce 100 tons per week. They were followed by three Pyro factories – P4, P5, and P6 – with a potential production capability of 216 tons per week. P4 and P5 were fitted out but never produced Pyro, whilst P6 was destined to house a top secret project.

It was necessary to build in the southern part of the Valley Works site a separate assembly section called the Danger Area where the charged and bonded munitions were fitted with explosives and fuzes. Meanwhile, a pipeline had been constructed to pump the site's treated processing effluent and sewage about six miles to discharge into the receding tide of the Dee estuary.

The first operations until 1941 involved the mustard shipped from Randle being charged and bonded with the munitions in the charging sheds. After twenty-four hours bonding the munitions were transported to the Danger Area where they were handed over to employees who filled the bombs with explosive, fuzed them and painted their casings with identifying colour bands. They were then packaged and made available for dispatch to the RAF Maintenance Units responsible for chemical weapons. From 1940 onwards 25% of bomb loads held on RAF bomber stations were chemical weapons.

The charged munitions were dispatched by train and escorted by personnel trained in dealing with spillage and "leakers". The presence of an adjacent railway line had been one of the factors involved in the choice of the Valley site and a siding and loading platform had been rapidly constructed.

Rosina Parry worked at Valley Works as one of fifty on-site weapons inspectors. During an interview with historian Dan Snow, she recalled her time at Rhydymwyn:

"When we first went through the gates we had to go to a big building. You had your own locker there. You took your clothes off and went through the shower room and into the other room where you put their clothes on. And then you reported to the office where they told you which particular cave you were going to go in on that particular day.

"The bombs were laid out for us to inspect. We had to pass them, to make sure they weren't damaged in any way, that they weren't leaking before they were sent through to be packed. We knew you couldn't have any leaks. You only needed a little spot and you'd be burned. People in the air force were going to handle them after us so we had to be sure there was nothing wrong with them when they went out."

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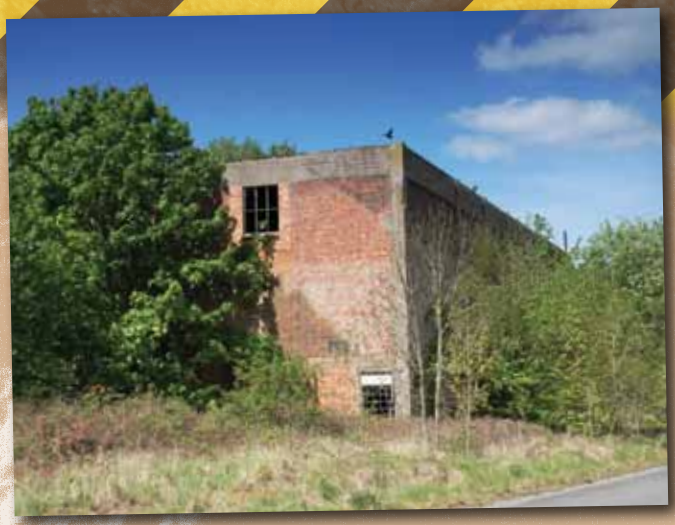
In July 1941, the Maud (Military Application of Uranium Detonation)



ABOVE LEFT: **The Runcol Production Building – building No.65 – again with traces of camouflage paint still visible. The considerable tree growth around these historic buildings is shortly to be removed.**

ABOVE RIGHT: **On 26 February 2008, William "Bill" Henney, a former member of staff at Rhydymwyn, visited the site for the first time in over sixty years. He is seen here sat on a bench with the Runcol Production Building, building No.65, in the background. Following the outbreak of war, Bill was employed at the at the Randle chemical weapons factory on Wade Island in Runcorn in the Runcol production section. He was transferred to Rhydymwyn as a shift leader on the commissioning team which installed building R4 – the first Runcol unit which went on line on 1 January 1942.**
(Courtesy of the Rhydymwyn Valley Site; www.thevalleysite.org.uk)

