***Left:** Ruth Bourne pictured in her Wren uniform during WWII. The band on her hat reads, 'HMS' but no ship is named, which was a subtle indication of her intelligence work*

WOMEN OF BLETCHLEY

PART I: THE BOMBE OPERATOR

WORDS **TOM GARNER**

In the first of a two-part series, Ruth Bourne reveals how she operated the famous codebreaking machine developed by Alan Turing and Gordon Welchman

Although it was shrouded in secrecy for decades, the codebreaking work of Bletchley Park is now recognised as an extraordinary wartime achievement. Prodigiously talented cryptanalysts devised various methods to decipher Axis communications. This produced vital intelligence to aid military operations. Their work shortened the war by two to four years and saved approximately 14 million lives.

To achieve this astonishing success, Bletchley Park industrialised codebreaking to unprecedented levels by developing machines such as the Turing-Welchman 'Bombe' and the world's first electronic computer 'Colossus'. These devices were built in their hundreds and required many people to operate them.

By 1945, almost 10,000 people worked for the Bletchley Park organisation. 75 per cent of these employees were women, and of those, 60 per cent were uniformed personnel. This included Ruth Bourne, who was a young recruit from the Women's Royal Naval Service (WRNS or 'Wrens'). Bourne was only 18 years old when she worked at Bletchley's outstations, but she had a responsible job as a Bombe operator. Now a lauded but modest veteran, Bourne describes her secret role operating one of the most technologically complicated but decisive machines of WWII.

"Breaking German codes"

Born in 1926, Bourne joined the Wrens in June 1944 shortly after she turned 18, although her reasons for volunteering were partly aesthetic. "I wanted to join the services, and one of the appeals was the uniform, which was designed by Hardy Amies. The other uniforms were just ordinary men's jackets off the peg, and I didn't even like the colours! The Wrens were much more stylish. My aunt was one of the first women doctors in the army, and she said that the Wrens always had the best time when they were off duty."

After joining the Wrens as a rating, Bourne's training was very different from the job for which she would eventually be chosen. "The basic training was nothing to do with Bletchley. We went up to Scotland and you learned naval terminology, how to scrub floors, get up early and salute, etc. We were then given uniforms and categories before being sent down to Eastcote via London."

Bourne and six other Wrens were assigned to 'Special Duties X', which led to a fateful interview. "It was with a female petty officer

Bombe machines were a key part of the work to decipher Enigma codes during WWII

and she said, 'The work you will be doing is highly secret. You'll be asked to sign the Official Secrets Act and you won't be able to tell anybody what you did, saw or heard. The hours are antisocial and there will be no promotion. After your training you'll get a slightly higher specialised pay and you'll be working within 50 miles [80 kilometres] of London at all times."

Bourne willingly volunteered for this clandestine role. "My ears pricked up because Birmingham was very boring and I always wanted to live in London or have access to it. We all said yes and signed the Official Secrets Act before the petty officer said, 'All I can tell you is that we are breaking German codes'. That's all I ever heard."

Now a member of 'Ultra', the Government Code and Cypher School (GC&CS) designation for British military signals intelligence, Bourne had joined the high-level decryption team that came to be collectively known as 'Bletchley Park'. She believes she was recruited for her linguistic skills: "It was possibly because I was very interested in languages. I had done French, German and Spanish and wanted to be a journalist. I hadn't done them to university level but I had got an entrance to London University and received a lot of distinctions when I did my school certificates." Despite her language skills, Bourne trained to operate an advanced machine to break Axis codes: the Bombe.

"BY THE END OF THE WAR OVER 200 BOMBES WERE OPERATED BY 1,676 WRENS AND 263 MALE RAF PERSONNEL"

A "weird codebreaking factory"

By the end of the war over 200 Bombes were operated by 1,676 Wrens and 263 male RAF personnel. After signing the Official Secrets Act, Bourne was deployed to Bletchley's outstations at Eastcote and Stanmore. At Eastcote she spent a fortnight training on Bombes, which were housed in separate wings that were named after occupied Allied countries. From Bourne's perspective, Eastcote was "like working in a weird codebreaking factory. You went from one machine to another in a large room, which was a sort of 'Bombe bay'. You saw all these machines around you but you just took it for granted."

Two Wrens were assigned to each Bombe at any one time, although Bourne was unaware of Enigma's existence. "I never heard the word 'Enigma'. We understood 'No questions' so I didn't even bother to ask." Nevertheless, finding the key settings of the German cipher machine was central to the Bombe's purpose, as Bourne later discovered: "The Enigma operator chose three out of five scramblers with moveable alphabet rings on the side of each. Under these was a 26-letter plug board where he could join up ten sets of letters. These settings were changed every 24 hours, so if you permutated this and other variations it gave about 159 million million million possible Enigma settings."

