of the world war. The surrendered German fleet was interned at Scapa Flow, scene of recent German air raids, on July 21, 1919. The British fleet had just put to sea for maneuvers when Rear Admiral Ludwig von Reuter issued a secret order reading:

"PARAGRAPH 11, ACKNOWLEDGE"

That paragraph, in its way, was a code phrase meaning, "Open all sea-cocks, scuttle the fleet."

Fifty of the 74 German vessels, led by their flagship, Friedrich der Grosse, went to the bottom before the British could do anything about it. It was one of the greatest naval losses in history.

And so the cryptographers' war will go on. Not until years from now, when the present day history of the world's Black Chambers can be written, will we know just how important a part secret writing is playing in the war now being fought in Europe.

SECRET CODES

Everybody has a secret. Sometimes it's a very personal secret to be kept in a diary for private use. Most of the time, however, the secret, to be really enjoyed must be shared, but not with everyone. The trick, then, is to keep your secrets from being discovered. That's why the science of secret writing, or cryptography, was invented. Today it has become a fascinating study, a hobby and, at times, grim business.

Now secrets vary greatly in importance. A secret shared by two friends, for example, is only important to them. But if the secret of a great nation becomes known to enemies, a war may be lost. And, in the same way, if the secret of a great corporation becomes known to its competitors, thousands of dollars may be lost.

THE LAWRENCE "SECRET CODE MAKER"

The Lawrence "Secret Code Maker" is a clever yet simple device that can be used to construct millions of codes that will be difficult to "break" by even an expert. Only those owning a Lawrence Rule and knowing the secret "key" will be able to decode your message with ease.

Before we go ahead with our first message, however, let's examine the Lawrence "Secret Code Maker" more closely. You have to get the hang of it before diving head-foremost into a code, even though the rule is designed to enable anyone who can read to code and decode messages quickly by any of a vast number of different plans. The rule, you notice, consists of two parts: The Body and Slide.

On the Body of the code-maker there are two complete alphabets along the top, one after the other. On the lower face of the body are figures in series of ten digits, thus: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2 and so on. Besides the alphabets along the top and the figures along the bottom there are two arrows one at the top and one at the bottom for use in setting the Slide.

The Slide has two alphabets along its upper edge exactly like the ones at the top of the Body. Two more alphabets, this time reversed, and reading from right to left, appear along the Slide's center. On the bottom edge of the Slide, there is a continuous row of figures just like the one on the Body.

At this point we may as well take time out for a few other simple definitions. Cryptographers, for example, call the communication to be put into code, or enciphered, the "clear," the method used a "cipher," and the final coded communication, the "message," or a cryptogram.

HOW TO USE THE LAWRENCE SECRET CODE MAKER

All right. Now—jump back to the time of Julius Caesar, some 60 years before the birth of Christ. Let's say that Caesar sat in his tent one night and wanted to write down one of his most famous communications in code. His system was to shift each letter of the "clear" (the original message) four places down the alphabet. It would have been an easier job for him if he'd had a Lawrence code-maker, but anyhow he accomplished his task. Here's how we'll do it with our rule. The "clear" is this:

I CAME, I SAW, I CONQUERED

First we select the key letter "C." (We can use any letter as key letter.) Place the Slide so that the key letter "C" at the top of the Slide comes directly under the arrow at the left end of the Body. This will place the "A" on the body directly over "D" on the slide, thus achieving the same effect Caesar strove for. We now can go ahead and code the sentence above. Find each letter of the "clear" on the Body and jot down the letter on the Slide that appears just under it. Find the first letter of the message, in this case "I." Directly beneath "I," you will find "L." The next letter of the message is "C" and the corresponding letter on the slide is "F." By the same method, "A" becomes "D," and so on. The coded message, when completed, will look like this:

L FDPH, L VDZ, L FRQTXHUHG

Now then, although we know that Caesar had no such thing as a watch when he lived—they were not invented until many years later—let's say he did have one and wanted to record the time he coded his message. Say the time was 11:30 a. m. The numbers of the message are to be found on

the lower edge of the Slide and the coded numbers directly beneath on the body. In code, then, the message will look like this:

L FDPH, L VDZ, L FRQTXHUHG 8807DP.