RIGHT: **A picture of Llandudno West Beach front taken on 26 May 1944. The US Army had a Hospital Training Area in the district during the build-up to the Normandy Invasion. Gas was seen as a possible counter-measure that might be employed by the Germans, hence the nurses seen here during a training exercise.**

BELOW: **A panorama of the Valley Works site taken prior to 2003, with the gatehouse on the far right and Danger Area to the left. The tunnel entrances can just be seen on the hillside at the top of the picture, roughly in the centre of the site.**
(Courtesy of the Rhydymwyn Valley Site; www.thevalleysite.org.uk)

Committee concluded that a useable atomic bomb was theoretically possible. There was also the probability that the Germans were ahead of the British in the knowledge necessary to build one. The major question was would it be a weapon useable in the current conflict? It was decided to form an enterprise code-named Tube Alloys, this would be tasked with establishing if it was feasible to produce fissile material on an industrial scale at a price which made it a viable weapon.

Ironically, the German and Central European scientists who had fled from the Nazi regime had not been given security clearance to work on projects such as radar. However, they could work on the atomic bomb and Tube Alloys employed them at the various laboratories involved in the project.

The redundant P6 Pyro building at the Valley Works, already within a high security zone, proved ideal to house the test equipment required to examine the feasibility of large scale production of Uranium-235. It was estimated in 1942 that it would take between ten and fifteen kilograms of U-235 to make a bomb which would explode with a force of 1,800 tons of TNT. If this could be achieved, it might be possible to produce two atomic bombs per month by 1944. Building P6 housed the test units and a team of scientists of the highest order, one of whom, Klaus Fuchs, was to achieve notoriety after the war when he was identified as a long term agent of the Soviet Union.

The internal layout of P6 was changed to reflect the needs of Tube Alloys. This included the insertion of partition walls, the building of physics and chemistry workshops, a glass-blowing laboratory, the fitting of new air conditioning, and the sealing of half of the building as a secure unit. Access to the building was to be limited to one guarded entrance and all of the staff were to be strictly segregated from the other site workers.

Two hostels were fitted out locally for the use of the seventy or more scientists, many of whom would be transient. A pool of ten young female laboratory assistants was recruited from a national base for testing some of the equipment.

In very simple terms, the basic principle was to put a gaseous form of

Uranium (Uranium Hexafluoride or Hex) in a heated chamber and force it against a very fine meshed membrane. The output would be slightly enriched at the top of the membrane with U-235 which has a lower atomic weight than U-238. This slightly enriched output would then be used as the input to the next of hundreds of stages of diffusion until a sufficiently enriched product was achieved.

As a result of this work, during this period the experiments taking place in a redundant poison gas factory building in a tiny village in North Wales were at the cutting edge of one of the most important developments in the whole of history. The British Government were providing unlimited funds to conduct pure research in the most glamorous field of physics, but it was not to last.

In August 1943 Great Britain, the USA and Canada signed the Quebec Agreement which committed the future development of an atomic bomb to take place in North America out of the reach of German bombers and closer to the greater resources available there. This resulted in a British contingent of twenty-three scientists (mainly of foreign birth and education) travelling to North America to help with the Manhattan Project. Work continued on the gaseous diffusion process in the UK but at a slower pace after the momentum in the project had swung to North America. Then, in 1945, the test equipment was moved to Harwell and Didcot, P6 becoming a general storage facility.

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Throughout this period, the rest of the Valley Works site had continued its work oblivious to what was going on in P6. From January 1941 onwards the Runcol factories in buildings R3 and R4 began production and by 1945 had produced 15,477 tons. The constituent chemicals were shipped to the site by rail. The "Syrup" came from Randle and, in the later years, Pyro was received from Springfields. Bulk mustard, both Runcol and Pyro, was later shipped in rail tankers to the Forward Filling Depots (FFDs) near the bomber bases in eastern Britain. Indeed, the standard and most cost effective British gas weapon of the Second World War was the 65lb light case bomb – in effect a slightly strengthened four gallon kerosene/petrol can that had fitted on one end a long rectangular flag that provided the tank stability when in flight. This was an extremely fragile device which was notoriously difficult to transport in quantity without incurring a number of "leakers". The provision of bulk storage of mustard gas close to the bomber stations solved this problem.

