ENIGMA: CRUISE MISSILES, ROCKETS AND SUPERGUNS – FIRST TIME ROUND!

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Introduction.

My Xmas shopping gift tip is Martin Handford's "*Where's Wally*", where you search among cartoon crowds to find the red-and-white sweatered hero. The game is something like intelligence work, which these days is a lot about finding the important messages among a lot of noise – Prism, Tempora and such GCHQ goodies.

But suppose your enemy is capable of new technological leaps. Your problem is not only that you don't know *what* to look for, but you don't even know *if* they've even taken those leaps; your own scientists may say the leaps are impossible. So 'Where's Wally' now becomes a game where *you don't know what Wally looks like, or even if he's in the picture at all.*

Now, in the Second World War, England was attacked by rockets, by cruise missiles and superguns! How did we find out about this triple threat?

Breaking German codes helped immensely, and this paper concerns Britain breaking German ENIGMA cypher. That was *Beyond Top Secret*, and was called ULTRA, the *Ultra Secret.*

The paper deals with the little-known story of how ENIGMA code-breaks fitted together with other sources of information to defeat those cruise missile, rocket and supergun attacks.

And this is absolutely not a 'boy's toys' story. *Most* of the people who worked at Bletchley Park were women; the youngest was Mimi Galilee, aged just 14.

The Enigma: basics

First of all, let's look at the star of the show, the Enigma itself. Not very remarkable – looks like a very old-fashioned typewriter.

It has a keyboard like a German typewriter (hence QWERTZU, not QWERTY); a lamp-board, with a set of lamps, each of which lights up under a letter of the alphabet when a key is pressed; three code-wheels or 'rotors' with letters round their rims; and at the front, under a flap, a plug-board with lots of plugs and sockets.

You spell out your message *one letter at a time* - press a letter key, a lamp lights under a letter; press another key, another letter lights up, and so on; a cipher clerk writes down the letters. The Enigma doesn't transmit anything – when the cipher clerk has written down the letters, a radio operator sends the message by Morse code in 5-letter groups.

So what's clever? How does it work?

Press a letter key, a lamp lights up a letter – so far, so easy. But now, suppose between the keyboard and the lamp we put a rotor, a code-wheel, on a spindle. This code-wheel has electrical contacts on each face, and these are wired across in a

random way to the contacts on the other.

So we press the A key, and the current from the "A" key goes into the contact on one face of the code-wheel, flows through the wiring inside the code-wheel and it comes out at, say, the 'X' contact. So we've pressed A, but X lit up. X is the code (technically, the *cipher*) for A.

Imagine that as we pressed that key, the code-wheel moved round one 26th of a turn, one 'step', a bit like the mileometer on old cars. Now, if we press A again, the electricity still goes into the code-wheel at A, but this time different wires inside the code-wheel are now in place and so another letter, say H, lights up.

Again the wheel moves one step. Press A again and F lights up; press it once more, and T lights, and so on.

There are factorial 26

(26x25x24x23x22x21x20x19x18x17x16x15x14x13x12x11x10 x9x8x7x6x5x4x3 x2 x1) ways of wiring this wheel – that's about 400 million, billion, billion possibilities.

But if there was a machine with only one code-wheel, and we captured it, we'd only have to tap the same letter 26 times and write down the result. After 26 taps, we'd see the same coded letter sequence begin again.

Not much of a code, so let's scramble it a bit more. Let's put TWO wheels on the spindle, and arrange for the second to move on just one step for every full turn of the first. The second wheel is still wired inside, but differently from the first. The combination of the two wheels means that we are now at

160 million, billion billion, billion billion, billion possibilities.

But again if we capture a machine with both wheels, and if someone helpfully keeps pressing the same letter, the output letters will repeat after 26x26 = 676 times. Too easy!

Now let's add a third wheel with different wiring again. Mathematically, 65 million, billion billion, billion billion, billion billion, billion billion possibilities.