Do you begin to see now why cryptography is so interesting and so much fun? But we've only begun—you haven't seen anything yet!

The person to whom this message was sent had to decipher it in order to read the meaning. With a Lawrence Code-Maker and the knowledge that the key letter was "C," the job would have been as easy as shelling peas. He'd simply set the slide at "C," then move along until he came to the first letter of the coded message on the slide, in this case the letter, "L." Directly above it, of course, on the body of the rule appears the first letter of Caesar's communication. Naturally, it's "I." The next letter, "F" becomes, "C" of the "clear" and so on. The numbers, likewise, fall into place by looking for the numbers on the Body and reading them on the Slide. The whole process, you see, is backwards.

Caesar, however, didn't have a handy Code-Maker and so he wasted a lot of time setting up alphabets and counting off letters. Besides that he probably made many errors. Had he owned the Lawrence "Secret Code Maker," he could have set it on any key letter for another code. By using the reversed alphabets along the center of the slide, he would have had another series of codes. Using "C" again as the code word, but this time using the reversed alphabets for our code, Caesar's message would be set up this way:

Set the letter "C" of the reversed alphabets under the arrow. Again using the alphabets on the Body as the letters of the communication, slip the runner down to "I" and beneath it, on the Slide, in the reversed alphabet, appears the letter "T" which becomes the first letter of the coded message. Follow this procedure letter by letter and the message then looks like this:

I CAME, I SAW, I CONQUERED 1130AM

T ZBPX, T JBF, T ZNOLHXKXY 7796BP

The message is deciphered by setting the slide at the same key letter and going through the same process backwards.

Spacing the words of a cryptogram often is a giveaway. So as coding became more and more of a science, cryptographers arranged the letters of the coded message in groups of five and dropped the punctuation. Following this procedure, the last coded message then looks like this:

TZBPX TJBFT ZNOLH XKXY7 796BP

If a stop, or punctuation mark, is required to show the end of a sentence, a little-used letter, such as "J," "Q," or "Z," can be substituted in

place of the period or other marks. Such letters in a coded message are called "nulls." Sometimes they are used to fill out the end of a line or fill in empty spaces of more complicated codes.

Had Julius Caesar owned the Lawrence "Secret Code Maker," he would have had still another series of codes ready for instant use. This new series provides for the use of alternate letters. Let's do one.

Set the "C" of the slide under the arrow as we did in the first code. We'll use the same clear, "I came, I saw, I conquered." Find the first letter of the sentence on the body and use the letter from the top alphabet of the slide for the first letter of the coded message. In this case it is "L." For the second letter of the clear use the reversed alphabet on the slide. For the third, use the top alphabet, and so on, back and forth. The coded sentence will then look like this:

L UDKH O VWZ O FIQGXSUSG

The message can be decoded just as easily as the others.

The Julius Caesar cipher is what is known among cryptographers as simple substitution. There are a great number of variations of it on this rule alone. Many times, however, arbitrary signs, or symbols, are used instead of letters. Edgar Allen Poe illustrates a classic example of such a code in his story, "The Gold Bug." Other examples of it are the pig-pen cipher, also known as the Rosicrucian cipher, and the zig-zag system once commonly used by criminals.

HOW SIMPLE SUBSTITUTION CIPHERS ARE SOLVED

Through the Dark Ages, cryptography suffered a decline. The only literate persons of those times were the rulers and the monks. So there was small use of secret writing although isolated examples of cryptography arose. Such an example was the enciphered manuscript of Roger Bacon, which hasn't been decoded to this day—thus refuting the statement that there never has been a cipher that couldn't be broken.

