



*Professor Wilhelm Conrad Roentgen*

# *Roentgen's Mysterious Rays: 100 Years Of Progress*

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**E**xperimenting with a Crooke's cathode tube, Professor Wilhelm Conrad Roentgen accidentally — and officially — discovered X-rays on Nov. 8, 1895. Working in his physics laboratory in Wurzburg, Germany, Roentgen was amazed to see a shimmering light emanate from a barium platinocyanide screen on a workbench several meters from the charged Crooke's tube. As early as 1890, others had dismissed the significance of similar incidents. Roentgen was the first to draw the right conclusions about the phenomenon, which was to become an essential part of the medical world.

At the time, physicists such as Roentgen were investigating the nature of light. Researchers conducted experiments passing electrical charges through electrodes

in sealed glass tubes, similar to a light bulb, from which most of the air had been removed. Roentgen was experimenting with the fluorescing or cathode rays, which we now refer to as electrons, in attempt to determine whether light consisted of waves, particles, etc. On the date of the discovery, Roentgen was trying to detect the presence of cathode rays outside the glass Crooke's tube.



Knowing cathode rays were not the cause of the glow, based on the research of others, Roentgen held different objects, including his own hand, between the tube and the surface of the fluorescent screen. Rather than casting a shadow as expected, Roentgen saw the bones and outline of his hand reproduced on the screen. Working intensely and secretly in his laboratory during the next six weeks, the professor began documenting his findings. He meticulously experimented and described all the major properties of X-rays that are known today.

Knowing this incredible discovery should not be withheld from the scientific community, his paper "On a New Kind of Rays," was published on Dec. 28, 1895 in *Sitzungsberichte der Würzburger Physik-medic* and reprinted in the Jan. 23, 1896 issue of *Nature*. Interestingly, Roentgen presented and demonstrated his experiments with X-rays only once, talking to his colleagues at the Würzburg Physical-Medical Society in January 1896.

Immediately, his discovery spread, via cabled news, throughout the world. Roentgen received the first Nobel Prize for Physics in 1901, but he refused to discuss the breakthrough or accept any personal monetary awards. Interestingly, Roentgen requested that all the documents relating to his discovery be destroyed after his death. For this reason, the historical documents of the discovery of radiology differ in the description of dates and events. But there is no dispute that the announcement of the discovery of the "mysterious Roentgen rays," as they were called, quickly began transforming the worlds of medicine and science.

