

Summer 1989

Focal Spot, Summer 1989

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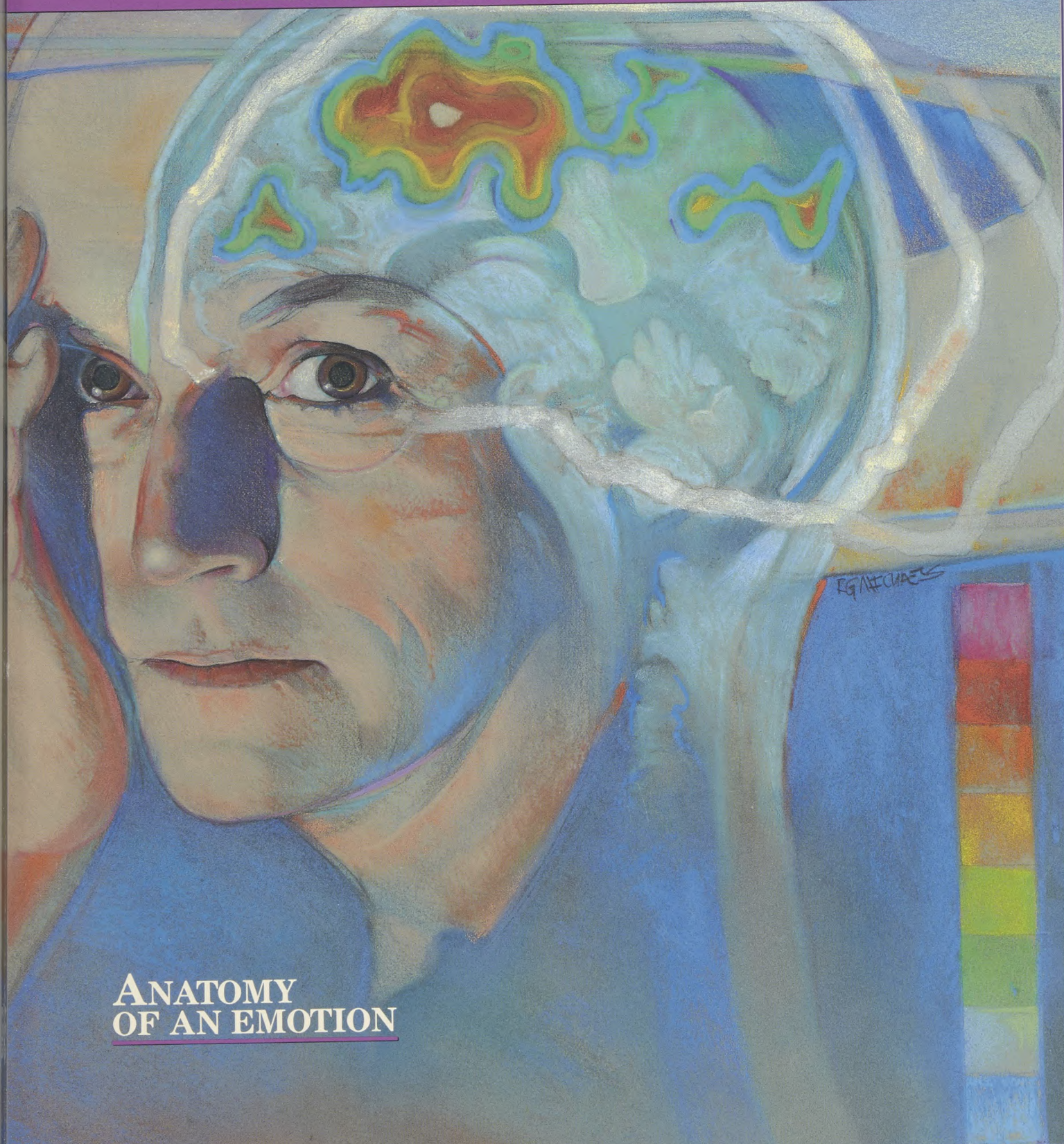
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SUMMER, 1989

VOLUME 20, NUMBER 2

FOCAL SPOT

MALLINCKRODT INSTITUTE OF RADIOLOGY

ANATOMY
OF AN EMOTION





Rhesus monkeys from the primate colony at Cayo Santiago have played a major role in providing brain models for determining heritability. Photograph by James Cheverud.

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SUMMER, 1989 VOLUME 20, NUMBER 2

MALLINCKRODT INSTITUTE OF RADIOLOGY

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ANATOMY OF AN EMOTION

For the first time, researchers are able to image the exact area of the brain involved in the expression of anxiety. Positron emission tomography (PET), developed at Mallinckrodt Institute in the early 1970s, is making it all possible.

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MONKEY BUSINESS

Thanks to a colony of rhesus monkeys in Cayo Santiago, a team of scientists has begun to determine that brain features in humans could someday predict risk factors for certain diseases.

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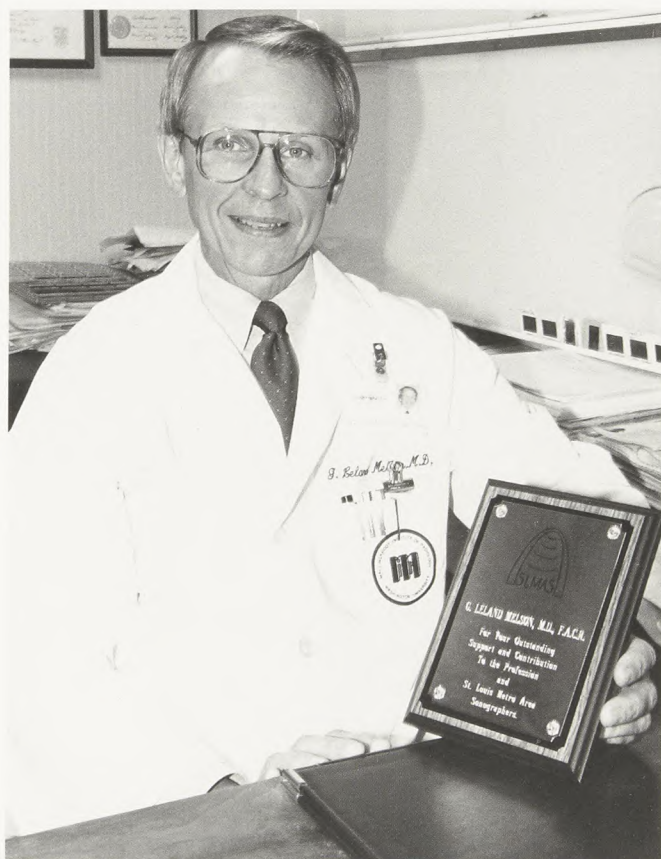
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REFLECTIONS

ON THE COVER:

Throughout the ages, scientists have sought to unravel the mystery of human emotions. Using positron emission tomography (PET), researchers at Mallinckrodt Institute have for the first time imaged an emotion—*anxiety*. Illustration by R. G. Michaels.

SPOT NEWS



Melson Honored by Area Sonographers

G. Leland Melson, M.D., professor of radiology and chief of clinical ultrasound, had a surprise waiting for him at the April meeting of the St. Louis Area Sonographers. Worked into a routine business meeting, or so Melson thought, was an award ceremony, complete with plaque, for Melson's "outstanding support and contribution to the profession and to St. Louis Metro Area Sonographers."

Melson has more than 12 years of experience in the area of ultrasound and is a popular lecturer on the topic, in addition to actively participating in the American

G. Leland Melson, M.D.

Registry of Diagnostic Medical Sonographers.

According to Melson, "It's always gratifying to receive an award for your work, but when the recognition comes from your peers, the honor is doubled."

Fourth-Year Students Earn Wilson Award

A new tradition appears to be emerging. For the third consecutive year and for the fourth time in the 21-year history of the Hugh M. Wilson Award, two recipients shared the honors associated with this recognition. Dual award winners were also named in 1985, 1987, and 1988. Jeffrey Hoffmeister, M.D. and Robert Quarles, M.D. were 1989 co-recipients of the award given to graduating medical students for meritorious work in radiology.

Hoffmeister, who worked with Michael Vannier, M.D., professor of radiology and director of the image processing lab, has contributed extensively to digital image processing and computer graphics. The results of his work can be applied to 3-D reconstruction.

In his work with the Nuclear Medicine Division, and specifically the positron emission tomography (PET) team, Quarles, who is also a chemical engineer, used his skills to develop testing and calibrating parameters for the Super-PETT-II scanner.

According to Fernando R. Gutierrez, M.D., associate professor of radiology, who assisted in reviewing the nominations, "Hoffmeister and Quarles are both extremely bright, hardworking

individuals who, as fourth-year medical students, have made significant contributions with their work at the Institute."

Ronald G. Evens, M.D., director of the Institute, made the official presentation of the Wilson Award to Hoffmeister and Quarles at the Annual Senior Awards Night in May.

Mintun Named Outstanding Young Investigator

The prestigious Tetelman Memorial Award is presented annually by the Society of Nuclear Medicine to a young nuclear medicine physician who has shown promise in research and in the clinical application of that research. This year's recipient is Mark A. Mintun, M.D., assistant professor of radiology.

