MysteryTwister C3

THE CRYPTO CHALLENGE CONTEST

Wheatstone Cryptograph – Part 2

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Introduction (1/2)

The Wheatstone Cryptograph is a simple device invented by Charles Wheatstone in the late 1800s. Variants of it were used until World War II. The device resembles a clock with two hands. For each hand there is a ring of symbols. The longer hand points to the outer ring, which holds the plaintext symbols. The plaintext alphabet consists of the 26 letters of the English alphabet and the space character. The shorter hand points to the inner ring, which holds the ciphertext symbols. The ciphertext alphabet is the key of the device and is a permutation of the 26 English letters; it does not include the space character.
For further information on the Wheatstone Cryptograph see the references on page 10.

Introduction (2/2)

The hands are geared so that they always move by the same number of symbols on their respective rings in the clockwise sense, but not by the same angle. The short hand moves through an angle that is 27/26 times the angle moved by the long hand.

Figure: https://www.shutterstock.com/image-vector/cipher-algorithm-performing-encryption-decryption-less-1394832830

Method of Encryption (1/4)

Before encrypting, double letters are removed from the plaintext; the second of each double letter is replaced with Q. As a check, a space character can optionally be added to the end of the plaintext. The plaintext can contain only letters and spaces.

The hands of the device are placed in the 12 o'clock position, so that the long hand points to the space character and the short hand points to the first letter of the key. For each character in the plaintext, the hands revolve until the long hand points to that character. The short hand moves the same number of steps on the inner ring. The character to which the short hand points is the corresponding ciphertext character.

Method of Encryption (2/4)

Let's work through a short example. Suppose the plaintext is

MEET AT DAWN

and the key is from the example in part 1, SAMZEBNCDORF-PGQTHUKIVJWYLX. First, we must prepare the plaintext by hiding the second E and (optionally) adding a space to the end of the message.

MEQT_AT_DAWN_

The Cryptograph begins with both hands pointing upward. To make this exposition easier, we will unwind the rings of the device and write each ring repeatedly. The initial position is this:

```
_ABCDEFGHIJKLMNOPQRSTUVWXYZ_ABCDEFGHIJKLMNOPQRSTUVWXYZ...
SAMZEBNCDORFPGQTHUKIVJWYLXSAMZEBNCDORFPGQTHUKIVJWYLXSA...
^
```

Method of Encryption (3/4)

To encrypt the first letter, we move until the long hand points to M. The short hand point to G.

```
_ABCDEFGHIJKLMNOPQRSTUVWXYZ_ABCDEFGHIJKLMNOPQRSTUVWXYZ...
SAMZEBNCDORFPGQTHUKIVJWYLXSAMZEBNCDORFPGQTHUKIVJWYLXSA...
                ^
```

We continue clockwise (rightward in the unwound view) to the second letter, E. Its encryption is N.

```
_ABCDEFGHIJKLMNOPQRSTUVWXYZ_ABCDEFGHIJKLMNOPQRSTUVWXYZ...
SAMZEBNCDORFPGQTHUKIVJWYLXSAMZEBNCDORFPGQTHUKIVJWYLXSA...
                                  ^
```

Method of Encryption (4/4)

Then onward to Q.

```
_ABCDEFGHIJKLMNOPQRSTUVWXYZ_ABCDEFGHIJKLMNOPQRSTUVWXYZ...
SAMZEBNCDORFPGQTHUKIVJWYLXSAMZEBNCDORFPGQTHUKIVJWYLXSA...
                                                    ^
```

We continue in this manner to get the full ciphertext:

GNKJMZWZCBAIN

Challenge (1/2)

Here is a ciphertext that has been encrypted with the Wheatstone Cryptograph.

```
RZFLQRQNESMYPZOWBYUJNHBRWVHDGFFFKFXREGRSBTLKHKJSWPGVZ
FFWPPKYSRGLXRMIVCQUPFPCNGQVACJLVSLSCLWAWYPWOZLFUMTPAE
MGNRQXVVFZTDUYEGZQZAOKLINLZGJODPNZFLBSJDTZEGWPFGZMCFE
XMIXKCVWJDUVCBZQUSYSJZZLVRCQBYPALXKKDZTIWPPMRJQJXSXGR
WJSQUGBEXHOOKLHZFSCRDRTAJHBNOJXOXBOUHZKDKWYZALAEILEXT
ALGXVILDJXNJEPSQMIUJDKPJI
```

Challenge (2/2)

The key is a randomly generated permutation of the 26 letters of the English alphabet, so that a dictionary attack would be unwise. The plaintext is in English. An X has been placed between sentences before encryption. (Note that sentences are not encrypted separately, in violation of Wheatstone's prescriptions.)

The solution to the challenge is the 26-letter key. Remember that the key begins with the letter that is directly under the space in the plaintext alphabet on the Cryptograph.
Please enter the solution in upper-case letters without any spaces or punctuation.

References

- Charles Wheatstone, “Instructions for the Employment of Wheatstone’s Cryptograph”, The Scientific Papers of Sir Charles Wheatstone, The Physical Society of London, 1879, pages 342-347, https://books.google.to/books?id=CtGEAAAAIAAJ
- William F. Friedman, Several Machine Ciphers and Methods for their Solution, Riverbank Laboratories Department of Ciphers Publication No. 20, 1918, http://www.campx.ca/Several_Machine_Ciphers.pdf
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