Against such odds of finding the 'key' for the day, the Allies had developed the Bombe to help decrypt Enigma in rapid time. "It could replicate up to 36 possible Enigma settings in 15 minutes, and there were three 'wheels' that we put on to replicate the scramblers. They were technically 'drums' but we called them wheels. We fixed them onto the machine in a certain way before setting it off, and we also plugged it up at the back in the replica plug board. When the machine stopped we wrote down the 'answers'."

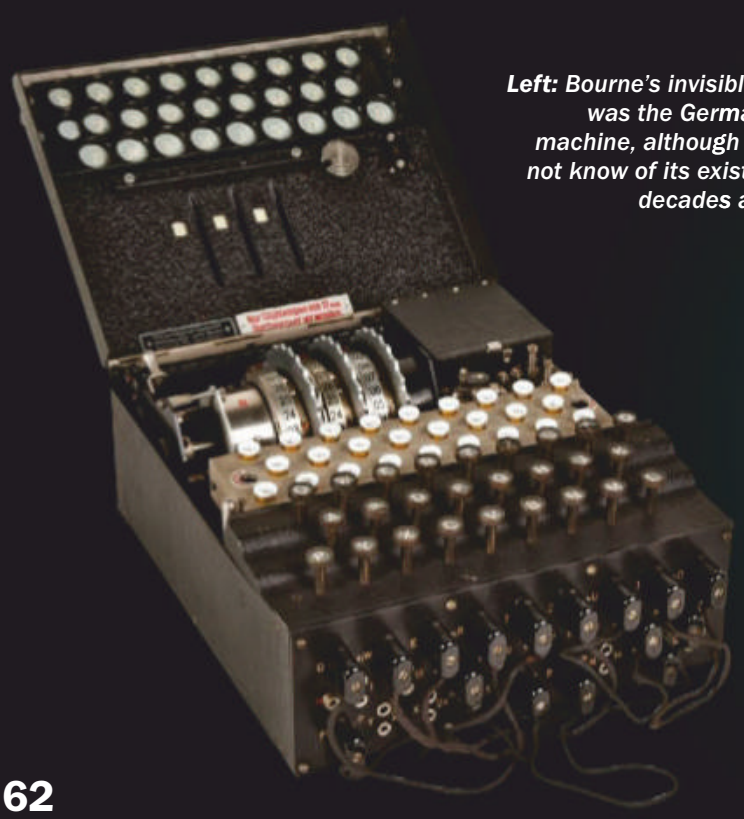
A MACHINE OF GENIUS

THE BRAINCHILD OF VISIONARY MATHEMATICIANS, THE BOMBE WAS A PRECURSOR TO THE MODERN COMPUTER AND CRUCIAL TO ALLIED VICTORY

Based on a previous Polish deciphering device, the Bombe was initially designed by Alan Turing and later refined by Gordon Welchman. With the ability to assist in the breaking of 3,000-5,000 intercepted messages each day, the brilliance of Turing's design was that the machine compared patterns of the encrypted message ('cribs') and a known portion of plain text to break the key. Additionally, Enigma could not code a letter as itself, so it inadvertently aided the Bombe. Therefore, encryptions could be lined up with a crib until no letter lined up with itself.

The Bombe would mimic Enigma's rotors and plug board and check 17,500 possibilities before it found a match and stopped. A checking machine would then process the match before the relevant information was passed on to codebreakers to fully decrypt. Using this system, the Bombe ultimately helped to crack 2.5 million messages by the end of the war.

The first Bombe was operational from August 1940, and 211 were eventually built. Their impact was sensational in intelligence-gathering from land, sea and air campaigns. Bletchley Park's staff were able to decode quickly and pass on information with enough time to be acted upon. This had a dramatic effect on Allied success, and Enigma decrypts from the Bombe were crucial to the outcomes of decisive victories such as the Second Battle of El Alamein and D-Day, among many others. These machines industrialised codebreaking and were so successful that the Germans never knew that the 'unbreakable' Enigma had been cracked.