Another reason for the decline was the fact that cryptographers had found a relatively easy way to decode the substitution codes then in use. As a matter of fact anyone owning a Lawrence Rule could break these ciphers after a few trial settings if he had patience and time enough. The other, but more complicated, method of breaking ciphers is based on the frequency of letters and words in the written language. Thus, in English, "E" is the most frequently used letter and symbols for "E" in a coded message will be repeated more often than any other.

To break or solve a code by this method, a count of all the letters, or symbols, in the coded message is made. This always is the first step. If 200, or more, letters have been used, the system of decoding is almost mathematically certain. In other words, the most frequently used letter or symbol of the message will always be "E" of the clear. This is put down in place of the symbol and the cryptography will then go on to the next most frequently used letter—this time "T"—and make the substitution. The letters of the alphabet, in the order of frequency, are as follows: E, T, A, O, N, R, I, S, H, D, L, F, C, M, U, G, Y, P, W, B, V, K, X, J, Q, and Z.

Cryptographers, however, never would have to go through the complete alphabet, for after several letters of the original message have been deciphered, certain word and letter combinations would be disclosed. This, in turn, would reveal still more letter probabilities of the original message. Expert cryptographers have at their command elaborate tables arranging such words and letter combinations in the order of their mathematical frequency. We haven't space here to go into the entire method in detail, but if you care to find a classic solution of a substitution code, read Poe's "Gold Bug." Any expert cryptographer can break a simple substitution code easily, provided the message is long enough.

With the rise of learning and the growth of trade in Italy during the Renaissance, cryptography again came back into its own. Abbot John Trithemius of Spanheim wrote a book published in 1518, two years after his death, in which he developed an elaborate system of suppressing frequencies of commonly used letters by the substitution of a number of symbols or phrases for them. His system, though, required a special code book in the hands of both the receiver and sender of a message so that it could be enciphered and translated.

Francis Bacon, several years later during the reign of Queen Elizabeth in England, suggested a cipher based on the use of two fonts of printer's type. His idea, by the way, while not using his exact method, is embodied today in the Morse telegraph code and the wig-wag flags used in Navy signals.

Girolamo Cardan, an Italian mathematician of the Sixteenth Century, developed what became known as the "Cardan Grill." Cardan's system was the earliest appearance of the transposition cipher in the modern world. He placed a grill-like sheet over a blank piece of paper and wrote a message through the holes. The grill was then removed and the blank places of the paper were filled with words that fit, in meaning, with the words of the coded message. In this way the coded message was buried in a harmless letter or note. To decode such a cipher, the receiver of the message had only to place a similar grill over the cryptogram and read the decoded communication through the holes.

HOW TO MAKE A TRANSPOSITION CIPHER

While we won't use a Cardan Grill, we can produce a transposition cipher easily with the Lawrence "Secret Code Maker," for basically it is a system in which the letters are merely shuffled around. We will combine it here with the substitution code we've already illustrated. We'll use the same message from Caesar although his eyes would pop out if he could see what we're going to do with his little code. It's a cinch that the man to whom Caesar sent the message never would have been able to read it if he wasn't in on the new wrinkle. Using "C" as the code letter, our coded message reads:

L FDPH L VDZ L FRQTXHUHG 8807DP

Now write the first five letters of the message in one line, place under them the next five letters and under these five, the next five and so on. Like this:

```
L F D P H
L V D Z L
F R Q T X
H U H G 8
8 0 7 D P
```

Now take the first column of ciphered letters, from the top to the bottom, and write them out as a regular message. Follow this with the second column and so on. The message will now look like this:

LLFH8 FVRU0 DDQH7 PZTGD HLX8P

To anyone who might hit upon the key letter and who himself owns a Lawrence "Secret Code" Rule, the message will be a puzzle unless he knows of the pre-arranged plan of setting the message up in blocks of 25 letters each. If he decodes it now (try it on your own rule) the message will read:

IICE1 CSOR3 AANE0 MWQDA EIU1M

Boy! Is that a tough one! But wait—they get better as we go along.

