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SECRET INKS—By Herbert O. Yardley

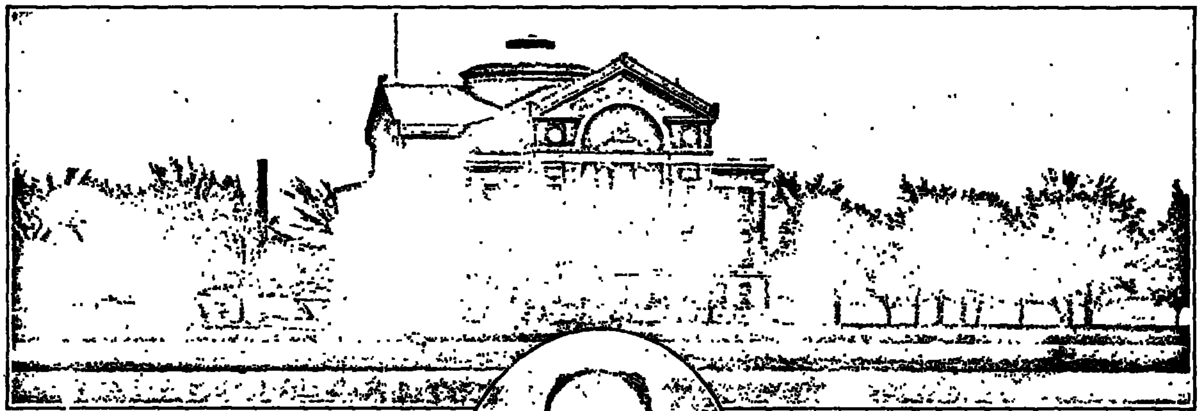
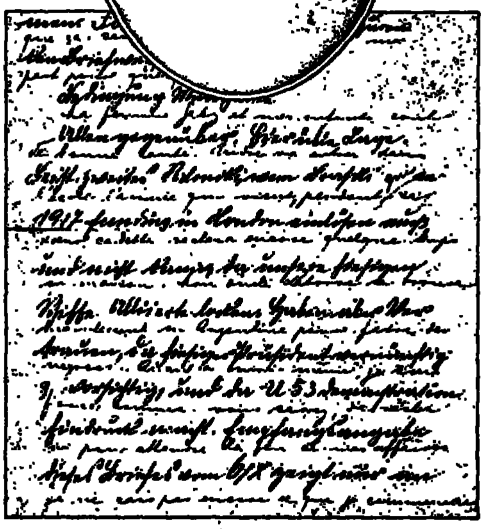


PHOTO. BY EDWIN GALLOWAY, N. Y. C.

The War College, Headquarters of the Military Intelligence Division. Where the Author First Met General Van Deman, the Father of American Intelligence



In Oval—Herbert O. Yardley, From a Wartime Photograph. Below—Secret Writing in German Between the Lines of a Letter in French From Brazil to Germany

THE Code Room at the State Department looked out on the White House tennis courts. It was 1913. Washington was a sleepy Southern town. I was a young telegraph operator who knew exactly nothing about solving codes, ciphers and secret inks. No one else in the country knew much.

Madero was assassinated in Mexico and Huerta quarreled with Wilson. Japan protested the Californian alien land laws. China became a republic! The latest Balkan war ended and Russia and Austria demobilized on their mutual frontier. Code messages came and went. The code clerks yawned and asked for the baseball scores.

But when I was shifted to night duty, I found another scene. Minor officials, section chiefs, sometimes the Secretary himself, made the Code Room a loafing place or dropped in after state dinners to talk shop. One night half the Cabinet came in to watch the deciphering of the message which would tell us whether Mexico would salute our flag. Mexico refused and we seized Vera Cruz.

Bryan's deep, resonant voice charmed me, and his good nature was infectious, though we laughed more at him than with him. His tailor at one time must have possessed a small part of our diplomatic archives, for it was the Secretary's habit to stuff original telegrams into the tail of his frock coat and forget them.

If the spirit moved him he would stop at a telegraph office and file a wire to some embassy in plain English. The next day an inquiry would come: "Just received uncoded, undated telegram signed Bryan. Advise if authentic." He sent a cable of congratulations to Henry Lane Wilson, our minister to Mexico. President Wilson was not on the best of terms with Minister Wilson, and the former was outraged when he saw the message. The next day Bryan cabled that the congratulations were an error and must be canceled.

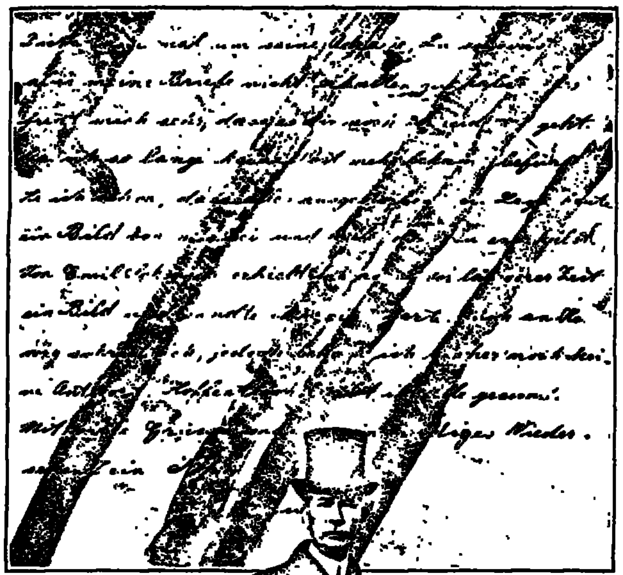
I began to study cryptography. The Library of Congress is our great library, but I soon exhausted its resources. The little information it contained on the subject was elemental and of no practical worth. I read Poe's Gold Bug and found his ciphers childish.