***Left:** Bourne's invisible nemesis was the German Enigma machine, although she would not know of its existence until decades after WWII*

***Below:** Each Bombe was 2.1 metres [six feet ten inches] wide, two metres [6 feet seven inches] tall, weighed one ton, and had 19 kilometres [12 miles] of wiring and 97,000 different parts*

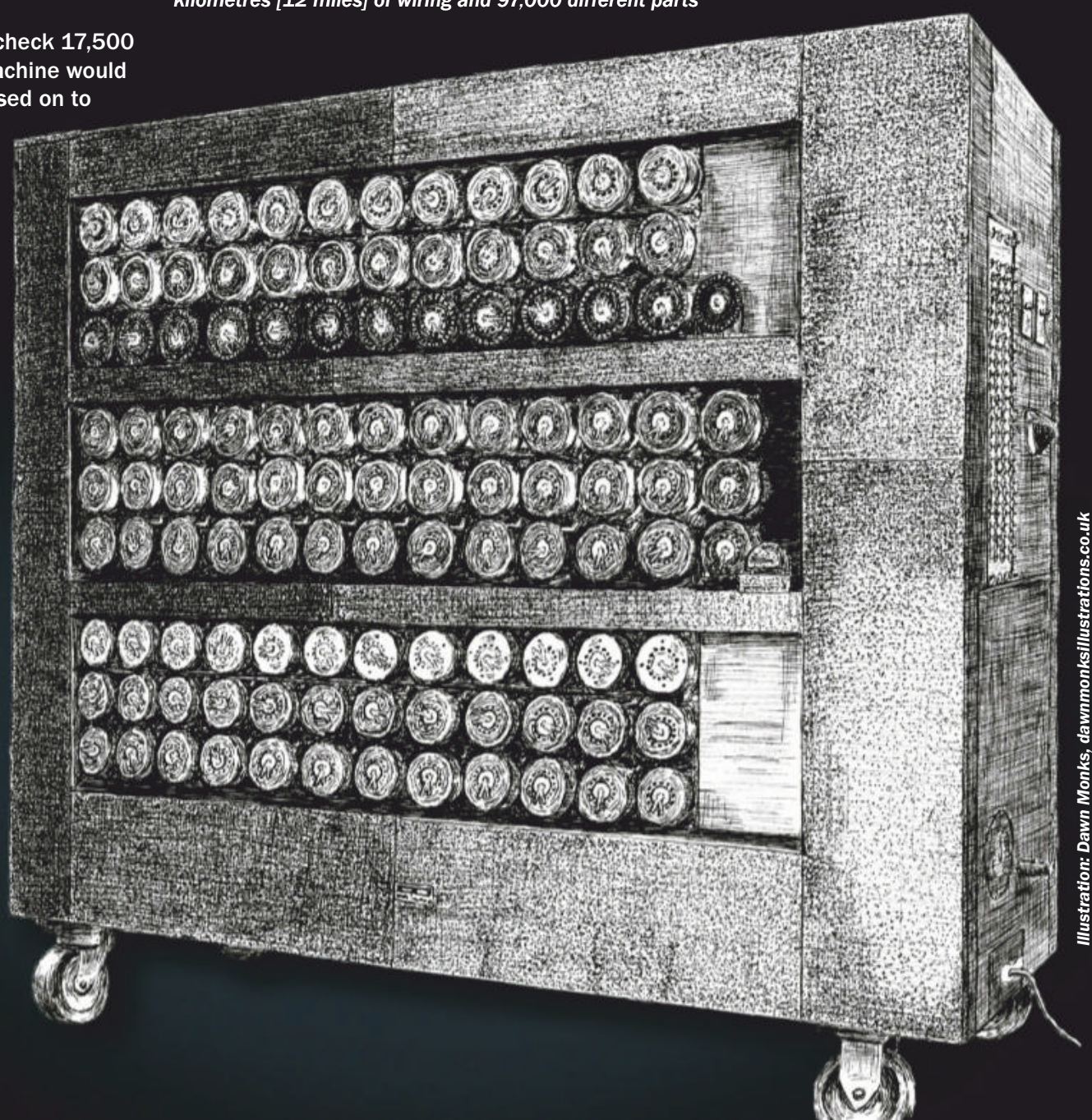


Illustration: Dawn Monks, dawnmonksillustrations.co.uk

Preparing the Bombe for a key searching 'run' was a delicate process. "Because the three wheels replicated the scramblers they had to be very accurately set. They had four rows of 26 wire brushes at an angle and 17-19 strands of wire in each brush. One brush could not touch another, so we had to tweeze the used ones out while the machine was running because we didn't want to waste time. You couldn't turn the drum in the wrong direction otherwise you could cause short circuits."

Working behind the Bombe was vital so that instructions sent by Bletchley Park could be accurately carried out. "You went around the back with your checking partner and joined up the plugs that replicated what were in the front of the Enigma. This was because the 'Stecker' plug board on the machine was changed every day. You did all this by following a vitally important worksheet called a 'menu'. This was constructed by the codebreakers at Bletchley, which represented their projections of what the Enigma key settings might be."

