THE HUMAN SIDE OF SCIENCE

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ALMOST 60 years have passed since Wilhelm Conrad Röntgen, professor of physics at the University of Würzburg (in November 1895), saw the effect of a strange and unusual phenomenon while he was performing some experiments in his laboratory. This was the bright fluorescence of some barium platinocyanide crystals near an electrically excited Hittorf-Crookes tube. He pursued the study of this effect in a most masterly and thorough manner, and discovered it to be due to "new kind of rays," which he called the "x-rays" and which now are often called the "roentgen rays." This famous discovery, which so profoundly influenced many branches of science and medicine, placed Röntgen in the ranks of the world's great men.

With a discovery so epoch-making as that of the x-rays, and in view of the immediate and unprecedented interest in it on the part of the scientific world and the general public, it was perhaps inevitable that some confusions and even unjust criticisms concerning it should arise to disturb and plague Röntgen. Because he reacted to criticism with great sensitivity, and even bitterness—though he also did his best to avoid and evade acclaim—an account of these negative unpleasant accompaniments of the discovery forms an interesting chapter on scientific controversy and polemics.

Some of the controversy regarding priority in regard to certain phases or features of the discovery was undoubtedly not inspired by dishonesty, but rather by the confusion which arose naturally from the tremendous publicity concerning the new scientific wonder and ignorance concerning its real nature. The distinction between the new rays and the well-known cathode rays was confusing to nonscientific minds, and this confusion was evident in some of the stories that were circulated regarding the discovery. Another factor which gave rise to some of the unfounded and inaccurate accounts of the event was the desire of certain little persons in the periphery of Röntgen's environment to gain personal prestige by pretending to know some "inside story" connected with it. These gossipy rumors and descriptions undoubtedly were exaggerated and magnified by Röntgen's aversion to publicity and his own reticence in discussing the actual happenings.

In addition to these factors, it is unpleasant to record that evidently most of the unfair criticism came from certain scientists who were jealous of Röntgen's success. Many prominent scientists had been investigating the cathode rays, and felt chagrin that they had failed to observe the phenomena which led Röntgen to detect the existence of the x-rays, although undoubtedly x-rays had been produced in their experiments, as was recognized after the discovery was announced.

False claims of priority and attempts to belittle the importance of the discovery and Röntgen's genius in making it were already appearing early in 1896, even before the first tumult of acclaim and praise had subsided. Although these criticisms were puzzling and disturbing to Röntgen, he apparently resolved to ignore them philosophically, as he indicated in a letter to his friend Ludwig Zehnder: "My work has received recognition from many quarters . . . This is worth a great deal to me, and I let the envious chatter in peace; I am not concerned about that." Nevertheless, the record and his own behavior later clearly demonstrate that he was concerned about it, and became increasingly so with the passage of the years. He mentioned it in letters to his friends only a year or so before his death. As his resentment increased, his reticence became more and more pronounced, and reached such exaggerated proportions that, after his three original communications, he refused to publish anything more on the x-rays; and he also stipulated in his will that all records of his work and all correspondence about the discovery between 1895 and 1900 be burned unopened at his death—a provision, which, unfortunately for the historical record, had to be carried out.

The claims of priority in the discovery arose largely from confusion regarding the reports of previously unexplained accidents caused by the x-rays. Sir William Crookes, whose cathode-ray tubes Röntgen had used in many of his experiments, had observed that unopened boxes of photographic plates were fogged and had complained repeatedly to the manufacturer that they were unsatisfactory. That this effect was caused by x-rays he did not know until their discovery was announced. Others had had similar experiences with photographic plates, but had not investigated the reason for it. A. W. Goodspeed, professor of physics at the University of Pennsylvania in Philadelphia, actually made an accidental x-ray photograph on February 22, 1890, during the process of demonstrating a Crookes' tube. He kept it with a collection of freak photographs, but recalled and unearthed it six years later, when the discovery of x-rays was announced, and proved that it was actually an x-ray photograph. Goodspeed described this in a lecture on the roentgen rays which he gave in February 1896 but added: "We can claim no merit for the discovery, for no discovery was made."

Typical of the inaccurate descriptions and stories about the discovery was the fable of book and key, which was originated by an American student attending Würzburg University and widely circulated in the United States. This gave April 30, 1895, as the date. "Röntgen had a Hittorf tube covered by a light tight paper energized by a coil and was studying the fluorescence of the screen one afternoon, and being called away for a few minutes, he laid the glowing tube upon a book which contained a large flat key, which was being used for a bookmark. A loaded photographic plateholder happened to be lying under the book. When he returned he shut off the current from the tube, took the plateholder with several others and spent the afternoon out of doors, exposing several plates in the practice of his favorite hobby, photography. On developing the plates, he found the shadow of the key bookmark on one of them.

He wondered how this happened and questioned several of the students, but none could explain the incident."

