MYSTERIOUS RAYS:

Nuclear Energy

by VIVIAN GREY

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SECRET OF THE

The Discovery of

illustrated by ED MALSBERG

SECRET OF THE MYSTERIOUS RAYS:

The Discovery of Nuclear Energy

To Leslie and Jackie
who understand why

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V. G.

Contents

1 Roentgen Stumbles on the Mystery of X Rays

Although he was staring straight at it, Professor Roentgen could not believe it. Never in all the twenty years that he had taught science had he seen anything as strange as this. Yet there it was in his laboratory, lying about three feet away from the experiment he was working on: a piece of paper that seemed to give off its own yellow-green glow of light!

It was all the more puzzling because there was nothing on or near the paper to make it glow. According to every known rule in science, there had to be something that was causing the paper to gleam. Yet, as far as he could tell, there was nothing, nothing, that is, but the equipment he was using for one experiment.

"What does it mean?" he asked himself. "Why is this happening?" The more he thought about it, the more he realized that this must be something mysterious.

Walking about his small laboratory, the tall, slender professor seemed much younger than his fifty years. His rather long, dark hair stood straight up from his forehead, but his short, pointed beard and narrow mustache were clipped and trimmed with the same precision that made him a careful scientist.

Faced with finding an explanation, he began by thinking over all the parts of the mystery. Perhaps he might find a clue.

He knew that the paper was coated with the chemical barium platinocyanide, which had been used in some recent experiments. Someone must have dropped the coated paper on the laboratory bench. Yet although he often worked in the laboratory at night, he was certain that he had never noticed any

(*Left*) Wilhelm Konrad Roentgen, discoverer of X rays.

glow before. Most certainly he had never seen the paper give off a strange yellow-green light. Now, he wondered, what had happened on this particular night that was different? What could make the paper shine that way?

Alone in the quiet, darkened laboratory, he turned the puzzle over in his mind. Was this a genuine scientific problem? Or was it just a strange and interesting accident?

After all, in 1895, men believed that most of the mysteries of physical science, or physics, had been solved.They had long since done away with all old-fashioned ideas, including the one that "magic" controlled nature. Hundreds of years earlier, people had believed that everything in the world was under the influence of some mysterious, invisible power that controlled the sun, moon, and earth. But in 1895, neither Professor Roentgen nor any other scientist believed in the invisible. For them, everything in science had to be tested in order to be believed. However, they tested only what they could smell, feel, taste, weigh, and, most important, see.

Even the very name "scientist" showed that people no longer thought of them as magicians. The word "scientist," used since 1840, came from the Latin word *scire*, meaning to know or to learn. A scientist, then, was a man who worked only with whatever his hands could touch and his eyes could see.

But now, this one sheet of glowing paper was forcing many unusual questions. If a good scientist could not use "magic" or "invisible forces," what should he say about the glowing paper? There was nothing he could see, smell, taste, or touch that made the coated paper give off light. Was he dealing with some known but extra-powerful light ray? Or was this something new?

Could the mysterious light be related somehow to the experiments he had been working on? He had been experimenting to find out more about a new scientific discovery called "electricity." No one really understood electricity. That was why he and other scientists were struggling to find out more about

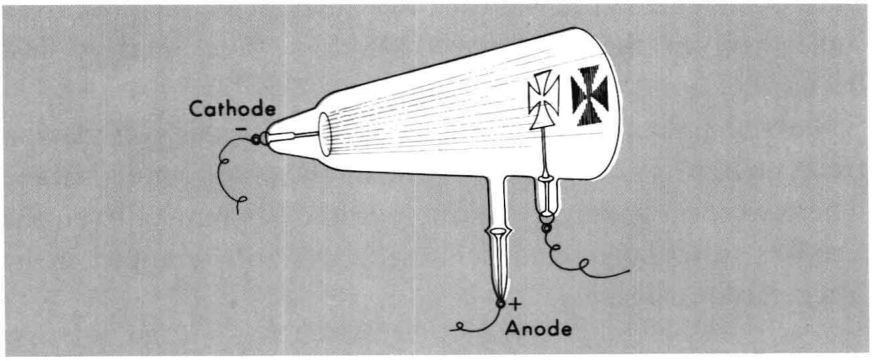
it. His thoughts jumped to what was already known; perhaps he could find a clue to the glowing paper.

In physics, the word "electricity" was used to explain *how* things behaved and traveled. Electricity itself was not anything real. It was not even something that started or stopped. "Electricity" was a word used for a description, and nothing more.