Of course, if you are in on the secret of that transposition arrangement all you have to do is to set the letters back in vertical rows, write the letters out horizontally again, from left to right instead of from top to bottom, and decode in the usual way. If the original clear runs to more than the number of words used here, simply repeat the blocks of 25 letters each on the pre-arranged plan. Naturally, there's nothing against using 6, 7, 8, or more letters in a row in the set up blocks—just so your correspondent knows the secondary key.

HOW TO MAKE MORE ADVANCED CODES

Now then we'll tackle some really difficult codes and tell the story of cryptography as we go along.

The greatest cryptographic invention made after the time of Julius Caesar was the Vigenere Tableau. Strangely enough the man who invented this system was in Italy at the same time that another man, J. B. Porta, a mathematician, invented a tough-to-break substitution system of suppressed frequencies. For this Porta earned the title of "father of modern cryptography," but it remained for Blais de Vigenere to really turn the flash of genius on the science of cryptography.

In 1587, after the eccentric Blaise returned to Paris, he published a book called, "A Treatise on Secret Writing," which contained an explanation of his system. It was Vigenere's tragedy that the system was little used at the time for few persons read his book. Later he was hailed as a genius by the Germans who took up his code and adopted it to their own uses. It was not until 300 years after de Vigenere's death that a sure-fire method was discovered to break messages written using the tableau. Even then the method was a highly complicated mathematical procedure, requiring the use of elaborate syllable frequency tables.

Fundamentally, the Lawrence "Secret Code Maker" is based on de Vigenere's system—only the rule provides the opportunity for a number of other "tableaux" than the single one that Vigenere described in his treatise. Not only that, but the rule is so simplified and streamlined that at first glance, the uninitiated never would realize the infinite possibilities of the device. Let us suppose you are writing to "Tom" and he knows that his name will be used as the key word. Now let us imagine that we are secret operatives and must send the following communication to "Tom" who is our chief. Our communication is:

"Must Have Papers By 1130 Tonight"

First write the sentence out and then write "tom" over it, letter for letter and time and again. Like this:

```
tomt omto mtomto mt omto mtomtom
Must Have Papers By 1130 Tonight
```

Now set the Slide of the Code-Maker so that the first letter of the keyword, Tom—in this case "T"—is under the arrow. This time use the top alphabet on the slide as the letters in the communication and the alphabet on the body as the ciphered message. Ready?

Okay. Now write the code letters of the message that come under the "T's" above. The numbers on the Body under those of the Slide appear in

the ciphered message. Like this:

```
TomT omTo mTomTo mT omTo mTomTom
Must Have Papers by 1130 Tonight
S  Z  B  G  X  E  3  U  M
```

Now set the slide to "O," the second letter of the key word "Tom," and write the code letters of the message that come under the "O's." Like this:

```
tOmt OmtO mtOmtO mt OmtO mtOmtOm
Must Have Papers by 1130 Tonight
SF Z S BP  GA XD  E 6 35  UY MS
```

The next step, of course, is to set the Slide at "M" and write the rest of the code letters. Like this:

```
toMt oMto MtoMto Mt oMto MtoMtoM
Must Have Papers by 1130 Tonight
SFFZ SNBP CGARXD OE 6835 GUYVMSG
```

This is just as easy to decode and read as the others if you have the Code-Maker and know the key word. Without the key word, the message is meaningless.

Now back to our rule which makes these things so easy. We can use the same key word with the reversed alphabet on the Slide. Then the coded sentence will look like this:

GTTZ GLXJ WSYHBV KU 9768 SEADMGS

The whole system opens up unlimited numbers of possibilities—in fact no count can be made of the number of combinations that can be used. For example, it is also possible to use a number as a key. This might be the street address or telephone number of either the sender or receiver of the message. Suppose Tom lives at 328 Elm Street. This address could be used as a key for coding the same sentence, in which case you would start like this:

```
328E lm32 8Elm32 8E lm32 8Elm328
Must Have Papers by 1130 Tonight
```

