SPECIAL ISSUE:

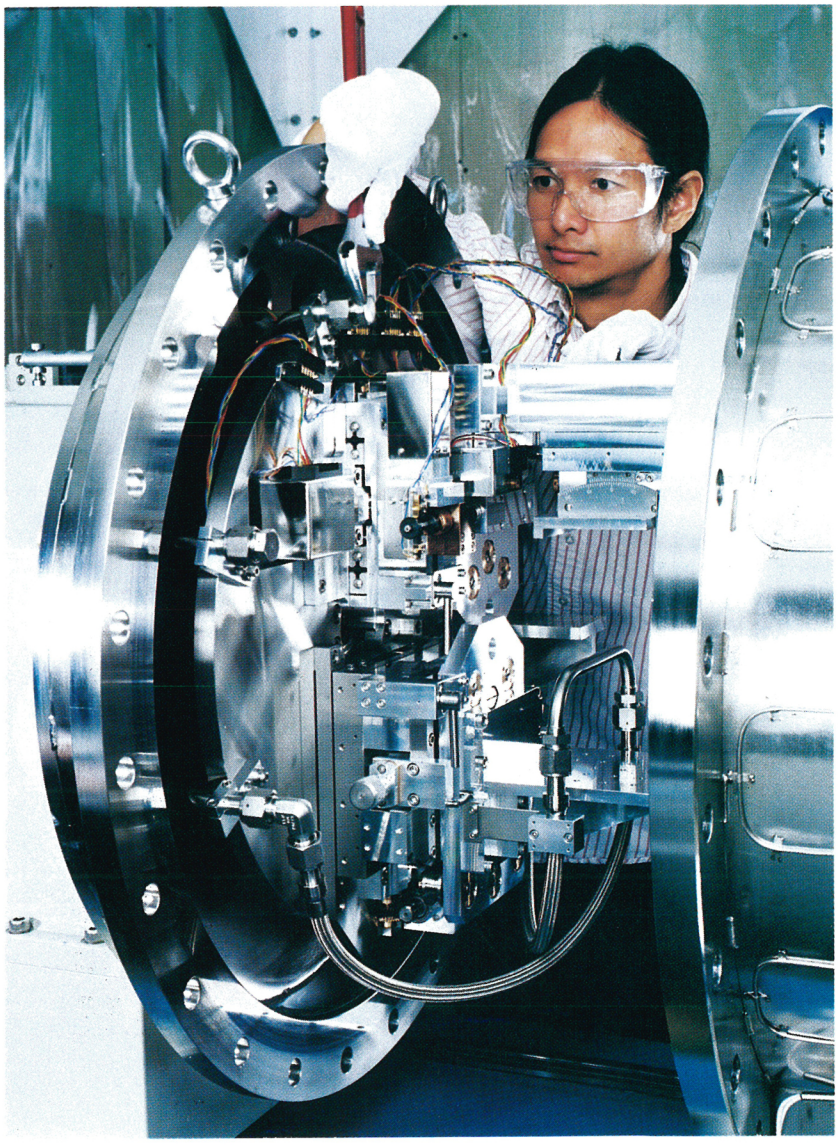
X RAYS 100 YEARS LATER

One century ago this month, high-energy electromagnetic radiation—the "X" or "unknown" ray—was discovered by Wilhelm Conrad Röntgen in his basement laboratory. Few other scientific discoveries were as immediately sensational. From hospitals to airports, in physics and biology labs, in the fabrication of nanostructures for electronics and machinery, x rays have come to permeate the modern world. In this special issue we cannot look at the full history and extent of research using x rays. Rather, we have chosen to take a few snapshots of research then and now.

Starting on page 25 Howard Seliger takes us into Röntgen's basement on that fateful 8th of November in 1895 and shows us the state of cathode-ray research at the time. Along the way we find out why it was Röntgen who first saw that "glimmer of light" and recognized it for what it was.

We then jump to the present and use progressively wider-angle lenses for our snapshots. Jens Als-Nielsen and Gerhard Materlik describe x-ray imaging, diffraction and spectroscopy down to the atomic level, beginning on page 34. Included in their discussion of the many exciting new uses of x rays in condensed matter physics are topographic x-ray images of crystal lattices, x-ray magnetic scattering and x-ray standing waves.

We next move to the burgeoning field of x-ray crystallography of biological macromolecules. In 1994 alone, 352 new macromolecular structures were determined with x rays. Wayne Hendrickson (page 42) gives us a brief tutorial on modern methods—how the structure of a truly large molecule of 10^4 or more atoms is unraveled—and a survey of some classical molecular structures and recent triumphs. One major application of these results is the design of drugs and other molecules with specific properties.



THE NEXT GENERATION of research results will be helped by Argonne's Advanced Photon Source. Here we see an adjustment being made on the mechanics of a double crystal monochromator, used to select specific x-ray energies for experiments.

Our focus then shifts from biology to medicine. Physicians recognized the importance of Röntgen's discovery almost immediately, first for diagnostic imaging, then for radiation therapy. Starting on page 51 William Hendee discusses the physics of x-ray imaging, the evolution of computed tomography and digital imaging, the development of radiation therapy for cancer and the recent merger of these techniques; now a patient's tumor can be located and the treatment planned, implemented and monitored all with the same machine.

Finally we look at x rays on the grandest of scales: the rest of the universe. As David Helfand tells us (page 58), our understanding of black holes, neutron stars, cosmology and the origin of the elements has been greatly enhanced by analyzing x rays from far beyond Earth.

We hope you will enjoy this brief tour of late 20th-century physics, revolving around that momentous discovery 100 years ago of the "unknown" x ray.

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