By now, scientists used the words "electric current" to describe the flow of tiny bits of electricity, much too small to see even with the most powerful microscope. The names given to these tiny bits, or electric particles, depended on their "electric charge." There were two kinds of electric charge: the positive charge, written as a plus sign (+), and the negative charge, written as a minus sign (−). An electric current was the path made by the negative particles.

When these negative particles moved through space instead of through a wire, the current they made was called a "cathode ray." Scientists had already found that cathode rays could penetrate very thin sheets of metal. So far, though, no one knew how many other materials the cathode ray could penetrate. How strong are the cathode rays? he wondered. Are they strong enough to pass through materials that block the passage of light?

He could find out by watching the outside of a special kind of glass tube called a "Crookes tube." He knew that when an electric current was sent through the space inside a Crookes tube, it became a cathode ray. From earlier experiments, too,



A Crookes tube.

he knew that when the cathode rays came in contact with air they caused a glow of color to appear. He had often seen a yellowish-green glow spreading around the outside of the Crookes tubes.

That evening, as always, Roentgen had been extra careful about each step in his experiment. Before turning on the electric current, he had covered his Crookes tube with a shield made of black cardboard. He had turned off all the laboratory lights and had switched on the current. He heard the familiar crackling, snapping sound made by the electric current and smelled the faint odor that always came with it. Then he waited. Would the cathode rays be strong enough to penetrate the glass walls of the Crookes tube as well as the black cardboard shield?

The ticking of the laboratory clock seemed even louder than usual. The only other noise was the snapping sound of the electric current. Straining to see in the darkness, he watched for the light. But he saw nothing. After more time passed, he was still seeing only the blackness of his laboratory. There was no glow, not even the faintest glimmer of light.

Finally, he had convinced himself. He was sure. The cathode rays could not travel through the shield. He would never see any light outside the black cardboard. He had just learned a new fact about cathode rays: they were not strong enough to travel through glass.

The experiment was over.

In the darkness, he reached for a lever, meaning to turn off the electric current. It was then that he noticed the glow from somewhere in the darkened laboratory. The mystery had begun.

At first glimpse he did not believe it. Were his eyes playing tricks on him? Where was the glow on the paper coming from? There were no lights on anywhere in the laboratory. Even the Crookes tube, he reminded himself, was still wrapped in its black cardboard shield.

His fingers quickly found his laboratory notebook, the one in which he recorded the findings of his experiments. There in the dimness he wrote: "This is a new kind of invisible light. It is clearly new, something unrecorded."

Suddenly he knew that he had reached a crossroads. He must make a decision: Should he continue with his experiments in electricity? Or should he drop everything and try to find out why a forgotten piece of paper was glittering in the dark?

The more he thought, the more he knew the decision was not really his to make. He *must* stop all his other research immediately, even his work on electricity. There was only one thing to do—investigate.

At once, the professor began testing to find out if the Crookes tube could be affecting the chemical-coated paper. He moved the paper closer to the tube. As he did so, its faint yellow-green glow grew brighter and brighter. Then, as he pulled the paper away from the tube, the glow grew dimmer again, but did not disappear.

Roentgen was certain that he had found his first clue to the mystery. Somehow the current inside the tube had sent out invisible rays. Those unseen rays had traveled through the walls of the tube, through the black cardboard shield, and across the room, causing the paper to glow!

More confused than ever, he decided he must first name those mysterious rays. Since he knew nothing about them, he decided to call them "X rays."

And so began Roentgen's search into the secret of X rays. It was going to be his private search. Not even his two most trusted laboratory assistants would be told what he had found. One day he would tell the world about X rays, but only after he alone had found the answer.

Once the mystery had taken hold of him, nothing else mattered. Days and nights turned into one jumble of time. He no longer watched the clock. Day after day, he apologized to

his wife, Bertha, for he was never home on time for meals. Luckily, his wife seemed to have more than her share of patience and understanding. He told her he was working on an especially important piece of research. Finally, at Bertha's suggestion, he moved into the laboratory and lived there. After the research was completed, he would return home. It was to be seven weeks before he did so.

In spite of his wish to keep his secret, one day he could not stop himself from telling his closest friend, "I have discovered something interesting, but I do not know whether or not my observations are correct."

As his friend asked question after question, he silently scolded himself for letting some of the secret slip out. In spite of the other's many pleas, he refused to say any more. He had told too much already. Nothing more must be said about X rays until the time was right.

