

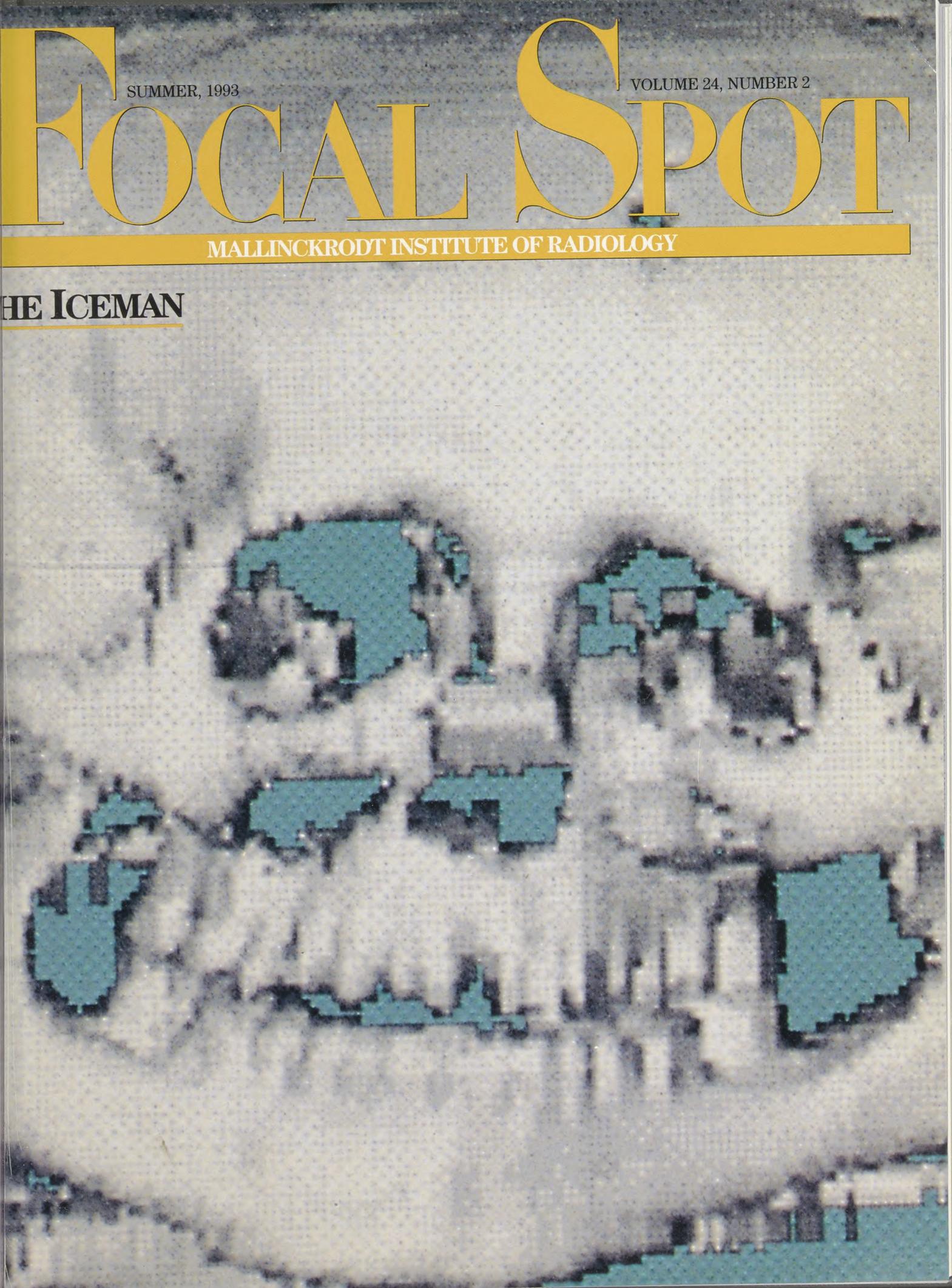
SUMMER, 1993

VOLUME 24, NUMBER 2

FOCAL SPOT

MALLINCKRODT INSTITUTE OF RADIOLOGY

THE ICEMAN





The 1991 Alpine discovery of a 5,000-year-old mummy known as the Iceman has provided scientists with a rare glimpse into the Stone Age. Three-dimensional imaging data, from which this replica of the Iceman's skull was developed, enables research teams to gather valuable information without damaging the body. To learn about Mallinckrodt Institute's role in this important link to the past, please turn to page 12.

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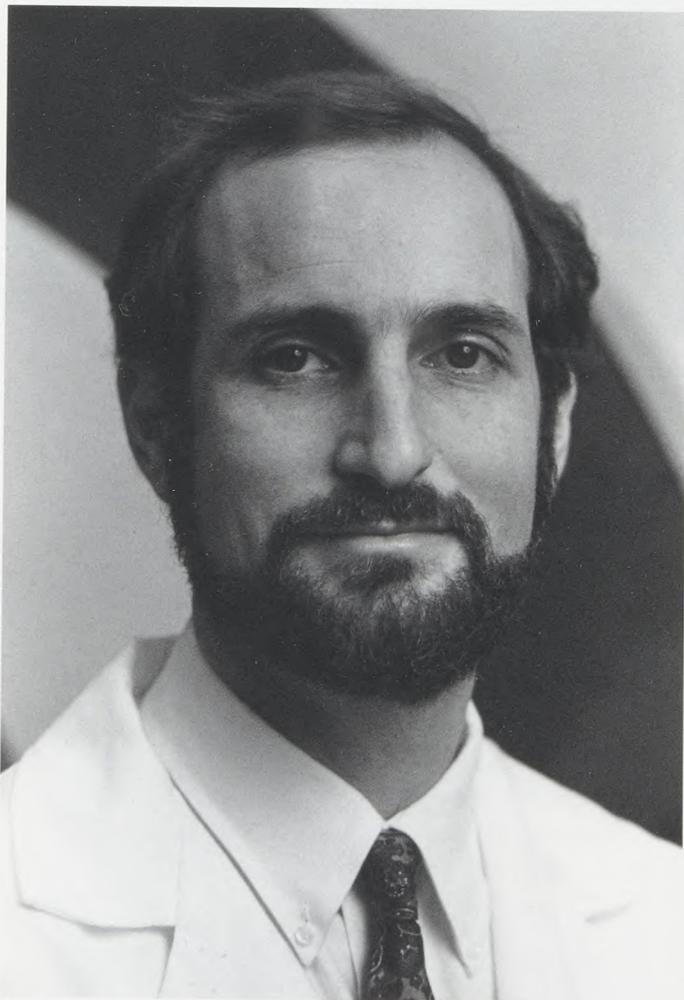


MIR
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MEDICAL CENTER

ON THE COVER:

Using a process called cylindrical reprojection, the MIR image processing team converted a three-dimensional computed tomography scan into a two-dimensional map of the Iceman's skull. Photography by David Burjoski.

SPOT NEWS



Joel S. Perlmutter, M.D.

NIH Grant Earmarked for PET Study of Dystonia

As principal investigator, Joel S. Perlmutter, M.D., associate professor of neurology and radiology, received a \$789,161 National Institutes of Health (NIH) grant to study the physical and chemical factors associated with the syndrome known as dystonia. There are more than 1,000 patients in the St. Louis area who are affected by the intermittent or sustained involuntary

muscle contractions associated with dystonia. This muscle tension causes repetitive twisting movements, either simultaneously in numerous parts of the body (generalized dystonia) or in limited areas (focal dystonia).

During the three-year project, the researchers will focus specifically on two groups of patients: those with blepharospasm (involuntary, forceful contraction of the eyelid muscles) and those with hand cramp (involving the arm and hand). By measuring radioligand binding *in vivo* with positron emission tomography (PET), the study team will test the hypothesis that patients with dystonia may have abnormalities in the dopaminergic pathways. Dopamine acts as a neurotransmitter in the central nervous system.

The study data will serve two purposes: determine if either group of patients has an elevation of receptor binding and, if so, whether the location of maximal binding differs between the two groups. This information should provide insights about the physical and chemical factors involved in focal dystonia and could lead eventually to improved treatment methods.

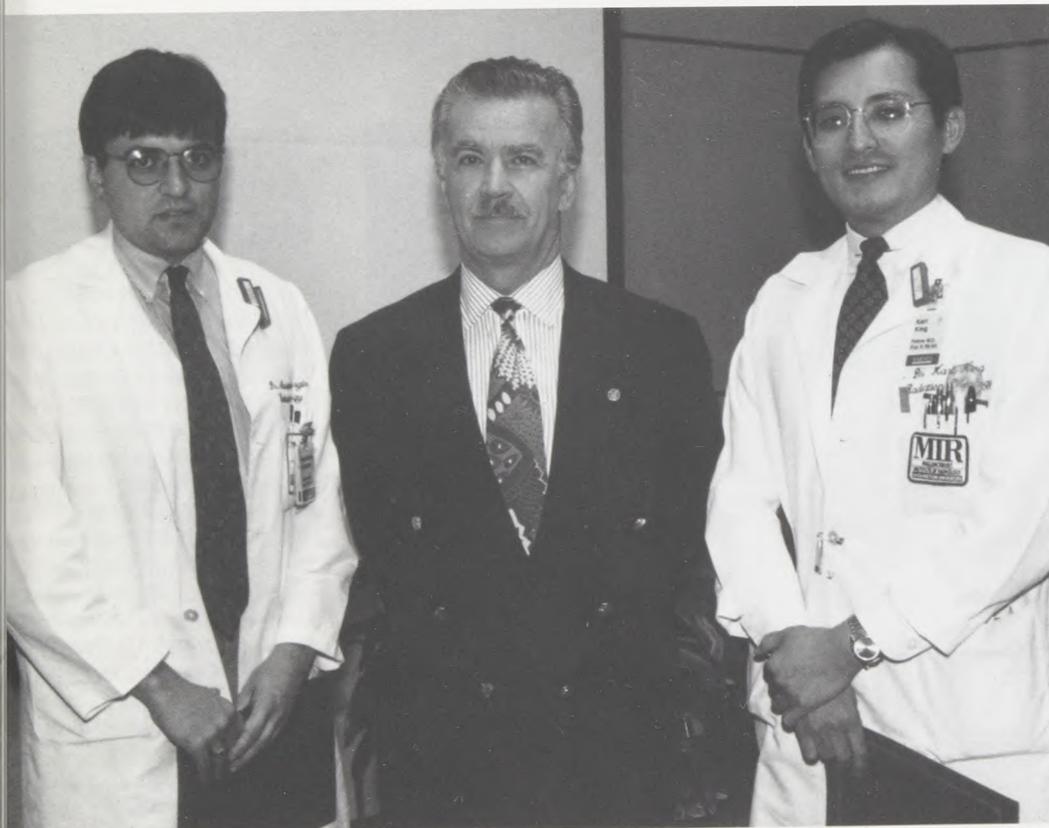
Research team members are Perlmutter; Juanita Carl, M.S., research instructor; William Hart, M.D., Ph.D., professor of ophthalmology and visual science; Joseph Jankovic, M.D., professor of neurology at Baylor College; Lori McGee-Minnich, R.N., BSN, clinical coordinator; and Stephen Moerlein, Ph.D., associate professor of radiology and biochemistry.

Royal Rates CDC Studies

As a committee member appointed by the National Research Council's Commission of Life Sciences, Henry D. Royal, M.D., professor of radiology and associate director of the Division of Nuclear Medicine, is analyzing the scientific validity of radiation studies conducted by the Centers for Disease Control (CDC). The appointment was effective April 1, 1993, and runs until September 30, 1994.

The National Research Council, the principal operating agency of the National Academy of Sciences and the National Academy of Engineering, invited experts in the field of nuclear medicine to join the "Committee on an Assessment of CDC Radiation Studies." Tasks lying ahead for the group are a review of dose reconstruction studies and related epidemiologic follow-ups (particularly the analysis, statistical reliability, and scientific interpretation) and recommendations as necessary to strengthen study protocols and ensure scientific validity of study results.

The Committee will work directly with CDC staff in setting up nuclear facility site visits to gather information concerning local conditions. Also, on the agenda is the initiation of open workshops, covering topics that will aid the CDC and the Center for Environmental Health and Injury Control in the management of community-based radiation-related studies.



The Missouri Division of the American Cancer Society (ACS) annually awards certificates to ACS oncology fellows, signifying the completion of advanced cancer studies. Shown at this year's June 11th ceremony are (left to right) Anatasios Georgiou, M.D.; Carlos A. Perez, M.D., director of the Radiation Oncology Center; and Karl King, M.D.

ACR to Assess Competence in Radiology

Back in 1988, the American College of Radiology (ACR) set up a Task Force on Documenting Continuing Competence. The ACR was founded in 1924 and is the principal radiological organization, serving more than 28,000 members in diagnostic and therapeutic radiology and related disciplines. As mandated by the ACR Council, the group's objective was the establishment of a formal program for documenting ability and skill of radiologists, radiation oncologists, and medical physicists. The impetus for this program came from many areas:

- the plan of numerous boards associated with the American Board of Medical Specialties to institute recertification requirements (to date, 22 out of 25 specialties have voluntary recertification programs in effect),
- a congressional proposal in the late 1980s requiring recertification as a condition for participation in Medicaid, and
- the benefit of using the program for recognizing radiologic expertise.

Over the past five years the group reviewed and monitored radiology activities and made recommendations to the ACR. In February of this year, Bruce L. McClennan, M.D., professor of radiology and chief of

MIR's abdominal radiology section, was appointed chairman of a reorganized task force. This group will explore alternatives to recertification (such as practice audits, self-assessments, and continuing medical education programs) for radiologists as well as radiation oncologists and medical physicists.

Some important first steps have been implemented: a mission statement has been drafted; an extensive literature file on assessment of competence was assembled, giving an overview of radiology and identifying areas for further study; and a search has begun for additional ACR support staff with educational expertise in physician education and evaluation.