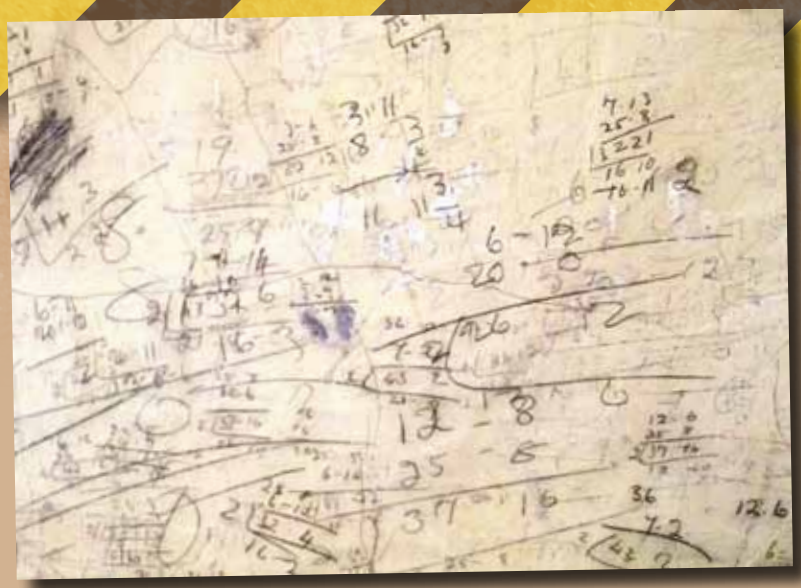
By 1942 there were around 2,200 people working at Rhydymwyn, the vast majority were directed to work there by the government and billeted with local families. A total of 5,200,000 munitions were manufactured at the site in the war years, many of them smoke generators which were heavily utilised from D-Day onwards for concealment on the battlefield.

Initially, the adjacent Antelope Field Satellite Storage Area, named after the Antelope pub which is still there today, had been used for external storage in tanks. This was a temporary arrangement until a more permanent site was prepared at Gwern-y-Marl Farm, about two miles

RIGHT: **A painted "Cleanway to Canteen" sign that can still be seen in Building No.109, a Weapons Receipt Store located at the beginning of the former Danger Area.**

BELOW LEFT: **Surviving buildings in the Danger Area. The roads here are paved with a very high quality asphalt designed to be virtually spark-proof.**

BELOW RIGHT: **A general view of the interior of Building No.109.**



ABOVE LEFT: An example of some of the graffiti that can still be seen on buildings throughout the site.

ABOVE RIGHT: This Toxic Burial Pit sign is popular with visitors on open days. The author's grandson, Matthew, is seen here. Throughout the site there are numerous boreholes that the authorities use for monitoring whether there is any leakage from the significant number of toxic waste burial pits which are marked and fenced off on the site.

BELOW: Seen from a hilltop to the east, the photo shows how well hidden the site was. The massive buildings at lower centre would have been much less obvious when in full camouflage paint. The Clwydian Range Area of Outstanding Natural Beauty begins about two miles beyond the site.

to the north-east. This was given the cover name Woodside and was sited off a narrow lane. Buried tanks provided a capacity of up to 2,090 tons. The farmer remained in residence and was evidently told that the installation was for aviation fuel!

During 1941 a decoy site to mislead enemy bombers was established on Ffrith Mountain about three miles to the south-west of Rhydymwyn. A QF decoy site, this facility used fires to mislead enemy pilots. The control bunker was an Anderson shelter protected by blast walls. Steel troughs and baskets on the mountain slope were filled with inflammable material fed by fuel from distant elevated tanks. When ordered, they were ignited remotely from the bunker which still exists, although now surrounded by trees. It is recorded that the last bombs fell on North Wales on 11 February 1941, though the site was not abandoned until May 1943.