This story has had wide appeal for the general public, and has reappeared in numerous distorted versions of the discovery, but even in its original form, it contains inaccuracies. Laying a glowing tube on a book would necessitate disconnecting the high voltage from the tube and hence no x-rays could be produced. "Studying the fluorescence of the screen" around a Hittorf tube would indicate that the fluorescent effect of the rays had been noticed previously. Neither Röntgen nor any of his intimate colleagues and friends ever spoke of anything connected with the book and key experiment. Röntgen was always most accurate and painstaking in recording experimental data, yet he never referred to any such observation on April 30, 1895. His two senior assistants, one of whom helped to evacuate the Hittorf tubes, did not know about the discovery of the x-rays until Röntgen's announcement in December 1895. If these men who were working rather intimately with Röntgen knew nothing of the discovery, it seems extremely unlikely that a student at the University should have had any inside information as to the work the professor was doing.

One of the most pernicious and persistent rumors was that the discovery was merely an accident and that the first crucial observation of the fluorescence of the screen was made by a laboratory assistant. In his last years, Röntgen once said, "What miserable envious soul must have invented this story."

Of all the criticism and antagonism directed towards Röntgen, the most distressing to him was the attitude of Philipp Lenard, which grew increasingly bitter and puzzling with the years, and continued—so far as Lenard was concerned—after Röntgen's death in 1923.

Of the scientific events antedating the discovery of the x-rays, Lenard's scientific contributions on the properties of the cathode rays immediately preceded and undoubtedly were a principal factor in stimulating Röntgen's researches that led to recognition of the "new" rays. However, Lenard's work and also Röntgen's, rested on the discoveries of many scientific predecessors, especially the experimental work of Hertz—who was Lenard's teacher—and the theories of von Helmholtz. Röntgen gave Lenard due credit for his "wonderful" experiments in his first communication and also mentioned the Lenard vacuum tube as one of those he used in his experimental work. Immediately after the discovery, Lenard's attitude toward Röntgen was friendly, as proved by letters still in existence, but a definite antipathy and bitterness, on Lenard's part, appeared at about the time Röntgen received the first Nobel prize for physics in 1901. From the time when Lenard himself received the Nobel prize in 1905, it seemed clear that he had embarked upon a campaign to minimize the work of Röntgen, and to make him appear a bungler who merely happened accidentally to make a great discovery. He said in his Nobel prize lecture: "In reality I had made several unexplainable observations which I carefully kept for future investigation—unfortunately not started in time—which must have been the effects of traces of wave radiation." In his publications on cathode rays which appeared before Röntgen's discovery, Lenard did not

mention these observations: hence any attempt to give Lenard the credit for discovery of the x-rays is without any historical foundation.

In Lenard's publications during later years, he has either ignored Röntgen or dismissed him and the x-rays (high-frequency rays, as he called them) in a casual footnote. He has tried to perpetrate the idea that anyone who was wide-awake and using a Lenard tube could have discovered the x-rays. He excuses his own failure to discover them by saying that, as a good scientist, he concentrated on his own special line of investigation and postponed the study of strange phenomena until after his original work was completed.

During a controversy in 1929, Lenard intimated that perhaps more data in regard to the discovery of "high-frequency rays" might be revealed at a later date. On August 18, 1929, he wrote to me: "There is no doubt that the road to the discovery led over my researches. At that time I was prevented by external circumstances from pursuing to my satisfaction in every direction the great number of new phenomena that appeared in my studies on cathode rays. But in my opinion, this is not yet the proper time to express myself more thoroughly on the subject than I did in my Nobel prize lecture. That would be only biographical anyway, and what has already been said must suffice for the judicious. With this I believe that I have done everything that the history of science can expect of me on this point at this particular time." Lenard continued later to maintain this enigmatic attitude.

It is interesting that Lenard's extreme nationalism and strong anti-Semitic prejudice assured him an outstanding position in Hitler's regime, and added great weight to whatever he had to say. Hence, with the ascendency of the Nazis, the controversy regarding the credit that Lenard should receive in connection with the discovery of the x-rays assumed distorted and exaggerated proportions that extended outside the realm of a priority claim in the field of physics. In 1935, friends of Lenard made a concerted effort to prove that Röntgen used the Lenard tube in making the discovery, but the evidence was not sufficient to alter the story of the discovery. Just preceding and during the war years, there was considerable discussion, carried out with the help of the Nazi press and some party members, over the position of Röntgen in the annals of science. Articles appeared in certain daily papers suggesting that he had done nothing remarkable, but merely had carried to its inevitable conclusion the work of the great Aryan scientist, Philipp Lenard, Director of the Physical Institute at Heidelberg University.