Before he knew it, the month of November was gone. Then it was toward the end of December 1895, and others were planning parties for the New Year, but he was feverishly rushing his investigation of the X ray. He desperately wanted to finish testing by December 28, when there would be a meeting of an important scientific group called the Physical Medical Society of Würzburg. What better way to end up the year, he thought, than by announcing his startling discovery at that meeting.

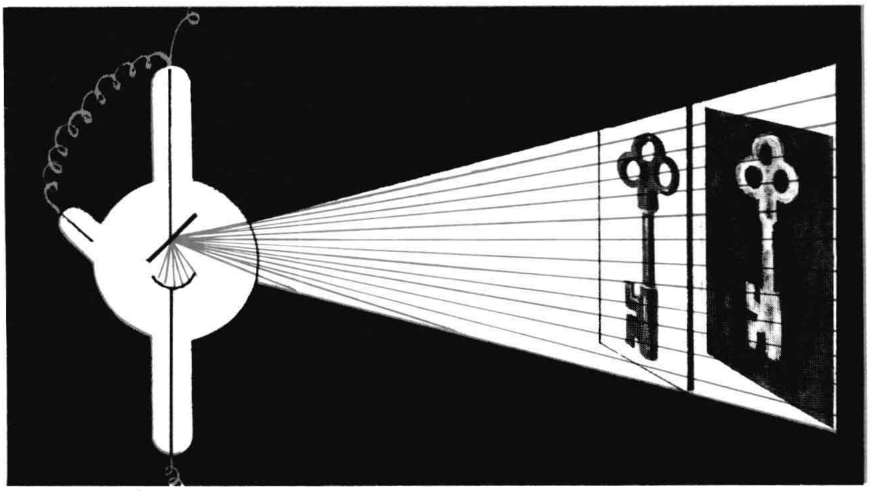
One day he decided that in order to compare X rays with ordinary light rays, he would take a photograph using X rays instead of ordinary rays of light. "Would the invisible X rays be powerful enough to take a photograph?" he asked himself. There was no reason to suspect what he was to find out about X rays. He could not know that his simple idea would change the future of science.

All the professor knew was that he was going to attempt to take a picture with X rays. He decided to try to photograph his

own brass house key. If the X rays were only as powerful as ordinary light rays, nothing would show up on the film. If they were stronger, then he would see a photograph of the key.

He took a piece of unexposed film, called a "photographic plate," and wrapped it in black paper to keep out ordinary light. Then he put his brass house key on the paper, placed the wrapped-up plate near the Crookes tube, and sent an electric current through the tube.

As quickly as possible he developed the film, printed it, and inspected the photograph. This was no ordinary picture. All that appeared on it was the outline of his door key. There was nothing more. The rest of the picture was dark. As he stared at the strange photograph, he realized that he had just taken a picture of his key's X-ray shadow!



X rays coming from the Crookes tube are powerful enough to travel through glass, wood, and rock.

To be certain, he placed several different items on a table. They were made of metal, wood, and glass. Then he took more X-ray pictures. Once the film was developed, he saw that the X rays had penetrated some items and not others. Wherever the rays were unable to penetrate an object, the item cast its blurry shadow on the exposed film. It was just the same as in ordinary light when an object casts a shadow on the ground.

There was little time left before the December 28 meeting, but he wanted to know about X rays and humans. Would X rays travel through people as they did through paper, wood, and other materials? Since X rays had this great penetrating power, it seemed natural that they would also pass through the human body. There was only one way to find out. He would take a picture of himself, using X rays.

Looking around the laboratory, he spotted a short-legged wooden table about the size of a small chair. This small table would do as a stand for him to rest his hand on. Placing this stand on top of one of the larger laboratory tables, he painted it coal-black. Then he put a Crookes tube a few inches from the underside. Ready for the photograph, he placed his hand flat on top of the stand, then laid the glass photographic plate over his hand. Reaching over to the light switch, he turned off all the lights in the laboratory. A moment later, the silence was broken by the rapid snapping sound of the electric current.

When Roentgen developed the film, he could barely make out the pattern of lights and shadows on it. But as the print became clear, he began to have an uneasy feeling that he was not looking at the usual photograph of a hand. Then he realized why. The skin and flesh covering his bones were not shown.

Skin and flesh were nowhere to be seen in the picture. He had made a shadowy photograph of his own living bones! The X rays had traveled through skin, even muscle, before they were finally stopped by his bones. His film showed the first photograph of the inside of the human body!

Roentgen's X-ray photograph of his hand.