McClennan believes continuous quality improvement (CQI) concepts could be used as a model for maintenance and improvement of

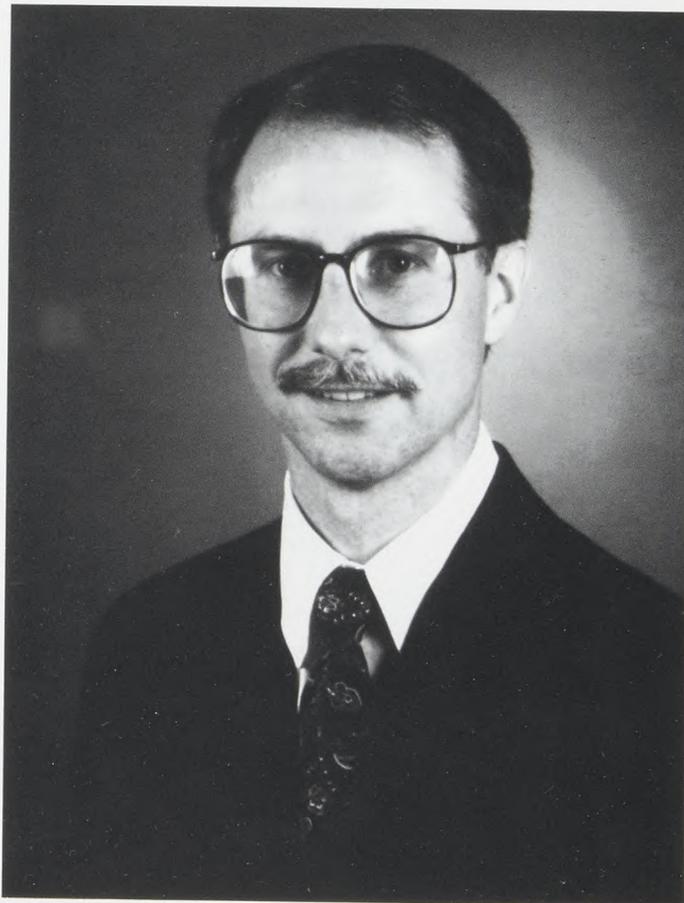
competence in the practice of radiology. According to McClennan, "The task force will look at the whole issue of competency — what is it, how to measure it, how to document it."

SPOT NEWS

Wilson Award in 25th Year

The 1993 Hugh M. Wilson Award for Meritorious Work in Radiology was presented to Ameet C. Patel, M.D., at the Washington University School of Medicine Senior Program on May 14. The award cites Patel's clinical and radiologic study of spinal column dysplasia conducted under the tutelage of William H. McAlister, M.D., chief of pediatric radiology. According to McAlister, Patel wrote the first draft of the paper detailing the investigation results, which was submitted for publication in the journal *Medicine*.

Celebrating its silver anniversary this year, the award is a tribute to Hugh M. Wilson, M.D., second director of Mallinckrodt Institute, who established a system of radiologic subspecialties at MIR and was a tireless proponent of education during his 14-year directorship.



William D. Middleton, M.D.

MIR's Teacher of the Year

William D. Middleton, M.D., associate professor of radiology and head of ultrasonography, received the 1993 Annual Senior Residents' Distinguished Teaching Award. Middleton was diagnostic radiology chief resident, 1984-1985. He was at the Medical College of Wisconsin for two years and joined the Mallinckrodt Institute faculty in September of 1987.

Initiated by the class of 1983 residents, the award is a tribute to the faculty member annually making the greatest contribution to resident education. After teachers are nominated and a final vote is taken, the pre-

sentation is made at the residents' and fellows' farewell dinner in June.

Past faculty members earning the award are doctors Dennis M. Balfe — 1983 and 1987, Marilyn J. Siegel — 1984 and 1989, David Ling — 1985, Fernando R. Gutierrez — 1986, Stuart S. Sagel — 1988, Barry A. Siegel — 1990, Franz J. Wippold — 1991, and Anthony J. Wilson — 1992.

A new rendition of the "Teacher of the Year" plaque, including a brass nameplate for each recipient and a photo of the current year's honoree, was installed near Scarpellino Auditorium.

Hounsfield Award Goes to Brink

James A. Brink, M.D., assistant professor of radiology, received the Hounsfield Award, which is presented by the Society of Computed Body Tomography and Magnetic Resonance for outstanding computed tomography (CT) research. The award is named in honor of 1979 Nobel Prize winner Sir Godfrey Newbold Hounsfield, who in the late 1960s developed a diagnostic technology called computed tomography that produces cross-sectional images of the body.

Funded by a \$326,000 grant from Sanofi Winthrop, Brink is principal investigator of an 800-patient study to determine the optimum dosage and delivery method of contrast media used in spiral CT. Introduced to U.S. medical centers in 1990, spiral CT is a newer version of computed tomography that promises to reduce scanning time and improve imaging capabilities.

The Society, an international medical organization, annually presents the Hounsfield Award and an accompanying \$15,000 grant for further CT research. This year's paper, "Spiral CT Angiography for Renal Arterial Stenosis: In Vitro Assessment of Technical Parameters," was coauthored by Brink; Lane A. Deyoe, M.D.; Jay P. Heiken, M.D.; Roberta L. Yoffie, R.T.; and Michael W. Vannier, M.D.

Kanterman Attends Research Program

Robert Y. Kanterman, M.D., second-year resident in diagnostic radiology, was chosen as one of 40 residents nationwide to participate in the "Introduction to Research" program. Sponsored by the American Roentgen Ray Society (ARRS), the Association of University Radiologists (AUR), and the Radiological Society of North America (RSNA), the pilot project encourages residents to consider research and an academic career as professional options. The 1993 program, directed by Bruce L. McClenan, M.D., vice chairman of the ARRS Instructional Course Committee, ran concurrently with the ARRS Annual Meeting held this year in April in San Francisco.

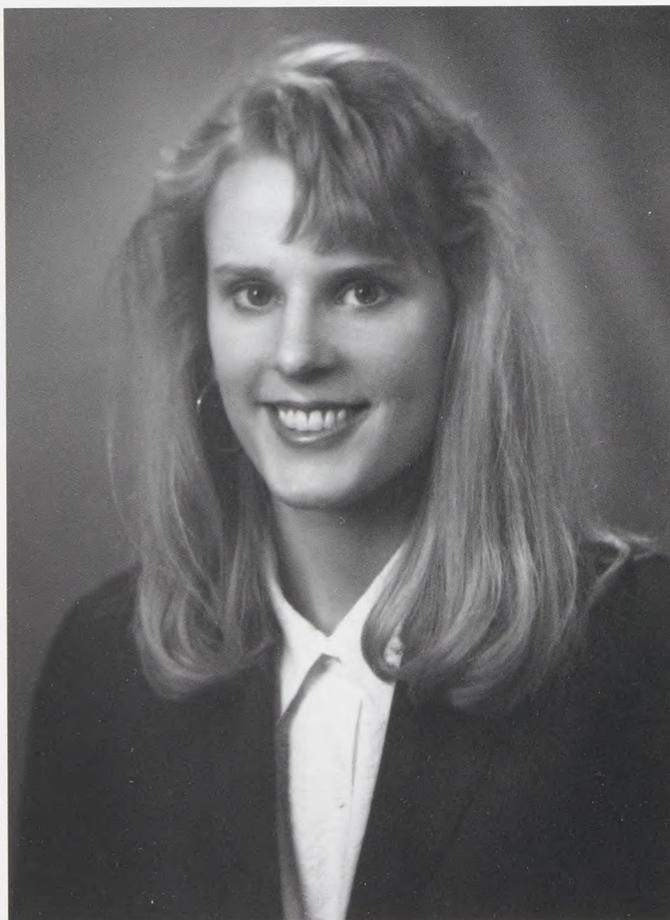
Davidson Heads Up HFMA Chapter

Linda M. Davidson, C.P.A., assistant business manager, was elected to a one-year term as president of the Greater St. Louis Chapter of the Healthcare Financial Management Association (HFMA). HFMA is the leading personal membership organization for more than 31,000 professionals nationwide who are concerned with financial management of health-care institutions and providers.

Anderson Proposal Earns Research Fellowship

Carolyn J. Anderson, Ph.D., assistant professor in radiology, Division of Radiation Sciences, received a \$30,000 research fellowship from the Society of Nuclear Medicine. Anderson's research project "Comparison of Copper-64 and Copper-67 Labeled Antibodies for Radioimmunotherapy" was in response to a call for proposals on the use of unsealed sources for radiotherapy. Anderson and her colleagues Judith M. Connett, Ph.D., Washington University School of Medicine's Department of Surgery, and Sally W. Schwarz, R.Ph., M.S., plan to compare copper-64 (produced at the University of Missouri Research Reactor) with copper-67 (which can be produced only on a large physics accelerator at either Brookhaven or Los Alamos national laboratories).

MediPhysics for Therapeutic Nuclear Medicine sponsored the fellowship to stimulate research in the expanding area of nuclear medicine. The award was presented at the Society's 40th Annual Meeting held the week of June 8 in Toronto. Founded in 1954, the Society of Nuclear Medicine (SNM) is a multidisciplinary, international organization of more than 12,000 nuclear medicine physicians, scientists, and technologists.



Carolyn J. Anderson, Ph.D.

Sonographers Honor Melson

In April, the St. Louis Metro Area Sonographers (SLMAS) established a scholarship fund as a lasting tribute to G. Leland Melson, M.D., who died in November of 1992. At the time of his death, Melson was a professor of radiology and head of ultrasound in the Institute's abdominal radiology section.

Melson's effective teaching skills were infused with his devotion to the field of radiology, his enthusiasm for

education, and a genuine love of all people. The SLMAS scholarship will perpetuate Dr. Melson's academic standard of excellence by providing financial assistance annually to a sonography student enrolled at St. Louis Community College at Forest Park — Missouri's only accredited ultrasound program.



No assembly required — On May 25, 1993, the aluminum TCA was rolled off the delivery truck, enroute to its new home in the basement of MIR's East Building.



TCA:



The Dream Machine

Out of the ashes of former President Reagan's plan for a U.S. defense system has risen a cost-effective aid in the fight against disease. By proverbially beating swords into plowshares, researchers at Mallinckrodt Institute of Radiology and Science Research Laboratory parlayed the technology behind an anti-missile gun developed under the Star Wars program into a new breed of linear accelerator. And in the process, they have established a benchmark for President Clinton's plan to transfer military-related science into peacetime advances.

The Tandem Cascade Accelerator (TCA) offers a less complex alternative to the conventional cyclotron-produced radiopharmaceuticals necessary for positron emission tomography (PET) studies. More importantly, TCA promises not only to make the imaging procedure more accessible for community hospitals but ultimately to lower the cost of a clinical PET examination by as much as 25 percent.



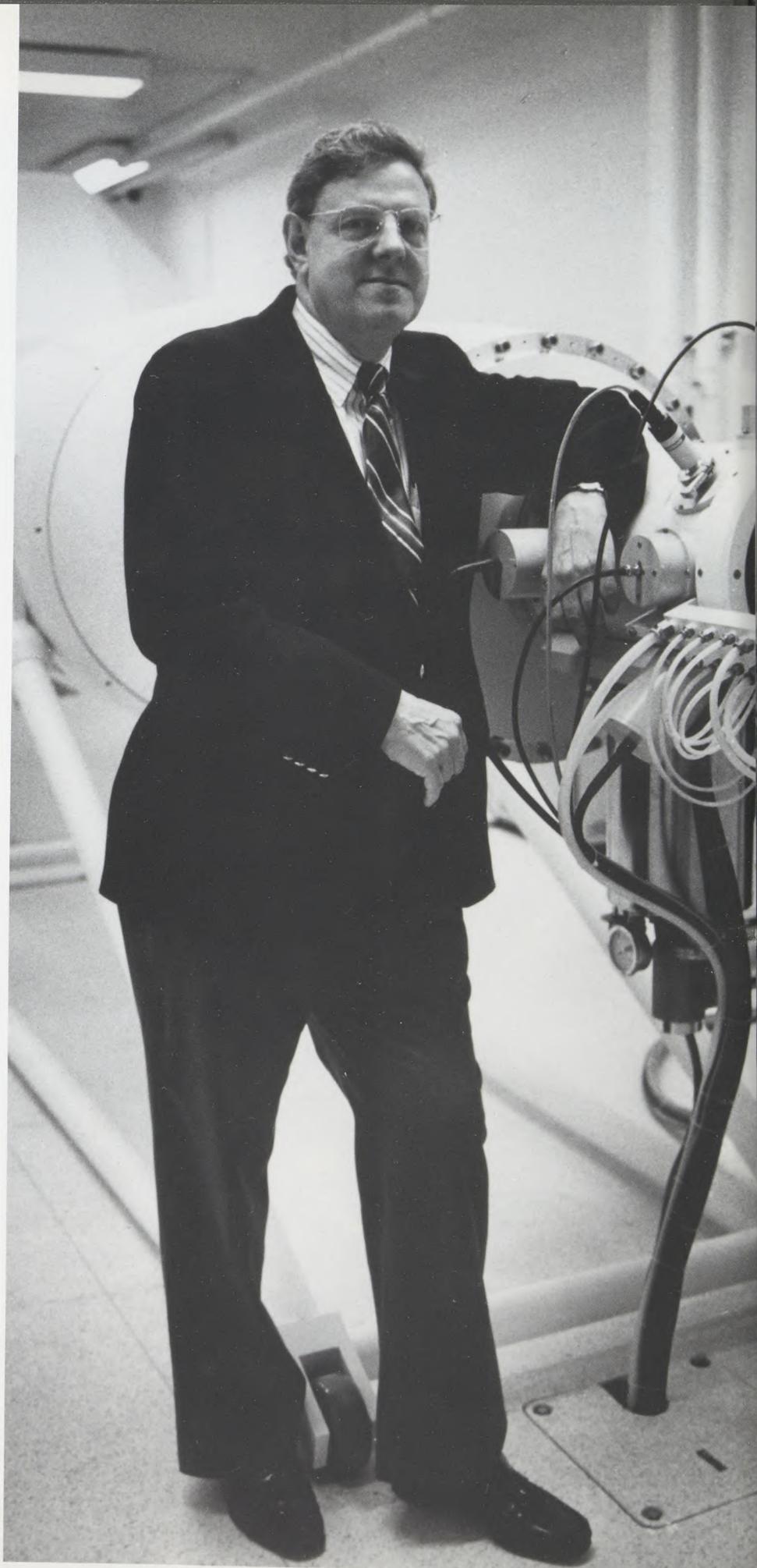
PET has been around since the early 1970s when the first scan of the body's biological activity was recorded by tracing the path of radioactive isotopes through a human patient's system. This information was then transferred to a computer program that reconstructed a cross-sectional image of the radionuclide's distribution within the body. The imaging procedure was hailed as a breakthrough in modern medicine for it allowed physicians and scientists to see pictures of an organ's activities, such as metabolism or circulation, rather than the structural or anatomical form visible on X rays.