Although Bourne was not involved in the mathematical aspects of codebreaking, her operational diligence was important. "The information was given to us because we didn't and couldn't work it out. However, it was beaten into our brains that we had to be accurate. I was told that 100 per cent accuracy was no good: it had to be 150 per cent."

RAF Eastcote, pictured from the air in 1945. This government site was an outstation for Bletchley Park's codebreaking operations

Once the necessary preparations were complete the machine would be started for a 15-minute run to find the key to the coded messages. "You pressed the starter button, and while it was running you filled in a log sheet. At the end of a run you would take some of the wheels off and put on others according to your instructions. You took off the used wheels while the next run was going and tweezed out any wires touching each other, before putting them back onto a wall rack. You also logged down how the machine behaved during the previous run."

When the machine stopped, Bourne's next job would be to write down information that might indicate that an intercepted message key had been found. "You wrote the information about the wheel orders, which were the equivalent to the three Enigma scramblers and also the letters on another set of wheels. These were related to the letters chosen by the German operator before he dropped his scramblers into his machine."

More detailed information about the message was needed for the cryptanalysts at Bletchley. "You went to the side of the Bombe where there was a 'letter box', where three little rows of the alphabet going from A-Z had a little bale in each window. The machine was telling you which rows of wheels were of interest: the top, middle or bottom. You wrote that down because they were the most important bits of information the mathematicians were looking for. It would tell them if the code setting on the Enigma machine was the right or wrong one."

The key to the coded message was then given additional scrutiny on a 'checking machine'. "You would get the information up

"THESE MACHINES INDUSTRIALISED CODEBREAKING AND WERE SO SUCCESSFUL THAT THE GERMANS NEVER KNEW THAT THE 'UNBREAKABLE' ENIGMA HAD BEEN CRACKED"

on your machine from the same 'menu' that was on your Bombe. The three wheels were put on and everything was checked. It was very mathematical, and the checking machine would look for strong possible letter pairs relating to the Enigma plugboard, among other factors. 'A' for example might be connected to 'Z' for 24 hours, and if we could find one combination others might be worked out that might break the code for that day."

Speed was now essential in order to get the information decoded. "You'd run like a lunatic from your machine all the way to the bottom of these very large rooms. It was a straight line with long barrack-like rooms with 10-12 Bombes in each one. There was a lot of noise but when you got a message you'd have to go along to the end of one of these off-shoots and hand in your information."

"If the checking machine had found a good 'Stop' on the Bombe then Bletchley would be immediately informed. "There was a red telephone, which was a voice scrambler, but we didn't say, 'I think there is a good answer to a code' etc. The Bombe bay we were in was called 'Norway' and each machine was named after a Norwegian town or village. For example I would say, 'This is Norway. I have a good Stop for you on Stavanger.' Then you would describe the 'Stop' on the Bombe."

Once Bourne's code was handed over to Bletchley it would be analysed on one of the park's resident Enigma machines. "If any kind of clear German came out it would possibly be the answer to all messages in that particular warzone up until midnight, when it would be changed again."

"IF YOU GOT A CODE WRONG THAT WAS 24 HOURS WASTED, MAYBE HUNDREDS OF PEOPLE DYING AND ALL THOSE CLEVER PEOPLE WOULD HAVE BEEN WASTING THEIR TIME"

A code confirmation was known as a 'Good Stop' but as Bourne describes, "it might have been the correct code but the Enigma machine could also give you two or three other 'Stops' in each 15-minute run." If Bourne's intercepted message was finally confirmed as a 'Confirmation Stop' she would be briefly informed. "They wouldn't phone you back but the petty officer in charge of the watch would come up and say, 'Job up. Strip.' This meant pulling off the wheels on the Bombe and pulling the plugs out on the back, which were equivalent to the Stecker plugs. You then started all over again with new wheels. It was very organised."

Although Bourne routinely performed this complicated operation every day she felt gratified when her intercepted messages were confirmed. "You never knew what had been in the message but you felt very pleased that you hadn't made any mistakes. It was also a matter of luck depending on which wheel orders you'd got, but you did feel good if you heard 'Job up'."

Pressure, burnout and secrecy

Because of the immense importance surrounding Bletchley Park's operations, Bourne was never complacent about her work. "It was very serious. If you got a code wrong that was 24 hours wasted, maybe hundreds of people dying and all those clever people would have been wasting their time. It was like being a link in a chain or the beginning of a pathway, and that's why we were going for 150 per cent accuracy."

The pressure of operating the Bombe was also compounded by gruelling shifts. "During the first week in a month you would work from 8am-4pm, the second week 4pm to midnight, midnight to 8am during the third week and by the fourth week there was an extra shift, which was quite difficult. You worked in Block B, but in Block A, where you ate and slept, you were considered an ordinary Wren again. You still had to do other duties like fire watching and washing up, whether you were tired or not."