Set the slide with the first "3" at the left of the Slide over the arrow on the Body of the Code-Maker. Now every letter of the message over which the number "3" appears will be coded at this setting. Like this:

```
328E lm32 8Elm32 8E lm32 8Elm328
Must Have Papers by 1130 Tonight
J     S     O     O     D
```

The next numeral of the key word is "2." Set the rule at "2" and proceed as before. Like this:

```
328E 1m32 8E1m32 8E 1m32 8E1m328
Must Have Papers by 1130 Tonight
JS     SC     OQ     08     DF
```

The same process is repeated with the other number "8" and the letters of the key word. The completed message will look like this:

```
328E 1m32 8E1m32 8E 1m32 8E1m328
Must Have Papers by 1130 Tonight
JSKO VNSC HVDROQ TT 9808 LJBVDFL
```

Another development of the Vigenere system, and the most difficult to break unless one knows the key, came later. It works like this. We make each letter of the message the key for coding the following letter and use a pre-arranged key letter to start with. For example, if we use "B" as the starting key letter, the sentence would be coded in this way—the top line being the key:

```
Bmus thav epaper sb yl13 Otonigh
Must Have Papers by 1130 Tonight
```

The first letter of the message, "M" is coded with the slide set at "B," which gives us the coded letter, "K." The second letter, "U," is coded with the slide set at "M" and gives us the coded letter, "H." And so on through the message. The final coded message by this system then becomes:

KHXA NSUI KKOOMA IW 6027 JUYUXAL

To decode this message, the letter "B"—previously arranged—is used to decode the first letter and then that letter is used to decode the second, which, in turn, becomes the key for the third and so on.

HOW TO MAKE A TWO-STEP CIPHER

The next step that was developed to make cryptogram even more difficult to break—even by use of mathematical tables, lots of time and brainwork—was to combine this double substitution system with transposition. The result was a two-step cipher.

Easy variations would be to write the message backwards, or from the bottom upwards in a vertical line. We can confuse it by any method we choose just so long as the persons receiving the cryptogram knows the exact method used so he can decode it.

We'll try a two-step cipher, this time using the entire alphabet itself as

one long key word. There is no limit to the number of key words that can be used. We can even use a line of poetry or a passage from a well-known book. All we have to do is repeat it over and over again. Incidentally, another stunt used to change key words and hide their meaning from others, is to pick a book owned by both correspondents. Writing a message in code, we'd jot down the number of a page, the number of lines from the top and the number of words in from a line. Thus, the beginning of a message might read: 328-8-4. Translated, this means the key word can be found on page 328, eight lines from the top of the page and four words in. Catch on?

Now back to our original problem—the alphabet as a key word. Coding the same sentence that we've been using, the completed cryptogram is the third line below:

```
abcd efgh ijklmn op qrst uvwxyza
Must Have Papers by 1130 Tonight
LSPP CUOW GQESEE MI 4340 YSQKHHS
```

Now to get the transposition step in, we write the message out in series of nine letters each. Like this:

```
LSPPCUOWG
QESEEMI43
40YSQKHHS
```

Now then, if we start with the top letter of each vertical line and read down, one line after another, we get a message that looks like this:

LQ4SE0PSYPESCEQUMKOIHW4HG3S

We can add a still further complication by dividing the coded message into groups of four letters each to make the groups look like words and to mislead others not in on the secret. Like this:

LQ4S E0PS YPES CEQU MKOI HW4H G3S

This certainly doesn't look like our original message, but it can be decoded easily with the Code-Maker if the system and key is known by the receiver. If the letters of the original message do not come out even when first grouping off in lines of nine each, nulls can be used to fill out the rest of the cryptogram.

EXCITING SIDE LIGHTS ON SECRET CODES

In times of war secret writing becor..es of major importance. Hundreds of thousands of lives may depend upon methods used to conceal messages,

plans and orders. It is at such times that all the resources of cryptographers are called upon. They not only must devise ciphers, or codes, but also must be ready to decipher, or decode, messages of the enemy that may have been taken from prisoners or intercepted by spies.