And again, if we've captured all three wheels inside a machine, the sequence will repeat after only 26x26x26=17,576 times.

So, not difficult enough yet; and here's where have a flat plate (think of a drinks mat from a bar) with electrical contacts round its face; these contacts are cross-wired to other contacts on the same face, so that they act as a 'reflector' (a mirror, if you like) to take the output of our 3 code wheels, carry it through wires across the face of this reflector and then put the electricity back through the 3 code-wheels again. There are factorial 13, i.e. nearly 8 million, million, ways that this reflector can be wired, so the numbers multiply up again.

Let us make things more difficult again. Let's suppose that you can slide the 3 wheels on and off the shaft, and put them on in any order – that's 6 times our 17, 576 times.

Better still, let's have 5 different code wheels and every day we choose a different 3 from the 5, and put them on in a new and different order. That's now times 60 to multiply our total.
So say you have typed in Z.

- The *first* code-wheel ciphers Z as T,
- T goes into the *second* code-wheel, which ciphers it as

Q

- Q goes into the *third* code-wheel which ciphers it as A.
- A goes into the *reflector* which cross-wires it to J.
- J goes back into the *third* code-wheel, which enciphers in as B
- B feeds back into the *second* code-wheel which enciphers it as S
- S goes back into the *first* code-wheel which enciphers it as Q, which is the output.

Now first code-wheel turns a 26th of a turn so if you press Z again, a whole new set of ciphers comes into play.

And wait a moment. All this depends on knowing the position where the code wheels start each day; you'd read that off from windows above each lettered code-wheel. There are 26x26x26, or 17,576 possible start points every day, because each of the 3 wheels can be set to any one of 26 possible starting letters – so multiply the already huge numbers by another 17,576.

But not difficult enough yet – it'd only be that simple if the rim of the code-wheel with the letters on it was *fixed*.

But let us make all those rims able to be moved round, so that they can be set up on a different position every day.

You might intercept my message, and you might have captured all the code wheels and the reflector, and put them on in the right order, but you're still helpless – you don't know the rim setting for the day.

Multiply our number by another 700.
NOW suppose I now add into the circuit a series of plugs and sockets so that any letter can be plugged to any other.

There are roughly 500 million, million possible combinations of the 13 pairs of plugs and sockets.

Code-wheels can be captured, so you could find out their internal wiring, but now you also have to know *EACH DAY* the details of:

- Which code-wheels are being used
- and in which order
- Where the wheel rims are set for that day
- Where the code-wheel starts the day
- What every connection on the plug board is daily
-

The theoretical number of possible combinations for a 3-rotor Enigma is 3.3 x 10 to the power 114, i.e. 3 with 114 zeroes after it – a bit more than the number of atoms in the known universe.

When the German U-boats started using a 4-rotor Enigma, the figure was 2.3 x 10 to the 145th power, 2.3 with 145 zeroes after it!!

In Summary: Capture a machine, so that you know the principle and the wheel wiring, and you *still* need to capture a codebook

….and even then, your 'break' will work only for *one* group of stations within *one* of *100* Enigma code groups, for *one* day only.

You have a problem – TIME!

If you captured a machine, all its rotors, *and* you had a copy of a message and its coded equivalent, *and* you had 100 replica

machines trying to break the code with 30 seconds to try each possible combination, working 24 hours a day, you'd get the answer in just under 6 years, meaning you'd just have discovered the Germans had invaded Poland in September 1939 by mid-1945.

And then during the war, the Germans changed all these settings not every 24 hours - but every 12 hours. *Then later still, changed them all every 6 hours.*

Let's suppose you capture even the codebooks.

Sorry, not enough! As a further bit of security, the operator had to think of 3 random letters (yes, a PIN!) at the start of a message, set the wheels with those letters at the top, encode them and at the start of the war, send them off as part of the message. So now there's a day start point for the code-wheels and a message start point you need to know.