Bourne recalls that the relentless working hours were exhausting: "It was like having constant jet lag. Sleeping was difficult and you'd have indigestion from having your 'lunch' at midnight and having your breakfast at 8am when you came off, before going to bed. 72 of us slept on double bunks in a 'cabin' at Eastcote that was more like a barracks with concrete barrier walls. The curtains were cheap and thin so if you went to bed at 10am it was very hard to sleep with the light coming through."

Eventually, the fatigue took its toll. "A lot of us were knackered and suffered from burnout, including

Above: *A Bombe pictured at Bletchley Park in 1943. There were different variants of the machine that were given nicknames to reflect the bulky size, including 'Jumbo', 'Ogre' and 'Giant'*

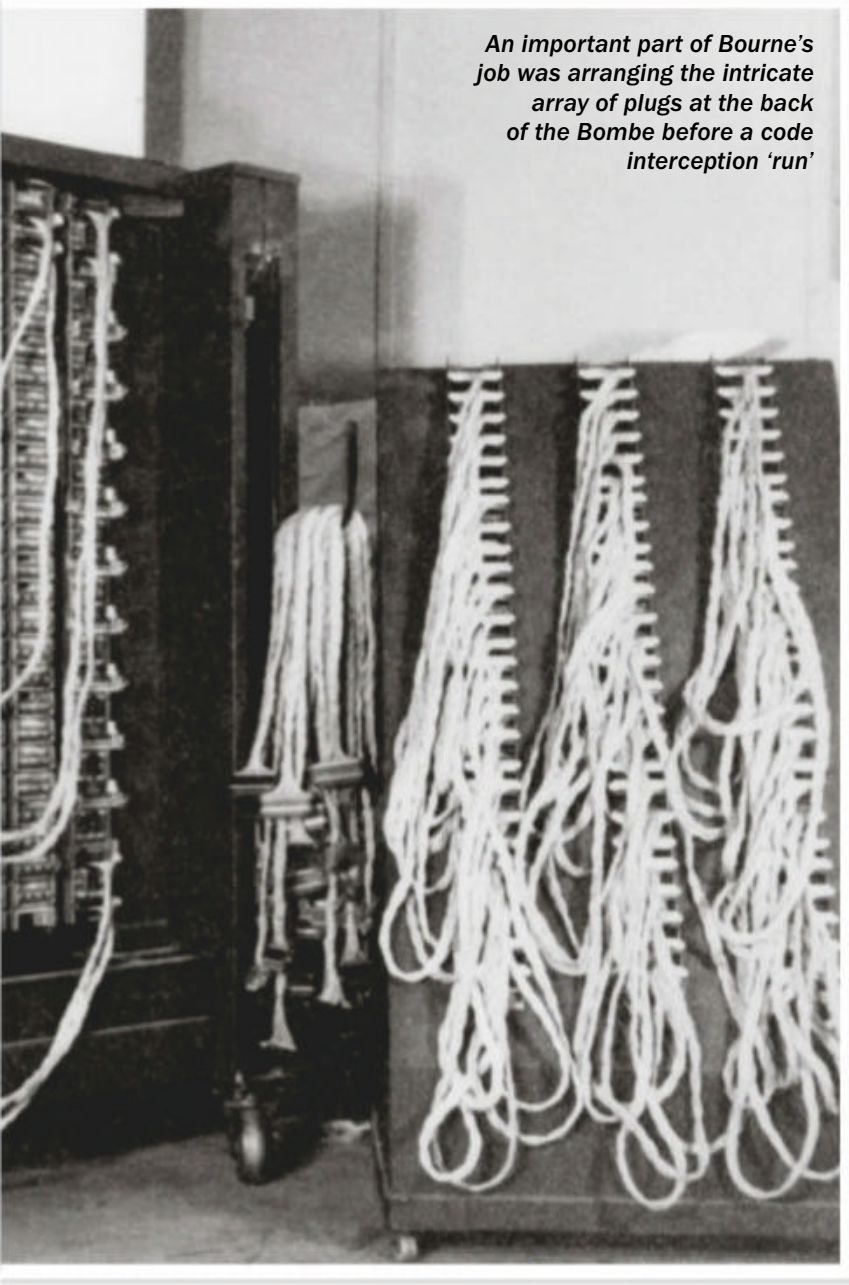
Right: *Bourne wearing the Bletchley Park commemorative badge and her newly awarded Légion d'honneur, 12 December 2018. She says that receiving the French award was "absolutely amazing"*

myself. I initially didn't know what it was and only knew I didn't feel well. When I went to sickbay and the doctors asked what the matter was I just said, 'I don't know' and started crying. They put me to bed for four days and my mother came down from Birmingham and brought me what seemed like half a chicken! They gave me a week's leave, which was very unusual, but I bounced back."