At last I came across the Army pamphlet on military ciphers, a textbook of the Signal Corps school at Leavenworth. Here were the solutions of many ciphers, but ciphers so simple that a bright schoolboy might solve them without a book of instruction.

I had to do my own pioneer work, apparently. Knowing many telegraph operators, I easily got hold of sheafs of coded telegrams filed by various embassies. The clerical work of breaking them down was enormous; later I was to keep fifty typists busy making elaborate frequency tables. Some I solved, some I did not.

One night I heard the New York cable office notify the White House operator that it had five hundred code words from Colonel House for the President. I copied the message as it was relayed. This should be good practice material, for surely the President and his trusted agent would use a difficult code.

I solved the message in less than two hours. House was in Germany and had just seen the Emperor. This message had passed over British cables. The colonel must be the Allies' best informant. I trembled with my secret. I could inform my superiors, but the President, we understood, was notorious



A Letter After It Has Been Treated for Secret Ink. Each Streak Is Made by a Different Reagent or Chemical

Colonel House

his resentment of all advice. He would have someone's head for presuming to read his secret dispatches. I had other uses for my head, so I touched a match to the sheets of paper.

If a novice could unravel the House-Wilson code in a few minutes, what about the State Department code? Was it impenetrable, as supposed? Who knew? No one, so far as I could find. Other countries used cryptographers not only to devise their own codes but to read the codes of foreign governments. Probably they were reading ours.

I went to work. At last I laid one hundred typed pages before my superior; it was an Exposition on the Solution of American Diplomatic Codes.

"You mean to say that our codes are not safe?" he demanded. "I don't believe it."

"Very well," I answered. "This has taken me nearly two years. I merely ask you to read it."

Some months earlier he had changed the combination of the code-book safe. I saw him do it and noticed that he chuckled to himself. This was Saturday, and I was to open up Sunday morning. He failed to tell me the new combination and I forgot to ask. This I realized as I opened the office Sunday morning. He would not permit us to carry a string of combination figures in our pockets. Instead, we needed only to remember a name. The telephone number opposite that name in the phone book, anagramed and distorted in a certain way, was the combination.

Interested in subtle problems, I thought it would be great fun to open the safe by deduction. I could do it if I only could think straight enough. He had thought of a name and laughed. What name was on everyone's lips? The President had just announced his engagement. Mrs. Galt!

I leafed the phone book to her name and spun the safe dial. A moment later the phone on my desk rang.

"Yardley, I forgot to give you the combination ——" he began.

"No need. The safe is open."

"Open?" he yelled. "Who left it open?"

"No one. I just fiddled around until I opened it."

This had made the impression I had hoped for. A few days after I gave him my hundred-page memorandum he called me in. His face was grave as he glanced up.

A Black Art

"HOW long have you been doing this sort of thing?"

"Nearly ever since I came here almost four years ago."

"Who else knows about this memorandum?"

"No one," I told him.

"If you had the problem to do over, how long would it take?"

"Well," I replied slowly, "with ten assistants to do the drudgery, I might do it in a month."

"Say no more about this. I shall see what can be done."

A month later my superior introduced a new method for encoding our secret dispatches. My fingers itched to tear it apart. I thought of little else. One night I woke and the answer flashed as clear as a simple problem in arithmetic. I got up and typed it down before I could lose it again. I was at my superior's desk when he came in the next morning. War had been declared when, several weeks later, I handed him the full solution of his new code. He seemed content to let the matter drop, assuming the hopeless view that nothing is indecipherable. I was to learn that the Black Chamber, as we called the Bureau of Cryptography, later established, produced the same reaction on all government officials. What we did seemed to them pure legerdemain.

It was in this fashion that I became a captain in Military Intelligence-8 at the War College under Major, later Major General, Van Deman. His only assistants were a thin-faced captain and his secretary, the day I reported. Almost overnight this force grew into an efficient organization of thousands of officers, clerks and agents, until its tentacles encircled the earth.

The code and cipher compilation subsection, the communications subsection and the shorthand subsection which I quickly organized were all necessary. But the really exciting activities came through actual contact with German-spy cipher and secret-ink documents. If I had never dreamed that the organization of the three foregoing subsections would fall to my lot as a cryptographer, the final surprise came when Van Deman called me to his office and handed me a folded blank sheet of ordinary writing paper.

I unfolded it and held it up to the light. There was not a trace of writing. I wondered what the next mystery would be, for a Department of Justice agent had just brought me a dead carrier pigeon and wanted me to determine whether or not its perforated feathers carried a hidden message. I wondered if this blank sheet of paper, like the dead pigeon, was but a false alarm, and whether or not I could determine its meaning so readily. For I had, after examining the pigeon carefully, plucked several of the unperforated feathers and placed them in my desk drawer for examination the following day.

The Message in the Feathers

BUT upon taking them out again, I found that they had become perforated overnight. The deceased carrier pigeon had been innocent of hidden messages. Its only offense was that it had parasites.

And now a blank sheet of paper.

"What do you make of it?" Van Deman asked.

"Nothing," I said candidly.

"It has to be something," he replied in a serious tone. "We have had a woman suspect in Mexico under surveillance. When she attempted to cross the border she was arrested and searched
sheet of paper was found in the heel of

"Secret ink?" I asked.