According to Andrew Taylor Jr., M.D., vice-president of the Education and Research Foundation for the Society of Nuclear Medicine and co-director of the Division of Nuclear Medicine at Emory University Hospital in Atlanta, "Our committee reviews all applicants; we look at the whole person, not just the work. And we felt that Doctor Mintun not only had made excellent contributions to nuclear medicine with his work in positron emission tomography imaging, but that he also possessed exemplary personal qualities."

The award has a twofold purpose: to perpetuate the memory of Marc Tetelman, a nuclear medicine physician who was murdered in Atlanta about 10 years ago while attending a Society of Nuclear Medicine national meeting; and to reward

Thomas Murry

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young (under the age of 36) investigators for their accomplishments to date, while encouraging them to continue career development in the field of nuclear medicine.

Mintun, who has an undergraduate degree in chemical engineering, has focused his career on the application of engineering techniques to address physiologic questions. During his medical school years, he was able to combine data analysis skills from his chemical engineering background with the knowledge and insights acquired from his medical education to successfully research tracer methods.

Since coming to Mallinckrodt Institute, Mintun has been an active member of the positron emission tomography (PET) research team. He developed the first validated PET method for measuring oxygen metabolism which has been applied to the study of the human brain, particularly in stroke research. He has collaborated on breakthroughs in such receptor research projects as the first *in vivo* visualization of neuro-receptor distribution, quantitation of receptor kinetics, and imaging of estrogen receptors in human breast cancer. His most recent work has been in the development of methods for the functional mapping of the human brain.



Kathryn Hasek and Carlos A. Perez, M.D.

Ten Years and Counting

On May 10, 1979, Kathryn Hasek celebrated a birthday that was simultaneously the birthday she'll always remember and the one she'd most like to forget. On that day, Fleming Harper, M.D., a physician at Barnes Hospital, performed a radical mastectomy on Hasek's left breast.

"I think my doctors were more concerned than I was. My mind had stopped working three days before when Doctor Harper informed me that the lump I had found might be cancer," said Hasek.

Hasek came through her surgery and recovery period with few complications and began radiation therapy at the Institute's Radiation Oncology Center on June 18, 1979. Her treatments extended through July 24, and, according to Hasek, "I became good friends with Cobalt Sixty."

Because she received excellent care during her therapy, Hasek promised the Center's staff that if she remained well, she would return in ten years and celebrate with all the people

who took care of her.

On May 10, 1989, a vibrant Kathryn Hasek, accompanied by husband Oliver and other family members, celebrated a healthy, happy birthday. True to her promise, she brought refreshments and thank-yous to the Radiation Oncology Center staff.

Carlos A. Perez, M.D., director of the Radiation Oncology Center, and many of the staff who were on hand ten years ago wished Hasek many more healthy birthdays to come.

Team Approach Saves Larynx

When Nicholas J. Cassisi, D.D.S., M.D., came to St. Louis to deliver the Probststein Oncology Lecture on May 26, he brought along some impressive study results. In a 20-year study involving 300 patients with carcinoma of the voice box, a Tumor Board of surgeons, radiotherapists, pathologists, oncologists, dentists and radiologists individualized treatment for each case which also involved the

patient in the decision-making process. Results of the study proved a 70 to 95 percent success rate in saving the larynx, depending on the stage of the cancer.

According to Cassisi, "A unidisciplinary approach in the treatment of head and neck malignancies can no longer be appropriate. The best and only treatment is the multidisciplinary approach."

Cassisi is professor and chief of the Division of Otolaryngology, Department of Surgery, at the University of Florida in Gainesville. He also holds the positions of joint professor of oral surgery in the University's College of Dentistry and assistant chief-of-staff at Shands Teaching Hospitals and Clinics.

Cassisi reported that at the University of Florida, every new cancer case is presented to the Tumor Board and "the number of patients seen in one year has increased two times over."

The Probststein Lecture was established in appreciation of William Fair, M.D., former head of the Urology Division of the Department of Surgery; Carlos A. Perez, M.D., director of the Radiation Oncology Center at the Institute; and the staffs of Barnes Hospital and the Washington University Medical Center. This annual lecture honors outstanding contributors to clinical oncology and provides current information in cancer prevention, diagnosis, treatment, and rehabilitation.

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Barbara J. McNeil, M.D., Ph.D.

Doing the Right Thing

On March 13, Barbara J. McNeil, M.D., Ph.D., concluded her discussion of "Issues Facing the Diffusion of Medical Technology" by saying that the expansion of new technologies "is not in a dismal situation; however, the future must be carefully managed. And in the end, we'll end up doing the right thing."

Speaking at the third annual Daniel R. Biello Memorial Lecture, McNeil cited statistics showing that since 1976, percentage increases in health-care expenditures have doubled those of the Gross National Product. Figures also prove that in the last four to five years, expenses per patient case are considerably higher than revenues, causing hospital profit margins to drop. Since clinical research involving imaging technologies in teaching hospitals depends heavily on institutional financial support, proposed decreases in indirect teaching allowances may affect evaluative research.

Her findings show there is no clear-cut evidence that cost containment programs

over the past four years have had a major impact on diffusion of modern technologies. However, according to McNeil, "the environment is changing dramatically, and we may be in for significant effects in the next few years in how we practice medicine."

McNeil, internationally recognized for her important research contributions relating to the cost effectiveness of diagnostic and therapeutic procedures, is concurrently professor and head of the Department of Health Care Policy and professor of radiology at Harvard Medical School and director of the Center for Cost-Effective Care at Brigham and Women's Hospital in Boston.

Thomas Murry

Society of Nuclear Medicine Names Award Winners

Three of the top awards sponsored by the Society of Nuclear Medicine were presented to Washington University faculty at the Society's National Meeting June 13-16 in St. Louis.

Marc E. Shelton, M.D., fellow in the Division of Cardiology, received the first annual Cardiovascular Young Investigator Award presented by the Cardiovascular Council of the Society of Nuclear Medicine. After the six projects submitted for consideration were presented orally at the national meeting, a panel of designated judges then chose three finalists, naming Shelton as recipient of the first-place award. His presentation focused on the use of a new tracer (F-18-fluoromisonid-

azole) for the non-invasive detection of intercellular hypoxia (low tissue oxygen) with positron emission tomography. The preliminary work has shown this new procedure may be useful in identifying potentially salvageable heart tissue.

The first annual Mallinckrodt, Inc.-Society of Nuclear Medicine Fellowship Award was presented to Farrokh Dehdashti, M.D., fellow in the Division of Nuclear Medicine, for her work in tracing radionuclides in estrogen- and progesterone-receptive breast cancers. The one-year grant, sponsored by the Society and underwritten by Mallinckrodt, Inc., was established to further the development of current successful research. According to Ronald Hopkins, general manager of the Nuclear Medicine Division of Mallinckrodt Medical, Inc., "Doctor Dehdashti's project fit all our criteria for first-place selection. She is a physician fellow actively doing research in nuclear medicine, and her work clearly fits the pattern and high standards of the Institute's overall research program."

After 39 judges narrowed the field of 28 entries down to three finalists, Mallinckrodt Institute faculty garnered a first-place honor in the Society's Scientific Exhibits Award. James W. Brodack, Ph.D., research instructor in radiology, and Michael J. Welch, Ph.D., professor of radiation chemistry in radiology, shared the spotlight for their exhibit on "Laboratory Robotics: The Preferred Automation Method for Routine PET Radiopharmaceuticals." All exhibits were scored in four categories: quality of science, originality, quality of presentation, and overall quality and appearance.

Nuclear Medicine Collaborates with Siemens

Tom R. Miller, M.D., Ph.D., associate professor of radiology, and Jerold W. Wallis, M.D., assistant professor of radiology, are currently working on two two-year tomographic projects with Siemens Medical Systems.

The first project, "3-D Display of Tomographic Images in Nuclear Medicine," involves the development of new computer techniques for displaying images. Techniques developed at the Institute will be transferred to the Siemens Max Delta and Delta Manager computers, ultimately evolving into new display software.

The second project includes Donald R. Snyder, Ph.D., professor of electrical engineering at Washington University, who is collaborating with Miller and Wallis to improve the quality of single photon emission computed tomography (SPECT) images. SPECT data is acquired by a gamma camera rotating in a 360 degree circle around the patient. SPECT imaging produces cross-sectional slices similar to CT, but SPECT differs in that it shows uptake of radioactive tracers by organs within the body.

Although there is a very broad interest in 3-D displays, especially in radiology, says Miller, there are very few groups in nuclear medicine doing the type of work covered in these projects.

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NCI Awards Purdy \$1.4 Million for 3-D Treatment Planning

James A. Purdy, Ph.D., professor and chief of radiation oncology physics, has been awarded a \$1.4 million research contract from the National Cancer Institute as part of a collaborative effort to develop new computer-based support systems that provide the radiotherapist and medical physicist in the field of radiation oncology treatment planning with new tools that will help to make three-dimensional (3-D) treatment planning a routine activity.