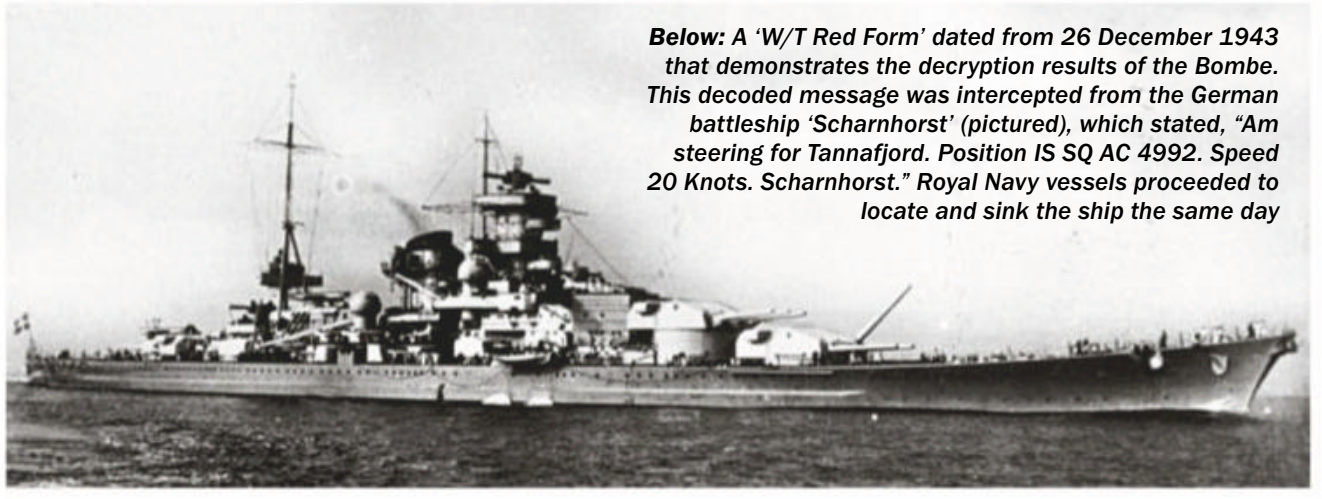
Despite her mother's visit, Bourne could not tell her about her work. "She was very miffed and would say, 'You can tell me, I'm your mother' but I thought, 'Yes, but it would be around Birmingham in five minutes flat'. She hadn't signed the Official Secrets Act but I had, and 'nice girls' like me did what they were told."

Maintaining Bletchley's secrecy was considered to be vital. "We were told, 'You must never tell anybody. That's forever and if by any chance you let the word out you will be immediately sent to prison.' It was not cool to go to prison so we took it very seriously."