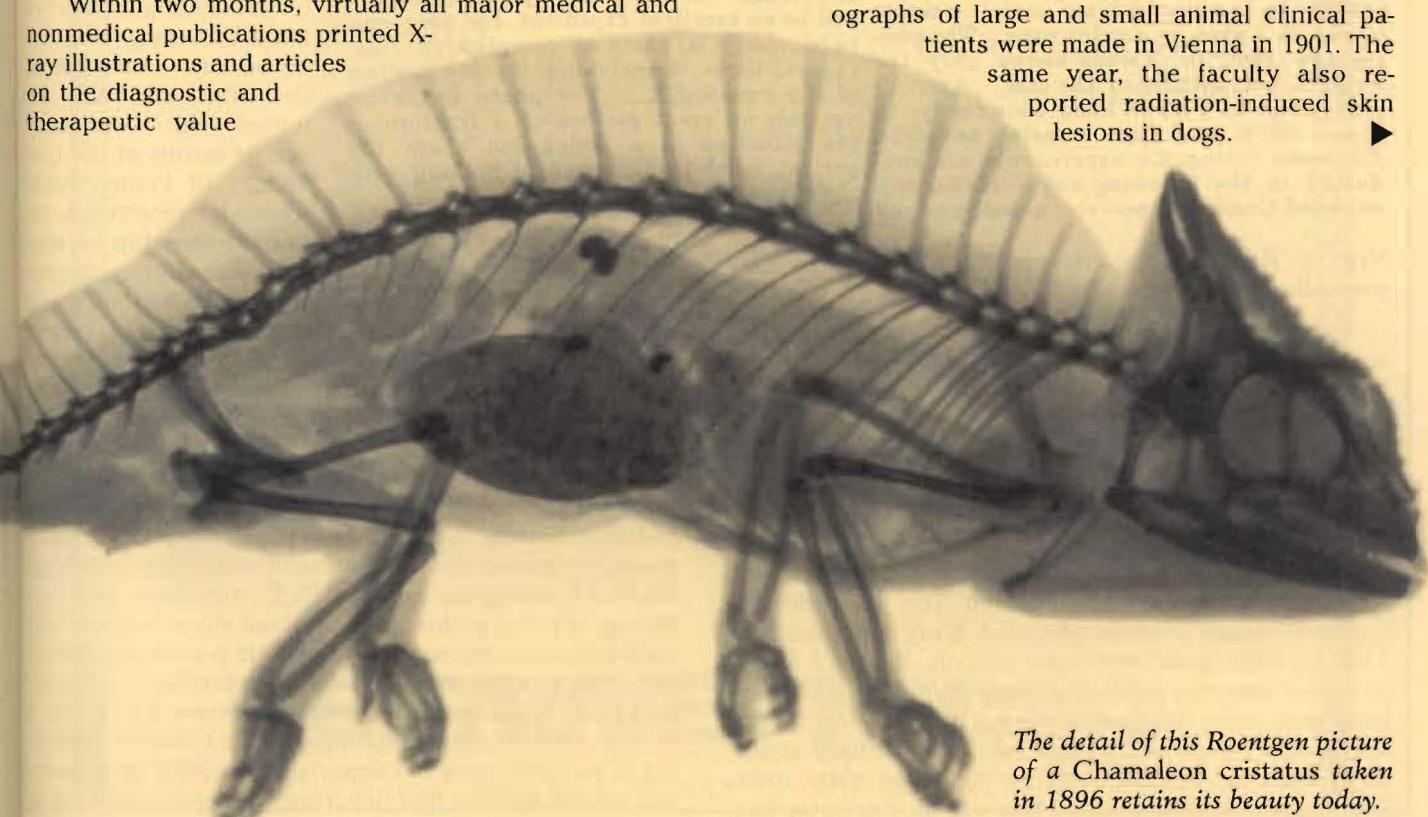
Within two months, virtually all major medical and nonmedical publications printed X-ray illustrations and articles on the diagnostic and therapeutic value

of X-rays in human and veterinary medicine. In 1896, more than 1,000 papers were published on the technology, including six papers on the use of X-rays in veterinary medicine. In the flurry of refinement, contrast media and intensifying screens were also introduced that year. The discovery of X-rays quickly led to the development of radiology, providing noninvasive, accurate and increasingly sophisticated methods of diagnosis and treatment.

## X-rays In Veterinary Medicine

One of Roentgen's close friends was Professor Eberlein, a veterinarian. Professor Eberlein, director of the Surgical Clinic and the Royal Veterinary Academy in Berlin, was the chairman of the first and second Roentgenological Congress held, respectively, in 1905 and 1906. The only veterinarian to have ever held this prestigious position, Dr. Eberlein outlined the usefulness of radiology in the veterinary field. Describing the techniques used in making radiographs and predicting the future of radiation therapy in veterinary medicine, Dr. Eberlein rightfully earned the title "Father of Veterinary Radiology."