The project entitled "Radiotherapy Treatment Planning Tools" will involve an interdisciplinary research team made up of medical physicists, computer scientists and physicians. Co-investigators include Drs. John Wong, Martin Weinhaus, Robert Drzymala, Larry Simpson, Bahman Emami, Joseph Simpson and Michael Vannier at the Mallinckrodt Institute; and Drs. John Matthews, Michael Kahn and Mark Frisse from the Institute for Biomedical Computing.

The Mallinckrodt Institute team will work in tandem with researchers from the University of Washington in Seattle and the University of North Carolina to

develop a user/computer interface for 3-D treatment planning tools, making use of the new expert system technology.

This work is intended to further develop computerized 3-D treatment planning systems. Such systems utilize anatomical detail and tissue density information provided by computed tomography (CT) imaging and make use of high speed numerical processing and realtime display systems to calculate and evaluate the delivery of radiation from any possible orientation, thus allowing the cancer specialist to tailor a specific plan for treating patients individually by aiming the maximum dose of radiation directly to the tumor without damaging healthy tissue nearby.

Balfe Heads Colorectal Study

One year ago, the National Cancer Institute (NCI) issued a call for study proposals to determine if radiologic staging of pancreatic and colorectal cancers provided adequate information for the treatment of these diseases.

Spurred on by Barbara J. McNeil, M.D., Ph.D., professor and head of the Department of Health Care Policy and professor of radiology at Harvard Medical School, representatives from New York University, University of Michigan, Johns Hopkins University, University of Washington-Seattle, and Washington University submitted sample protocols for a multi-institutional study. McNeil will act as statistical analyst for the participating universities.



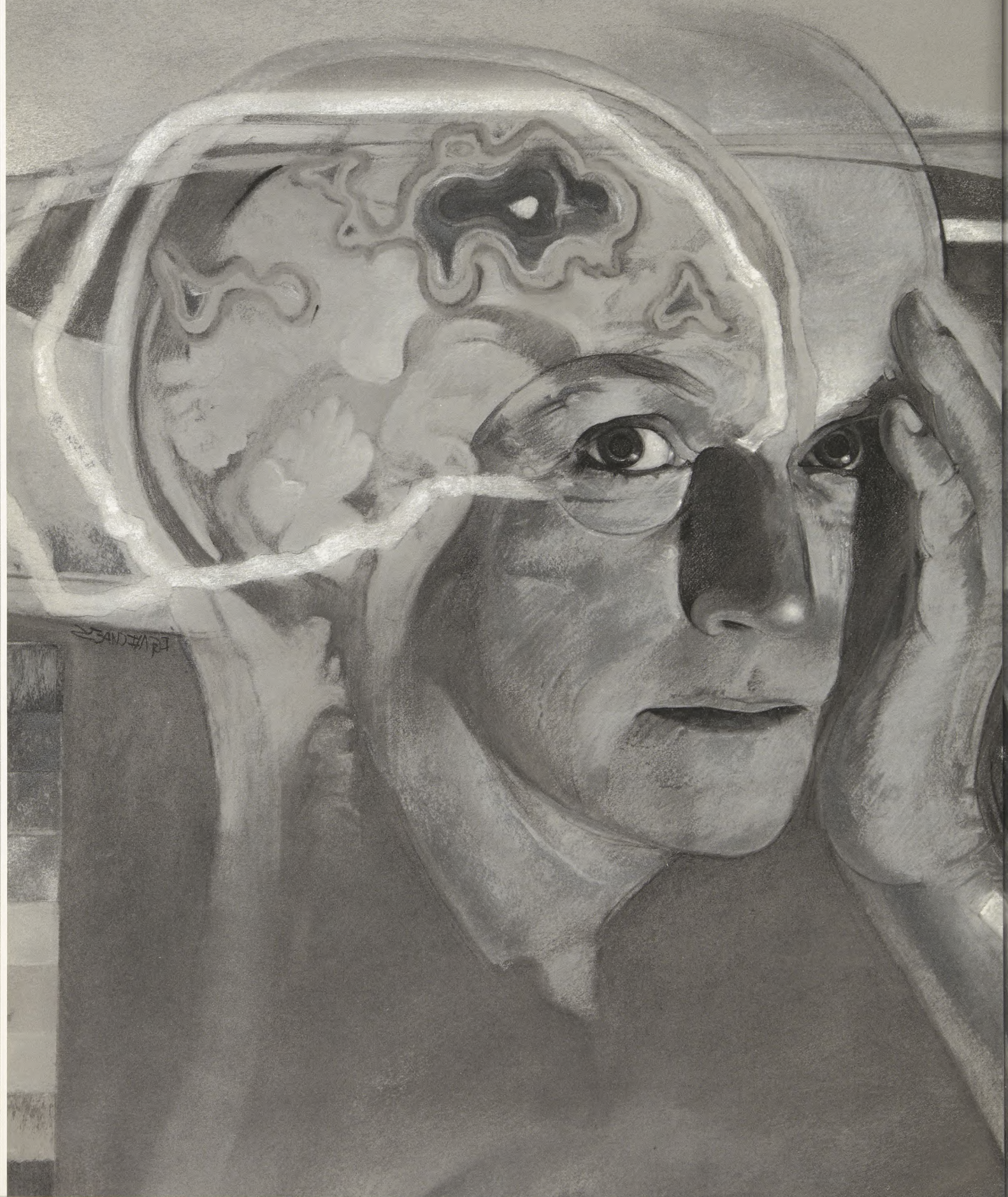
Patti Gabriel

According to Dennis M. Balfe, M.D., associate professor of radiology and principal investigator for the Washington University study, "A large percentage of colorectal cancers could be treated differently if we knew the extent of the disease. The extent of these cancers ranges from stage one, which is localized, to stage four, which is widespread. There is no reason to treat widespread cancers with radical surgery. Another problem we are looking into is liver metastases. Surgical intervention can help patients who have a limited number of liver metastases, provided part of the liver is spared. Our study will look at the radiologic methods in

Dennis M. Balfe, M.D. (standing) and Larry D. Schertz, M.D. discuss the day's cases.

staging colorectal cancers and evaluate the ability to do accurate follow-up over the first eighteen months."

Funding for the grant proposals was awarded in varying dollar amounts to each of the five institutions, with Washington University receiving a four-year grant for \$100,000 per year.





ANATOMY

OF AN

Emotion

By Cliff Froehlich

In the Middle Ages, early physicians intuited a relationship between physiology and feeling, asserting that humors, or bodily fluids, influenced temperament: A man filled with black bile was predisposed to melancholy; the prevalence of blood resulted in a sanguine individual full of optimism and cheer.

Scientific investigation soon disproved such folkloric notions, but the connection between anatomy and affect, between the physical and the emotional, was never entirely dismissed. Ancient ideas still held an undeniable enchantment: Our emotions—in some inexplicable manner—must be controlled by physiological processes within the brain. Or so we felt.

Now, because of work currently underway in the Mallinckrodt Institute of Radiology, we are beginning to know. Using positron emission tomography (PET), researchers have for the first time “imaged” an emotion—anxiety—locating a discrete area of the normal brain involved in its expression.

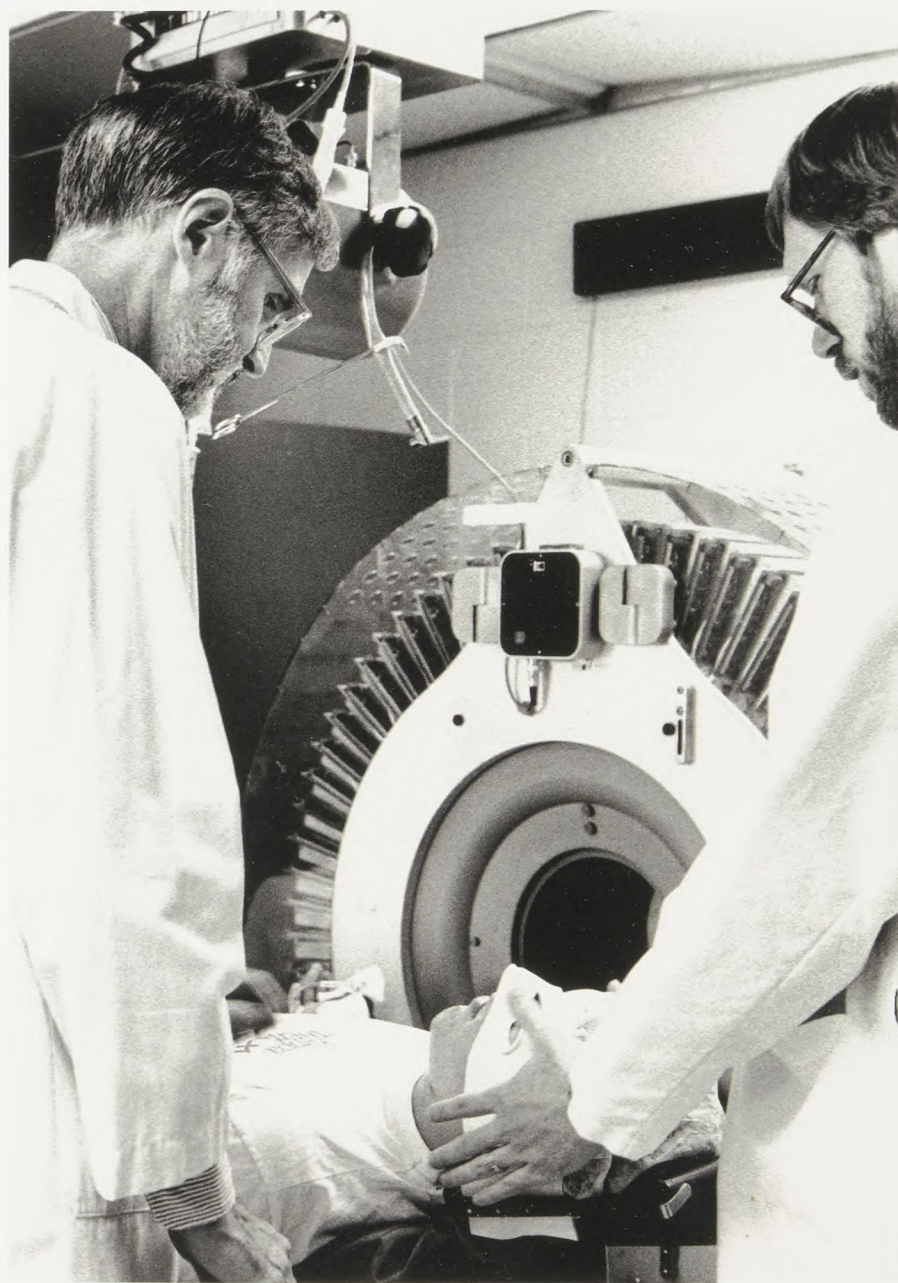
As Marcus E. Raichle, M.D., asserts, such PET studies “begin to unfold, if you will, an anatomy of emotion. With these imaging techniques, we seem to have a window on the brain.”