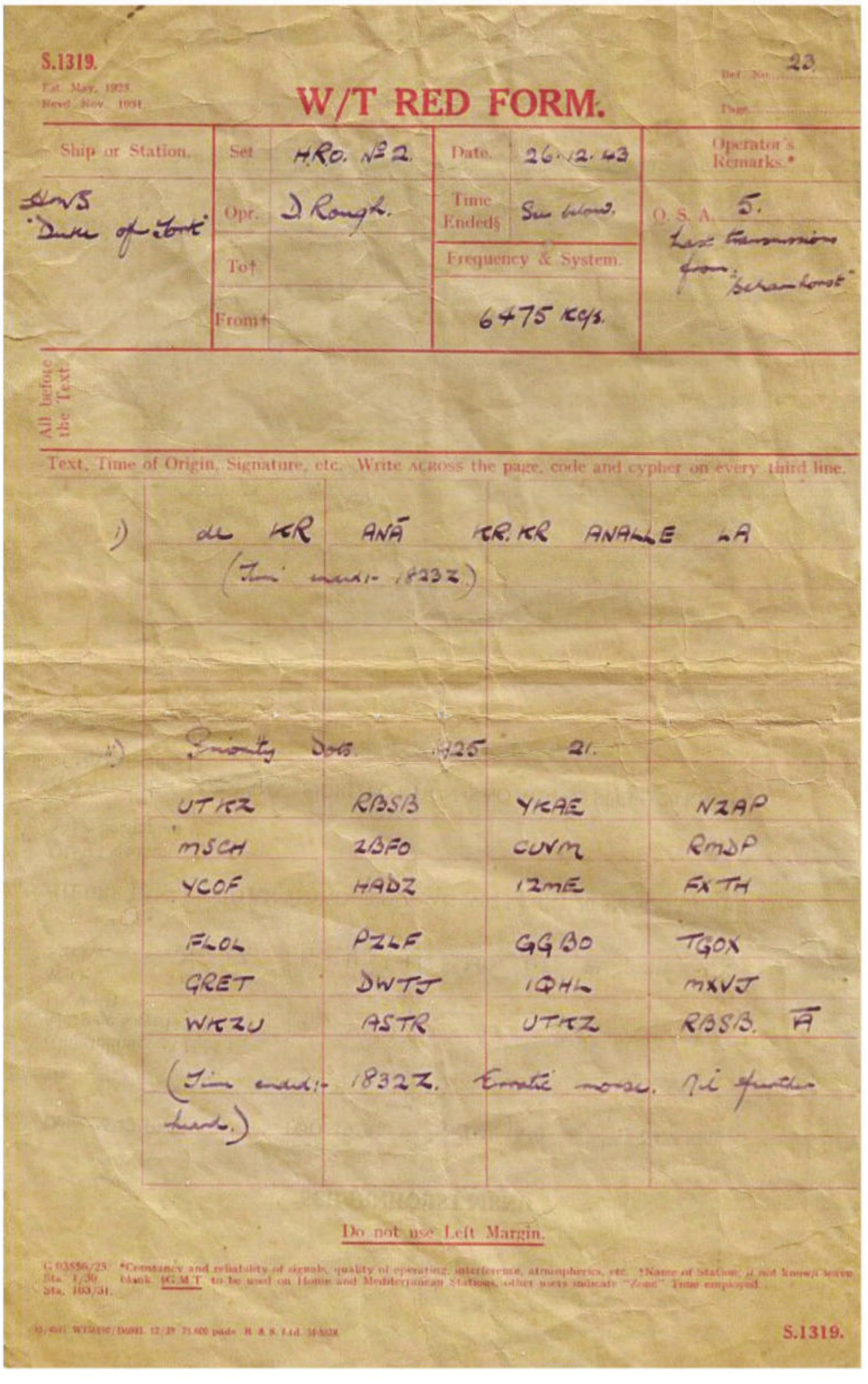
Bourne's anonymity took practical forms, although she once encountered a fellow secret operative from headquarters. "We had no badges on our uniforms to say what we were doing, although other categories of Wrens did. I once met a girl and we asked each other what we were doing and she said, 'I'm at Bletchley'. I replied, 'That's nice. Our quarters are horrible, what are yours like?' but she simply repeated, 'I'm at Bletchley'. I knew then that she wasn't going to say another word, that's how it was." Such was the successful silence surrounding Bletchley that Winston Churchill sent a thankful telegram to Eastcote. "He was very fond of bird analogies and described the Bletchley



An important part of Bourne's job was arranging the intricate array of plugs at the back of the Bombe before a code interception 'run'



***Below:** A 'W/T Red Form' dated from 26 December 1943 that demonstrates the decryption results of the Bombe. This decoded message was intercepted from the German battleship 'Scharnhorst' (pictured), which stated, "Am steering for Tannafjord. Position IS SQ AC 4992. Speed 20 Knots. Scharnhorst." Royal Navy vessels proceeded to locate and sink the ship the same day*



S.1319.
Est. May, 1925
Revd. Nov. 1941

W/T RED FORM.

23

Ship or Station.	Set H.R.O. Nº 2.	Date. 26.12.43	Operator's Remarks.*
H.M.S. "Duke of York"	Opr. J. Rough.	Time Ended§ Sunblind.	O.S.A. 5. Last transmission from "Scharnhorst"
	To†	Frequency & System.	
	From†	6475 kcs.	

All before the Text.

Text, Time of Origin, Signature, etc. Write across the page, code and cypher on every third line.

1) du KR ANĀ KR. KR ANALLE uA
(Tim ended: 1832Z.)

2) Priority Dots 425 21.

UTKZ	RBSB	YKAE	NZAP
MSCH	2BFO	CUVM	RMSP
YCOF	HADZ	12ME	FXTH
FLOL	PZLF	GGBO	TGOX
GRET	DWTJ	1QHL	MXVJ
WKZU	ASTR	UTKZ	RBSB. Ā

(Tim ended: 1832Z. Erratic morse. Ni further luck.)

Do not use Left Margin.

C.03556/25 *Constancy and reliability of signals, quality of operating, interference, atmospherics, etc. †Name of Station, if not known leave Sta. 1/30. Black G.M.T. to be used on Home and Mediterranean Stations, other users indicate "Zone" Time employed. Sta. 103/31.