But we will see how pre-war work by the Poles and the French, aided by a German traitor, plus the genius of some exceptionally clever people at Bletchley, reduced the number of possibilities for the 3-rotor machine to one hundred thousand, billion, billion; and for the 4-rotor machine to 16 million, billion, billion. These are still truly terrifying numbers, but capable of being attacked by brilliant people and the machines they invented.

Please remember they were always working against time; this is war – decoding five minutes too late could mean a battle lost, a convoy going up in flames. This driving urgency is what BP people remember; as one of them said to me "We always knew that out there were real people doing really brave things. If we were late, or wrong, or couldn't break the code, *real*

people really died"

The V weapons and Intelligence.

All intelligence problems look easy with hindsight. *Today* we know the answers to World War 2's puzzles.

Now we know that the Germans possessed and used a cruise missile, the V-1, doodlebug or buzz-bomb. You perhaps didn't know they used them as *air-launched* cruise missiles as well as firing them from the ground; they did.

Now we know that they also possessed and used a ballistic missile, the V-2. You perhaps didn't know that some could be fired *from railway trucks*; they could.

And a few readers may have visited Mimoyeques, in Northern France, and so know *now* that the Germans had a long-range supergun, the London Gun, which was bombed out of action before it could be used – though a smaller version was used elsewhere. This was the V-3.

But in 1942, we knew none of this. The story about how we found out involves Enigma code-breaking but also secret agents, spying on prisoners of war, air photography, and more.
Enigma and the V-weapons pre-war.

First, we should go back to 1918, when Arthur Scherbius, Enigma's developer, first suggested the concept to the German Navy; he then patented his device and built a model for commercial sale. But there wasn't much money about in 1923 Germany– at least not until Winston Churchill wrote his memoirs of how the British broke German codes in the Great War!

Suddenly, there were orders! First orders came from the German Navy, then the German Army, where one Rudolf Schmidt was the buyer - r*emember the name*.

Scherbius would have been delighted, but alas, he'd died in a very low-tech accident, killed by a horse and cart in his factory yard.

At the same date, under the Versailles Treaty, the Germans were restricted by the Allies on almost every weapon – but not rockets, thought of as harmless playthings. A picture of the German Rocket Club shows, half-concealed behind a man with a giant firework, one Werner von Braun.

Werner worked hard at his hobby and his studies. Captain Walter Dornberger, from the German War Office, recruited him in 1932. By 1934 Werner had fired a rocket a mile into the air, and got funds to build a secret research establishment, for which Werner's mother suggested a Baltic island, with a village called Peenemunde. The German Air Force joined in, Dornberger built the establishment, and Werner built bigger rockets, promising by 1937 a 160 mile range. Werner also gained "new best friends", most in uniform and peaked caps. He had a lot of problems; many rockets blew up on launching; so, he kept researching!

What about ENIGMA, meanwhile?

Code-breakers *had* been attacking Enigma – but mainly not British code-breakers. Poland had two powerful neighbours, Russia and Germany, and needed information. In 1928, the German embassy left a package in Polish Customs - and then urgently wanted it back. It was late Friday; Customs said "Come back Monday" and rang their Cipher Bureau, who

carefully analysed the Enigma inside, then repacked it before Monday.

3 of the brightest Polish maths graduates, Rejewski, Rocyski and Zygalski soon made significant breaks into Enigma. They made use of Enigma's Achilles Heel - *this machine can never encipher a letter as itself*. So A can never be enciphered as A, B never enciphered as B and so on.

This was slow work – it needed a bit of help from espionage, which now came into its own. The French had used seduction; Hans-Thilo Schmidt, brother of Rudolf Schmidt, Enigma buyer for the Wehrmacht, had a champagne lifestyle but a bread-and-butter income – as the French said, "he loved money very much, because he loved women even more". He offered to sell some Enigma secrets. The Deuxieme Bureau bought some instruction and code books.

These were useful, but showed more was needed, such as the random letters beginning each day – and the French approached the Poles.