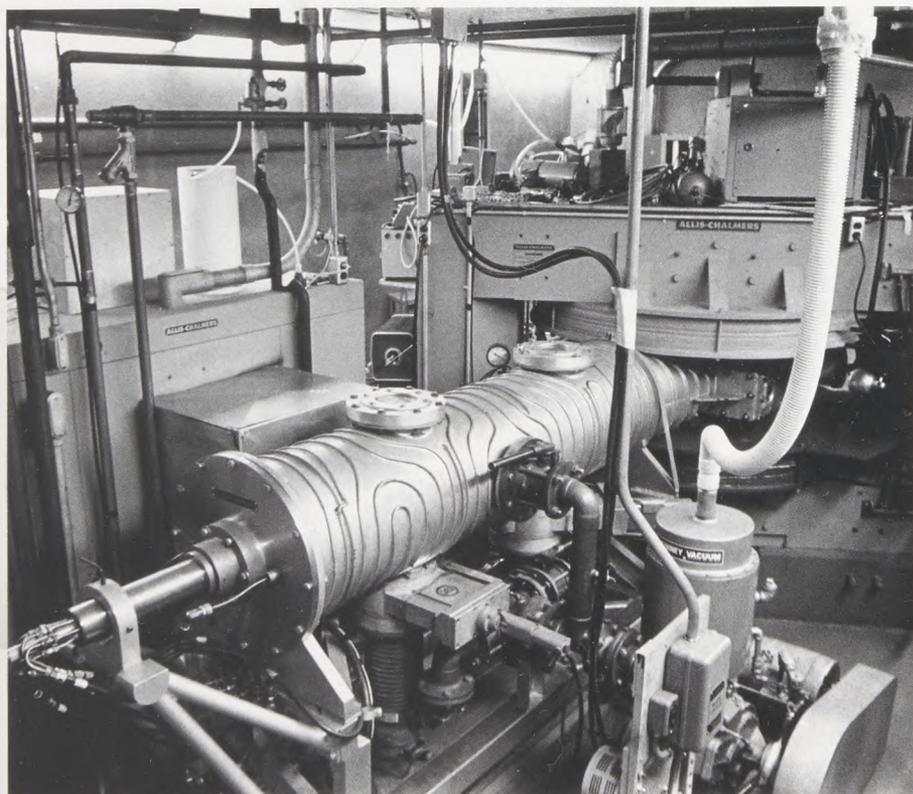
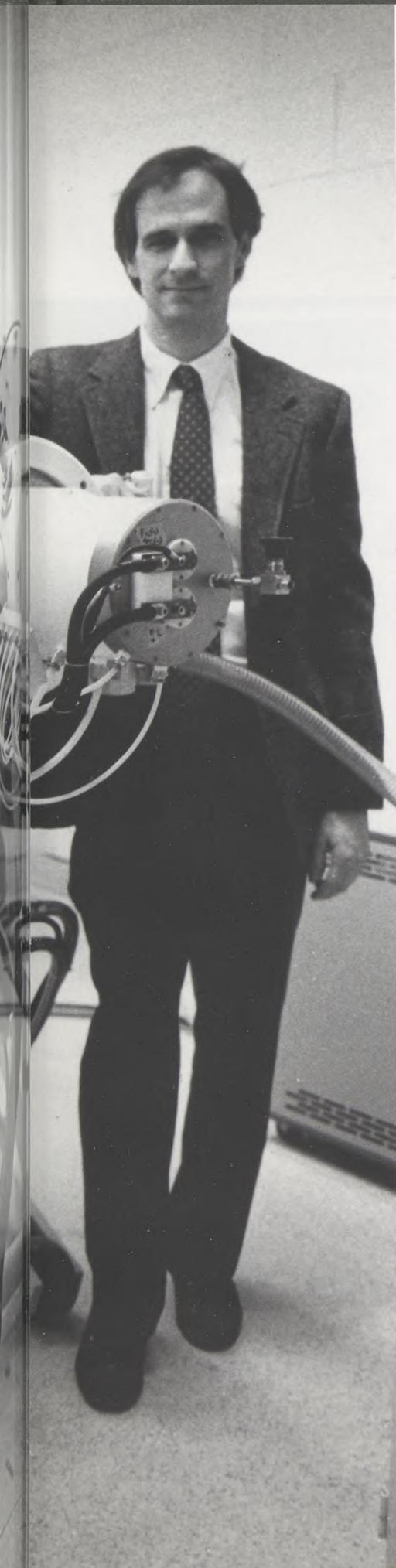
While there are more than 150 PET centers worldwide, the technology carries a hefty price tag, making it financially available for a small market of medical facilities. The average cost of a PET examination is around \$2000, with 40 percent of those dollars attributed to isotope production.

Isotopes are created by rotating particles, usually protons or deuterons, within a massive steel-plated machine called a cyclotron. These particle beams, irradiate non-radioactive nuclides (targets) to produce radioactive nuclides of oxygen-15, nitrogen-13, carbon-11, and fluorine-18 — elements found in all biomedical compounds. The isotopes are fed through pneumatic lines to the PET scanner. In PET studies, for example, glucose combined with fluorine-18 produces fluorodeoxyglucose, which can yield

*If this works,
...nobody would buy a
cyclotron."*

—Michael Welch, Ph.D.





Left: MIR's Michael Welch (left) and SRL's Robert Klinkowstein are shown with the compact TCA, which is around 12 feet long, 5 1/2 feet high, and 3 feet in diameter.

Above: Allis Chalmers, best known for manufacturing durable farm equipment, assembled Washington University's first cyclotron. Adequate space was not available at the Medical Center so the cumbersome machine was housed on the University's main campus.

important information about glucose metabolism in tumors, the brain, or the heart. The short half-life of these radiopharmaceuticals, ranging from two minutes to two hours, advocates the installation of an on-site cyclotron that runs around \$1.5 million. The overall price continues to climb with the addition of annual operating costs (including 150kw of power) and facility renovations usually required to house the 20- to 30-ton cyclotron.

Enter the TCA — an accelerator that provides the same capabilities as the cyclotron while offering these appealing economic advantages:

- Cost: around \$750,000
- Operating costs: uses 15kw of power and less air conditioning and water cooling
- Installation: compact and easy to maneuver (a light-weight one ton), requiring minimal or no structural modifications.

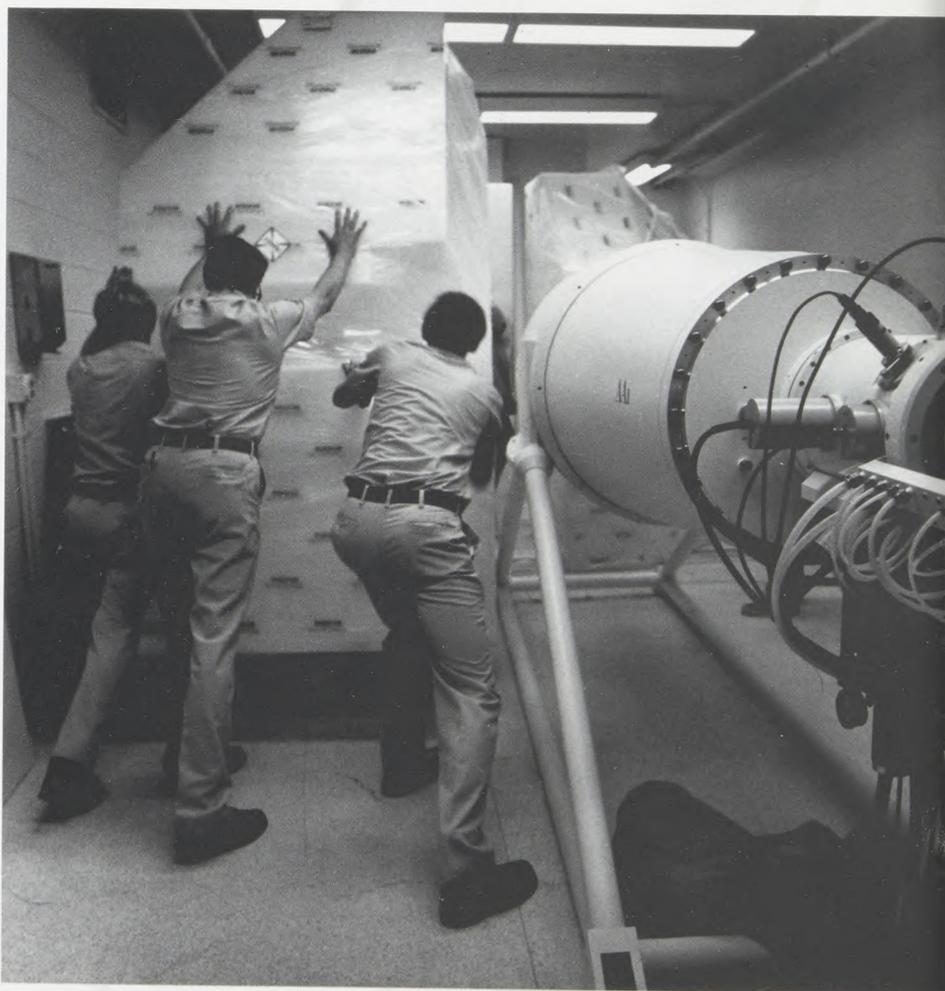
The low-energy TCA requires only inches of shielding; the cyclotron, several feet of shielding. Plus the machine is user-friendly, equipped with a PC-based computer control system and user interface software that allows either fully automated operation or full-manual control of system functions.

TCA

Is this machine a dream come true for clinical and research facilities? According to Michael J. Welch, Ph.D., director of Mallinckrodt Institute's Division of Radiation Sciences and one of the lead scientists in the development of the TCA, "If this works, and we're sure it will, nobody would buy a cyclotron."

Science Research Laboratory (SRL), a Massachusetts-based independent research and development company has developed high-tech accelerators and lasers for industry, defense, and energy programs since 1983, but the TCA is their first venture into the medical applications of that technology. During the Strategic Defense Initiative Organization program (SDIO but commonly referred to as Star Wars), SRL scientists worked on the development of a satellite-mounted gun using charged atomic particles to destroy enemy missiles or warheads. The end of the Reagan administration also brought about the demise of the Star Wars program, but SRL physicists (Robert E. Klinkowstein, Ruth E. Shefer, and Barbara J. Hughey) were interested in converting the military technology to medical applications. Funding for a feasibility study and prototype exploration was provided by a National Institutes of Health grant.

"But we still needed expertise in target chemistry and radiopharmaceutical synthesis," says Klinkowstein. "And in all of our inquiries, Mike Welch's research was consistently referenced."



Welch's application of fundamental science to the solution of practical clinical problems has made a tremendous impact on the field of diagnostic medicine. His work is used worldwide in biology and medicine, and Welch was one of the first researchers to apply modern organic chemistry to the preparation of radiopharmaceuticals used in medical imaging. His production of novel radiopharmaceutical imaging agents provided a basis for breakthrough clinical research studies on breast tumors, the brain, and the heart.

The five-year MIR/SRL collaboration has been productive. Currently funded by SDIO's Office of



The accelerator's specially designed, igloo-shaped target shield is formed by four polyethylene units, each filled with 500 gallons of a water and boron mixture that acts as a neutron absorber.

Technology Applications, the study has progressed from the research phase to commercialization of a TCA-based PET Isotope Production System that uses innovative accelerator targets to produce high-yield radioisotopes while maintaining low energy, high current beams.

Since late May, the prototype has been operating in Mallinckrodt Institute's East Building, adjacent to the proposed site of a comprehensive, multidisciplinary imaging center. There, MIR scientists will test the purity of TCA-produced isotopes, a continuation of tests begun at SRL. Eventually, the TCA will support the extensive research at the imaging center as well as the clinical and research PET machines at the Washington University Medical Center.

Accelerator Applications, Incorporated, a spin-off company of SRL that will manufacture and market the accelerator, envisions other medical possibilities for the technology — neutron therapy for cancer patients as well as providing better cardiac imaging with coronary angioplasty. In a circuitous way, the TCA may be returning to its defense roots by providing a neutron source for the detection of plastic explosives in airport luggage. □

With the installation of the world's first TCA prototype at the Institute, the technologies of the medical cyclotron and PET complete a 55-year circle — for both have close ties to Washington University.

1938 Funded by a grant from the Rockefeller Foundation, Washington University scientists who were interested in the application of nuclear physics to medical and biological ailments designed the first cyclotron dedicated to medical use.

1942 By this time, the cyclotron was kept busy producing cobalt, iron, and phosphorous isotopes to support a broadening interest in nuclear medicine research.

1944 At the U.S. government's request, the University's isotope production for medical studies was supplanted by plutonium production for the development of the atomic bomb under the Manhattan Project.

Early 1950s MIR scientist Michel Ter-Pogossian believed that a device for detecting radiation in living organisms held promise for medical researchers. This machine was the forerunner of today's PET scanners.

1958 MIR researchers began pilot experiments in using cyclotron-produced radioactive oxygen to study the distribution of oxygen in malignant tumors.

1959 The Atomic Energy Commission funded the development of short-lived radioactive isotopes for medical use.

1964 Additional funding was received to purchase a second cyclotron to support the expanding PET research. The cyclotron was installed on the ground floor of Barnard Hospital; Washington University was the first medical center nationwide to house two cyclotrons.

1967 Michael Welch, Ph.D., came to MIR to develop complex positron-emitting radiopharmaceuticals used with PET.

1971 Marcus Raichle, M.D., joined the PET team to direct physiological aspects of research.

Early 1970s MIR scientists led by Ter-Pogossian developed PET III, the first useable PET scanner for human studies.

1980s Extensive PET research at the Institute assisted in producing medical breakthroughs, such as functional mapping of the brain, detection of estrogen receptors in breast cancer cells, and the viability of heart muscle after heart attacks.