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Washington University scientists have been prying that opening ever wider since PET's development at Mallinckrodt Institute in the early 1970s. PET, through the use of short-lived radioactive nuclides, produces an image of brain function rather than form. The cross-sectional pictures it yields show areas of increased circulation or metabolism during assigned tasks, allowing researchers to pinpoint the specific anatomical locations associated with a given activity. Continuing improvements in scanner design, isotope production and, in particular, data analysis techniques have enabled increasing exactitude in detection, resolution and localization of responses in the 1980s.

Raichle, professor of radiology and neurology and supervisor of neurological PET research, first began peering at anxiety through PET's technological window at the urging of Eli Robins, M.D., professor and emeritus chairman of psychiatry at Washington University School of Medicine.

"The story goes back a ways in that I was approached a number of years ago by Eli Robins," recalls Raichle. "He called me over ostensibly to talk about PET, but I think on his agenda was to introduce me to the disease we call panic disorder. It was a disease that I hadn't thought about before, but he pointed out it was a disease that would be very interesting to study with PET, because it could be reproduced in the laboratory. That obviously meant we could not only study the resting state in these individuals but also an actual panic attack in a PET scanner. These are attacks of extreme anxiety that occur spontaneously without any provocation."



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By infusing the chemical sodium lactate into patients with panic disorder, the researchers are able to produce an attack. Normal control subjects are rarely affected. This phenomenon was discovered at Washington University in 1968, says Raichle: "It's well-known as an observation; to this day, it is not totally understood." With the first volunteer, the investigators produced what Raichle describes as "one of the most dramatic things I've ever seen in the PET scanner. Not only did we get the resting state, but we were able to produce a full-blown attack."

Marcus E. Raichle, M.D. (left) and Mark A. Mintun, M.D. make the final adjustments to the thermoplastic mask used in all brain studies. The mask comfortably restricts movement of the subject's head in order to accurately image specific areas of the brain.

Eric Reiman, M.D., assistant professor of psychiatry, participated in the examination of the results obtained from these early studies of panic attack. "We initially analyzed data from the non-panic state prior to lactate infusion. To our surprise, we found that the patients with panic disorder who were vulnerable to lactate-induced panic had an abnormal asymmetry of blood flow, blood volume and metabolic rate for oxygen in a region of the posterior temporal lobe during the non-panic state prior to the infusion."

"What this said was here was the first biological evidence in the brain that these people had a disease," says Raichle.

"In August of 1984 this was published in *Nature*, and it really caused as much a stir in the lay community as it did in the scientific. Because what it said to these tens of thousands of people who have this disease is that, by golly, it was a disease, there's a problem here, it isn't in your head, you aren't inadequate."

Having identified an apparent abnormality in an area of the posterior temporal lobe during the non-panic state, the researchers next wanted to examine the panic attack itself. That, however, proved difficult at the time. "The problem was that these people became quite ill in the scanner and they tended to move slightly," explains Raichle. "We like to take the resting state and then subtract it from a scan of the panic state and we look at the difference. We have some rather sophisticated computer techniques that will tell us exactly where these areas of change are. But that kind of strategy is absolutely dependent on them not moving. A number of serious attempts were then made, and

finally successful attempts, to develop computer algorithms that could take this data and, in an extremely precise way, figure out how much the subjects had moved.

"We then used those computer algorithms to manage this problem of movement and came out with the fact that it wasn't just the entire brain that had become active during the attack but very, very discrete areas. The areas most intensely active were the tips of the temporal lobes. There were also some areas of activity deep within the brain and further back in the brain and down deep in the area we call the

The key question was whether the areas of the brain that became active during a panic attack would also become active in a normal person during an anxious moment.

cerebellum. It appeared that during the panic attack we had uncovered at least some components of a network within the brain that were concerned with the expression of this emotion. So these data were compiled and recently published in the June issue of *Archives of General Psychiatry*."

These findings led the investigators to develop a model to explain how anxiety attacks occur and how they may be treated, says Reiman. "We postulate that the posterior temporal lobe abnormality is involved in a predisposition to panic, that it initiates an anxiety attack in response to some triggering event, and that it does so by sending a message to structures like the temporal poles which are involved in the elaboration of an anxiety attack. If this theory is correct, then therapeutic interventions could correct the regional abnormality, interfere with the triggering event, or interrupt the elaboration of an attack at sites like the temporal poles."

Until this point, the researchers had been investigating a disease. Then, the key question that arose was whether the areas of the brain that became active during a panic attack would also become active in a normal person during an anxious moment.

"After conducting our study of panic disorder," says Reiman, "we were interested in knowing how this pathological form of anxiety relates to a normal form of anxiety. In addition, we were excited about the prospect of investigating, for the very first time, the regions of the human brain that were involved in a normal emotion."

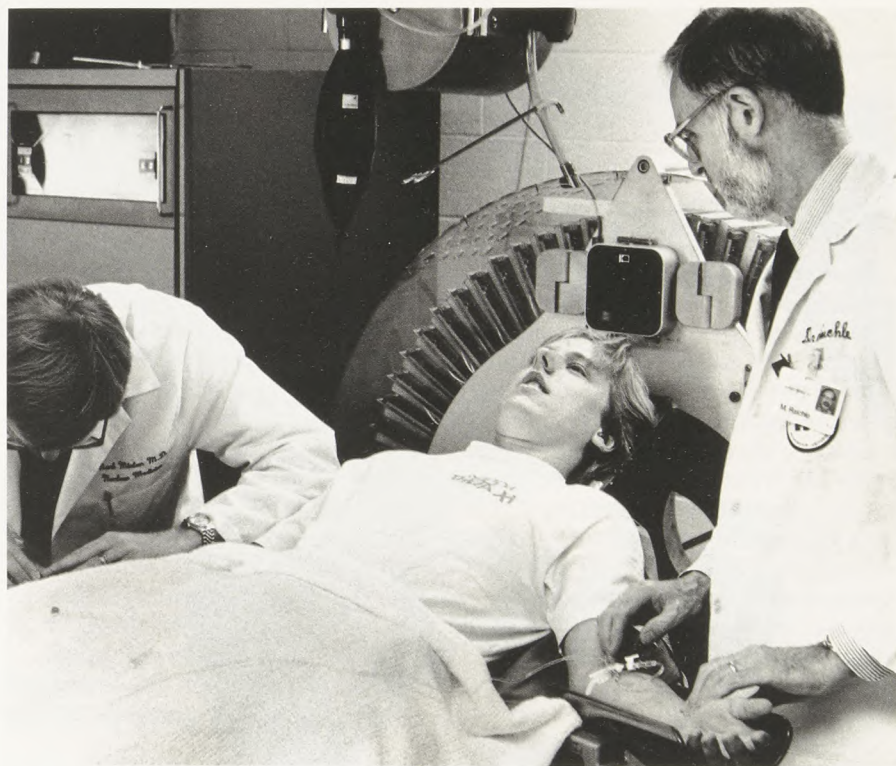
In making the transition from the study of panic attack to normal anxiety, the researchers first had to design a method of producing intense anxiety in the normal volunteer. "To study normal anxiety," Reiman explains, "we chose to employ a time-tested procedure for producing normal anxiety in a laboratory setting: Volunteers were studied before, during and after the anticipation of a painful electric shock.