"Probably. See what you can do wi

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Solving a Sheet of White P

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After I had handed him the blank
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send this to the British laboratory in

"That would take three weeks. Wh
on a small portion of the paper? I'm
myself; afraid I'll scorch or seriously b
You can do this, can't you?"

"Yes, I can apply heat without injur

"Suppose we go down in the base
it," I suggested. He told me he had w
in his laboratory. I sent a messeng
equipment, and within a half hour we
the basement.

I watched him carefully as he too
his skillful fingers and passed a sma
back and forth over the heat. Again
this, but the page was still blank.

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if it contained writing, with heat. S
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"Here are traces of writing!"

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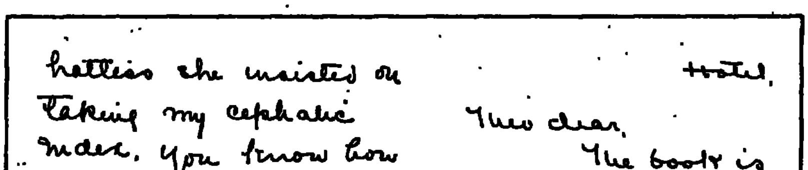
studied the curious characters which
as though by magic. But only sm
writing were visible, and these were

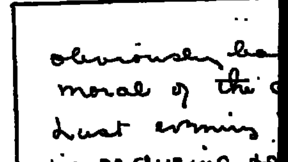


hatless she insisted on
taking my cephalic
index. You know how
it goes. You used to be
"bugs" on it, too.

I shall be pleased to send
the fashion sheets, and the
face creams. My mother and
sisters join in good wishes and
remembrances to all of you
& in hopes that you may
visit us again in the very
near future. Fondly,
Pat

Hotel,
Theo dear,
The book is
here. it is just lovely &
reminds us of Hopkinson
Smiths under a White
Umbrella. Laura is
reading the latest-war
book "Men in War" by
Andreas Latzko, an
Austrian Socialist. We
wonder the book is in
circulation here. as it is

The Hieroglyphics in This Letter Caused It to be Held Up by the Censor on the American Border



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Last evening
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to read poetry
read it somet
The long strokes are
Do you like it. if
You more. I do

These Were Never Solved, But Re-Be

REF ID:A44770

border she was arrested and searched. This blank sheet of paper was found in the heel of her shoe."

"Secret ink?" I asked.

"Probably. See what you can do with it."

Van Deman's success was due largely to the confidence he placed in his subordinates. We were so fond of him that I do not believe anyone ever thought of telling him that something he suggested could not be done.

I knew absolutely nothing about secret ink except what little I had read in British reports of spy activities and the general fact, of course, that heat would make visible elementary forms of secret-ink writing. But I had little confidence in heat, for the British report had stated that Germany's most skillful chemists had discovered secret inks for the use of their spies which could not be developed by heat or any other known chemical reagent. But perhaps these new major inks had not yet reached German agents operating in Mexico and the United States.

Solving a Sheet of White Paper

I IMMEDIATELY telephoned the National Research Council and asked for the name of the most skillful chemist in Washington. Within an hour he was in my office.

After I had handed him the blank sheet of paper and told him my story he said, "I am a chemist, but I know nothing of secret writing. Why don't you send this to the British laboratory in England?"

"That would take three weeks. Why not try heat on a small portion of the paper? I'm afraid to try it myself; afraid I'll scorch or seriously burn the paper. You can do this, can't you?"

"Yes, I can apply heat without injuring the paper."

"Suppose we go down in the basement and try it," I suggested. He told me he had what he wanted in his laboratory. I sent a messenger to get the equipment, and within a half hour we were buried in the basement.

I watched him carefully as he took the paper in his skillful fingers and passed a small portion of it back and forth over the heat. Again and again he did this, but the page was still blank.

I had given up all hopes of developing the writing, if it contained writing, with heat. Suddenly he exclaimed:

"Here are traces of writing!"

He held the paper under the light while we both studied the curious characters which had appeared as though by magic. But only small portions of writing were visible, and these were too faint to be made out. It had been impossible to anticipate what language the message might be written in, although we had expected German, Spanish or English. We continued to study the faint traces of what was revealed to us thus far. Perhaps it was cipher. Then suddenly, as I studied the characters, my heart stood still.

"The writing is fading!" I cried.

But the chemist laughed at my distress.

"Heat will bring it back again," he assured me. "Have you a photostat room here?"

"Yes."

"Have them get a camera ready. We will have to photostat this writing after I apply more heat.

"It's written in Greek letters," he told me when I returned. "Is the camera ready?"

"Yes," I said excitedly. "But what does it say?"

"I don't know," he replied. "You'll have to find a Greek scholar."

A few moments later the photostat operator, his face the color of death under the dim green lights of the photostat room, handed me several copies of this mysterious message.

First Aid From England

AFTER the improbable feat of producing visible writing upon a blank sheet of paper, the task of locating a Greek scholar was negligible. I found a man, obtained a translation of the message, which was in modern Greek, and within a few hours after Van Deman had handed me the mysterious paper, I was again before him with the solution.

The translation read:

Mr. ——
San Antonio,
Texas.

I beg you to betake yourself quickly to Galveston, in order that the representative of —— may deliver to you the $119,000 which you ask for in your letter of 5/8.

There is no need of your having trouble (disputes) with the I. W. W.

Your friend,
R. De L.