After 1945 the United Kingdom did not manufacture any more mustard gas, although Randle had the capability to manufacture both Pyro and Runcol and its plants were kept on standby into the mid-1950s with periodic inspections, maintenance and up-grades. Springfields, which only ever produced Pyro, was rapidly decommissioned, cleaned up and handed over to the nascent Atomic Energy Authority to prepare uranium ore and to chemically separate the plutonium content of the output from the Windscale (now known as Sellafield) reactors.

In May 1946, a total of 928 250kg German bombs charged with the deadly nerve agent Tabun were transported from Germany to the Valley Works for storage within the tunnels. At some time in 1947 the bombs were moved to RAF Llandwrog (now Caernarfon Airport) to join a stock of more than 70,000 other Tabun weapons. In 1955 they were beginning to deteriorate and were considered irrelevant in a nuclear age. Subsequently they were all disposed of by deep sea dumping in the Beaufort Trench, an area of deep water between Scotland and Northern Ireland that has been used for dumping munitions since the First World War.

On 4 June 1946, mustard gas stocks in the UK totalled 13,200 tons. This was made up as follows: Springfields 1,000 tons, Rhydymwyn 3,000 tons, RAF mustard stocks in poor condition 1,200 tons, Woodside 2,000 tons, RAF-filled bombs 1,500 tons, and RAF FFDs 4,500 tons. By 1948 all of the mustard gas in the UK had been reduced to 5,000 tons in the Valley tunnels and 4,500 tons in the FFDs. As a consequence of the policy decision in 1956 to destroy all chemical weapons, the AOS (Apparatus Oil Smoke) burner ran non-stop between 1956 and 1958 at Randle Works and destroyed all of the 5,000 tons Valley stock.

Subsequently, many of the buildings were used mainly as a buffer storage depot, but some were demolished because of their dangerous condition.

ABOVE: One of the cross chambers located at the end of the tunnels at Rhydymwyn. There are four in total, all of which are identical and have rough rock walls painted white.

BELOW LEFT: A photograph that illustrates how seriously the gas threat was taken – personnel of 312 (Czechoslovak) Squadron in full gear on anti-gas training at RAF Penrhos, near Pwllheli, during the winter of 1940/41. (Via Zdenek Hurt)

BELOW RIGHT: One of the entrances to the tunnels at Rhydymwyn. As can be seen, the original entrance was much bigger but has been partially bricked up.

In the 1980s the effluent disposal pit was filled in, the pipeline to the Dee estuary was removed where practicable or filled with concrete-based slurry, and a number of buildings were made safe or demolished.

In 2003 major remedial work took place when many more buildings were demolished, the toxic drains were filled in and any suspect areas were covered with membranes, and a large number of monitoring points installed. As part of this package a visitor centre was built on the site of the old gatehouse. The site is still guarded but managed access is encouraged by the Department for Environment, Food and Rural Affairs, the government body responsible for its administration. The toxic pits and the site generally are extensively monitored with on-site instrumentation and, not surprisingly, digging anywhere is forbidden.

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Chemical weapons were not used in the Second World War against any of the major powers, though the Japanese continued to deploy chemical weapons against what they considered to be "inferior" races as they advanced through South-East Asia in 1942. Some of these weapons were captured and analyzed by the Allies which prompted Australia to secretly import 1,000,000 chemical weapons from the UK, in case it felt the need to retaliate in kind.

An even more sinister development followed the discovery of the lethal nerve agents Tabun (in 1937) and Sarin (in 1939) by Gerhard Schrader, a chemist of I.G. Farben. It has been reported that by 1945 the Germans had 7,000 tons of Sarin alone which was considered enough to kill the occupants of thirty cities the size of Paris. The Germans did not use any of these because they fear retaliation but these substances were unknown to Britain at that time. ■

- Now an important nature reserve, the Valley Site at Rhydymwyn is open for educational and recreational visits to members of the public and organised groups by prior arrangement. For more information, please visit: **www.thevalleysite.org.uk**