When the Iceman was first discovered only his head and upper torso were visible, as though he were climbing out of the ice. Later examinations would reveal that the mummy was amazingly intact, including the eyes, brain, and internal organs.



THE ICEMAN

**Twentieth-century radiology unravels mysteries
of a Stone Age man**

In September of 1991, two German mountain climbers gained international prominence, not by scaling great heights but by discovering a male corpse that would prove to be the oldest, most well-preserved, intact human body ever found. The man, naturally mummified by cold dry wind and centuries of ice accumulations, had been buried within the Similaun Glacier in the Tyrolean Alps, the section of central Europe's mountain range running between the borders of Italy and Austria and into Yugoslavia. In March, a desert storm in the Sahara had propelled a whirlwind of hot air and layers of dust into the Alps, causing a thermal-blanket effect that melted the glacial ice at the phenomenal rate of four inches per day. By September, the body was partially released from its icy tomb, along with an assortment of tools, hunting implements, and remnants of clothing. Radiocarbon dating techniques and an ax with a nearly pure copper blade gave researchers important clues in determining that this human may be modern archaeology's most important discovery.

The man, scientifically known as *Homo tyrolensis* but called the Similaun Iceman or simply the Iceman, was estimated at more than 5,000 years old — a rare specimen from Europe's Neolithic or Late Stone Age. Multidisciplinary teams of top-notch researchers are analyzing the Iceman, who now rests in a temperature-controlled vault at Austria's University of Innsbruck. One of those experts is William A. Murphy, Jr., cochief of the musculoskeletal section at Washington University's Mallinckrodt Institute of Radiology.

THE ICEMAN

Murphy, a highly regarded bone-and-joint radiologist, is well known for his pioneering accomplishments in modern forensic radiology, an exacting science that provides valuable information from X rays for use in the identification or evaluation of crime victims and their injuries. There are no full-time practitioners of this undeclared subspecialty, but forensic radiologists are important members of death investigation teams. Since 1975, Murphy has donated his time as a consultant for the offices of the medical examiners for St. Louis City and County and frequently works with death investigators on state, national, and international cases. His puzzle-solving abilities have provided medical information in cases ranging from the unusual to the grisly, such as assessing the injuries of the parachutist who died after falling from the top of the Gateway Arch or making a positive identification from three remaining limbs of a torture/ murder victim in Philadelphia's widely publicized Heidnik case.

Occasionally, Murphy is asked to lend his skills to another challenging and little known medical field — paleoradiology, the radiological analysis of remains that are of anthropological interest. Through these two sidelines to radiology, Murphy has met some interesting and unusual patients.



Preliminary information suggests that over the past 50-plus centuries the human body has changed little anatomically.

Murphy's medical detective work was featured in the February 25, 1992, edition of the *St. Louis Post-Dispatch's* "Everyday" section. Coincidentally, Dr. Herwig Imhof, one of Austria's leading radiologists, was visiting Mallinckrodt Institute's musculoskeletal section, gathering information for setting up a similar clinical facility in Vienna. Imhof was fascinated with the report on Murphy's forensic work and put Murphy in touch with Professor Dieter zur Nedden, an Austrian colleague who heads up the radiologic analysis of the Iceman. In September, Murphy was on his way to see the Iceman.

First on the agenda at Innsbruck was the examination of computed tomography scans (CT) taken



(Foreground, left to right) Professor Dieter zur Nedden, William Murphy, Rudolph Knapp, and Klaus Wicke (background) studied 3-D images of the Iceman, processed from individual CT slices stacked in the computer and developed into volumetric scans.



Michael Vannier, M.D., director of MIR's Division of Radiology Research and head of the image processing laboratory

during the first week after the Iceman's discovery. Professor zur Nedden, along with University of Innsbruck radiologists Klaus Wicke and Rudolf Knapp, had obtained the CT scans and reformatted them into two- and three-dimensional reconstructions.

CT, developed in 1968, produces cross-sectional images of the body by incorporating X-ray and computer technologies. The result is an imaging method that is more sensitive to differences in tissue densities than conventional X rays and can distinguish healthy tissue from diseased tissue. CT can detect fractures, tumors, abnormal cavities and fluid collections, blood

clots, and enlarged organs and can differentiate among some soft tissues (fat, tendon, and muscle). The technology is especially adept at detecting dense tissues, such as bone, which are easier to reconstruct three-dimensionally. Mallinckrodt Institute was instrumental in the medical adaptation of CT and in 1972 received one of the first prototype CT head scanners, followed in 1975 by one of the first whole-body CT units.

Alive, the Iceman is estimated to have a been a slight man, standing around five foot three inches and weighing 110 pounds, but severe dehydration has shriveled the corpse to a mere 44 pounds. With essentially no fat or water remaining in the body, CT scans revealed only slight differences among the tissues, and the internal organs were malformed and displaced because of dehydration and the pressure of the glacier. These circumstances posed

serious interpretation problems for the radiologists: locating the organs and demonstrating the relationship among the organs. Yet, in three days of work at Innsbruck, the team made good progress and laid plans for further investigations.

THE ICEMAN

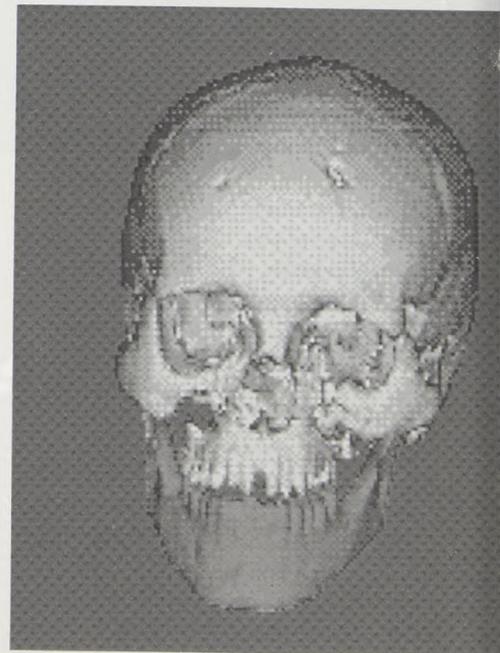
According to Murphy, the next logical step was to send the scans to Dr. Michael W. Vannier's image processing lab at Mallinckrodt Institute where experimental software packages for 2-D and 3-D reconstruction could help solve the anatomic and CT mysteries. Under the direction of Vannier, a pioneer in 3-D imaging, MIR's lab has earned a well-deserved reputation for innovative imaging techniques.

The electronic raw data from the CT scans were air-expressed to MIR from Innsbruck. After the information was loaded into the MIR computers, the 3-D imaging team (Vannier; Robert Knapp, technical supervisor; Roberta Yoffie, assistant technical supervisor; Barry Brunsden, research engineer; and Ron Walkup, systems analyst) could see what they were up against. All tissue values were distorted because of the dehydration and the organs were in extreme proximity. Because of the low contrast, the edges of the organs were not easily definable so every organ had to be separated electronically.

With essentially no fat or water remaining in the body, CT scans revealed only slight differences among the tissues.



Using sophisticated software called "Analyze" that was developed at the Mayo Clinic, the MIR team studied the morphology of the tissue. They also ran a multispectral classification by selecting two images and plotting them against each other (for example, skin to bone) and then assigning individual values. They discovered that the skin and bone, and even the blanket the Iceman was wrapped in after his release from the glacier, all had high values. One exception was the ear tissue which was extremely thin and did not scan at all. To reconstruct images of the organs, the researchers first had to electronically peel the skin from the scans, but bits of skin and blanket remained and appeared as speckles on the resulting images. Preliminary information gained from the 3-D images suggests that over the past 50-plus centuries the human body has changed little anatomically.





Above: A CT scan conversion (shown in detail on the front cover) allows side-to-side and front-to-back visualization of the Iceman's skull.

Left: Three-dimensional scans, such as this image of the Iceman's skull, enable the radiology team to continue their investigation without damaging the body.

When the Austrian radiologists arrived at the Institute on February 25 of this year, the 3-D scans were ready. According to Murphy, the electronic reconstruction was an important process, but the work is far from over. The researchers will continue to concentrate on the images and use the acquired information to direct small sample tissue biopsies, taking care not to damage the organs or the body.

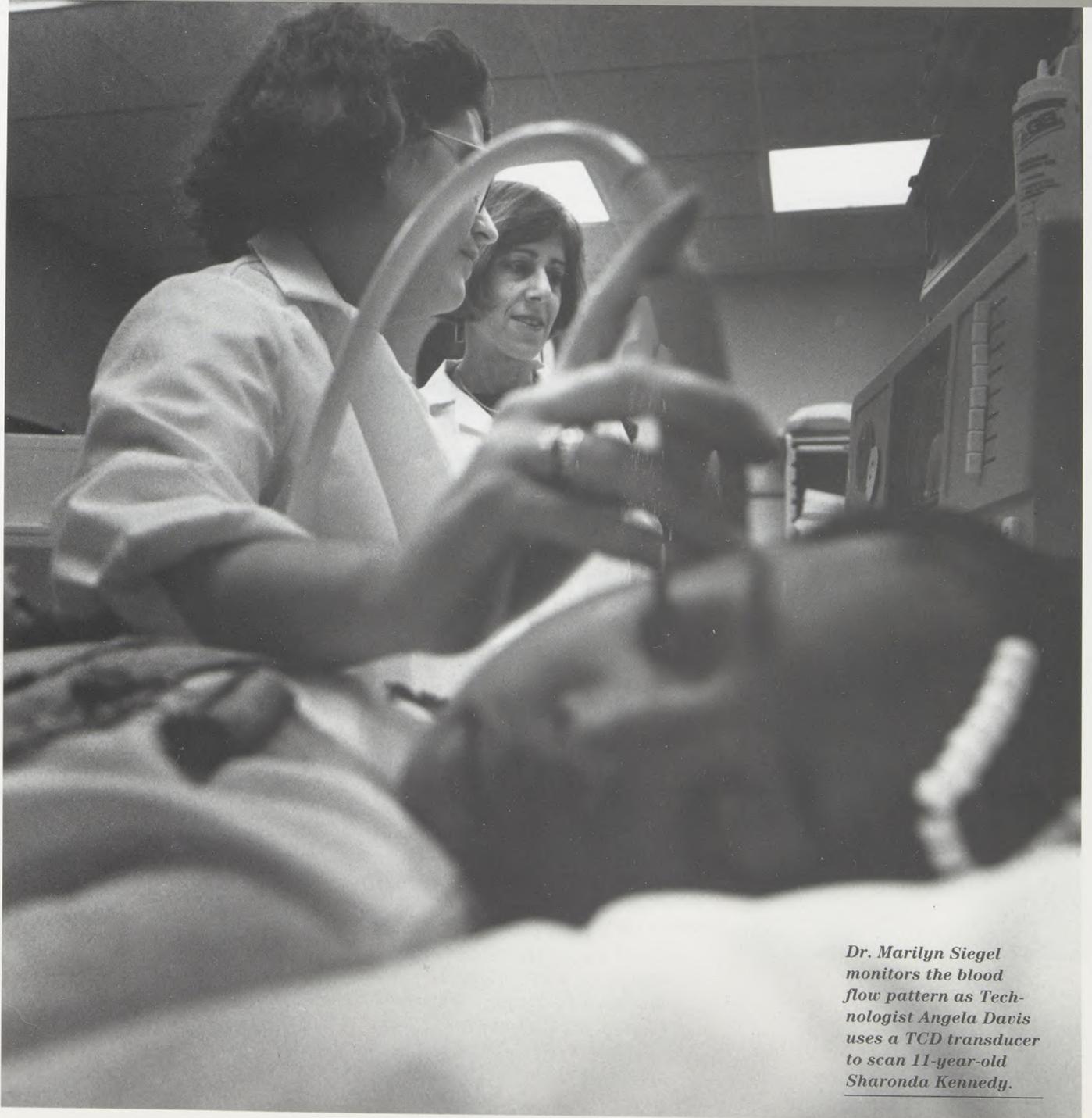
"We must have tissue samples to progress with the study. Only through imaging and image-guided, minimally-invasive biopsy

can further analysis be accomplished," says Murphy.

There are roadblocks: Thawing is one of the Iceman's greatest enemies. The body can be removed from the vault, which is set at the glacial temperature of -6°C , for only 20 minutes every two weeks. Physical examinations can damage the body so no additional scanning has been scheduled. But, the researchers have devised a safer method for increasing their data: three-dimensional reconstruction of the skeleton. A stereolithographic (a chemical process using plastic) replica of the Iceman's skull was recently completed, and in time the scientists hope to replicate the entire skeleton and, perhaps, the entire body surface.

The discoveries of Egyptian mummies, many of which predate the Stone Age, have enabled scientists to document the lives of the nobility, but the Iceman provides a chance to study the common Stone Age man. According to Murphy, "Because of the Iceman's importance to the history of humankind and to the progress of our scientific understanding of humanity, the body must be preserved for future generations as well as for new technology. The body must be as whole as possible for new technology to be effective, and MIR will have played an important role in that process." □

Children



Dr. Marilyn Siegel monitors the blood flow pattern as Technologist Angela Davis uses a TCD transducer to scan 11-year-old Sharonda Kennedy.

at Risk

Preliminary research at MIR points the way for detecting stroke caused by sickle cell disease.

Sickle cell disease (SCD) primarily affects African-American children — with one out of every 375 infants diagnosed with sickle cell anemia, the most common form of the disease. SCD also strikes children of Mediterranean, Caribbean, South and Central American, Arabian, and East Indian ancestry, and a small number of cases has been reported in the American Indian population. There is no cure for sickle cell disease — no immunization against it — no operation to rid the child's body of the disease. SCD is a debilitating and deadly assailant of more than 50,000 American children and teenagers.

Screening permits early detection of those children who are SCD positive and of those who have sickle cell trait, which is not and cannot become sickle cell disease. However, if both parents have sickle cell trait, there is a 25 percent chance their child will have the disease. First documented in 1910, SCD is a group of genetic disorders in which the body produces red blood cells that go awry, becoming curved or sickle-shaped. These cells block blood flow and eventually cause tissue damage. Sickle cell disease is the most common cause of stroke in children, with the odds that approximately five to 17 percent of children and adolescents diagnosed with SCD will have a stroke before they are 15 years of age.