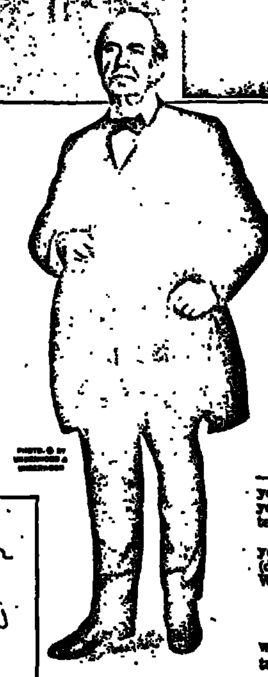
In the excitement which followed I returned to my office and drafted a cable, for Van Deman's signature, to our military attaché in London, requesting that the British Government cable full instructions regarding necessary equipment and personnel for a secret-ink laboratory. The message also urged that they send at once one of their best chemists to act as an instructor.

We received an immediate reply, stating that Dr. S. W. Collins, England's foremost secret-ink chemist, would sail as soon as possible. The answer also gave us specific instructions. I therefore immediately ordered commissioned several of our most brilliant chemists and instructed them to set up a laboratory according to the plan.

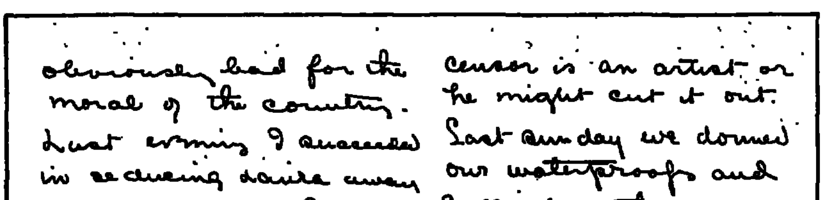
While awaiting the arrival of Collins these chemists scoured the country for scientific information on secret ink. But as all had suspected, almost nothing was known in America on this subject. With the exception of a few

(Continued on Page 140)

A Typical Black Chamber. The British Laboratory for the Exposing of Secret-Ink Communications



W. J. Bryan


obviously bad for the
moral of the country.
Last evening I succeeded
in securing Laura away
from it for an hour
to read poetry. now we
read it something like this
The long strokes are rests, of course
Do you like it. if you do tell
You more. I do hope the
censor is an artist or
he might cut it out.
Last Sunday we donned
our waterproofs and
sallied forth for a
wade in the most
luscious rain I ever
encountered. we did
a good six miles.
At the muir woods we
we fell in with Natty
our anthropologist. you
know, and as I was

These Were Never Solved, But No Doubt Contain a Hidden Message. The Meter of the Poem is Ridiculous

S WILLIAMS

ERT W. CROWTHER

vers had so uniformly *failed*, we decided
ground. There was, Chet said, a place
er below the Biehel farm where he had
goodsock when all other chances failed.
told me he got two down there last Fri-
remembered, and we climbed into the car.
thought he was too
" I remarked; but
ed my mistake.
young Biehel," he
t fired *out of* his job
d come home to live
. He's done
g than any-
ll fall."
now him, I
sed. "What
did he have?"
I ever heard
hot admitted,
d and asked
should drive
the Biehel
the old man,
rifty farm on
road, with a
dings in good
t on a knoll
he east. But
e would stop
ame to the
gun down
rchard to the
had in mind.
back through
d passed an-
d Chet ex-

Mal Biehel!"
back. "He's
the store.
d him to have
e. He'd always kind of laid it
n was a fool to stay up here."
father's glad to have him,"
and Chet agreed.
man needs someone with him," he an-
d he's got enough for him and Mal
ell fixed, he is. Maybe Mal figured he

SECRET INKS

(Continued from Page 5)

scattered references in the writings of alchemists and brief reports in encyclopedias, there was nothing to be learned.

The references we found included the use of fruit juices and milk, all of which may be developed by means of heat. It was obvious, then, that if our chemists were to compete with German scientists, who had already had four years' experience in this battle of tubes and chemicals, they would need as instructor a man not only schooled in secret inks but one familiar with the ramifications of German espionage.

As an analytical chemist, employed by His Majesty's Postal Censorship in England, Collins had dealt directly with the secret-ink letters of the most daring enemy spies. As soon as he arrived, the work of training began.

"Germany, as you well know," he began, "at the outbreak of the war led the world in chemistry. And as thorough in espionage as in warfare, she immediately summoned her scientists to concentrate upon the problem of developing secret inks which would defy the analysis of Allied chemists.

"For several years Germany was so successful that England and France scarcely made a move that was not promptly reported to headquarters in Germany by enemy spies. Secret inks were the spies' most powerful weapons. Although we, as well as France, set up a rigid censorship of all mail crossing the borders, the information which Germany desired still continued to pass.

"The German system of communication is elaborate and involves thousands of cover addresses whereby letters in secret ink are mailed to persons in neutral and Allied countries who are not already under suspicion. German spies are instructed to memorize long lists of cover addresses of persons who would never be suspected by our intelligence system. The spy then writes letters to several of these in secret ink. After the ink dries, he then writes an unsuspicious social or business message in ordinary ink, crosswise to the invisible writing. All three or four letters are mailed to the various cover addresses; this multiplication assuring the arrival of at least one message."

Looking for the Invisible

"Further to complicate the system, these cover addresses are carefully watched and compared. Thus, if a triplicate letter, for instance, sent to three different cover addresses, reaches two correct destinations but fails to reach the third, the Germans assume immediately that the third address is under suspicion and therefore no longer useful.

"Shortly after the declaration of war we were stunned when we discovered through our own undercover agents in Germany, who had meanwhile cleverly entered the German Secret Service, that thousands of secret-ink letters were passing the censorship. The situation was critical, for we were unprepared for secret-ink espionage. We quickly gathered together many of our chemists, and slowly and painfully discovered reagents for developing the German inks; but no sooner had we done this than the Germans devised more difficult and subtle ones."