Their information was what the Poles needed, who then read some, but not all, Enigma messages for 5 years - but without telling the French! Rejewski had cracked one early Enigma code, but for most of the 1930s the Germans were still using only 3 rotors.

In December 1938, they moved to any three from 5. The Poles needed more equipment than they could make to crack the new challenge, and, in 1939 in woods near Pyry, they met the French and British.

What had the British been doing? The British code-breaking

effort did have 90 code-breakers, but they had to handle the whole world's codes. Our best code-breaker, Dillwyn Knox, tried and almost cracked Enigma, but he needed to know the order the wires went from the German QWERTZU keyboard to the first code-wheel. His first question at Pyry was "What's the QWERTZU?"" and a mystified Rejewski said …."ABCDEF of course"!

DUH!! (As Homer Simpson says). Dillwyn had thought ABCDE too obvious and hadn't tried it.
We quickly set to work recruiting clever people from the universities.

How clever? The comment of one BP code-breaker – "I first met my friend when he beat me in the finals of the British chess championship; I'd won it the year before. I remembered because it was my 16th birthday". Or an American visitor: "Bletchley? A hell of a place to play chess for money".

Security was always tight. Young Bletchley recruits, many just 18 and away from home for the first time remember a uniformed officer took them through the Official Secrets Act saying "You must never reveal, even to your closest family, what you have done" and then drew his revolver, pointed it at them, and finished, "And if you do, I will personally shoot you". You don't get interviews like that at Manchester Council. Even 70 years later, recruits say he had their total, undivided attention at that point.

Bletchley Park and Enigma.

In 1939, the first intercepts were broken by hand; two code-breakers, Alan Turing and Geoffrey Welchman, started to build machines. They didn't start at AAA and work through every

combination – they guessed, and tried out the guesses, or *cribs* – remember that Enigma's Achilles heel is that Enigma can never encrypt a letter as itself.

The test check placed the original code against what the decrypt might be if the crib was right, and then look for a *clash*, a case where the letter in the coded text was the same as the letter in the decode – because, using Enigma, that could never happen, so the guess must then be wrong. If there was no clash, then it just *might* (but only might)be a correct crib.

Rapid testing of cribs needed machines, and these were the British "Bombes", invented by Turing and Welchman, with drums which were turned electrically to test the cribs.

But where to get the "cribs", those 3 random letters starting the first message of the day? John Herivel earned his keep by guessing what these might be. Any reader use birthdays as passwords? Or the same password for two different sites? Herivel thought the same way:

- He thought tired or lazy soldiers would use girl-friends' names, like ANN or PAM
- He thought they might look at the keyboard – QWE, WER, ERT – or diagonals
- He also thought they might use swear words
-

Mavis Lever, just 18, said "I became the world's expert on German and Italian rude words!".

In an equally incisive insight, Gordon Welchman realised how much information could be gained from *linking decrypts together*. Knowing "*Leutnant Schmidt is to move to the Baltic*" is a lot more use when your file index tells you "*Leutnant*

*Schmidt is a specialist in radar tracking and his Baltic station is Peenemunde".*In Welchman's own words:

> "I drew up a comprehensive plan which called for the close co-operation of radio interception, analysis of intercepted messages, breaking Enigma keys, decoding messages and extracting intelligence from the decodes".

The war and missiles: 1940 – 1942

The war didn't start well for Britain. When the German armies smashed into France, the lesson was hard–code breaking won't help you against a Blitzkrieg and a crumbling ally. But then came the Battle of Britain; the RAF drove off the Luftwaffe.

The following year, Hitler made the mistake of his life - invading Russia. By 1942, his forces, including aircraft, were bogged down there; Hitler knew he could not send many bombers against Britain now – but 'Bomber' Harris' had started to burn Lubeck, Rostock, and Cologne.

To retaliate, Hitler had to have new weapons; enter Faust's Mephistopheles, the genius Albert Speer, Hitler's armaments boss. Speer remembered Werner's rockets - and Werner's rockets had begun to succeed. In October 1942, one succeeded brilliantly, landing just 4,000 yards from a target 120 miles away. Speer got Hitler to back Werner; Hitler wanted *5,000 rockets a month*.