Marilyn Siegel, M.D., a pediatric radiologist at Mallinckrodt Institute of Radiology, wants to lower those odds. Working with Benjamin C. P. Lee, a pediatric neuroradiologist, she recently completed a pilot study to assess radiology's role in identifying children with sickle cell disease who are at risk of having a stroke. Siegel, a professor of radiology on staff at St. Louis Children's Hospital, is calling for a multicenter trial to better determine which of two noninvasive procedures is more sensitive and more specific in that assessment: magnetic resonance angiography or transcranial Doppler ultrasound.

Children at Risk

Children with SCD endure numerous complications of the disease, including anemia, pulmonary infection, entrapment of blood in the spleen, renal failure, bone marrow infarction or infection, painful swelling of the hands and/or feet, and stroke. Small infarctions may result in minor strokes, causing weakness, sensory changes, or language disturbances; larger infarctions may cause classic, disabling strokes. Health-care providers believe that SCD-related stroke begins with severe anemia accompanied by high velocities of blood flow that damage the layer of cells lining the cavities of the heart and of the blood and lymph vessels. The large vessels, usually the internal carotid artery and the proximal middle and anterior cerebral arteries, narrow and a vascular obstruction develops.

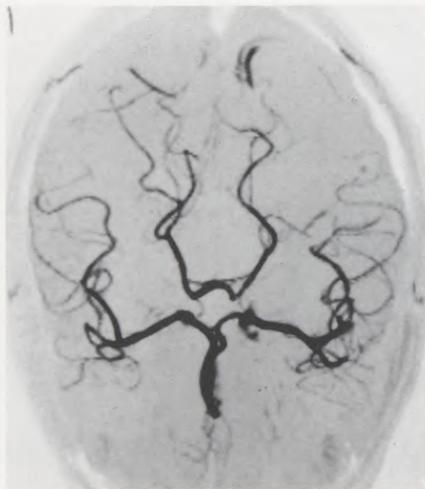


There were 34 patients in Siegel's study, all under 18 years of age. Seventeen of those patients previously had a stroke, a fact initially unknown to the researchers so as not to influence the study results. Using transcranial Doppler ultrasonography and magnetic resonance angiography to image cerebral blood flow, the goal was twofold: determine the presence or absence of a cerebral infarct and compare the effectiveness of the two imaging procedures.

Marilyn Siegel, M.D., hopes to include 200 or more patients in her proposed multicenter study.

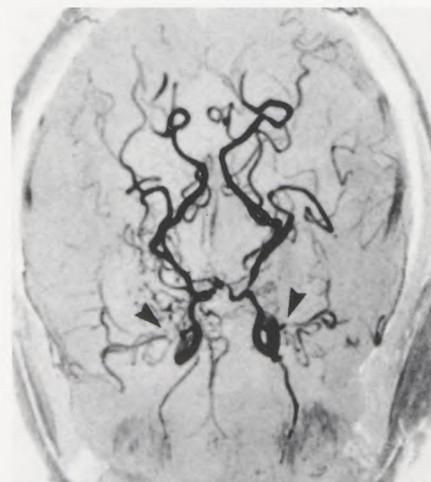
Ultrasound is an offshoot of technology used to detect submarines by tracking the change in the frequency of sound waves (known as the Doppler effect). In medical use, the Doppler effect characterizes blood flow and can image vessels deep within the body. The workhorse of the ultrasound unit is the transducer — a small crystal that vibrates when it is electrically stimulated, producing sound waves that are transmitted into the patient's body. The sound waves bounce up against organs and other anatomical structures, creating echoes. The transducer receives the echoes and emits a small electrical charge to the ultrasound machine that, in turn, produces an image with the aid of electronic signals.

In infants up to one year of age, cerebral blood flow can be imaged with conventional ultrasound by placing a transducer on the fontanelle or soft spot on the top of the head. After the bones of the

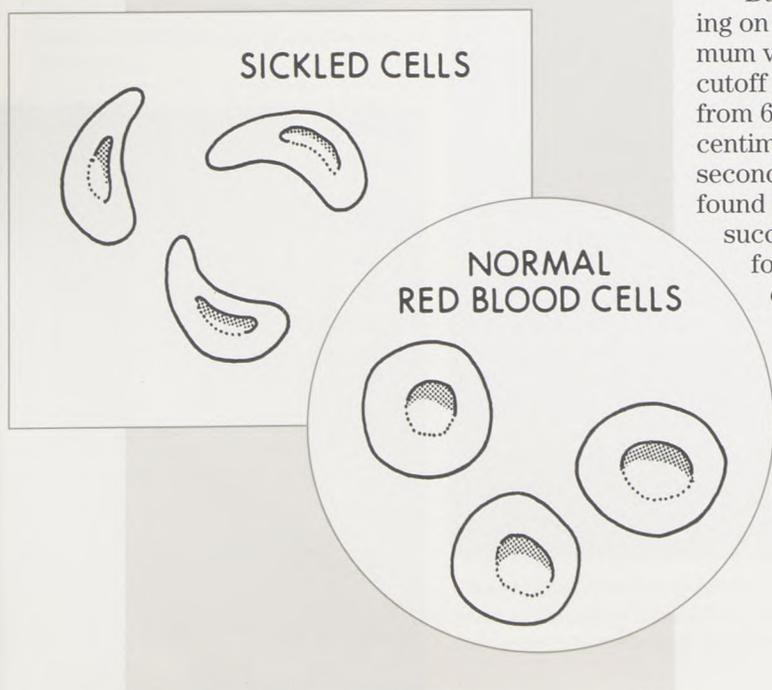


skull fuse, transcranial Doppler ultrasonography (TCD), a more sophisticated modality, can be used to investigate the brain. With TCD, the transducer is placed on the thin part of the skull in front of the ear. This low-frequency, high-energy technology offers advantages over some other imaging equipment: no adverse side effects, real-time imaging, cost-effectiveness, and equipment portability.

But, depending on the maximum velocity cutoff (ranging from 60 to 180 centimeters per second), Siegel found that the success rate for detection of stroke with TCD averaged only 50 percent.



MRA scans above clearly show smaller vessels that often are affected by a stroke. Top scan reveals normal blood flow; on bottom scan, arrows mark a blockage.



Approximately 5 to 17 percent of sickle cell disease patients will have a stroke before they are 15 years of age.

Children at Risk

"Ultrasound is limited," she says. "It doesn't see all of the vessel, and some of the stroke-affected vessels are very small. For the time being, I recommend another imaging procedure; otherwise, SCD patients at risk of stroke will go undetected."

The success rate in identifying stroke and nonstroke patients with magnetic resonance angiography was an overwhelming 100 percent.

Siegel believes an alternative modality may be magnetic resonance angiography (MRA). Magnetic resonance imaging uses a powerful magnet that interacts with atoms in the body to produce an image. A transmitter and a receiver produce energy during the scan, and that energy is processed by computers. Special coils, designed to fit any portion of the body, obtain a clear signal and high resolution. The resulting images differentiate soft tissue, including blood and flowing blood.

The study patients imaged by ultrasound were examined again by MRA, with the results evaluated by Lee. The success rate in identifying stroke and nonstroke patients was an overwhelming 100 percent.

"So far, MRA appears to be the way to go if a physician suspects a patient has had a stroke or wants to evaluate a patient at risk. Although our results at Mallinckrodt Institute suggest that MRA is more effective



Benjamin C. P. Lee, M.D.

than ultrasound in screening patients at risk for stroke, our study was limited by a small sample size. We need a larger study population to determine the exact role of TCD and MRA," says Siegel.

A grant proposal for a larger study was sent to the National Institutes of Health. Siegel anticipates trials at four medical centers, including Mallinckrodt Institute, will be underway in 1994. □

LT MCA

According to the U.S. Department of Health and Human Services, universal screening of newborns, regardless of racial or ethnic background, should be routine practice since it is not possible to accurately determine an individual's heritage by physical appearance or by family name.

Funded by the National Heart, Lung, and Blood Institute of the National Institutes of Health, sickle cell screening programs have been in effect since the 1972 passage of the National Sickle Cell Anemia Control Act. Statewide newborn-screening programs were not implemented in the U.S. until the late 1980s. A 1992 U.S. Department of Health and Human Services study revealed the following statistics about screening programs in U.S. jurisdictions:

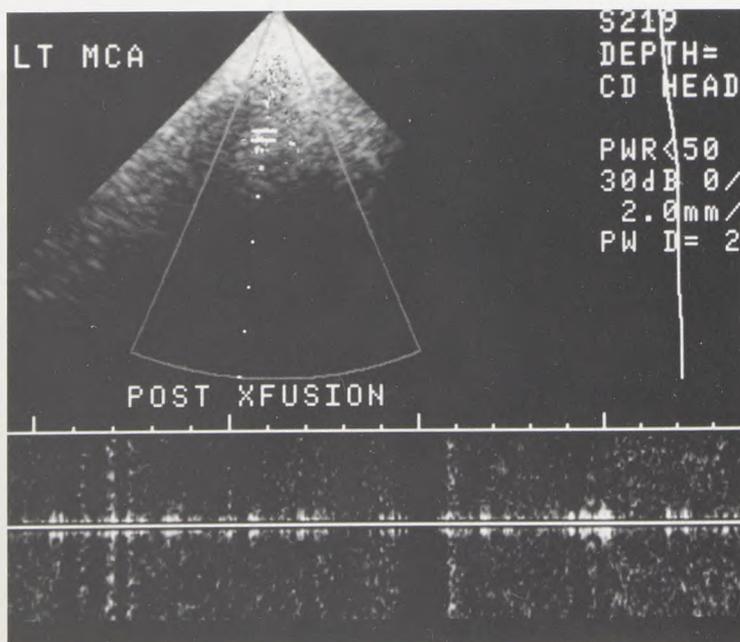
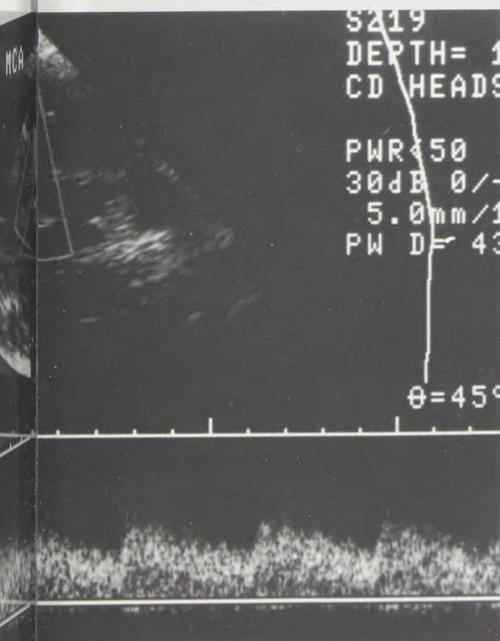
Newborn Sickle Cell Disease Screening Programs*

In Effect 43**	Not in Effect 10
Mandatory Screening 29**	Voluntary Screening 14
Universal Screening 34**	Nonuniversal Screening 9

*Includes 50 states plus Washington, D.C., Puerto Rico, and the U.S. Virgin Islands

**Includes Missouri and Illinois

Below: On TCD scans, "peaks" record the pulsation of unobstructed blood flow.



Above: The absence of peaks on the TCD scan indicates a blood flow blockage; this patient previously had a stroke.

THE DIRECTOR'S OFFICE REPORT

NEW STAFF

George Chacko, M.D., research associate, Division of Nuclear Medicine

Y. Abel Cheng, M.S., instructor in radiology, Division of Radiation Oncology

Thomas E. Conturo, M.D., Ph.D., assistant professor of radiology, Division of Radiology Research

Michael G. Crowley, Ph.D., instructor in radiology, Division of Radiation Sciences

William B. Dawson, M.D., assistant professor of radiology, Division of Diagnostic Radiology

Steven Don, M.D., assistant professor of radiology, Division of Diagnostic Radiology

E. Mark Haacke, Ph.D., professor of radiology, Division of Radiology Research

Jacqueline C. Hodge, M.D., instructor in radiology, Division of Diagnostic Radiology

David M. Hovsepian, M.D., assistant professor of radiology, Division of Diagnostic Radiology

Debiao Li, Ph.D., assistant professor of radiology, Division of Radiology Research

Weili Lin, Ph.D., assistant professor of radiology, Division of Radiology Research

Ann-Mary MacLeod, B.S., research assistant, Division of Radiation Sciences

David L. Melson, B.S.E.E., research assistant, Division of Diagnostic Radiology

Douglas D. Robertson, Jr., M.D., Ph.D., assistant professor of radiology, Division of Diagnostic Radiology

Patricia J. Rubin, M.D., research associate, Division of Nuclear Medicine

Alan E. Schlesinger, M.D., assistant professor of radiology, Division of Diagnostic Radiology

Daniel P. Schuster, M.D., associate professor of radiology, Division of Radiation Sciences

Cary L. Siegel, M.D., instructor in radiology, Division of Diagnostic Radiology

Celette Skinner, Ph.D., research associate, Division of Radiology Research

James E. Stark, M.D., assistant professor of radiology, Division of Diagnostic Radiology

Robert P. Vander Waal, Ph.D., research associate, Division of Radiation Oncology

Deborah T. Wadsworth, M.D., instructor in radiology, Division of Diagnostic Radiology

Dmitriy A. Yablonskiy, Ph.D., research associate, Division of Radiology Research

Donald T. T. Yapp, B.Sc., research associate, Division of Radiation Sciences

PROMOTIONS

Dee Claire Anderson, M.D., was promoted to professor of radiology, Division of Diagnostic Radiology.

Gulab Bhatia, M.S., was promoted to instructor in radiology, Division of Radiology Research.

Jeffrey J. Brown, M.D., was promoted to associate professor of radiology, Division of Diagnostic Radiology.

Michael D. Darcy, M.D., was promoted to associate professor of radiology, Division of Diagnostic Radiology.

Carmen Dence, M.S., was promoted to research instructor, Division of Radiation Sciences.

Venkata R. Devineni, M.D., was promoted to associate professor of radiology, Division of Radiation Oncology.

John O. Eichling, Ph.D., was promoted to professor of radiology, Division of Radiation Sciences.