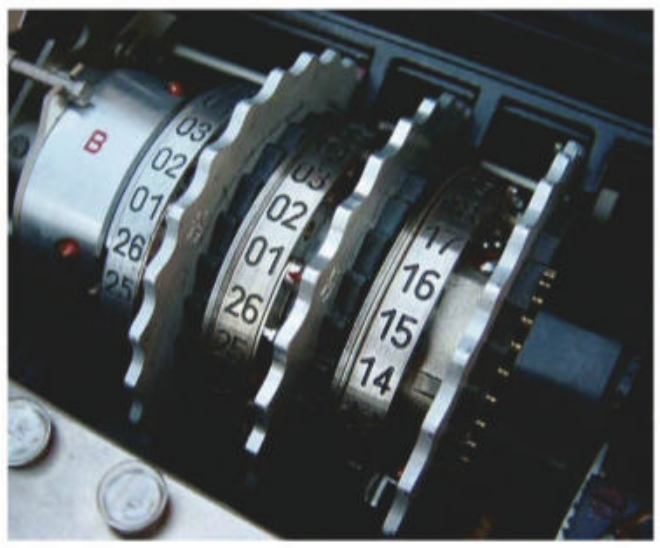
S.1319.

employees as ‘the geese that lay the golden eggs but never cackled’. I remember reading on the notice board a message he sent to the Wrens that said, ‘Glad to hear the hens are laying so well without clucking’.”

Despite the pressure and silence surrounding Bletchley Park’s operations, Bourne did find time to enjoy herself. “I was quite happy and we had a lot of fun. In between your shifts there were lots of attractions in London where you could stay out with late passes. It also very much helped being in uniform. For example, we could get cheap theatre tickets and go out the back to meet stars such as Laurence Olivier and Emlyn Williams. They would sign our programmes and have a few words with us, which was nice.”

Following VE Day, Bourne was due to be posted overseas to work on Japanese weather codes, but Japan’s surrender ended that possibility. “We were selected to go to Malta or Gibraltar, where the new GCHQ was based, but we never got there. I clearly remember the atomic bomb was dropped while we were queuing to have our vaccinations to go abroad at Stanmore.”

Instead, Bourne was ordered to destroy the Bombe machines she had worked with throughout her wartime service. “Churchill had apparently ordered that they be dismantled, and we tore them apart. We had a soldering iron and there were 12 miles [19 kilometres] of wire in each Bombe. The wires had little connections, and these had to be unsoldered.



The three rotor stacks inside the Enigma machine were ingeniously replicated on the Bombe

The connections went into one box, the wire went into another box and a lot was sold off as army surplus.”

Silence and recognition

Bourne served in the Wrens until she was demobbed in November 1946. She didn’t speak of her wartime work for decades, until the secrets of Bletchley began to be publicised. “It wasn’t very difficult to forget about it because it had just been a job and I was getting married etc. What I had done went by the board and my parents died not knowing what I did, they hadn’t a clue. We [the surviving veterans] would still never have said anything, but books started to come out, like F.W. Winterbotham’s *The Ultra Secret* in 1974. Even that first book was very limited because all the information was still held in the Public Record Office.”

Nevertheless, Bourne eventually became determined to highlight the importance of the wartime codebreakers. In 1994 she became a volunteer guide at Bletchley Park, working there for over 20 years. During that time she became more aware of the value of her own work. “I had to be very knowledgeable and started reading all the books and making notes. I learned about how Enigma really worked and its connection to the Bombe, and then of course the whole picture began to add up.”

Through her guiding, Bourne began to be publicly recognised for her contribution, which she initially found a little disconcerting. “It was only when I started volunteering that more information kept emerging. People started to want to shake my hand for what I had done during the war, and that was very embarrassing but they thought it was important.”

Despite her modesty, Bourne is now a celebrated veteran and was awarded the Légion d’honneur by the French government on 9 November 2018. She is also more comfortable with the attention she rightfully receives: “Now I feel very proud but not because of what I particularly did in a way. The only thing I’m proud of is that I did it accurately and never told anybody. I can’t say I was a codebreaker because I wasn’t. However, I was part of it and trusted to be part of it. I’m very much surprised at the recognition, but I feel very pleased and happy.”

Images: Getty, Shutterstock, Ruth Bourne

“BOURNE IS NOW A CELEBRATED VETERAN AND WAS AWARDED THE LÉGION D’HONNEUR BY THE FRENCH GOVERNMENT ON 9 NOVEMBER 2018”

A Bombe unit room at Eastcote c.1943. The women are sat in front of the checking machines, which scrutinised the Bombe’s intercepted messages before being passed on to Bletchley Park