But the Luftwaffe wasn't going to leave the sky to the Army. Fieseler proposed a pilotless ramjet powered missile – a *cruise missile*– of cheap pressed steel for £140 apiece.

In April 1941, the Luftwaffe air-tested its ramjet with a very brave pilot flying the German equivalent of a Tiger Moth

powered by the ramjet! Fieseler shared Werner's problems – many missiles blew up, some even turned a circle and demolished both launch ramp and crew, which didn't help the call for volunteers.

The Luftwaffe wanted TWO THOUSAND cruise missiles a month, built by - Volkswagen, the people who later would bring us the Beetle.

The German artillery had a weapon too – the V3 Supergun, or "high pressure pump" (*hochdruckpumpe*). A long, sloping barrel was used, with pairs of chambers at each side all along its length. When the shell was fired, as it passed each pair of chambers a new charge was exploded, driving it faster and faster until it burst out of the muzzle, soared into the stratosphere and achieved phenomenal ranges – such as London from North France. Mimoyecques, Northern France, allowed the V3 to be entirely underground, supplied by railway, with only the muzzle tip projecting through a thick concrete slab.

Complexities of the Intelligence War.

Now, we had an idea *something* was going on, from bugging two captured German generals chatting about a planned rocket attack on London - "it must have been delayed as we haven't heard any explosions and we're near London".

But we did not know there were *two* different weapons, so arguments kept getting confused between the V1 cruise missile and the V2 rocket. Our scientists hadn't experimented with liquid-fuelled rocket engines as had the Germans, only with cordite-fuelled rockets such as Dr Ailwyn Crow used; and for a cordite-fuelled rocket to reach the UK, it would need to weigh

about 90 tons.

The young assistant director of air intelligence, called R V Jones, thought Crow was wrong, and the Germans could make a liquid fuel rocket– as indeed they had.

Now Enigma began to pay off; *Enigma* told us that something very important was going on at Peenemunde, so Churchill ordered photo reconnaissance aircraft to find out what. Jones asked Bletchley Park to track the ENIGMAs of two German radar groups; he guessed they would be asked to track test firings. Our agents also began sending us reports.

However, the photo-interpreters weren't sure what they were looking for, and the spy planes' photos were indistinct. In fact, there were both rockets and missiles at Peenemunde – the Luftwaffe was testing V1s in one area, the Army V2s in another. Both groups' misfires used to crash in each other's areas, which added spice to their rivalry.

Finally in June 1943, a photo showed a cylinder 35 feet long and 5 feet diameter, and Enigma told Jones the radar trackers had moved to the Baltic.

Churchill was advised. In the Cabinet War Rooms, he was briefed by Jones. Churchill's Ministers feared that if this was a rocket, it might cause 4,000 casualties per rocket, so Peenemunde was agreed as a priority bombing target.

Bomber Command was not very happy; Peenemunde would be a deep penetration raid on a short, light summer night – so, many casualties were to be expected. On 17/8 August, Operation *Hydra*, with 500 bombers, went in. Their target was the scientists' houses; some key scientists, such as Thiel, were