ANATOMY OF AN EMOTION

“The volunteers were informed there would be no shock during the first and third PET scans and that these scans would provide baseline information. In contrast, they were informed that a shock would be delivered to their hands sometime after the onset of the second scan. They received a mild stimulus to their hands immediately after the second scan was completed. To give you an idea of how anxious they got, the volunteers’ heart rates increased by an average of 36 beats per minute during the second scan.”

“During all this, a variety of measurements were made of anxiety,” says Raichle. “We asked a series of questions that have been validated as good measures of anxiety. In addition to that, we measured such things as heart rate and skin conductance, which I suppose would be the equivalent of sweaty palms. By all of those measures during that period of anxiety, the subjects were clearly clinically and physiologically expressing anxiety. Heart rate went up, skin conductance went up, all measures of anxiety went up.”

The first scan was used essentially to acclimate the subjects to the scanning process itself. The second scan, obviously, served as the measure of anxiety. The third scan provided the control state and was used for baseline measurements. Raichle explains: “We need a control state, because our strategy is to take a control state and subtract that from the stimulated state. The reason for doing the third scan was to find out if there had been recovery. Were we looking at a



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buildup of anxiety by just being in the scanner and going through all this? Or was this a discrete episode that we could bracket by two resting control states? It was, in fact, the latter. It was very dramatic.”

Perhaps surprisingly, says Reiman, volunteers adjusted to the scanning procedure with little difficulty: “When I looked at the anxiety measurements of the first and third scans, there really was essentially no difference. The subjects became acclimated pretty quickly.”

In half the subjects, three additional scans were performed to eliminate the possibility that the activity seen during the second scan was simply related to movement or increases in motor tension. “The regions activated might have been related simply to those motor components,” says Reiman. “So we studied half the subjects opening and closing their right fists during a fourth scan. A fifth scan was a control scan without movement, and a sixth scan of their right hands forming a fist was made.” As the investigators hoped, the areas activated during the study proved unrelated to motor tasking.

Anxiety study patients receive the chemical sodium lactate intravenously in an attempt to induce panic attacks.

“We predicted,” Reiman continues “that normal anxiety would be associated with increased blood flow in the temporal poles and that prediction was confirmed.”

“When these scans were looked at,” says Raichle, “the thing that was very interesting was that again right up at the tips of the temporal lobes were intense responses that were localized right to that area. Clearly, panic disorder patients and normal subjects who are experiencing an intense episode of fear or anxiety express it through some of the same mechanisms.

“For this particular condition of panic disorder, we see a brain that has a predisposition to have an attack—there’s something abnormal about the brain itself. But, at least in part, when the emotion itself is expressed, it’s expressed through a system that’s common to all of us.”

For the panic disorder patients themselves, these PET studies clarify not only what is abnormal in their brains but also point researchers toward possible remedies. "People often ask what implications does this have for the treatment of the disease," says Raichle. "Well, in the long run, it has some significant ones, in that if we can define the predisposing neuroanatomy of the disease, we can begin to more appropriately understand what kinds of drugs would be effective. Because, after all, neurons talk to other neurons through receptors and transmitters. Drugs that treat anxiety, that treat a whole host of symptoms that come out of the nervous system, are ultimately targeted at those relationships. The more specific you can make them, you would hope, the fewer side effects and the more effective the medication."

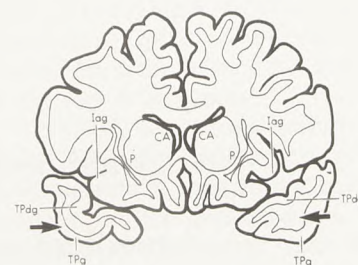
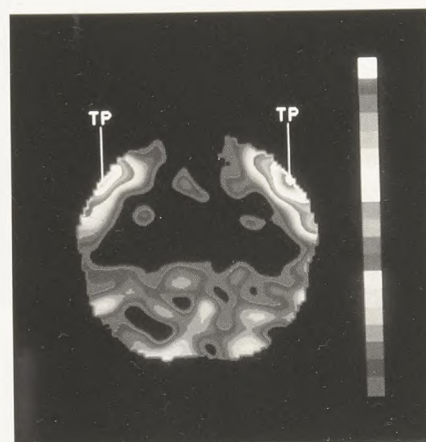
The investigators are even now pursuing one means of furthering that understanding of anxiety. "We're in the process of getting ready to look at this in people who have phobias," Raichle explains. "There are several reasons for this. If somebody who has an intense fear of a rat or a mouse gets an anxiety attack, is this also expressed in the same way? The other interesting thing is that you can only play this trick of threatening to shock their fingers once with normal people, so we get one shot at each person. But with people who have phobias, you can expose them to a mouse or a spider or something like that and they'll have the anxiety reaction, then you take it away, and the attack goes away, and then you bring it right back. This would allow us to make multiple measurements in the same person. We're fairly well along in designing those experiments."

"Some people might say, 'My God, you've been threatening to

shock people, now you're going to dangle a rat or a snake in front of them. What sort of nonsense is this?' But I think people have to keep this in perspective. In the case of a phobia, that's exactly how they're treated. It will allow us the opportunity to much more clearly define the exact areas that are involved, because if we can look at something repeatedly in the same person—we don't mean hundreds of times, but maybe four or five times—we can get a much more accurate fix on these areas than we can if we get just one measurement in a dozen, two dozen people. So that's kind of the next thing in line here."

*Ultimately,
Mallinckrodt
Institute researchers
are engaged in a
project much larger
than the study of
anxiety alone.*

Ultimately, of course, Mallinckrodt's researchers are engaged in a project much larger than the study of anxiety alone. "Eventually, we would like to dissect normal and abnormal psychological processes into their elementary mental operations and then relate them to specific regions of the brain," says Reiman. In this way we hope to learn precisely how the mind



Top photo: A PET image displays significant increases in blood flow in the bilateral temporal poles (TP) associated with anticipatory anxiety.

Above photo: Top: A bisected brain with the horizontal line representing a plane through the front and rear portions; the vertical line indicates the plane of a front section through the temporal poles. Bottom: Arrows show sites of maximal blood flow increases.

and brain are functioning. Our recent studies represent the first step in a long quest to determine exactly what's going on in these normal and abnormal forms of anxiety. We hope that our work will lead to better ways to treat and prevent anxiety disorders." □

Cliff Froehlich is a former managing editor of Focal Spot. He is currently senior editor of The Riverfront Times.



James Cheverud

Monkey

B U S I N E S S

A Colony of Primates
Helps Researchers Unlock the Brain's Secrets

By Regina Engelken

Bert and Amy Gleason are awaiting the results of daughter Jamie's pre-fourth grade medical exam. The doctor had performed the usual battery of tests, including one the Gleasons had not expected: a brain scan. "Don't worry," Dr. Johnson had assured them, "brain scans have become routine during the past few years. We don't expect any abnormal findings."

A few days later, the Gleasons receive the results. "Everything looks good," Dr. Johnson says, "but we did find some abnormalities in the brain scans that suggest Jamie could develop epilepsy when she gets older."

This scenario may be far-fetched for 1989; but although pioneering research into the brain's surface, shape and structure is only at a preliminary stage, investigators believe that brain scans in childhood could someday predict the onset of such conditions as epilepsy. Thanks to a study of rhesus monkey skulls from Cayo Santiago, an island off the coast of Puerto Rico, a team of scientists may be unlocking secrets long stored on the surface of the human brain.

"We have known for centuries that the brain's surface, or cortex, is grooved," says team member Michael W. Vannier, M.D., professor of radiology and director of the image processing laboratory at Mallinckrodt Institute of Radiology, "but we haven't known what the sulci, or grooves, indicate and whether their pattern is random or inherited. In the past, we had to wait for people to die or undergo brain surgery before we could study the surfaces of their brains."

Four years ago, when the monkey-brain study was started, "magnetic resonance imaging was not developed enough to show sulcal patterns in sufficient detail," Vannier says. "The pictures were too noisy—groove details were undecipherable. We have made major advancements in the past year."

In addition to early intervention measures, increased knowledge of brain morphology (shape and structure) could help surgeons remove brain tumors. "Certain functions are localized in specific areas of the brain," Vannier says. "If you are treating a brain tumor, determining the method of treatment depends entirely on the tumor location."

The team also includes Charles Hildebolt, Ph.D., assistant professor of diagnostic services, School of Dental Medicine, who is working in Vannier's laboratory, and James Cheverud, Ph.D., a geneticist at Northwestern University, who is joining the Washington University School of Medicine faculty this fall. Dean Falk, Ph.D., the team's leader, is professor of anthropology at the State University of New York, Albany. Their findings have been accepted for publication in the *Journal of Human Evolution*, *The American Journal of Physical Anthropology*, the *Journal of Heredity* and *Folia Primatologica*.

Because rhesus monkeys are primates and share a common evolutionary line with *Homo*

*"In the past, we had
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sapiens, they have been popular animals for behavioral and medical research into alcoholism, atherosclerosis, cancer, malaria, polio, salmonellosis and tuberculosis. Rh factor, the most complex of all human blood groups, was discovered in and named for the rhesus monkey.