Collins paused for questions, but there were none. Our chemists, judging by their long faces, were a bit awed.

"There are many ingenious ways of carrying secret inks," he continued, "so as not to arouse suspicion. In one case, because of the discovery of forged passports, we carefully examined the belongings of two suspects who had just arrived in England, and finally concluded that they had no secret ink in their possession. But at the last moment we discovered the ingenuity of the agents. Had they carried cobalt salts, potassium ferrocyanide or other secret-ink materials with them openly, we would have seized them without delay. But the spies had brought them in concentrated form. One had cleverly concealed potassium ferrocyanide in a tube of tooth paste. The other carried his supply in a cake of soap."

Betrayed by a Necktie

"This led to more thorough search of suspected persons, and this, in turn, led to amazing discoveries. The German system was based upon carefully considered chemical reactions, but it was also based upon practicability. In every possible case German chemists labored to devise an ink which could pass as something else if discovered. Some of their inks reach a concentration so low that only a spectroscopic analysis can detect the presence of silver in them. Among the seized possessions of one agent, the ink was in a scent bottle. The container concealed fifteen cubic centimeters of colorless liquid which had the appearance of many types of perfumes, and, moreover, had an authentic, though faint, aroma. On examination, the liquid revealed 0.01 per cent solid matter.

"As the Germans progressed it became less and less common for the agent to carry ink in a bottle of any kind. Technic developed to a point where they could conceal secret inks impregnated, without discoloring, in clothes, such as silk lingerie, handkerchiefs, soft collars, cotton gloves, silk scarfs, neckties, and the like. The spy had only to soak the garment in distilled water or some other prescribed solution. He then wrote his letter, threw away the immediate supply of ink in solution, dried the garment and put it away for further use in the same manner.

"There was one case of a suspect who, after a thorough search, seemed to have no ink in his possession. However, we noticed certain small, iridescent stains on his black necktie. On this we focused our attention, and soaked in distilled water a portion of the tie. Soon the water turned yellowish. Microchemical and spectroscopic analysis proved the presence of silver. The ink carried by this particular spy was of a kind which no ordinary ionic reactions for silver would develop. We found the same ink impregnated in the socks of other agents, as well as in a black shoe lace and in the cloth-covered buttons of an evening-dress waistcoat. Each of these cases called for extremely careful chemical research before the nature of the ink could be determined. And without this analysis its appropriate developer could not be discovered."

Here Collins was interrupted by a question as to the instructions received by German spies, types of pen and paper used, and other means of hiding secret writing.

"German agents are carefully instructed in the use of their inks," he

informed us, "although they are seldom told what chemicals they contain. Many agents who send secret-ink letters do not receive any and have no idea how the ink they carry can be developed. They are instructed to use a ball-pointed pen; glazed paper is always avoided—there must be a rough surface. Oftentimes the secret writing is placed on the flap of the envelope or under the stamp. A few attempts have been made to write secret-ink messages on the tissue-paper lining of an envelope, but it became the policy of the Postal Censorship to remove all paper linings before resealing letters. Efforts are sometimes made to conceal the secret-ink writing even further by putting it between split post cards, under photographs, labels, newspaper cuttings and articles pasted or gummed on paper.

"Not long ago Germany produced a new ink which they considered very secret indeed, but we surprised them by devising a developer. As a result, Germany lost a number of spies in England in one debacle.

"Theretofore all their inks could be developed by more than one reagent. They now strove for the lowest possible concentration to produce an ink which could be developed by no known chemical but one. In other words, there was to be a total absence of development except by one specific reagent. They produced F and P inks—these are merely our arbitrary designations of these two famous inks. F ink is very low in concentration. P ink is similarly low, consisting of silver proteinate, and complicated by the fact that a very similar substance is sold as an antiseptic under the name of collargol, or argyrol.

"One of the most famous German-spy cases in England is that of George Vaux Bacon, who possessed and used the P ink, operating between England, the United States and Holland. My testimony at the court-martial trial was directly responsible for the sentence of death which was imposed. Bacon had been a suspect for some time, and communicated with Schultz in Holland. He did not know how to develop the ink he carried and knew nothing of its chemical composition. All his instructions for writing with it came from Schultz, in a very simple code, from Holland."

Carrying Ink in Socks

"When Bacon, in his travels, again left Holland for England, Schultz, who knew he was under suspicion, warned him that under no circumstances was he to take a pair of impregnated socks with him into England. He was to use only the cloth-covered buttons of his evening-dress waistcoat, which were similarly impregnated with the P ink. But Bacon took his socks with him. He had received them in New York and had been given instructions to squeeze out the tops in water and use the liquid when it turned to a pale whisky color. Some of his letters he wrote in the solution of socks, some in the extract of dinner-jacket buttons.

"When our authorities arrested Bacon, it was a bottle marked Argyrol, found in his medicine chest, which was responsible for his bad luck. Analysis of the contents revealed a small silver content, but Bacon protested. He said that he carried the argyrol as a medicinal remedy and antiseptic. But when the P ink was discovered in his socks he confessed.

"As a matter of fact, Bacon was entirely sincere in protesting the argyrol. Having been given no information as to the chemical constitution of P ink, he did not know its similarity to collargol, or argyrol, and to him the bottle so labeled was, in truth, nothing more than an antiseptic.

"I made an examination of all Bacon's possessions and found that the concentration was so low in the solution of the socks that it defied chemical analysis. I made a final test by spectroscopic analysis. The test revealed the presence of silver.