killed, and the programme delayed by at least 2-3 months.
In addition, unknown to the British, a Friedrichshafen raid had halted production of the *V2*; and a later Kassel raid halted *V1* production for several months.
Now, the V-weapons campaign eventually started just after D-Day, 6 June 1944. IF the V weapons had started 2-3 months earlier, and on the scale described above, this would have made D-Day very difficult if not impossible.
The Germans now had to find a new location, invulnerable to bombers. The SS took over the rocket programme, and SS General Kammler was put in charge. Kammler knew about design and construction - he had designed the crematoria in the German concentration camps. Why were his skills needed?
Because V weapon manufacture was to go underground, under the Harz Mountains, in tunnels called "Mittelwerk". An army of slave workers from the nearby Concentration Camp Dora would build them - Kammler did not care how many slave workers he killed - and the V weapons manufactured in the tunnels, far beyond the RAF to interfere.
But the programme was delayed by the building yet again.
Now reports came from spies in France, such as Jeanine Rousseau, a young translator for the Germans – she was agent Amniarix of the Druids network. She said 108 catapult launchers, rising to 400, were to be built for German Commander Max Wachtel, each capable of launching a missile every 20 minutes.
In London, Jones found an engineer, Isaac Lubbock, who had worked in the USA on liquid oxygen/ petrol rocket fuels. At last British scientists realised that a rocket powered by liquid fuel, not cordite, *was* possible, and something like panic began.
From Enigma, Jones produced the V1 test firings from the radar trackers. At first, the missiles flew fairly inaccurately. The first V1 launch site in France was identified by air photo. The first bombing of the sites began on 21 December 1943.

Even so, the D-Day planners were advised to look for alternative ports to Southampton and Portsmouth. Jones predicted that a V-1 attack, probably after March 1944, could deliver 320 tons of explosive a day to a circle 10 miles round Charing Cross.

Breaks into the SS Enigma, codenamed QUINCE, identified the V1's fuel as low-grade aviation spirit – cheap, readily available – the cruise missile was ready to go!

By December 1943, the first definite photo-identification of a V1 had been made by the photo-interpreter Constance Babington Smith; a tiny shape on rails on an inclined ramp, less than a millimetre across, which meant a wingspan of less than 20 feet.

And by this date, the V1 was becoming a much more accurate and reliable weapon, as Jones was able to show from the radar trackers' ENIGMA reports. Bomber Command bombed the sites relentlessly.

But what of the V2 ballistic missiles? We last saw Werner and the V2 going underground at Nordhausen. The V2 testing ground also moved, to Blizna, *right*, 170 miles south of Warsaw, the SS training camp *Heidelager.* ENIGMA both revealed this, and named Kammler as in charge of construction. Polish farmers were not thrilled to be used as a missile range, and gathered crashed parts revealing hydrogen peroxide and liquid oxygen as potential fuels. Rocket parts were fished up from the River Bug, and smuggled to Britain by an RAF Dakota.

For Jones, who had been looking for huge launchers, many answers now fell into place with these parts to hand; he

realised a 35 foot square of concrete roadway could suffice.
The Launch Sites.

35 square metre patches of concrete hadn't been the Germans' first idea; they wanted bomb-proof sites built of reinforced concrete.

Wizernes in Northern France is the best preserved and open now to the public, as La Coupole. This huge reinforced bombproof concrete dome was to be fed by underground railways, the V2s assembled upright in the dome and wheeled out of the dome to be fired. The RAF from March 1944 churned up the countryside for miles so it was impossible to get anything into or out of the bunker. The construction was abandoned unfinished, and remains to this day –well worth a visit.

But we were on the trail of the V2 through ENIGMA messages; the Peenemunde/ Blizna network Enigma, codename *Corncrake*, had been cracked at Bletchley. Now Jones was able to work out from part numbers that there could have been as many as 1,000 made.

The V-1 was also progressing. Remember that after intense and continuing bombing, the RAF thought that by May 1944 that it had killed the V-1?

Not a bit of it. Max Wachtel, Commander of the world's first cruise missile battery, Flak Regiment 155, was a lot more resourceful. Long before the Allies had finished bombing the launch sites, Wachtel had taken over as missile stores a whole series of railway tunnels, and the launch sites were adapted to take a *prefabricated* structure which could be trucked up to a site and erected for use on concealed concrete footings within a

few hours.

The battle started all over again.

The British and Americans landed in France on D-Day, 6 June 1944. The British assumed that the bombing had made missile attack unlikely, so it was a shock when, 4 days later, a Belgian spy reported 33 rail wagons each with 3 missiles had passed through Belgium.