Perry W. Grigsby, M.D., was promoted to professor of radiology, Division of Radiation Oncology.

Jay P. Heiken, M.D., was promoted to professor of radiology, Division of Diagnostic Radiology.

Marshall E. Hicks, M.D., was promoted to associate professor of radiology, Division of Diagnostic Radiology.

Charles F. Hildebolt, Ph.D., was promoted to associate professor of radiology, Division of Radiology Research.

Andrei Laszlo, Ph.D., was promoted to associate professor of radiology, Division of Radiation Oncology.

Steven M. Moore, M.S., was promoted to research assistant professor of radiology, Division of Diagnostic Radiology.

Christopher J. Moran, M.D., was promoted to associate professor of radiology, Division of Diagnostic Radiology.

Tracy L. Roberts, M.D., was promoted to assistant professor of radiology, Division of Diagnostic Radiology.

Henry D. Royal, M.D., was promoted to professor of radiology, Division of Nuclear Medicine.

Noah Susman, M.D., was promoted to professor of clinical radiology, Division of Diagnostic Radiology.

William G. Totty, M.D., was promoted to professor of radiology, Division of Diagnostic Radiology.

Anthony J. Wilson, M.D., was promoted to associate professor of radiology, Division of Diagnostic Radiology.

Franz J. Wippold, II, M.D., was promoted to associate professor of radiology, Division of Diagnostic Radiology.

CHANGE OF STATUS

Mary A. Middleton, M.D., was named assistant professor of radiology, clinical track, Division of Diagnostic Radiology.

James A. Purdy, Ph.D., was named to a joint appointment as professor of biomedical computing, Institute of Biomedical Computing.

OFF STAFF

Terry C. Der, M.S., research associate, Division of Radiation Sciences.

Landis K. Griffeth, M.D., assistant professor of radiology, Division of Nuclear Medicine, has accepted a position in the department of radiology at Baylor University Medical Center, Dallas.

Karen J. Halverson, M.D., instructor in radiology, Division of Radiation Oncology, has accepted the position

of medical director of the department of radiation oncology at St. Luke's Hospital, St. Louis.

David J. Scherer, M.S., instructor in radiology, Division of Radiation Oncology.

Eric D. Slessinger, B.S., instructor in radiology, Division of Radiation Oncology, has joined the staff of the department of radiation oncology at St. Luke's Hospital, St. Louis.

phy of Hand and Wrist, Analysis of Complex Carpal Trauma," "Radiographic Analysis of Wrist Instabilities," "Tailored Approach to Hand and Wrist CT," "MRI of the Wrist," "Approach to Osseous Neoplasia," "CT of the Foot," and "Tenography of the Foot and Ankle" at the "Update, Musculoskeletal Radiology" conference, Milan, July 2 - 3. He spoke on "Imaging of the Hand and Wrist" and "Tailored Approach to Hand and Wrist CT" at the 18th International Congress of Rheumatology, Barcelona, July 4 - 7. Gilula also presented "Radiologic Approach to Osseous Neoplasia" at Hospital General de Catalunya, Barcelona, July 8. Gilula lectured on "Radiographic Analysis of Carpal Instabilities" at the Unitat de Diagnostic per La Imatge d'Alta Tecnologia (UDIAT), Barcelona, July 9.

Perry W. Grigsby, M.D., professor of radiology and clinical chief of the Radiation Oncology Center, spoke on "Carcinoma of the Endometrium - Prognostic Factors and Management" at an American Cancer Society sponsored lecture, Passaic, New Jersey, April 28.

Charles Hildebolt, D.D.S., Ph.D., associate professor of radiology, spoke on "Digital (electronic) X-ray Image Acquisition for Anthropologic Studies" at the Image Acquisition Analysis and Archiving: New Research Directions in Physical Anthropology symposium, the 62nd Annual Meeting of the American Association of Physical Anthropologists, Toronto, April 14 - 17.

Daniel K. Kido, M.D., professor of radiology and chief of the neuroradiology section, spoke on "Nonionics in Lumbar Myelography" at Update on Safety: International Assembly on the Clinical Safety of Ten Years of Use of Nonionic Contrast Media, St. Thomas, U.S. Virgin Islands, May 5 - 7.

Henry K. Lee, M.D., instructor in radiology, cochaired an oral session, "Clinical Hyperthermia," and presented "Predictors for Local Control in Patients Treated with Superficial Hyperthermia and Irradiation for Recurrent Breast Carcinoma of the Chest Wall: Importance of Specific Absorption Rate" and "Results with the Radiotherapeutic Management of Carcinoma of Biliary Tract and Gallbladder" at the International Congress of Radiation Oncology, Kyoto, June 21 - 25.

Bruce L. McClennan, M.D., professor of radiology and chief of abdominal imaging, spoke on "Contrast Media Reactions - Recognition and Response" and "Contrast Media - Update 1993" at the International Special Procedures Conference, Chicago, May 19 - 20.

Stephen M. Moerlein, Ph.D., associate professor of radiology, presented two poster exhibits "Flourine-18 Labeled Derivatives of Benperidol for PET Study of Dopaminergic D-2 Receptor-Binding In Vivo" (coauthored with **Joel S. Perlmutter, M.D.**, associate professor of neurology and radiology, and **David Parkinson, Ph.D.**, assistant professor of cell biology and physiology) and "Examination of Two Fluorine-18 Labeled Benzodiazepine Receptor Antagonists as PET Tracers" (also coauthored with **Perlmutter** and

VISITING PROFESSORS & INVITED LECTURERS

G. James Blaine, D.Sc., associate professor of computer sciences in radiology and head of the Electronic Radiology Laboratory, presented "An Introduction to ATM Technology: Telemedicine Applications" at the Eighth Annual Computers in Healthcare Conference and Exposition, Hilton Head Island, South Carolina, May 11. **Blaine** and codemonstrators **Robert A. Whitman**, research engineer; **Nilesh Gohel**, research associate; **Thomas Monsees**, consultant; **Peter Plugstad**, research associate; and **Jerome R. Cox, D.Sc.**, Welge professor and chairman of the department of computer science, demonstrated the ATM-based medicine doctor's workstation in the "Future of Telemedicine" booth at the ICA/COMNET Conference, Dallas, May 18 - 20.

James A. Brink, M.D., associate professor of radiology, as visiting professor spoke on "Spiral Computed Tomography" at Radiology Grand Rounds and participated in other departmental activities at Massachusetts General Hospital, Boston, June 9 - 10.

Bahman Emami, M.D., professor of radiology and associate director of the Radiation Oncology Center, presented "Physics Rationale Practicality and Future Prospects" and "Radiation Therapy and Combined Modality Treatment of Lung Cancer" at the Twenty-third Annual Concepts in Radiation Therapy at the University of Minnesota, Minneapolis, May 12 - 14. He spoke on "Pharyngeal Wall Cancer: Comparison of Three Treatment Strategies" at the XV World Congress of Otorhinolaryngology Head & Neck Surgery, Istanbul, June 20 - 25.

Louis A. Gilula, M.D., professor of radiology and cochief of the musculoskeletal section, presented "Arthrography," "Radiogra-

VISITING PROFESSORS & INVITED LECTURERS

continued from page 25

Parkinson) at the "Brain 93: XVI International Symposium on Cerebral Blood Flow and Metabolism," Sendai, Japan, May 22 - 28.

Joel S. Perlmutter, M.D., associate professor of neurology and radiology, served as invited chair of the "Parkinson's Disease - Functional Imaging Session," The American Academy of Neurology Meeting, New York City, April 28. He participated in poster presentations "In Vivo Pharmacological Activation of Dopaminergic Pathways in Primates Studied with PET" (coauthored with **Christopher Rowe, M.D.**, and **Lennis Lich, cyclotron supervisor**), "Tracer Kinetic Analysis for Measuring Regional Cerebral-Blood Flow by Dynamic Nuclear Magnetic Resonance Imaging" (coauthored with **Kenneth B. Larson, Ph.D.**, research professor of neurology; **William H. Perman, M.D.**; **Mohktar H. Gado, M.D.**, professor of radiology; and **John M. Ollinger, medical student**), "Fluorine-18 Labeled Derivatives of Benperidol for PET Study of Dopaminergic D-2 Receptor-Binding in Vivo" (coauthored with **Stephen M. Moerlein, Ph.D.**, associate professor of radiology, and **David Parkinson, Ph.D.**, assistant professor of cell biology and physiology), and "Examination of Two Fluorine-18 Labeled Benzodiazepine Receptor Antagonists as PET Tracers" (coauthored with **Moerlein** and **Parkinson**) at "Brain '93, The International Meeting of the Society of Cerebral Blood Flow and Metabolism," Sendai, Japan, May 22 - 28.

James A. Purdy, Ph.D., professor of radiology and associate director of the Radiation Oncology Center, spoke on "Radiation Oncology Physics Standards" at the 10th Annual Meeting of the American College of Medical Physics, Destin, Florida, May 1. As visiting professor, he presented "Advances in 3D Conformal Therapy" at the University of Minnesota at St. Paul, May 6.

Stuart S. Sagel, M.D., professor of radiology, chief of chest radiology, and cochief of computed body tomography, presented "Spiral CT in the Thorax," "Chest Radiographic Equalization Techniques: InSight versus AMBER," "CT of Vascular Mediastinal Lesions," "CT of Non-Vascular Mediastinal Masses," and "CT of the Thorax: Anatomic Variants and Pitfalls" at the Annual Meeting and Symposium on Chest Disease of the Fleischner Society, Boston, May 4 - 8. He spoke on "Techniques and Clinical Indications for CT of the Chest," "CT of the Pulmonary Parenchyma," "CT of Vascular Mediastinal Masses," "CT Anatomy in the Thorax," "CT of the Pericardium," and "Role of CT and MRI in Bronchogenic Carcinoma" at the European/Nordic NICER Course on Chest and Cardiac Radiology, Oslo, Norway, June 14 - 18.

Barry A. Siegel, M.D., professor of radiology and medicine, and director of the Division of Nuclear Medicine, as visiting professor spoke on "Diagnosis of Pulmonary Embolism" at the Western Pennsylvania Hospital, Pittsburgh, April 21 - 22.

Marilyn J. Siegel, M.D., professor of radiology, lectured on "Imaging the Pediatric Thymus" at the South Central Kansas Radiological Society, Wichita, May 18.

Michael J. Vannier, M.D., professor of radiology, director of the Division of Radiology Research, and head of the image processing lab, presented "Medical Imaging (MRI, CT, Surface Scanning)" at the NATO AGARD meeting on "3D Anthropometry," German National Cancer Foundation, Heidelberg, April 20-23. As chairman of the Continuing Medical Education Committee for both the St. Louis Metropolitan Medical Society and the Missouri State Medical Association, Vannier presented "Most Common Deficiencies Found in CME Provider Programs" at the Missouri State Medical Association CME Conference, Osage Beach, Missouri, June 11.

Michael J. Welch, Ph.D., professor of radiology and chemistry, and director of the Division of Radiation Sciences, as guest lecturer spoke on "SPET & PET Radiopharmaceuticals in Oncology" at the Symposium on Single Photon Emission Tomography (SPET) and Positron Emission Tomography (PET) in Cardiology, Neurology, and Oncology," "Advancements in Development of PET and SPET Pharmaceuticals," "SPET and PET Radiopharmaceuticals for Assessment of Myocardial Viability," and "Recent Radiopharmaceuticals for SPET and PET in Dementia and Psychiatry," Health Sciences Center, Kuwait University, Kuwait, April 10 - 14.

O. Clark West, M.D., instructor in radiology, presented "CT Patterns of Transsphenoid Basilar Skull Fractures" at the American Society of Emergency Radiology Meeting, San Diego, March 28. He presented the feature address, "Current Concepts in Imaging of the Blunt Trauma Patient," at DePaul Health Center's Blunt Trauma Symposium (Rapid Evaluation & Treatment), St. Louis, May 10.

Anthony J. Wilson, M.D., associate professor and director of emergency radiology, as invited lecturer spoke on "Musculoskeletal MRI" and "Musculoskeletal Digital Imaging" at the University of Iowa, Iowa City, April 26 - 27.

Franz J. Wippold, M.D., associate professor of radiology, as a visiting lecturer, spoke on "Preparing for the Oral Boards at Walter Reed Army Medical Center," Washington, D.C., May 4. He presented "Neuroradiology in the Emergency Room" at Uniformed Services University of the Health Services, Bethesda, May 6. Wippold presented "Imaging of the Head and Neck: The Role of Magnetic Resonance" and "Imaging of the Temporal Bone" at the 44th Military Medical Surgical Clinical Congress, Willingen, Germany, May 11.

SYMPOSIA

3D RADIATION TREATMENT PLANNING AND CONFORMAL THERAPY: AN INTERNATIONAL SYMPOSIUM

The following Mallinckrodt Institute staff members participated in the First 3D Radiation Treatment Planning and Conformal Therapy International Symposium, St. Louis, April 21 - 23.

Bahman Emami, M.D., "Welcome/Opening Remarks."

SESSION I: 3D Radiotherapy Treatment Planning (3D RTP)
James A. Purdy, Ph.D., moderator.

James A. Purdy, Ph.D., "Dose and Volume Specification for 3D RTP."

SESSION II: Clinical Experience with 3D Radiotherapy
Bahman Emami, M.D., moderator.

Bahman Emami, M.D., "Clinical Experience with 3D Radiotherapy - The Mallinckrodt Experience."

SESSION III: CT - SIMULATION
Carlos A. Perez, M.D., moderator.

Carlos A. Perez, M.D., "What is a Fully Integrated CT Simulator?"

SESSION IV: 3D Dose Calculation Algorithms/Treatment Aids
Jeffrey F. Williamson, Ph.D., moderator.

SESSION V: Stereotactic/Brachytherapy
Todd H. Wasserman, M.D., moderator.

Robert E. Drzymala, Ph.D., "Stereotactic Radiosurgery - Physical Principles."

Joseph R. Simpson, M.D., "Stereotactic Radiosurgery - Clinical Experience."

Jeffrey F. Williamson, Ph.D., "3D Brachytherapy Dose Calculations."

SESSION VI: Treatment Delivery/Verification
Carlos A. Perez, M.D., moderator.