"George Vaux Bacon, who was condemned to death in January, 1917, told, in his confession, that he had never developed secret ink and that he did not know its composition. He stated that while in Sander's office in New York he saw some of the secret writing from Denmark developed. The letters were placed in a photographic dish and the colorless contents of two brown bottles were poured over them. In ten seconds, he said, the writing appeared, clear and very black. When the solutions were mixed, heavy white fumes appeared. Bacon did not confess to the presence of P ink in the dinner-jacket buttons. This was not discovered until after the trial."

The Technic of Secret Writing

This was our first authentic story of George Bacon, the American, who, though condemned to death by the British Crown a few months before we entered the war, had been released and sent to the United States after strong representations by the United States Government, and sentenced to Atlanta Penitentiary for one year.

Collins continued: "There is an earlier case of Pickard, a German spy. This man carried the first example of a really clever secret ink. Before his time the enemy had relied on simple processes, such as lemon juice, potassium ferrocyanide and alum. Pickard was condemned to death by court-martial in September, 1916. He carried his ink in a bottle which also contained a small quantity of alcohol and perfume, hoping that the scent would be a protection.

"Alfred Hagn, like Pickard, carried the same ink. He possessed two bottles of this; one bearing the label Gargle, and the other marked Tooth Wash. We later found in his possession a sponge, three canvas collars and a scarf, all impregnated with the same ink.

"Hagn's mission as a German agent was to report the movements of hospital ships, and three of his letters got by our censor. But on May 12, 1917, a detective slipped into his hotel while he was out and stole a bottle marked Dentifrice, into which Hagn had poured a part of his ink.

"In another case we read a letter of instruction from one German agent to another and caught the spy red-handed. The letter instructed the colleague to 'boil nearly enough water to cover the impregnated handkerchief and let it boil fifteen to twenty minutes. Then add four or five spoonfuls of water and boil ten minutes more. Then the invisible ink is ready for use.' The agent was also instructed to use unglazed paper, and to write 'stop' at the end of the invisible portion of the message, if it did not go beyond one page. This, quite obviously, would save extra effort on the part of the person who received and developed it. The agent was further instructed, after the secret ink had dried, to mix an ammonia solution, 'strong enough to bring tears to the eyes,' and wipe the paper with

this on both sides. The reason for applying the solution to both sides was that the ammonia solution slightly discolored the paper, and in order to make both sides the same, the application must be made with great care. For this reason envelopes of an entirely different color were always used. 'When done,' wrote the agent's instructor, 'fold up the paper, put it between leaves of a heavy book and sit on it a couple of hours to get it flat.' Afterward, of course, an ordinary social message was to be written crosswise to the invisible message in ordinary ink."

A Simple Solution

Collins closed by saying that until a general reagent that would develop any secret ink was discovered, the Allies could not hope to compete. The scientists of England and France were straining to find such a reagent, and the last words of his superiors as he sailed for America had been that he urge the chemists of America to join in the quest.

I once had decoded a State Department message which stated that when our embassy staff had passed through Switzerland on its way home from Berlin, a German agent had approached one member and offered a large sum if he would report the insignia of all French soldiers he saw on furlough as he journeyed across France. The agent instructed this American, first, to dip a clean pen in cold water and write his secret message, dry the paper, then write a social letter with ink crosswise, and mail in triplicate to cover addresses in Switzerland and the Netherlands.

It occurred to me that if the Germans could develop a letter written in ordinary water, they must already have made the great discovery for which Allied chemists were groping. Collins confirmed this surmise.

Our group of scientists was now divided into two sections: one, for research for the great discovery; the other, for technical study under Collins, which included the restoration of secret inks after development, opening and resealing of letters, forging of letters and diplomatic seals, photography, duplication of paper and envelopes in cases where they were injured, duplication of postmarks, replacing or duplicating seals, and so on. Some of these duties required the employment of America's most adept criminals, skilled in forgery and counterfeiting.

The problem of discovering a general reagent was limited to one field; if the Germans could develop a letter written in clear water, their reagent obviously was not based upon chemical reactions. Was water used merely to keep the pen from scratching the paper? Or was there another purpose? Would not any fluid which touched paper disturb the fibers of the surface?

These premises seemed sound enough. Elaborate apparatus was therefore installed for photographing and enlarging letters written with distilled water. Though it seemed obvious to all that the fiber had been disturbed by the water, photography brought no results.

And then, overnight, the discovery! Credit for this discovery, which revolutionized the technic of secret-ink laboratories, is hard to place. There was such a close liaison among the scientists of all Allied laboratories as each idea was flashed back and forth by cable that I hesitate to mention one man or one nation. And like all great discoveries, it was so obvious that it left all the chemists wondering why they had not thought of it before:

A glass case; an iodine vapor! Nothing more!

Insert a secret-ink letter in a glass case and shoot in a thin vapor of iodine. This vapor gradually settles into all the tiny crevices of the paper, all the tissues that had been disturbed by pen and water. Even to the naked eye, there forms a clear outline of writing.

Our chemists had now caught up with those of our enemies. But we must surpass them. Germany, too, knew of the iodine vapor or some similar treatment. Our chemists must discover a formula of invisible writing that defied iodine vapor or any similar process.

Abruptly our examiners reported that iodine vapor no longer revealed secret writing, even in cases where invisible writing was absolutely known to exist. It meant but one thing. Our discovery had reached the ears of Germany. And with true genius in chemistry, German scientists had quickly discovered a method in which the iodine-vapor treatment was not effective. German chemists were still one step ahead of us.