In the early months of 1896, J.N. Eder and E. Valenta of Vienna, published X-ray photographs of a fish, frog, rattlesnake, crab and other small animals. Their radiographs were of outstanding quality with detail as good as modern day radiographic images. In 1897, the Vienna Veterinary College claimed the distinction of being the first veterinary school to obtain X-ray equipment. The first radiographs of large and small animal clinical patients were made in Vienna in 1901. The same year, the faculty also reported radiation-induced skin lesions in dogs. ▶



*The detail of this Roentgen picture of a Chamaleon cristatus taken in 1896 retains its beauty today.*



In 1927, the school received a large sum of money from the Rockefeller Foundation to establish a veterinary roentgenologic institute. The first director, Professor Alois Pommer held the position from 1938 until his death in 1958. He emphasized the biologic effects of radiation, described therapy protocols and listed types of animal diseases amenable to X-ray therapy. The dose and fractionation methods that he recommended for tumor radiotherapy are similar to those still in use today.

The first veterinary radiology text, *Veterinary Radiology*, was written by Dr. Paul Henkel and published by Paul Parey in Berlin, in 1926. The text included six chapters with 91 illustrations on roentgen physics, normal

## REMARKABLE SCIENTIFIC DISCOVERY.

**[FROM OUR CORRESPONDENT.]**

VIENNA, SUNDAY NIGHT.

A sensational discovery, which, if the reports are confirmed, is likely to be attended by important consequences for physical and medical science, is spoken of in scientific circles here. A new conductor of light has been discovered by Professor Röntgen, the well-known physicist at the Würzburg University. So far his experiments have resulted in the discovery that light penetrates wood and the flesh of men and animals, without, however, penetrating bones and metals. The professor succeeded in photographing metal weights placed in a shut-up wooden case. The photograph sent to Vienna shows only the weights, but nothing of the case. Another photograph of a man's hand shows only the bones, while the flesh remains invisible. Professor Röntgen's experiments are conducted in the following way:—He takes a so-called Crookes's pipe—viz., a well pumped

out glass pipe, with an induction current going through it, and by means of the rays which that pipe is emitting he photographs on ordinary photograph plates in contrast with the ordinary rays of light those rays penetrate wooden and organic matter and other opaque substances, just in the same way as the ordinary rays of light penetrate glass. Experiments were also made in photographing hidden metals with the apparatus shut, and produced equal success. The rays penetrated not only the wooden case containing the metals, but also the cover placed before the plate of the apparatus. The scientific world here is much agitated by the discovery, which it is believed will be of far-reaching importance for many branches of knowledge. Already in its present stage it will be an excellent expedient for surgeons, particularly in cases of complicated fractures of limbs, in searching for the bullets of the wounded, &c. The photo will show not only an exact picture of a fracture, or the situation of a bullet, but spare the patient much painful manual probing with the sound.

News of "Roentgen's mysterious rays" spread quickly around the world, even throughout the nonmedical community.

anatomy, diagnostic radiology and radiation therapy. Unfortunately this excellent text was never translated into English, which limited the development of veterinary radiology in other parts of the world.

## Coming To America

In North America, early use of X-rays in veterinary medicine are sketchily documented. The Colorado and Iowa veterinary schools obtained X-ray equipment in 1915. By 1930, most veterinary schools, Boston's Angell Memorial Hospital and some small animal private practices were using X-ray equipment. The hand-held fluoroscope was the most common piece of ancillary equipment used by veterinarians during those early days. Eventually scientists realized this was an extremely haz-

ardous device, exposing the operator to radiation.

In 1912, Dr. W. F. Guard, at Ohio State University, performed a radiographic examination of a fractured equine phalanx. In 1915, Dr. H.E. Kingman, Sr., professor of surgery at Colorado Agricultural College (later renamed Colorado State University), wrote the first American paper on veterinary diagnostic radiology. He described the bony change on six radiographs of horses with lameness.

The first paper on small animal radiography was published by Dr. J.C. Horning, Houston, Texas, in 1927. The North American Veterinarian published a series of articles on small animal diagnostic radiology by Dr. Gerry Schnelle in 1937. This series was based on the radiology

findings and final diagnoses of clinical cases seen at Angell Memorial Hospital. Dr. Schnelle published *Radiology in Canine Practice*, the first American book on radiology, in 1945. The second edition, published in 1950, *Radiology of Small Animals*, included both dogs and cats.