Hitler called for retaliation for D Day, so Wachtel managed to use 54 prefabricated sites to launch the world's first cruise missile attack at 0330 on 13 June.

The first few were a flop - 10 launched, 5 crashed and only 4 got to England. *But the hours which followed were not a flop*. By 15 June, Britain's defences were temporarily overwhelmed; 73 of the 244 missiles launched got to London. On Sunday 18 June, the Guards' Chapel, very close to Whitehall, took a direct hit, with 121 killed and 68 seriously injured.

The British Reaction.

Britain's first lines of defence were the anti-aircraft gun and barrage balloons. In 1940, these had been arranged in a ring around London to meet manned bomber attack. But if a gun or balloon cable hit a cruise missile over London, a ton of high explosive would blow up just above the ground, with many casualties and much damage.

The answer was to move all the guns, crews and radars to the coast, and Tim Pile, the boss of AA Command, did just that. It meant shifting 800 guns, 23,000 people and 60,000 tons of ammunition to the coast, much of it *in one weekend*. He

avoided any issues by telling his boss only after the event!

We should remember who was doing all this – both barrage balloons and AA defences had been used as a source of manpower for our armies, and by now most gunners were young women, and older men unfit for military service.

SomeV-1s were shot down by fighters, but surviving pilots agree that shooting at a ton of explosive from a couple of hundred yards away is not habit-forming! Most preferred to fly alongside, raising the fighter's wing underneath the V1s wing and letting the airflow tip the V1 over. Of course, to do this you had to have a plane fast enough, so only the Meteor, Tempest, Typhoon and special Spitfires would do.

Britain also used the double agent Eddie Chapman, 'Zigzag', to transmit a false picture of where V1s were landing, showing them hitting NW London and thus causing the Germans to shorten the range. WE WERE ABLE TO VALIDATE THAT THE BAIT HAD BEEN TAKEN BY READING GERMAN ENIGMA MESSAGES. What people in Kent said is unprintable.

The Coming of the V-2.

As launch sites began to be captured, it seemed that the V1 *cruise missile* threat could be dismissed. Jones' report saying the *rockets*, the V2s, could be used as early as September, had simply been filed. On 7 September, Minister Duncan Sandys announced that the Battle of London was over, the morning newspapers on the 8th carried the story, and that very same afternoon the first V2 rocket, launched from Koekoekslaan, in the Hague, Holland, crashed down in Staveley Road, Chiswick, killing Rosemary Clark, aged 3, at No.1, Mrs Ada Harrison

next door, and Private Frank Browning in the street outside. It was the first of over 1,000.

The V2 was a deadly menace; the factory was under the Harz mountains, beyond reach of bombs, so the Ministry of Home Security planned the evacuation of one million Londoners; many in fact now left of their own accord.

Worse still, a rocket which fell in Sweden (on 13 June 44) put us off the scent. It contained considerable electronics and we spent much time and effort developing 60 radio jammers. However, the rocket was a one-off test-bed for the *Wasserfall* anti-aircraft rocket, which was nothing at all to do with the V2. Our radio jammers were useless, for the V2 was guided by internal gyroscopes and integrating accelerometers.

And just like the V1, the Germans had not given up merely because one attempt at launching – the big bunkers, like La Coupole - had failed. Now the V2 would be transported on a lorry, raised on a base shaped like an outsized lemon squeezer to the vertical, and then fired from any 35 metre patch of concrete – roads, like Koekoekslaan, were good enough. There were indeed even rail mounted launchers.

Obviously, it was near-impossible to catch a rocket being fired from such a mobile site – though Raymond Baxter, the former BBC Tomorrow's World presenter, led a squadron of Typhoon fighters, one of whose pilots fired his fighter's guns at a V2 just launched from a road. Baxter recorded wryly that it was just as well it had no effect, otherwise his own Tomorrow's World might have arrived early.

As a result, the Tactical Air Forces concentrated on shooting up the missiles as they were moved around by rail.