It may seem incredible that the iodine-vapor discovery was so quickly known by our enemies. To understand this it is necessary to keep in mind constantly the intricacy and subtlety of the espionage system.

I recall the case of a French liaison officer who delivered a secret lecture before our Military Intelligence Division. Every precaution was taken to keep the meeting unknown to anyone save those who were admitted. Only a small group heard the lecture, and they were intelligence officers. The doors of the room were locked and bolted; guards were stationed outside so that no one could listen or come near the room. In his talk the liaison officer gave in great detail an account of the French positive espionage in Germany. These activities were of such a daring and sensational nature that the lecturer's words produced a tremor throughout the small audience. It was a necessary lecture, for the American positive-espionage system had been pronounced inadequate.

The Battle of the Laboratories

Forty-eight hours after delivering his secret lecture, the French liaison officer received a cable from his government ordering him to return to France to explain his indiscretion. This meant that even in that audience, composed of selected officers of the Intelligence only, there was a Frenchman to report the man's speech to French headquarters. How were the French to know that there was not, even in the uniform of an American Intelligence officer, a German spy to send back to enemy headquarters the sensational outline of French espionage which had been given?

What had the Germans done to prevent the success of iodine tests? What made iodine-vapor tests possible? Disturbed tissues of the paper—disturbed by the pen or fluid. How could this disturbance be prevented?

After more than one hundred experiments American chemists discovered that if a letter is first written in secret ink, dried, then dampened lightly by a brush dipped in distilled water, then dried again and pressed with an iron, the secret ink could not be developed by an iodine-vapor bath. Why? Because the dampening process disturbed all the fibers of the paper. Germany could no longer develop the secret-ink letters of our own spies. Nor could we develop those of our enemy.

The development of secret writing was now at a standstill on both sides. We had at last caught up with the Germans, but we were right back where we had been when Collins arrived.

We suddenly made another important discovery. We found a method of streaking suspected letters with two different chemicals; and if these two streaks ran together it proved that the letter had been dampened. And who would ever think of dampening a letter except a spy? Whether we could develop the ink or not, a dampened letter was sufficient proof that we were dealing with a spy message. But this was not enough. Inevitably in the battle of wits came this startling and greatest of all triumphs—the infallible reagent that revealed secret writing under any and all conditions.

A Secret Never Solved

This secret was of such vital importance to successful espionage and was so jealously guarded—I doubt if a dozen men know of its existence—that it did not find its way to enemy ears. Even here it would be unethical to reveal the nature of this scientific formula, which came only after repeated discouragements and after long months of experiment by chemists of all the Allied nations.

Shortly after our chemists made this discovery our censor on the Mexican border intercepted the letter shown on Pages 4 and 5, because of the hieroglyphics on Pages 2 and 4 of the letter.

The character of the secret ink and the importance of the plan revealed by the secret-ink writing indicate that this letter is from an important spy. The secret ink as developed reads:

> I wrote you about the incarceration of the trio. . . .

This must refer to three suspects that have been arrested.

> Let me know, as soon as you can, about the boys going to France. If of no use in France, they are preparing to flee.

We have already uncovered information that German agents plan to have at least one spy in each regiment. Patricia, who signs the letter, obviously is asking her superior how these boys are to operate when they reach France. There is more on this subject:

> I'm wondering if this ink is good. Let me know if those boys would be of any use to you in France.
>
> Preparations are being made for training and drilling in use of big guns in U. S. Officers returning from France for that purpose.

I regret to say that Patricia was never captured. This was due to overzealousness on the part of our agents on the West Coast. I also regret that we were never able to decipher the hieroglyphics. They certainly contain a hidden meaning, for, as anyone knows, the meter described on the second page is ridiculous. Perhaps the reader can decipher these characteristics. Or perhaps Patricia, if she sees this, will tell us all about it!

There is one thing about the open letter that is reminiscent—the name Hopkinson-Smith. A red-headed young lady—obviously a German agent—once made the statement to one of my cryptographers, "You and I must work for the same cause." She gave her name as Smith-Hopkinson and her

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address in care of a bank in Los Angeles. Is Patricia who writes of Hopkinson-Smith the red-headed Miss Smith-Hopkinson? They both disappeared very mysteriously.

A successful secret-ink laboratory is by no means entirely devoted to research. There are everyday problems to solve. Unless he is thoroughly trained for this particular type of work, even a skilled chemist is of small value. When *our own postal censorship* was established, our secret-ink bureau was confronted with the task of examining as many as two thousand suspicious letters a week. Many of these were not outwardly suspicious, but to insure some measure of security, a percentage of mail leaving or arriving at each port of entry was carefully examined by our chemists.

There were two types of suspected mail—that addressed to persons under suspicion, and that which referred to business or social affairs in veiled fashion. Such letters were submitted to major tests.

Spying on the Spies

Our laboratory developed a very delicate technic in the restoration of secret ink after it had been developed and photographed. For it was often important that these secret-ink letters, after they had been read by our bureau, be sent on to the addresses in order to avert suspicion. Sometimes it was better to wait awhile and intercept more letters than to make a hasty arrest.

In cases where it was suspected that the embassy, legation or consular officials of certain supposedly neutral countries were aiding the enemy, it was necessary for us clandestinely to intercept and open the diplomatic pouch and the letters it contained, photograph the contents, and then restore the communication to its original intact state before sending it on to its proper destination. Diplomatic mail being sealed with diplomatic seals, the problem often called for proficiency in forgery.