Dr. Mack Emmerson was the first veterinarian in North America to receive specialty training in veterinary radiology. After graduating from Iowa State University in 1925, he became a member of the staff. In 1929, he joined the veterinary school faculty at the University of Pennsylvania where he received a national fellowship to support masters degree training in pathology at the University of Zurich.

Switzerland. Returning to the University of Pennsylvania, he became responsible for the use of radiology at the veterinary school.

Dr. Emmerson credits Dr. Eugene F. Pendergrass chairman of the University of Pennsylvania Hospital Radiology Department, as the most influential person in his radiology career. Unlike many physicians, Dr. Pendergrass recognized the worthiness of veterinary radiology. With Dr. Pendergrass' support, Dr. Emmerson received radiology training at the medical school and attended most radiology conferences and rounds. He participated as an equal with physicians, presenting veterinary radiology cases. Dr. Emmerson also traveled to Austria to spend a month at Dr. Pommer's Roentgenologic Institute. Returning to the University of Pennsylvania in 1939, Dr. Emmerson established the first department of veterinary radiol-



ogy in a North American veterinary school. The urban environment of Philadelphia provided Dr. Emmerson with an affluent clientele knowledgeable about the benefits of X-ray diagnosis and therapy for pets. In 1945, Dr. Emmerson returned to the Iowa State University Veterinary School, where he continued to be a leader in radiology. He organized the American Board of Veterinary Radiology in 1960, becoming a charter member.

Veterinarians involved in radiology, whether in practice or at teaching institutions, during the 1940s and 1950s were self-taught or had received training from physicians. Perhaps fortunately, X-rays were not used extensively by veterinarians prior to this time, because the hazards of ionizing radiation were not understood and the equipment was electrically

unsafe. Major strides were made in the advancement of veterinary radiology and other clinical specialties during the 1950s, especially by small animal practitioners. The American Animal Hospital Association had a direct bearing upon the development of diagnostic radiology by including a presentation on the subject at each of its meetings.