Inevitably many V2s got through. 1,115 had reached England, 517 – about half – getting to London. 2,754 were killed and 6,523 seriously injured. The last V2 fell at 2pm on 27 March 1945 at Orpington.

Antwerp in fact suffered more than London – a key port for the Allies' supplies, 1,610 V2s and 8696 V1s were launched at that city.

The V-3 Supergun.

The V3 original concept was truly staggering – 15 barrels, each 150 yards long, firing a 12 inch shell. Pairs of side chambers opened into the barrel, and in those side chambers explosions of propellant would have been fired behind the shell as it moved up the barrel.

The RAF, including 617 Squadron, the Dam Busters, bombed Mimoyecques, using the 6 ton tallboy bomb designed by Barnes Wallis. The 6-ton bomb wrecked it, and the supergun was never used.

But the cruise missile and rocket was went on to the very last.
Final V-1 launches.

In 1945, V1s were carried under Heinkel 111 bombers and air-launched over the North Sea. Enigma warned us of these missions, and we intercepted many.

On Xmas Eve 1944, *Operation Martha* was a German attempt to attack Manchester with 50 V1s launched from Heinkels off Spurn Head. The attack was a failure - only one missile got to Manchester, though some casualties resulted. Manchester therefore shares with Antwerp and London the dubious

distinction of being one of the world's first three major cities to be attacked by air-launched cruise missile.

The V1 campaign ended on 29 March 1945 when Suffolk gunners shot down the last one. Of the 30,000 actually built, the RAF had denied the Germans two-thirds; just 10,500 had been launched; many crashed in France and 3,957 had been destroyed by the defences, and 3,531 crossed the coast; 2,420 reached London. 6184 were killed and 17, 981 injured – 2 killed and 5 injured by each, on average.

The Nordhausen factory and planned missiles.

When we got to Nordhausen at the end of the war, the British and Americans found at that underground factory a series of mass production lines for the V2, with hundreds of rockets, and more mass production lines for the V1 with thousands of cruise missiles.

This *reality* was not good, but the *plans* chill the blood. On one blueprint can be read "Schuttbehalter fur K stoff buchsen" which translates as "*container for canned nuclear waste*" – a dirty bomb, as we now say. Nerve gas and chemical warheads were also planned to be used.

And this was for a *monthly* planned rate of fire of 2,000 cruise missiles, 900 ballistic missiles and also, every hour, 100 supergun shells.

In Conclusion.

We owe thanks to Turing and Welchman who had first broken Enigma, and to all the Bletchley staff; to R V Jones who used Enigma information to brief Churchill; the Polish spies who

retrieved rocket parts; and to the RAF bomber crews who bombed Peenemunde, the cruise missile and rocket launch sites and the V3 supergun, many of whom died in the process. Harris, and the RAF bombing campaign, get much criticism these days, but remember that until D Day we had no other way of striking at the V weapons campaign, and if the Peenemunde raid had not delayed the V weapons by 3 months there might never have been a D Day.

And this was not Boy's Own Paper stuff; tribute should rightly go to the spy Jeanine Rousseau, agent Amniarix – captured and tortured by the Gestapo in Ravensbruck concentration camp; to the photo-interpreters, like Constance Babington Smith; the bombe operators of Bletchley; the radar operators and the gunners.

This paper has tried to show how the different pieces of the intelligence jigsaw fit together – ENIGMA, agents, photoreconnaissance, and electronic surveillance; the V weapons are a graphic case-study in intelligence work.

And what came of it at last?

Here in Manchester the story is well-known of Turing, the genius who had done much to break Enigma and to give Jones the information to counter the V-weapons, who was convicted of homosexuality, then a crime, and whose early death in 1953 after eating an apple coated with cyanide could have been suicide.

The rockets themselves, which had been built by the labour of slaves - many of whom died – and which had killed thousands, had been developed by another genius, whose life had a different outcome.

Werner von Braun ended on the front cover of TIME magazine.