The seeds of the current heritability study were planted in India in early fall, 1938, when sandy-colored Old World monkeys, all less than 2 feet tall, were loaded onto a ship for a voyage to the New World. The destiny of these young rhesus monkeys (*Macaca mulatta*), chosen for their breeding stock, was the primate colony of the School of Tropical Medicine, at Cayo Santiago.

Guardian of the monkeys sailing to Cayo Santiago was Clarence Ray Carpenter, a pioneering American psychologist studying mating patterns among primates in an effort to better understand the human female reproductive cycle. In the course of his research, Carpenter published several studies from the island before World War II intervened.

In 1956, behavioral scientist Stuart Altmann began tattooing the members of the prolific colony in order to keep genealogical records of mothers and their offspring. Now, generations later, the monkey colony population includes grandmothers, aunts, uncles, cousins and siblings. The rhesus monkeys have a female hierarchical structure; data on fathers are unavailable. In 1970, Donald Sade, Ph.D., professor of anthropology at Northwestern University, became chief scientist at the monkey colony and suggested collecting the bodies of monkeys as they died naturally and preserving the skeletal remains so researchers could determine which features of the skeletons were inherited. Sade worked with geneticist James Cheverud, then associate professor of anthropology in Sade's department.

Ten years later, anthropologist Dean Falk arrived in Puerto Rico to teach anatomy, and, shortly thereafter, she was asked to curate the skeletal collection.



Patti Gabriel

Michael W. Vannier, M.D.

Falk introduced yet another idea: making rhesus monkey endocasts (brain models cast inside the skull with latex) so detectable brain features could be matched with genetic data. She had previously made endocasts from skulls of primates in several museums, and had also studied endocasts from early hominids including the famous Taung child skull, which was discovered in 1924 in South Africa. During the Taung project, she worked with Vannier, who is renowned for his ability to apply his computer expertise to medical problems.

"I had an interest in brain evolution and I had already made endocasts in museums, so casting the Cayo Santiago collection of rhesus skulls seemed like an obvious thing to do," says Falk. For the first time in history, scientists had higher primate brain models that could be matched with genetic data to determine heritability and other factors. Falk was suddenly principal investigator of a pioneering, interdisciplinary research project.

"It is not unique to make a monkey-brain endocast," Vannier

says. "It is, however, unprecedented to also have an endocast from that individual's mother, siblings and other family members—so genetic similarities can be established—and endocasts from neighboring families for further comparison and contrast."

*"All tests of
repeatability passed
with flying colors."*

To assess reproducibility, Falk made two endocasts each of 15 monkey skulls by pouring melted latex into each skull. After the latex cooled and set, the resulting brain model was pulled out of

the skull through the neck region. Each endocast was painted gold, and the sulci were marked by a series of black dots.

Traditionally, sulci had been measured with a modern substance known commonly as "dental floss." Hoping to break through the low ceiling of sulci-measuring technology, Falk again called upon Vannier for his computer-engineering expertise. Vannier suggested a three-dimensional electromagnetic digitizer to measure points along the sulci and wrote computer software programs to string the points together and create 3-D images. The programs then interfaced with another software program—computer-aided design/computer-aided manufacturing (CAD/CAM).

Hildebolt had the dubious privilege of running the digitizer, which resembles a thick marker strung to a table, over the 15 double sets of endocasts and calculating sulcal lengths. Although his task sounds easy, it is painstaking. As a dentist, Hildebolt is trained to handle "the tedious, nitpicky task of making exceedingly precise measurements," Vannier says.

After making his calculations, Hildebolt then sent the endocasts to Falk's office, where they were wiped clean and redotted. Falk returned the redotted endocasts to Hildebolt for repeat measurements. All tests of repeatability passed with flying colors. The entire collection of 330 endocasts was then dotted and sent to Hildebolt for digitizing. The only remaining step was the analysis of the measurements by geneticist James Cheverud at Northwestern.

Through this painstaking course of research, the scientists were able to determine that some surface features of the brain are inherited, some vary between gender, and others differ on right and left sides. The study was the first clear demonstration in a non-human primate of heritability for certain morphological asymmetries in the right and left hemispheres of the brain, Cheverud says. This is important because similar asymmetries in human brains are associated with behaviors such as right-and-left handedness.

"We are just now developing the technology to answer questions that have intrigued us for centuries."

"Previously, we knew that humans had asymmetrical brains," Cheverud continues, "but we thought it was a special feature of humans because of language acquisition. We have found asymmetry in the rhesus monkey brain that has never been looked for in humans. Our findings also supported the use of rhesus monkeys as models in studies of brain lateralization of functions. That's important, because there are a lot of studies you can't do on people," he adds.

The team also showed for the first time that genetics can affect brain features. Previously, only brain size was studied, not specific regional features. "Thirty percent

of the differences in the brains were related to genetic factors," Cheverud says. "The rest were due to other non-inherited factors."

"The technology seemed obvious to me," Vannier says. "I kept insisting that the team had not searched the literature carefully enough. I thought this must have been done before. But the fact is, we are just now developing the technology to answer questions that have intrigued us for centuries."

In the next phase of the research, Falk will lead the same team in a study of inherited brain features in human twins, drawing from the extensive twin registry in Washington University School of Medicine's psychiatry department. Using non-invasive

Charles Hildebolt, Ph.D., uses the three-dimensional digitizer to trace the sulcal patterns of an endocast made from the skull of a rhesus monkey.

magnetic resonance imaging techniques developed by Vannier for heart studies, they will construct 3-D images, or maps, of human brains.

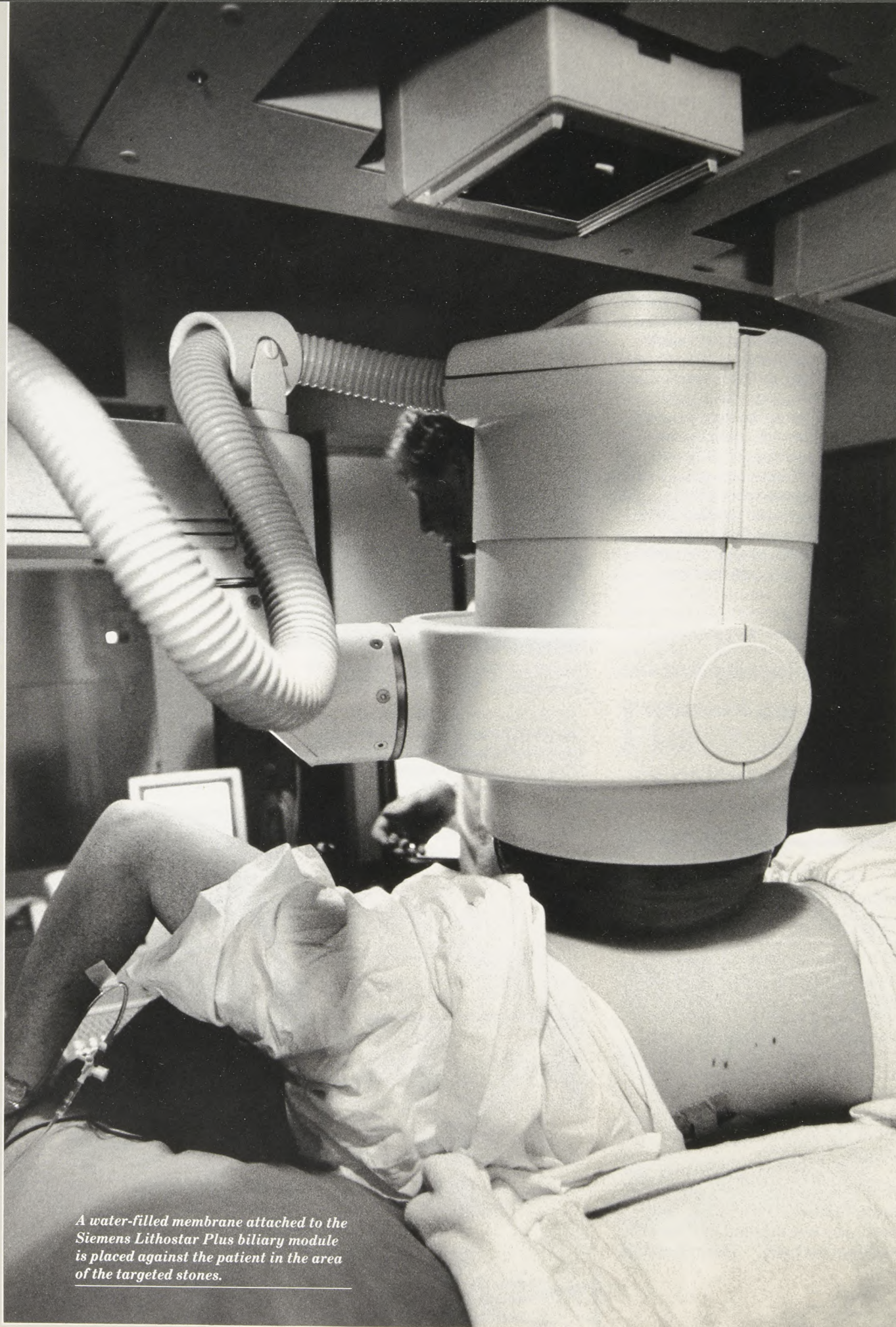
The team will study monozygotic (identical) twins and their parents. They expect to quantify the extent to which specific features (including asymmetries) of the human cortical surface are genetically determined.