G. James Blaine, D.Sc., "PACS, Computer Networking for Conformal Therapy."

Mary V. Graham, M.D., "Patient Positioning and Immobilizing Devices for Conformal Therapy."

Perry W. Grigsby, M.D., "Verify and Record Systems for Conformal Therapy: Needs and Reality."

Daniel A. Low, Ph.D., "On-Line Radiotherapy Treatment Verification Systems."

Jeff M. Michalski, M.D., "On-Line Radiotherapy Treatment Verification - Clinical Studies."

CMS USER SEMINAR 1993

The following Mallinckrodt Institute staff members participated in the Computerized Medical Systems, Inc. (CMS) User Seminar 1993, St. Louis, April 23 - 24.

Robert E. Drzymala, Ph.D., "3-D Computerized Treatment Planning for Stereotactic Radiosurgery."

Bahman Emami, M.D., "Clinical Potential of 3-D Conformal Radiotherapy."

William B. Harms, B.S., "Comprehensive RTP Quality Assurance Program."

Eric E. Klein, M.S., "Film Dosimetry for Photons and Electrons—Sometimes you need the rain to get to the rainbow!!"

Daniel A. Low, Ph.D., "Algorithm Quality Assurance (Photon and Electron)."

James A. Purdy, Ph.D., "Continuing Quality Improvement for Radiation Oncology."

AMERICAN ROENTGEN RAY SOCIETY 93RD ANNUAL MEETING

The following Mallinckrodt Institute staff members participated in the 93rd Annual Meeting of the American Roentgen Ray Society, San Francisco, April 25 - 30.

SCIENTIFIC SESSION
Bruce L. McClennan, M.D., associate chair for instructional courses and course director for "Introduction to Research Programs for Residents Sponsored by ARRS-RSNA-AUR."

Howard P. Forman, M.D.; Jay P. Heiken, M.D.; James A. Brink, M.D.; Bruce L. McClennan, M.D.; Lee A. Fox, B.S., medical student; Harvey S. Glazer, M.D., "Computed Tomographic Screening for Comorbid Disease in Patients with Prostate Carcinoma: Is it Cost Effective?"

Jay P. Heiken, M.D.; Erich K. Lang, M.D.*, "Posterior Pararenal Space Fluid Collections: Differential Diagnosis Based on CT Findings."
*Department of Radiology, Louisiana State University Medical Center, New Orleans.

Linda R. King, M.D.; Marilyn J. Siegel, M.D.; Dennis M. Balfe, M.D., "CT of Pancreatitis in Childhood: A Different Pattern than in Adult Pancreatitis."

Hamid R. Latifi, M.D.; Marilyn J. Siegel, M.D., "Color Doppler Sonography of Pediatric Soft Tissue Masses."

Gary D. Luker, M.D.; Marilyn J. Siegel, M.D.; Harvey S. Glazer, M.D., "Response to Therapy of Mediastinal Disease in Pediatric Lymphoma."

Kevin W. McEnery, M.D.; Anthony J. Wilson, M.B., Ch.B.; William A. Murphy, M.D., "Spiral CT Evaluation of Wrist Trauma."

L. Santiago Medina, M.D.; Marilyn J. Siegel, M.D.; George B. Mallory, Jr., M.D.*; Pablo A. Bejarano, M.D.; Harvey S. Glazer, M.D.; Dixie J. Anderson, M.D.; Janice W. Semenkovich, M.D.**, "CT and HRCT in Pediatric Lung Transplantation." *Department of Pediatrics, Washington University School of Medicine, St. Louis. **Department of Pathology, Washington University School of Medicine, St. Louis.

Mitchell A. Miller, M.D.; William D. Middleton, M.D.; Dennis M. Balfe, M.D., "Peripheral Portal Venous Blood Flow Alterations Induced by Hepatic Masses: A Color Doppler Sonographic Analysis."

SYMPOSIA

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VIEW BOX EXHIBITS

Shawn P. Quillin, M.D.;
Marilyn J. Siegel, M.D.,
Bronze Medal Award winner,
"Color Doppler Sonography of
Acute Lower Abdominal
Pain."

POSTER BOARD EXHIBITS

**Gerard M. Eagar, M.B.,
Ch.B.;** **Fernando R. Gutierrez,
M.D.;** **Mary C. Gamache,
M.D.*,** "The Radiology of
Implantable Cardiac Defibrillators."
*Department of Internal Medicine,
Washington University School of
Medicine, St. Louis.

Kevin McEnery, M.D.;
**Anthony J. Wilson, M.B.,
Ch.B.;** **William A. Murphy,
M.D.;** **Michael M. Marushack,
M.D.*,** "Spiral CT Imaging of the
Musculoskeletal System." *Department
of Orthopedics, Washington
University School of Medicine,
St. Louis.

Nhan P. Truong, M.D.;
William G. Totty, M.D.;
Louis A. Gilula, M.D., "Tailored
Imaging Approach to Ankle Tendon
and Tendon Sheath Disease."

Nhan P. Truong, M.D.;
Frederic A. Mann, M.D.*;
Louis A. Gilula, M.D., "Diagnosis
of the Cause(s) of Cryptic Wrist
Symptoms: Criterion-Based Patient
Selection is more Cost-Effective
than Routine Wrist Radiographic
Instability Series (WIS)." *Department
of Radiology, Harborview Hospital,
University of Washington Medical
Center, Seattle.

Yuming Yin, M.D.; **Yunzhao Wang,
M.D.*;** **Anthony J. Wilson, M.B.,
Ch.B.;** **Louis A. Gilula, M.D.,** "Endemic
Fluorosis of Bone: A Disorder with a
Diverse Appearance." *Beijing Ji Shui
Tan Hospital, Beijing, China.

THIRD INTERNATIONAL BRACHYTHERAPY AND REMOTE AFTERLOADING SYMPOSIUM AND WORKSHOP

*The following Mallinckrodt Institute
staff members participated in the
Third International Brachytherapy and
Remote Afterloading Symposium and
Workshop, St. Louis, May 19 - 21.*

Carlos A. Perez, M.D., symposium
chairman.

SCIENTIFIC SESSION I
Carlos A. Perez, M.D., "Welcome
and Introduction."

James A. Purdy, Ph.D.,
moderator.

SCIENTIFIC SESSION II
Eric D. Slessinger, M.S.,
moderator.

Eric D. Slessinger, M.S.,
"Quality Assurance and Safety
Considerations with Emphasis on
Low Dose Rate Remote Afterloading
Devices."

Jeffrey F. Williamson, Ph.D.,
"Dose Specification, Prescription,
and Design for Gynecological
Brachytherapy."

SCIENTIFIC SESSION III
Joseph L. Roti Roti, Ph.D.,
moderator.

SCIENTIFIC SESSION IV
Jeffrey F. Williamson, Ph.D.,
moderator.

SCIENTIFIC SESSION V
Joseph R. Simpson, M.D.,
moderator.

SCIENTIFIC SESSION VI
Carlos A. Perez, M.D.,
moderator.

Carlos A. Perez, M.D.,
"Brachytherapy in Carcinoma of the
Breast: The MIR Experience."

SCIENTIFIC SESSION VII & VIII
Mary V. Graham, M.D.,
moderator.

SCIENTIFIC SESSION IX
Perry W. Grigsby, M.D.,
moderator.

Perry W. Grigsby, M.D.,
"LDR Brachytherapy in Carcinoma
of the Endometrium."

Carlos A. Perez, M.D., "LDR
Brachytherapy in Cancer of the
Cervix."

SCIENTIFIC SESSION X
Carlos A. Perez, M.D.,
moderator.

Perry W. Grigsby, M.D.,
"Brachytherapy in Carcinoma of the
Vagina, Female Urethra, and Vulva."

SCIENTIFIC SESSION XI
Jeffrey F. Williamson, Ph.D.,
moderator.

Bahman Emami, M.D.,
"Interstitial Thermoradiotherapy."

WORKSHOPS
Bahman Emami, M.D.;
Joseph R. Simpson, M.D.,
leaders, "Head and Neck."

Perry W. Grigsby, M.D.;
Carlos A. Perez, M.D., leaders,
"Gynecology."

Jeffrey F. Williamson, M.D.;
Robert E. Dryzmala, Ph.D.,
leaders, "Quality Assurance."

THE SOCIETY OF NUCLEAR MEDICINE

*The following Mallinckrodt Institute
staff members participated in the
40th Annual Meeting of the Society
of Nuclear Medicine, Toronto,
Canada, June 8 - 11.*

ORAL PRESENTATIONS

Tom R. Miller, M.D., Ph.D.;
Jerold W. Wallis, M.D.;
Brian R. Landy, student;
Robert J. Gropler, M.D.,
"Measurement of Global and
Regional Left Ventricular
Function by Cardiac PET."

Jerold W. Wallis, M.D.,
"Three-Dimensional Display in
Nuclear Medicine: Principles,
Uses and Pitfalls."

Jerold W. Wallis, M.D.;
Michael I. Miller, Ph.D.*;
Christopher S. Butler, B.S.*;
Tom R. Miller, M.D., Ph.D.,
"Application of a Massively-Parallel
Computer for Three-Dimensional
Maximum A Posteriori Reconstruction
in SPECT" *Department of
Electrical Engineering, Washington
University, St. Louis.

John F. Walsh, M.D.*;
Anton Staudenherz, B.S.*;
Pilar Herrero, M.S.*;
Edward M. Geltman, M.D.*;
**Stephen R. Bergman, M.D.,
Ph.D.*;** **Robert J. Gropler,
M.D.,** "Perfusible Tissue Index
Parallels Oxidative Metabolism in
Predicting Recovery of Myocardial
Function After Coronary Revascularization."
*Department of Internal Medicine,
Washington University School of
Medicine, St. Louis.

Pilar Herrero, M.S.*; Carla J. Weinheimer, B.S.*; P. Diane Toeniskoetter, B.S.*; Joanne Markham, M.S.**; Anton Staudenherz, B.S.*; John F. Walsh, M.D.*; Robert J. Gropler, M.D.; Stephen R. Bergmann, M.D., Ph.D.*, "Does Per-fusible Tissue Index (PTI) Reflect Tissue That Can Exchange Water or Flow Heterogeneity?" *Department of Internal Medicine, Washington University School of Medicine, St. Louis. **The Institute for Biomedical Computing, Washington University School of Medicine, St. Louis.

Stephen R. Bergmann, M.D., Ph.D.*; Carla J. Weinheimer, B.S.*; P. Diane Toeniskoetter, B.S.*; John F. Walsh, M.D.*; Robert J. Gropler, M.D.; Pilar Herrero, M.S.*, "Estimation of Myocardial Perfusion with PET and Oxygen-15 Water Administered by Constant Intravenous Infusion." *Department of Internal Medicine, Washington University School of Medicine, St. Louis.

POSTER PRESENTATIONS

Joseph P. Hasapes, M.D.*; Jerold W. Wallis, M.D.; James A. Goldstein, M.D.*; Stephen R. Bergmann, M.D., Ph.D.*, "Direct Assessment of the Efficacy of Anti-Rejection Therapy Using In-111 Lymphocyte Scintigraphy in Patients." *Department of Internal Medicine, Washington University School of Medicine, St. Louis.

Jerold W. Wallis, M.D.; Tom R. Miller, M.D., Ph.D., "Iterative Reconstruction Algorithms: Is the Slow Way Really the Best?"

Jerold W. Wallis, M.D.; P. Duffy Cutler, Ph.D., "A Practical Algorithm for Assessing Flood Field Uniformity in Clinical Nuclear Medicine."

SCIENTIFIC PAPERS

Robert J. Gropler, M.D., judge, "Cardiovascular: Young Investigator Award Competition." Comoderator, "Cardiovascular PET: Metabolic Imaging."

Tom R. Miller, M.D., Ph.D., comoderator, "Instrumentation and Data Analysis: SPECT IV: Attenuation and Scatter Compensation Methods."

Carolyn J. Anderson, Ph.D.; Sally W. Schwarz, R.Ph., M.S.; Judith M. Connett, Ph.D.*; Pamela A. Rocque, B.A.; Li W. Guo, Ph.D.; Kurt R. Zinn, D.V.M., Ph.D.**; Gordon W. Philpott, M.D.*; Michael J. Welch, Ph.D., "Optimization of the Preparation of Cu-64-Labeled Monoclonal Antibody (MAb) Fragments (1A3-F(ab)₂) for Improved Biodistribution." *Department of Surgery, Washington University School of Medicine, St. Louis. **Research Reactor, University of Missouri, Columbia.

Carolyn J. Anderson, Ph.D.; Judith M. Connett, Ph.D.*; Mary L. Baumann, B.A.*; Sally W. Schwarz, R.Ph., M.S.; Kurt R. Zinn, D.V.M., Ph.D.**; Gordon W. Philpott, M.D.*; Michael J. Welch, Ph.D., "Comparison of Cu-67 and Cu-64 as Potential Radionuclides for Radiotherapy." *Department of Surgery, Washington University School of Medicine, St. Louis. **Research Reactor, University of Missouri, Columbia.

Thomas A. Bonasera, M.S.; Tammy S. Pajeau, M.S.; Farrokh Dehdashti, M.D.; Michael J. Welch, Ph.D.; John A. Katzenellenbogen, Ph.D.*, "Comparison of the Hepatic Metabolism of 16a-[F-18] Flourestrodiol (FES) and 16_b-[F-18] Flouromoxesterol (FMOX) Utilizing Isolated Hepatocytes from Different Species." *Department of Chemistry, University of Illinois, Urbana.

Brad O. Buckman, B.S.*; Carmen S. Dence, M.S.; Henry F. VanBrocklin, Ph.D.*; Stephen R. Bergmann, M.D., Ph.D.**; John A. Katzenellenbogen, Ph.D.*; Michael J. Welch, Ph.D., "Synthesis and Initial Evaluation of w-Carbon-11 Palmitic Acid as a Cardiac Imaging Agent." *Department of Chemistry, University of Illinois, Urbana. **Department of Internal Medicine, Washington University School of Medicine, St. Louis.