Even criminals use codes and in medieval England codes were based upon the slang used by the thieves of that day. In those far-away times successful thieves had to go through a rigid training period to learn all the code words used by fellow crooks. Today, in our prisons, convicts have adopted a secret language of their own. (As soon as a word—say "gat"—becomes known generally, a new word is invented.) "Gat," "heater," "rod"—all expressions used in place of "gun"—are not entirely slang as most persons believe, but a sort of crooks' lingo to hide the rightful meaning.

The history of secret writing is as old as the human race. Code writing probably got its first start when some pre-historic man, more intelligent than his brothers, drew the first word picture on the wall of his cave. Perhaps he had discovered a herd of reindeer feeding in a valley near by and wanted to let a brother hunter know about it without letting the whole tribe in on the secret. Food was of greater importance because it was scarce in those days. Before leaving for the hunt himself, he may have drawn the crude sketch of a reindeer and an arrow or spear pointing out the direction he had gone. To others, not in on the secret, the message meant nothing.

All savage tribes have used codes of some sort. Thus Indians in North America, as you know, used smoke signals. This is a form of secret writing —a sort of forerunner of present-day skywriting. African savages use drums and the message is directed to the ears of far-off listeners—just another form of secret writing and, in its way, not a lot different from the coded radio messages of civilization.

All written language, in a broad sense, is a code. Letters in themselves are only symbols we use to convey ideas after being combined into words. In a more exact sense, a cipher, or code (we use the word "code" loosely), is an arrangement of letters or symbols that hide a central idea from those not in on the secret. Thus in ancient Egypt, Babylon and the Dark Ages of Europe, when the vast majority of men could neither read nor write, simple written language was enough to hide secrets from the illiterate.

In India, not so many years ago, British officers found the use of ordinary Latin was good enough to hold the secret of their messages. Even today a foreign language probably would stump a good many of us. If you, for instance, or your friends, could write in Japanese, I'm certain you would be

able to carry on a correspondence that would remain unread by most English-speaking persons.

However, since we wish to convey secrets in the language we know, then we must resort to ciphers. Almost all of us have some use for code-writing. For instance, you may want to keep a diary that can be read only by yourself. Much of Samuel Pepys diary was written in a system of secret writing he had invented. Boy Scout troops may want to have a troop code system, and you and your best friend may want to have a private code of your own. For any of these purposes, the Lawrence "Secret Code" Rule can't be beaten.

A cipher is a systematic method of substituting symbols or letters for the actual letters in the message we wish to convey so that it cannot be read by anyone not in possession of the "key." A code, technically speaking, is an arbitrary system of substituting words, letters or groups of words for the words or phrases of the message. A genuine code, in its narrowest sense, demands the use of ponderous code books by both the sender and the receiver. However, we will use the word "code" in its widest sense.

The story of cryptography has been a long fight between those who devised codes and those who broke them. Many methods have been invented to disguise messages such as secret inks, sounds and signs. Among the earliest recorded methods of secret writing was used by the Spartans in ancient Greece.

This method consisted of winding a parchment strip spiral-wise on a mace, or baton—as though you'd wind a long, narrow strip of paper on a broom-handle. The overlapping edges of the parchment always would be the same distance apart. The message to be sent then would be written along this overlapping edge. The parchment was then unwound and the coded message would appear in the form of many disjointed characters that meant nothing to the person not in on the secret. To add to this complication, the Spartan army commanders filled in the blank portions of the parchment either with a harmless message, or with meaningless scrawls. The man receiving the message rewound the parchment on a mace of the same size used before and the coded message became instantly readable. Try it yourself and see what a kick you'll get.

Codes only come into common use when a large group is able to read. For this reason codes were a common practice among the well-educated Romans. Julius Caesar used codes in his communications to Cicero and his system still bears Caesar's name. The code is easy to duplicate through use of the Lawrence "Secret Code" Rule.