Reflecting upon their success, Vannier says, "This work could eventually help us predict people at risk, such as schizophrenics, epileptics, and alcoholics, early enough to begin preventive treatment."

Falk attributes her team's success to the unique combination of scientists. "Everybody is very focused and able to synthesize within their own fields. I am amazed to see what has come from the seed of an idea that began with the rhesus monkey colony coming to Cayo Santiago." □



Patti Gabriel



A water-filled membrane attached to the Siemens Lithostar Plus biliary module is placed against the patient in the area of the targeted stones.

Patti Gabriel

SHOCKING GALLSTONES

A New Procedure
Offers a Non-Surgical Treatment for Gallbladder Disease

By Candace O'Connor

A year and a half ago, James Shepp felt a sharp twinge in his side. Maybe a touch of food poisoning, he thought, dismissing it. But six months later, the pain was back, even more intense and ominous. This time, he knew exactly what it was—his sister had been through the same thing a few years before.

Gallstones. Like Shepp, some 20 million Americans have them and a million new cases are reported annually in the U.S. Each year, about half a million people opt for surgical removal of their gallbladder, the small, bile-filled organ behind the liver that produces the painful stones. But James Shepp heard about a new investigational procedure called biliary lithotripsy, available since March on two machines at Mallinckrodt Institute of Radiology and Barnes Hospital. After pinpointing the stones with a built-in ultrasound probe, the lithotripter machine sends powerful shock waves into the gallbladder to pulverize the stones—without the need for surgery.

“It’s an exciting technology,” says Bruce L. McClennan, M.D., professor of radiology, “and will be a benefit for a select group of patients.”

SHOCKING GALLSTONES

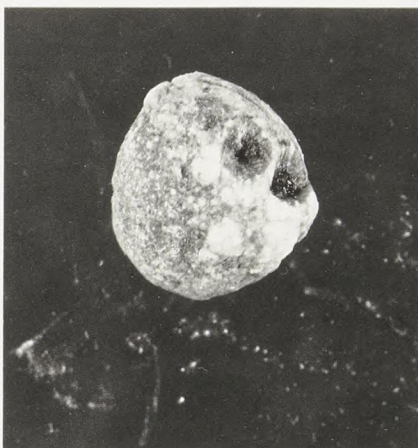
After his third gallbladder attack a few months ago, Shepp came to Washington University Medical Center to visit the newly created Gallstone Center, staffed by surgeons, radiologists and gastroenterologists from Barnes and Mallinckrodt Institute. Working within the guidelines of a Food and Drug Administration protocol, these physicians collaborate on evaluating and treating patients while determining the effectiveness of this new technology.

At the Center, Shepp underwent a series of X rays and ultrasound tests to determine whether he met the criteria for lithotripsy. To be eligible, he needed to have clear-cut symptoms, fewer than four stones from 0.5 to 3 cm. in diameter, stones that had not calcified, a gallbladder that could be targeted, a functioning gallbladder that could pass stone fragments out into his system,

Eventually, some 15 to 20 percent of gallstone patients will be candidates for biliary lithotripsy.

and no medical risk factors, such as liver disease or pancreatitis.

When Shepp learned he was a candidate, he felt delighted. "With surgery, you're looking at the possibility of six or eight weeks downtime, plus all the pain," says Shepp, a development technician



A gallstone is formed when cholesterol in the bile crystallizes.

Thomas Murry

who helps build simulator cockpits for McDonnell Aircraft Company." Here you're only talking about a day or two at most."

How Gallstones Develop

Nobody knows exactly why gallstones form, but the answer probably relates to different factors, including sex, diet, weight and genetics. Women develop them three times as often as men; societies or cultures that favor fatty or starchy foods tend to breed gallstones. Obesity and family history also seem to play a role.

Stones form in the gallbladder, the body's storehouse for bile produced by the liver to aid digestion. Occasionally, they also appear in the common bile duct, which links the liver and small intestine. Most are caused by cholesterol crystals in the bile, which crystallize to make stones.

A surgical procedure called a cholecystectomy removes the gallbladder, eliminating the place where the bile collects and stones form. Yet even with the advent of alternative treatments such as gallstone-dissolving drugs, shock waves delivered through a tube inside the body, endoscopic removal of the stones and laser-assisted gallbladder ablation, surgery remains the most widely accepted therapy.

Shepp's sister chose surgery after two excruciatingly painful gallstone attacks. Her operation was uncomplicated and successful. Yet she remembers several days of hospitalization and weeks of recovery before she was back to full strength.

Shepp himself had also been willing to undergo surgery if necessary. But not all patients feel that way. "Some patients will walk a hundred miles so they don't have to have an operation," says Nathaniel J. Soper, M.D., assistant professor of surgery at Washington University School of Medicine. "Lithotripsy is a patient-driven technology." In fact, the first patient treated on the Lithostar Plus at Mallinckrodt Institute was a 25-year-old woman who wanted to avoid a surgical scar and six weeks away from her job.

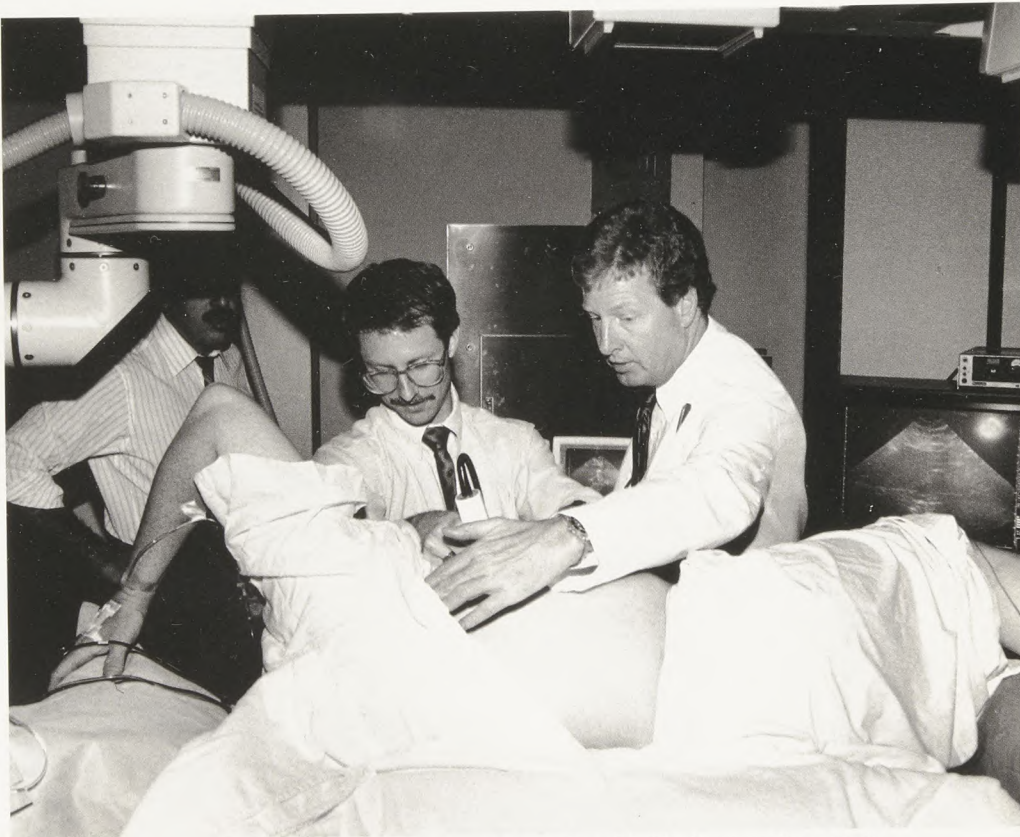
Ultimately, Soper says, some of the best candidates for lithotripsy may be older patients with medical problems that make surgery a significant risk. He estimates that eventually some 15 to 20 percent of gallstone patients will be candidates for this form of therapy. So far, Gallstone Center results have exceeded expectations. Physicians have screened over 80 potential lithotripsy patients and nearly one-third have qualified. Over a dozen have already been treated and others are being scheduled.

Performing the Procedure

At the Center, Shepp discovered just how lithotripsy works. A qualified patient is referred to one of two machines: the German-made Lithostar Plus, produced by Siemens A.G., which uses electro-magnetically-produced shocks to destroy gallstones; or the Northgate SD-3, powered by a large spark plug.

Shepp was assigned to the Lithostar Plus, originally designed to destroy kidney stones. An attachment, received March 1, adapts the machine for biliary use as needed. This machine, located on the third floor of Mallinckrodt Institute, is one of only six Lithostar Plus machines in the U.S. used to combat gallstones. Others are at the Mayo Clinic, the University of Texas Medical Branch at Galveston, Georgetown Medical Center, New England Deaconess Hospital and The Cleveland Clinic.