If the letters were damaged in the process of being opened, this necessitated the manufacture of new identical envelopes, the forging of diplomatic seals and handwriting, and the duplication of the postmarks.

There were, of course, cases in which some of the American diplomatic or consular representatives or their families were under suspicion of dealing with the enemy. Their correspondence, not being subject to censorship, was of necessity opened surreptitiously and the contents photographed before resealing.

In opening a letter, we held it for a few seconds in the steam from the spout of a kettle filled with rapidly *boiling water. We then inserted a desk* knife with clean, narrow blade and long handle under the flap of the envelope while the letter was still being held in the jet of steam, and by running the knife blade carefully between the flap and cover, raised the flap without much difficulty.

After photographing the contents we resoftened the remaining gum on the envelope flap by the steam method, and if sufficient gum did not remain, rubbed the edge against the moistened, gummed edge of an unused envelope. This was better than application of glue, for it assured the adherence of just the right quantity. Otherwise an oversupply might ruin the job by making it sticky and splotched. In case any gum marks showed after the letter was resealed, we brushed the cover lightly with moistened blotting paper, followed by blotting with similar dry material. In cases where the seams were obviously affected by this steam process, we pressed them out with a hot iron and removed all traces of our work.

Replacing or duplicating seals was a much more difficult task. For a rough, small seal, we used a thin sheet of lead with a backing of India rubber placed on it and screwed down under a writing press.

This took only a few seconds and any impressions which were made on the envelope during the process could be ironed out satisfactorily. *For a perfect large seal*, the operation was much more complicated.

We first dusted it with French chalk. Then we placed a piece of gutta-percha, slightly mixed with oil and heated with hot water, over the seal. This we put under pressure until the gutta-percha became firm and cold. Then, with another piece of gutta-percha, similarly heated, we made a second impression from the cold material after it had been covered with graphite and put under pressure as in the first operation. After taking the second impression, and after again thoroughly graphiting, we put it in a copper-plating bath and started an electric current.

Depending upon the amount of current we could force, the process of obtaining our copper deposit took from twenty minutes to an hour or more. We now broke away the copper deposit from the gutta-percha and on the side which had touched this material, we *had a perfect seal. The back we then* filled with ordinary solder and supplied with a handle.

Even more difficult than constructing a mold was the process of getting the original seal off the diplomatic letter. The wax must be heated to a certain temperature by a small, electric hot plate. Our success depended upon applying just the correct amount of heat to the seal. At the proper stage it could be scraped from the envelope with the use of a small scraper, and with this old wax, in case the seal was broken, we could make a duplicate with the mold already described.

Putting Convicts to Work

Such tasks as these scarcely came within the duties of the chemists. It was obvious that specialists in this particular science must be added to the American secret-ink laboratory. Thus two adept criminals who had been convicted for forgery and counterfeiting were sought out and their particular skill incorporated with that of the secret-ink subsection of MI-8.

There was one case in particular that always amused me. We were asked to open and photograph the contents of a letter addressed to General Carranza, President of Mexico. Before opening this letter our counterfeiter had made a copy of the seal, but after photographing the contents and resealing the envelope, we discovered that *the duplicate* seal was too defective to be used. The counterfeiter told us that he could, perhaps, approximate the original by engraving a seal. While this move was under discussion he made a closer examination of a portion of the original seal and discovered, happily enough, that it had been made with an old and rare Spanish coin. It was only necessary to obtain one of these coins from an obliging collector to make a perfect seal.

A LOOK AHEAD

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Such a type of construction will reduce ceiling-floor thickness several inches.

Coöperative-apartment buildings will solve the housing problem in tenement districts. Judging by what is now taking place in New York City, darkness, dirt and squalor will be eliminated. There will be built-in bathtubs, gas or electric refrigerators, self-operating elevators, incinerators, good air, sunlight and inner courts with shrubbery, flowers and fountains, all for a cost of $12.50 a room a month. Initial experiments have proved that such a rent will meet charges for maintenance, upkeep, taxes and interest, and also provide for the gradual amortization of the first mortgage on the building. Such apartments will cost $500 a room, with a required initial deposit of $150 a room.

On top of each apartment house will be a roof garden for adults and another one for children. There will be coöperative laundry service and milk deliveries at a cost below the market level. All of which will prove to the doubters that instead of slums being made by people, people are unmade by slums and can be remade by an environment. Early adventures in this field of humanics have shown that through the exercise of patience, discipline and *kindliness* a sense of coöperation and a better way of living can be gradually developed. The disclosure that decent housing at a low cost can be made to pay will have far-reaching effects.

Building in our large cities will continue its trend toward grandeur of mass and height. Important structures will more and more resemble overgrown monuments of solid blocks of granite. A single famous building now nearing completion in our chief metropolis will be large enough to house the entire business population of a city like Charleston, South Carolina. Famous architects assert that 100 stories is a maximum height to which we can build with safety, economy and accessibility. But who knows how high we can go if we are supplied with lighter and stronger materials?

One new all-metal, seventeen-story structure will have exterior walls of glass and a chromium-aluminum alloy, which is noncorrosive and nonrusting. Such a wall will have heat-insulating qualities equal to those of a thirty-six-inch brick wall. Another design calls for a skyscraper that will free tenants of the parking problem. The first eight floors will be used as garages for cars. Tenants arriving by car will drive up a ramp, park on one of the eight floors, step into an elevator and be whisked to their offices. Such plans merely indicate the important character of coming changes.

We are headed *for* multideck cities with various kinds of traffic stories above the ground level. This means churches and other institutions in high towers, and huge bridges connecting skyscraper structures. Aggregations of