Judith M. Connett, Ph.D.*; Carolyn J. Anderson, Ph.D.; Mary L. Baumann, B.A.*; Sally W. Schwarz, R.Ph., M.S.; Kurt R. Zinn, D.V.M., Ph.D.**; Gordon W. Philpott, M.D.*; Michael J. Welch, Ph.D., "Cu-67 and Cu-64 Labeled-Monoclonal Antibody (MAb) 1A3 as Potential Agents for Radioimmunotherapy." *Department of Surgery, Washington University School of Medicine, St. Louis. **Research Reactor, University of Missouri, Columbia.

Farrokh Dehdashti, M.D.; Landis K. Griffeth, M.D., Ph.D.; Joanne E. Mortimer, M.D.*; Diane M. Radford, M.D.**; Andrea H. McGuire, M.D.***; Maureen J. Fusselman, M.S., B.S.N.; Renee J. Burney, C.N.M.T.; Carmen S. Dence, M.S.; Thomas A. Bonasera, M.S.; Barry A. Siegel, M.D.; Michael J.

Welch, Ph.D.; John A. Katzenellenbogen, Ph.D.****, "Positron Tomographic Assessment of Breast Lesions with FDG and FES." *Department of Internal Medicine, Washington University School of Medicine, St. Louis. **Department of General Surgery, Washington University School of Medicine, St. Louis. ***Mercy Hospital, Des Moines. ****Department of Chemistry, University of Illinois, Urbana.

James R. Duncan, M.D., Ph.D.; Michael J. Welch, Ph.D., "Receptor Targeted Radiolabeled Polypeptides: Intracellular Metabolism."

Timothy J. McCarthy, Ph.D.; Thomas A. Bonasera, M.S.; Michael J. Welch, Ph.D.; Shlomo Rozen, Ph.D.*, "A Novel Method for the Introduction of C-11. The Development of [C-11] Methyl Hypoflourite." *School of Chemistry, Tel-Aviv University, Israel.

Timothy J. McCarthy, Ph.D.; Michael J. Welch, Ph.D., "In Vivo RAT Biodistribution of No-Carrier-Added [I-125] Diphenyleneiodonium Bisulfate. A Probe for Nitric Oxide Synthase (NOS)."

James P. O'Neil, Ph.D.*; Carolyn J. Anderson, Ph.D.; Kathryn E. Carlson, B.A.*; Michael J. Welch, Ph.D.; John A. Katzenellenbogen, Ph.D.*, "An Improved Progesterone-Technetium Complex as a Potential Imaging Agent for Steroid Receptors." *Department of Chemistry, University of Illinois, Urbana.

Tammy S. Pajeau, M.S.; Michael J. Welch, Ph.D.; Thomas A. Bonasera, M.S.; John A. Katzenellenbogen, Ph.D.*, "The Radiotoxicity of

SYMPOSIA

continued from page 29

16-a[F-18]-Fluoroestradiol ([F-18]FES) In Cell Culture."

*Department of Chemistry, University of Illinois, Urbana.

Gordon W. Philpott, M.D.*; **Sally W. Schwarz, R.Ph., M.S.;** **Carolyn J. Anderson, Ph.D.;** **Landis K. Griffith, M.D., Ph.D.;** **Judith M. Connett, Ph.D.*;** **Kurt R. Zinn, D.V.M., Ph.D.**;** **Claude F. Meares, Ph.D.***;** **Barry A. Siegel, M.D.;** **Michael J. Welch, Ph.D.,** "Initial Clinical Study of Cu-64-Labeled Anticolon-Carcinoma Monoclonal Antibody (MAB 1A3) in Colorectal Cancer." *Department of General Surgery, Washington University School of Medicine, St. Louis. **Research Reactor, University of Missouri, Columbia. ***Department of Chemistry, University of California, Davis.

APPOINTMENTS/ ELECTIONS

Ryuji Higashikubo, Ph.D., assistant professor of radiology, was elected treasurer of the Cell Kinetics Society.

William H. McAlister, M.D., professor of radiology and radiologist-in-chief at St. Louis Children's Hospital, was elected American College of Radiology councilor from The Society for Pediatric Radiology.

James A. Purdy, Ph.D., professor of radiology and associate director of the Radiation Oncology Center, was appointed chairman of the Radiation Oncology Physics Exam Committee for the American Board of Medical Physics.

HONORS/AWARDS/ GRANTS/FELLOWSHIPS

R. Gilbert Jost, M.D., professor of radiology and chief of the Division of Diagnostic Radiology, hosted a U.S.-European workshop on "Usage of Medical Workstations," St. Louis, April 29 - 30. Representatives from the United States and from several countries in Europe discussed common objectives for the softcopy display of medical images. MIR attendees included **Michael W. Vannier, M.D.;** **G. James Blaine, D.Sc.;** **Stephen M. Moore, M.S.;** and **David E. Beecher, M.S.**

Bruce L. McClennan, M.D., professor of radiology and chief of abdominal imaging, served as an American Board of Radiology guest examiner in genitourinary, Louisville, June 7 - 10. McClennan was a

panel member for the session on "Diagnosis" at the World Health Organization's (WHO) 2nd International Consultation on Benign Prostatic Hypertrophy (BPH), Paris, June 28 - 30.

Joseph L. Roti Roti, Ph.D., professor of radiology and associate director of the Radiation Oncology Center, has received NCI approval to continue a five-year grant project which began in 1990. The project entitled "Nuclear Determinants of Therapeutic Response" will have received \$2,027,000 upon completion in 1995, with \$438,000 being awarded for the project period April 1, 1993 - March 31, 1994.

Michael W. Vannier, M.D., professor of radiology, director of the Division of Radiology Research, and head of the image processing lab, was a member of a panel of experts in the arts and sciences who met on June 7 to judge the 1993 nominations for "The Computerworld Smithsonian Awards." Vannier also coedited the proceedings from "Electronic Imaging of the Human Body," a cooperative workshop sponsored by the Human Engineering Division of the Armstrong Laboratory, Wright Patterson Air Force Base; Lister-Hill National Center for Biomedical Communication, National Library of Medicine; the U.S. Department of Defense; and Mallinckrodt Institute of Radiology.

Henry D. Royal, M.D., professor of radiology and associate director of the Division of Nuclear Medicine, and **Marilyn J. Siegel, M.D.,** professor of radiology, were appointed by the National Council on Radiation Protection and Measurements as members of Scientific Committee 91 - "Radiation Protection in Medicine."

Anthony J. Wilson, M.B., Ch.B., associate professor of radiology and director of emergency radiology, was appointed MIR coursemaster of the senior medical student radiology elective program for the 1993 academic year.

CALENDAR

August 8 - 12, 1993

American Association of Physicists in Medicine Annual Meeting
Washington, D.C.

August 15 - 20, 1993

International Skeletal Society Annual Meeting
Toronto

September 10, 1993

Annual Probstin Oncology Lecture
St. Louis

September 19 - 23, 1993

American College of Radiology
Orlando

September 19 - 23, 1993

Fifth International Workshop on Targetry and Target Chemistry
Upton, New York

September 20, 1993

City-Wide Conference
Richard Semelka III, M.D.
St. Louis

October 11, 1993

City-Wide Conference
Wendell G. Scott Lecture
Douglas Maynard, M.D.
St. Louis

October 11 - 15, 1993

American Society for Therapeutic Radiology and Oncology
New Orleans

October 25 - 28, 1993

Tenth International Symposium on Radiopharmaceutical Chemistry
Kyoto, Japan

November 8, 1993

City-Wide Conference
John V. Cruess, M.D.
St. Louis

November 11, 1993

G. Leland Melson, M.D.,
Visiting Professorship and Lecture
St. Louis

Residents' and Fellows' Farewell Dinner

June 21, 1993

1. Humberto Fagundes, M.D., chief resident, Radiation Oncology (left) and Ronald Evens, M.D., director of the Institute.



1.

2. Ferrel VanWagenen, M.D. (left); Lora VanWagenen; and John Stahl, M.D.



8.

3. Past recipients of the "MIR Teacher of the Year" award are (left to right) doctors Anthony Wilson, Barry Siegel, Marilyn Siegel, Dennis Balfe, Stuart Sagel, and Franz Wippold. Not shown are David Ling and Fernando Gutierrez.



2.

4. James Duncan, M.D., and Ellen Duncan.

5. (left to right) Kelly Foti; Anthony Foti, M.D.; Neda Yagan, M.D.; Michele Semin, M.D.; Andrew Fisher, M.D.; Spencer Smith, M.D.; and Mary Alderman, M.D.



7.

6. (left to right) Allen Oser, M.D., cochief resident, Diagnostic Radiology; Scott Baker, M.D., chief resident, Diagnostic Radiology; and Len Wilger, Eastman Kodak.



3.

7. (left to right) Paul Hsieh, M.D.; Patrick Gordon, M.D.; and Howard Forman, M.D.

8. Clint Anderson, M.D. (left) and Mark Mayhle, M.D.



6.

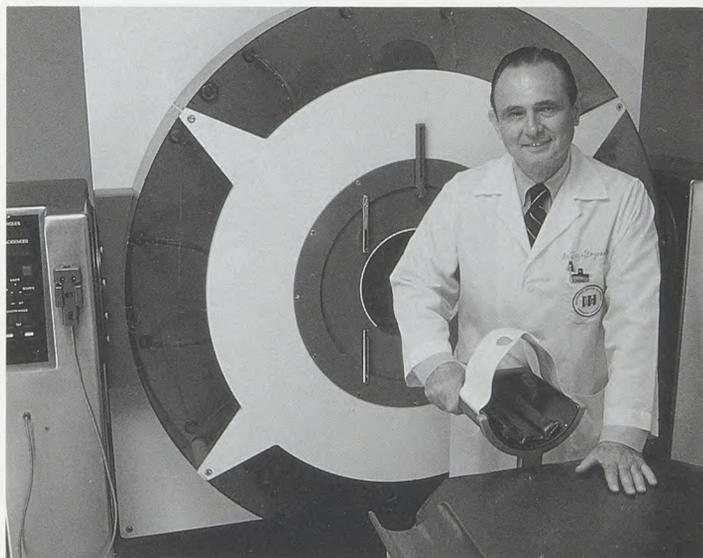


5.



4.

SPOTLIGHT



Michel M. Ter-Pogossian, Ph.D.

In October, the man who often has been dubbed “the father of PET” will once again be honored for his achievements in the field of nuclear science. This time, Michel M. Ter-Pogossian, Ph.D., professor of radiation sciences at Mallinckrodt Institute, will travel to Ontario to receive one of Canada’s most prestigious recognitions — the Gairdner Foundation International Award. This honor holds a special place among Ter-Pogossian’s achievements for it is given in recognition of his contributions to the development of positron emission tomography (PET).

In a scientific career that spans four decades, Ter-Pogossian, an internationally acclaimed physicist and nuclear scientist, has made significant contributions in evolving the instrumentation applied to the practice of nuclear medicine. His pioneering efforts in developing the use of cyclotron-produced radionuclides in biomedical research provided the foundation for breakthrough discoveries in studies of cerebral function and heart disease.

As a result of Ter-Pogossian’s early experiments with short-lived radionuclides, Mallinckrodt Institute researchers collaborated in 1964 on the design and installation of a cyclotron at Washington University Medical Center — the first cyclotron to be

located in a U.S. medical center.

Although Ter-Pogossian led the MIR scientists who developed in the 1970s the first useable PET scanner for humans, he modestly emphasizes that PET was a team project. Collaboration between radiologists and physical scientists is the philosophy behind Ter-Pogossian’s research, and he believes that working relationship has yielded a number of fundamental milestones in the progress of radiology. As examples, in radiation therapy he cites the application of physics principles to dosimetry and hyperthermia. In diagnostic radiology, those same principles led the way to the development of computed tomography, magnetic resonance imaging, and digital angiography.

MIR’s PET research team, started by Ter-Pogossian, is currently funded by a \$2 million grant from the National Institutes of Health. The 30-year research support is one of the longest running grants at Washington University.

A native of Berlin, Ter-Pogossian attended the Sorbonne and the Institute of Radium in France. He earned his M.S. and Ph.D. degrees in nuclear physics from Washington University and joined the University faculty in 1950 as an instructor in radiation physics. He was appoint-

ed a professor of radiation physics in 1961, professor of biophysics in physiology in 1964, and professor of radiation sciences in 1973. In September of 1990, Ter-Pogossian relinquished his administrative responsibilities as director of MIR’s Division of Radiation Sciences, a position he had held since 1950, to devote his full time to research and teaching.

Over the years, Ter-Pogossian has received numerous honors, including the Paul C. Aebersold Award, the highest recognition for science bestowed by the Society of Nuclear Medicine; the Georg Charles de Hevesy Nuclear Medicine Pioneer Award; the Herman L. Blumgart M.D. Pioneer Award; and the Amy Bowles Lawrence Distinguished Scientist in Research Medicine Award. He is a prolific author with more than 250 papers and book chapters to his credit and is a charter member of the American Nuclear Society and a fellow of the American Physical Society. In addition, he is a past trustee of the Academy of Sciences of St. Louis, a member of the Institute of Medicine of the United States Academy of Sciences, and has served as an advisor for several Department of Energy and National Institute of Health committees.

The Gairdner Foundation was established in 1957 by the late James A. Gairdner, a native of Toronto who believed that the significant achievements of medical scientists should be recognized in a tangible manner. Of the 225 recipients of the award to date, 40 scientists also earned the Nobel Prize — they’re in good company with Mallinckrodt Institute’s Michel Ter-Pogossian. □



CELEBRATING RADIOLOGY: 1895-1995 — A Century of Achievement

Wilhelm Conrad Roentgen's discovery of the X ray in 1895 marked the beginning of a revolution in medicine; for the first time physicians could see inside the body without surgery. The initial human X-ray produced by Roentgen was of his wife's hand; this early Mallinckrodt Institute image of the hand shows a tumor of the first metacarpal.

In anticipation of radiology's 100th anniversary, Radiology Centennial Incorporated, an organization sponsored by more than 40 national radiological societies, will create a series of yearlong activities highlighting the past, present, and future of diagnostic radiology and radiation oncology. One of the important projects already underway is a three-volume (diagnosis, therapy, and radiation sciences) history of radiology in North America. Coeditor of the diagnostic volume is Bruce L. McClelland, M.D., professor of radiology and chief of the abdominal imaging section at Mallinckrodt Institute. More than 45 contributors will write chapters for the book, which is slated for release in the fall of 1994.

FOCAL SPOT

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