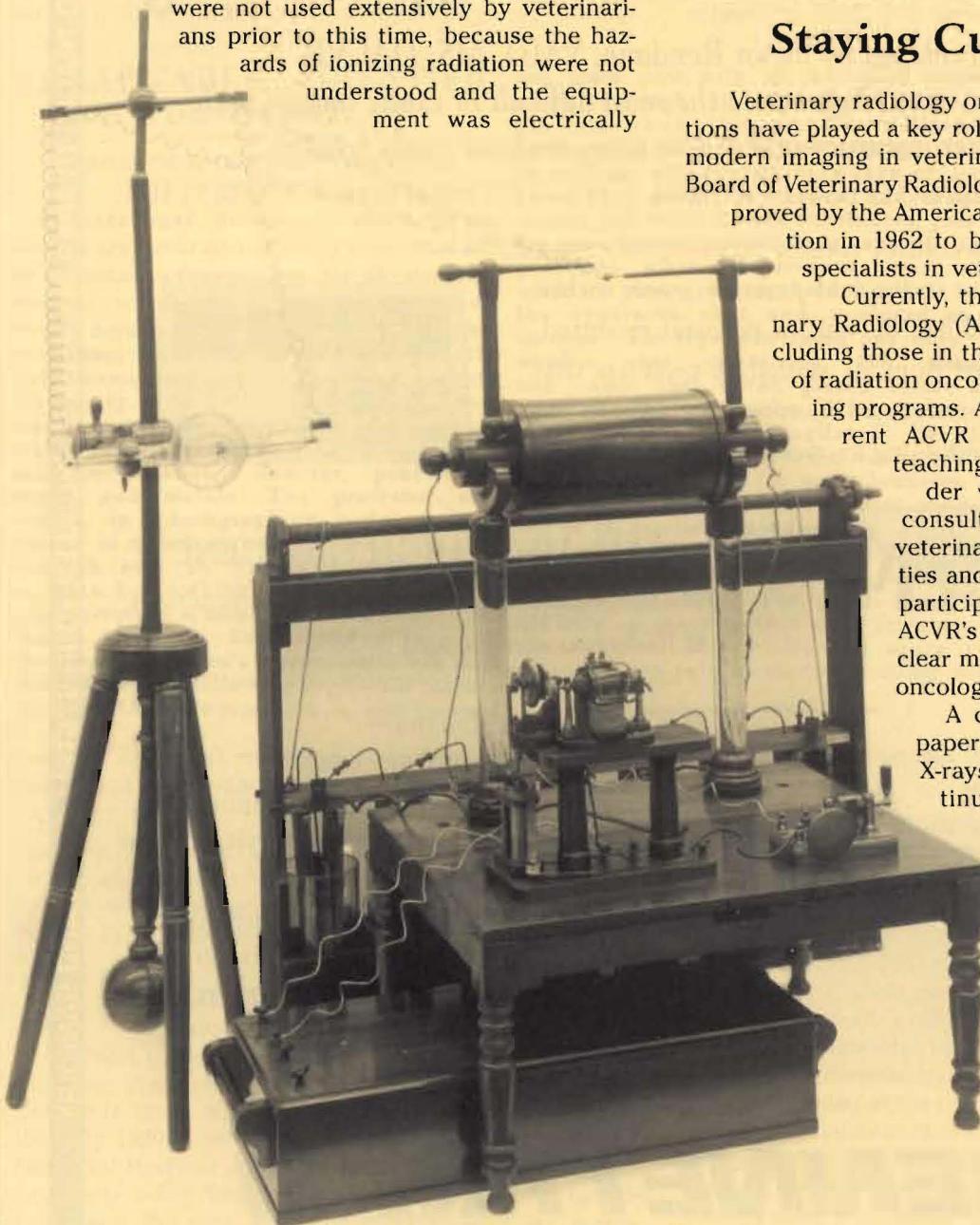
By the mid-1950s, Dr. William Carlson at Colorado State University and Dr. William Harker Rhodes at the University of Pennsylvania became the first two North American veterinarians to enter full-time radiology training for a graduate degree program.

## Staying Current Today

Veterinary radiology organizations and their publications have played a key role in the rapid advancement of modern imaging in veterinary medicine. The American Board of Veterinary Radiology was formed in 1960 and approved by the American Veterinary Medical Association in 1962 to begin certifying candidates as specialists in veterinary radiology.

Currently, the American College of Veterinary Radiology (ACVR) has 183 diplomates, including those in the newly established specialty of radiation oncology, plus 27 residents in training programs. Approximately 70% of the current ACVR diplomates are working in teaching institutions, with the remainder working in private radiology consultation practices. Numerous veterinarians in other clinical specialties and veterinary practitioners also participate in one or more of the ACVR's four societies: ultrasound, nuclear medicine, CT/MRI and radiation oncology.

A century after Roentgen's first paper announcing the discovery of X-rays, veterinary radiologists continue to publish information about new advances in the field. *The Journal of Veterinary Radiology and Ultrasound* has become the official publication of the American College of Veterinary Radiology, The European Association for Veterinary Diagnostic Imaging and the International Veterinary Radiology Association.



X-ray apparatus used in 1896-1897 in England, featuring a Watson Penetrator focus tube.



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This article is partially based on presentations given at the September 1995 celebration of the centennial of Roentgen's discovery of X-rays held in Berlin by the European Association of Veterinary Diagnostic Imaging in cooperation with the International Veterinary Radiology Association. For more information, contact the American College of Veterinary Radiology, Dr. Myron Bernstein, Executive Director, P.O. Box 87, Glencoe, IL 60022; Fax 708-446-8618.

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