The nations of the world wavered between the use of codes (in the technical sense) and ciphers for years. One Frenchman made code-writing history during the reign of Louis XIV of France. His name was Antoine Rossignol and he worked directly under the great Cardinal Richelieu. Rossignol developed a complicated system that became known as the "Great Cipher of Louis XIV." The code books became lost, however, after Rossignol's death and messages written in the Great Cipher in his time could not be read. So complex was the system that it was not until almost 300 years afterward—in 1890—that the code was partially broken by a French genius named Bazeries, commandant of the Army Cryptographical Department.

Modern times brought the telegraph, the trans-oceanic cables and wireless. Cryptography became a necessary science in the business, diplomatic and military world. Each nation concentrated on systems of their own and in the years between 1900 and 1914, each nation's spies were busy trying to steal another nation's codes. It became customary for the navies of the world to use complicated dictionary codes. These code books which had to be available to anyone wanting to read a message were always bound in lead. They still are. In case the ship is in danger of being captured or taken by the enemy, the code is heaved overboard, the lead taking it to the bottom almost instantly.

Dictionary codes are possible in the navy because of the limited number of maneuvers and the technical terms employed on ships. They have a great drawback, though, for an army because of the danger of their capture and because the army meets with situations in which such arbitrary systems are useless. Armies, therefore, employ ciphers for field work.

Some of the most dramatic moments in the first World War came in the Black Chambers of the world's nations. In August, 1914, German-controlled wireless stations sent out the message: "A SON IS BORN," a code phrase meaning, "War!"

Right from the start code-making was an important factor. The German plan of attack provided a "swing door" movement through Belgium, a piece of strategy that had been developed by a German army genius, General Alfred von Schlieffen. His plan provided that the armies of the right wing should swing through Belgium and then downward toward Paris. So rapid was this movement that communication lines were in a hopeless shape behind the advancing army. The commanders were forced to use radio, but when they did, they discovered that the cipher system employed by their experts was too complicated and allowed for too many errors in transmission.

It came about that General von Bulow advanced too rapidly. On August 25, 1914, the high command sent a message to von Kluck to close up the gap, but von Kluck never got the dispatch. The French did and realized what had happened. In fact a little 42-year-old officer named Maurice Gamelin sensed the Germans' dangerous position and pointed it out to Marshal Joffre. On September 4, von Kluck had continued his original course and the gap was wide open. It was then that General Gallieni, military governor of Paris, rushed the famous taxicab army into position for the first great battle of the Marne. Some military observers believe this early defeat of the Germans was a factor that lost them the war.

The Russians, in 1914, were ready for war. They had worked up a new code that never had been used. Unfortunately when the army went into the field, a copy of the code was in the hands of only the general of the First Army. Germans picked up many of the Russians' radioed messages in this new code and could make nothing of it. But neither could the Russian commander of the Second Army. He didn't have a copy of the new code and ordered the first general to send messages in the old code. The Germans knew this one and as a result knew the exact position of the Russian forces. What followed was the disastrous defeat of the Russian forces at Tannenberg, one of the greatest defeats in modern history.

Early in the war, Russians acquired a copy of the German naval code after the defeat of the German light cruiser, Magdeburg. The books, bound in lead, had been thrown overboard, but the Russians sent down divers and located the precious code. The system was passed on to the British navy which, so far, had failed to read German messages. For two years, the English always knew what the German navy was planning and were on hand to defeat it. After the Battle of Jutland, largest naval engagement of the last war, the Germans changed their code.

The English had an answer for that. When a submarine foundered near the English coast, they sent down divers and recovered the lead-bound code books.

And so it went throughout the war. For the most part, however, no genuinely new system of secret writing was invented with the exception of the English Playfair cipher, a simple, but difficult-to-break system based on transposition, double substitution and key words. In the United States, of course, cryptography was receiving like attention and the American Black Chamber, in charge of Major H. O. Yardley had its share of victories in the cryptographer's war.

Code writing figured in one of the most dramatic events that grew out