In 1944, the Physical-Medical Society of Würzburg made application to the Nazi Minister of Post and Telegraph to have a memorial stamp made for Röntgen, marking the fiftieth anniversary of the discovery of the x-rays, similar to the one issued for Robert Koch and other scientists; but the request was rejected with the comment that the proposal was not in order inasmuch as such an honor was reserved only for the illustrious. The Minister of Post, Dr. Ohnesorge, happened to be a good friend of Lenard's. Seven years later, the Ministry of Post of the Federal Republic of Western Germany issued a Röntgen-

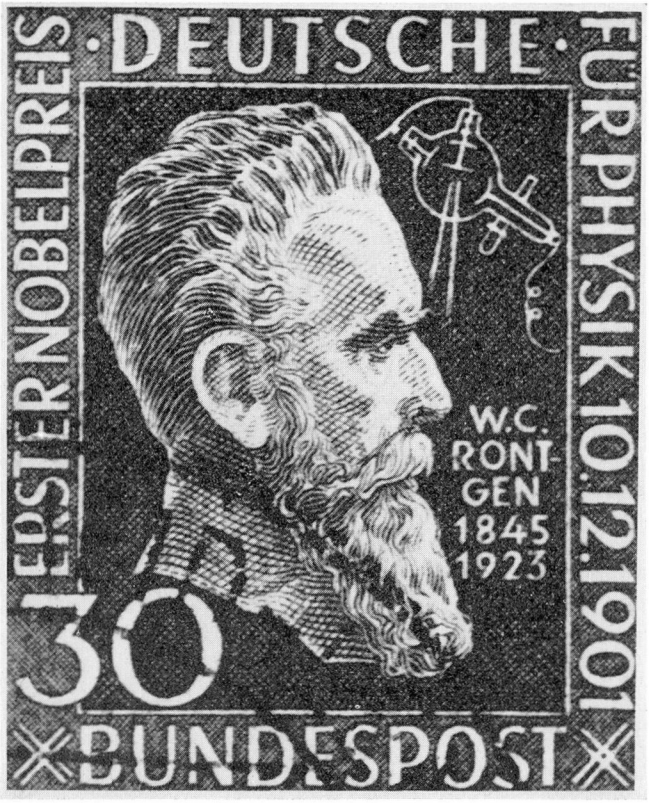

Fig. 1. Röntgen-stamp issued in 1951 by the Ministry of Post of the Federal Republic of Western Germany at the occasion of the fiftieth anniversary of the award of the first Nobel prize in physics to Röntgen.

stamp at the occasion of the fiftieth anniversary of the award of the first Nobel prize in physics to Röntgen (fig. 1).

In Lenard's four volume work, "Deutsche Physik," there is no mention of Röntgen or of Einstein in the text, and the foreword is a diatribe against the Jews. Many persons in Hitler's Germany naturally drew the inference that Röntgen was a Jew. When Lenard was asked directly, "Was Röntgen a Jew?" he replied, "No, but he was a friend of Jews and acted like one."

That Röntgen had good Jewish friends is a fact, for he mentioned them frequently, and with affection, in his letters. It is also true that he condemned anti-Jewish prejudice, as shown in this letter to a friend, written May 12, 1921: "The anti-Semitic incidents in Würzburg of which you write are exceedingly regrettable; it is not much better here (Munich). For instance, there is scarcely an advertisement of rooms for University students which does not contain the statement, 'No Jews,' and I know of one instance when a woman said to a

student who was looking at a room and mentioned his name, which sounded Jewish, 'I do not take any Israelites.' It is a bad sign of the times that decent persons can thus be so rudely insulted."

The record shows that Lenard's animosity towards Röntgen—which would seem to be based on resentment of Röntgen's greater fame—became more intense with the years. The extreme bitterness in his old age (83 years in 1945) was expressed in an interview with Lewis Etter as follows: "I am the mother of the x-rays. Just as a midwife is not responsible for the mechanism of birth, so was Röntgen not responsible for the discovery of the x-rays, which merely fell into his lap. All Röntgen had to do was push a button, since all the groundwork had been prepared by me . . . Without my help the discovery of x-rays would not have been possible even today. Without me the name Röntgen would be unknown. Röntgen was an opportunist who sensed that there was something to be found in experimenting with my tube which he carried out with an eye to fame . . . I was always too modest and did not rush into print. In my letter to Röntgen where I praised him for his great discovery I thought he would reply that he really owed it all to me and my tube, but I waited for this acknowledgement from him in vain."

It is sad and disillusioning that a man like Lenard, whose scientific achievements rank with the best, should be so consumed by jealousy that he should also try to take credit for the great discovery of a fellow scientist. It is also disappointing that one trained in the scientific method should forsake the broad, impartial, honest integrity—the ideal of Truth—of the scientific viewpoint and degrade himself by expressions of narrow partisanship, racial prejudice and petty jealousy and slander. This indicates that some scientists—though fortunately they are few in number—fail to live up to the high ideals of the cause they serve.

It was precisely because he failed to measure up to the high ideal of truth, which is the essence of science, that Lenard found such high favor in the Nazi regime. He tried to add to his own renown by subtracting from Röntgen's glory, and he succeeded temporarily, in his own country, because the environment of the Third Reich was one in which prejudice flourished.

When seen against this distorted background, the character of Röntgen stands out in bold relief. Because he was a man of real integrity—the true scientist in his life as in his work—and hence could not tolerate intolerance, his memory was not revered by the National Socialists. That they could not regard him as illustrious is, in one sense, a measure of his true universality and greatness. In democratic Germany and elsewhere in the world, Röntgen's honor and fame have steadily increased during the almost 60 years that have elapsed since his great discovery.

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