Binary Code and Cypher Challenge

Background
The new £50 banknote features Alan Turing, the World War II codebreaker and computing pioneer. Turing worked at the ***Government Code and Cypher School*** at Bletchley Park, in the section that was responsible for decoding German naval cyphers. He helped develop a machine that could find settings for the German Enigma machine and hence allow top secret messages to be decoded.

No printer? No problem
If you do not have a printer, grab a pencil and a piece of paper and follow the instructions in *blue italics* on page 2.

What you need to know – binary code
This challenge combines the use of binary code and a cypher, which helps to convert a series of 4 or 5 digit numbers into a two-word solution.

Binary code underlies all computer languages. Numeric values are stored using only the digits “0” or “1”, which represent “off” or “on”.

In the decimal system that we use every day, numbers progress in multiples of 10: 1 x 10 10 10 x 10 100 100 x 10 1,000	In binary code, numbers progress by a multiple of 2 1 x 2 2 10 2 x 2 4 100 4 x 2 8 1000 8 x 2 16 10000 16 x 2 32 100000

So the building blocks in binary code are 1, 2, 4, 8, 16, 32, 64, 128 and so on. Any decimal number can be expressed in binary code by breaking it down into the constituent building blocks. For example:
Decimal No = 57
Building Blocks = **32x1 + 16x1 + 8x1 + 4x0 +2x0 +1x1** = 111001 in binary code

What you need to know - simple cypher
A cypher allows a number to be converted to a letter.
For example:-
1=A 2=B 3=C 4=D 5=E 6=F 7=G 8=H 9=I and so on, up to 26=Z

So the code
19-5-3-18-3-20
when converted using the cypher above spells out
S-E-C-R-E-T.

The challenge

Using binary code and a cypher, your challenge is to find a 2-word solution (6+4 letters) to the following clue:

What is Alan Turing famous for breaking?

Step 1 - excluding the two example rows, copy the table below onto a piece of paper (5 columns x 6 rows).

Step 1 - convert the following binary codes (one for each letter of the solution) into a decimal number:

Letter	Binary Code	Calculation	Decimal Number	Letter of Alphabet (Step 4)
Example 1	11111	16 + 8 + 4 + 2 + 1	31	
Example 2	10011	16 + 0 + 0 + 2 + 1	19	S
L1	10110	16 + 0 + 4 + 2 + 0	22	V
L2	1101	8 + 4 + 0 + 2	14	N
L3	10010	16 + 0 + 0 + 2 + 0	18	
L4	10100			
L5	1110			
L6	11010			
L7	11000			
L8	1100			
L9	10111			
L10	10110			

Step 2 - copy the table below onto a piece of paper (7 columns x 3 rows).

Step 2 – convert the following binary codes to decimal numbers. This is your cypher:

Cypher Letter	T	U	R	I	N	G
Binary Code	111	110	1001	10010	1101	10100
Decimal Number	7	6?	9	18	13?	20?

Step 3 - write out the letters of the alphabet (A to Z) with space underneath for a decimal number.

Step 3 – write each decimal numbers generated above under the corresponding letter in the grid below. This is your cypher. You can now work out the decimal number associated with each letter of the alphabet:

A	B	C	D	E	F	G	H	I	J	K	L	M
						7		9				

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
14				18		21	22					

Step 4 – go to the last column of the table in Step 1 and, for each letter (L1-L10) and with reference to the grid above, insert the appropriate letter of the alphabet.

You should now be able to complete the grid below:

Copy the grid below onto a piece of paper (6 boxes, a hyphen, 4 boxes).

What is Alan Turing famous for breaking?

						-				
L1	L2	L3	L4	L5	L6	-	L7	L8	L9	L10