His treatment, an outpatient procedure, would take one or two hours and be virtually anesthesia-free. Analgesia is often not



Patricia Gabriel

required, but transcutaneous electrical nerve stimulator (TENS) electrodes are placed on the patient's back, knee and ankle to allay any possible discomfort.

A four-member team consisting of radiologist, surgeon or gastroenterologist, technologist and nurse conducts the treatment. First, they use a hand-held ultrasound scanner to target the stones and avoid nearby organs. Next they place against the patient a water-filled membrane attached to a movable biliary shock generation module; shock waves travel from the machine's generator through water and the skin to the targeted area—the gallstone.

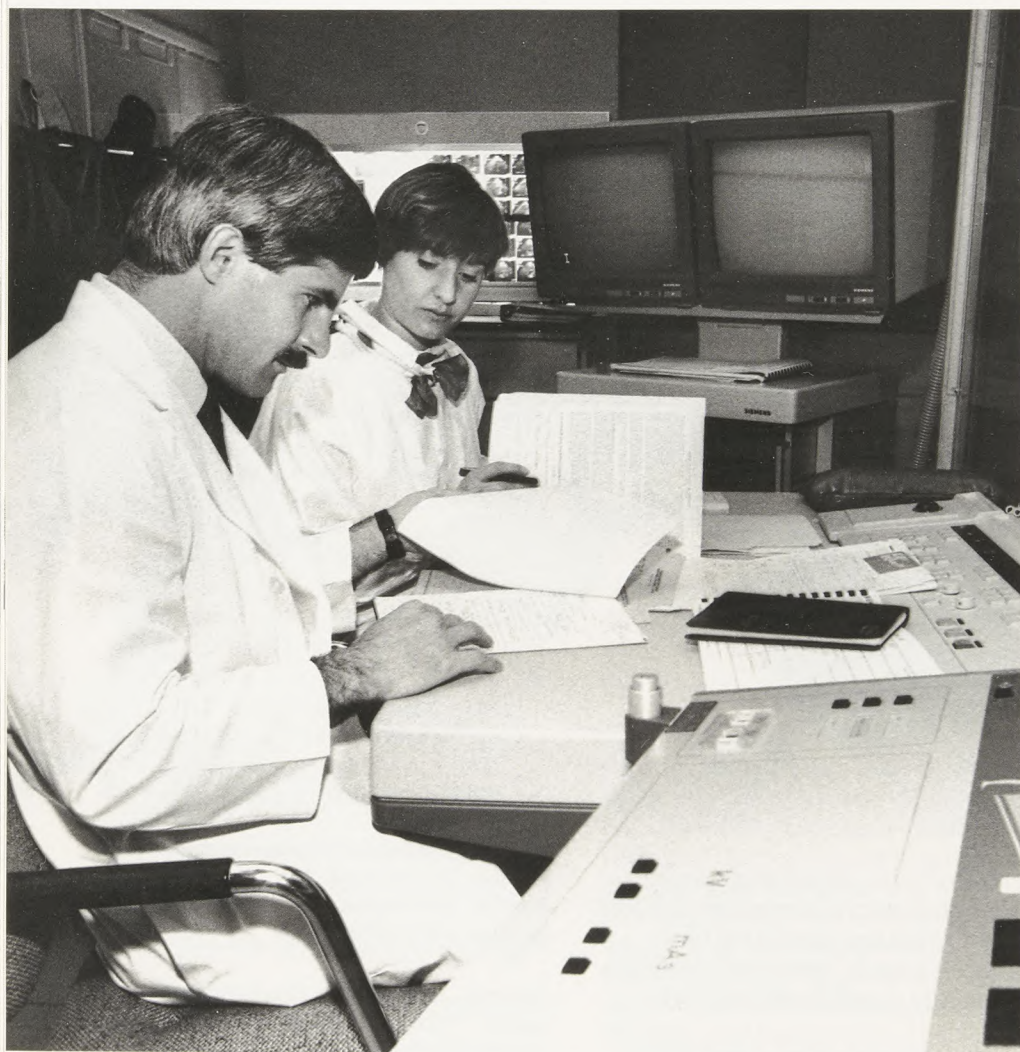
The Lithostar's ultrasound viewing screen shows the ongoing results as the stones, previously white points against a gray back-

Using a hand-held ultrasound scanner, William D. Middleton, M.D. (left) and Bruce L. McClennan, M.D. determine the location of the gallstones.

ground, respond to the bombardment. "You see the stone move and become less dense, more diffuse," says McClennan. "Then you see the fragments or the sludge and you know you've got it."

Gallstones, surrounded by liquid bile and highly movable, are harder to hit than kidney stones, which are lodged inside a kidney or ureter. They are also harder to shatter since gallstones are composed of rubbery cholesterol, while calcium-filled kidney stones are more brittle.

SHOCKING GALLSTONES



Seated at the Lithostar control console, Alyson Owensby, clinical research coordinator, and Nathaniel J. Soper, M.D. review James Shepp's medical history before treatment begins.

rates or statistics. Results have been "very encouraging," says McClennan. And the patients' responses? "Excellent," he says. "They are thrilled."

James Shepp is looking forward to an easier, more pain-free solution to the misery of gallstones

"We need to educate people about gallstones and let them know there are treatment possibilities that weren't available even five years ago."

than he had once expected. But more gallstone patients like him are needed to participate in the current protocols.

The answer lies in letting people know that the procedure and the Gallstone Center are available at the Washington University Medical Center, Soper says. "We need to educate people about gallstones and let them know there are treatment possibilities that weren't available even five years ago." □

The procedure usually ends when the team has applied the maximum number of shocks per treatment. If there is a very large stone or more than one stone, another treatment or two may be required. For several months, oral bile salts are given to the patient to dissolve stone fragments and to prevent recurrence. Follow-up ultrasound tests determine whether all stones have been eliminated.

Stones may eventually recur in some 30 to 50 percent of all

patients, in whom gallstones alone are destroyed, making surgical removal of the gallbladder a sound choice, especially among younger patients. It is not yet clear whether the recurrence rate will differ with lithotripsy patients.

But lithotripsy has its own advantages, McClennan says, including cost. While an uncomplicated cholecystectomy may run from \$12,000 to \$14,000, he says, expenses for an entire lithotripsy treatment may range from \$7,000 to \$9,000. To date, some insurance companies are willing to pay, while others will not.

Since the procedure is so new, it is too early to compile success

Patti Gabriel

FYI

THE DIRECTOR'S OFFICE REPORT

NEW STAFF

Thomas E. Herman, M.D., assistant professor of radiology, Division of Diagnostic Radiology

Jonas Singer, M.D., instructor in radiology, Division of Diagnostic Radiology

Jerry Tobler, M.D., instructor in clinical radiology, Division of Diagnostic Radiology

Franz J. Wippold II, M.D., assistant professor of radiology, Division of Diagnostic Radiology

OFF STAFF

Gregory S. Lannoye, Ph.D., research associate in radiology, Division of Radiation Sciences

Francisco Li-Aravena, M.S., research assistant in radiation physics, Division of Radiation Oncology

Balakrishna L. Lokeshwar, Ph.D., research associate in cancer biology in radiology, Division of Radiation Oncology

Thomas K. Pilgram, Ph.D., research associate in radiology, Division of Diagnostic Radiology

Klaus Sartor, M.D., associate professor of radiology, Division of Diagnostic Radiology

VISITING PROFESSORS & INVITED LECTURERS

Jeffrey J. Brown, M.D., assistant professor of radiology, spoke on "Magnetic Resonance Imaging: Current Status and Future Directions" at the Missouri Society of Medical Assistants Annual Meeting, St. Louis, April 15. As visiting professor, Brown presented lectures on "MR Imaging of the Body" and "Blood Flow Effects in MRI" at the University of Texas Health Sciences Center, San Antonio, April 17.

Judy M. Destouet, M.D., associate professor of radiology, presented "The Effect of Breast Implants on the Radiographic Detection of Microcalcifications and Soft Tissue Masses" at the 37th Annual Meeting of the Association of University Radiologists at the University of Washington, Seattle, May 21-25.

Bahman Emami, M.D., professor of radiology, spoke on "Interstitial Intracavitary Hyperthermia" and "Neck Nodes: Low Dose Radiation Plus Heat" at the Consensus Meeting on Clinical Hyperthermia in Cancer Treat-

ment, Trento, Italy, May 2-6. Emami presented "Treatment of Carcinoma of the Esophagus" and "Treatment Planning and Techniques in Irradiation of Lung and Esophagus" at the CME Conference-University of Minnesota, Minneapolis, May 17-19. He spoke on "Hyperthermia" at the 17th International Congress of Radiology, Paris, France, July 1-4. Emami spoke on "Technical and Methodological Aspects of Hyperthermia" and chaired a round table discussion on "Interstitial Hyperthermia Prospective" at the Second ODAM Seminar, Paris, France, July 5.

Mokhtar H. Gado, M.D., professor of radiology, presented "Principles of Interpretation of MR Images of the Brain" and "The Radiologic Approach to Evaluation of Low Back Pain" for the postgraduate course "Neuroradiology: MRI/CT of the Brain, Head, Neck & Spine and Basic Neurointerventional" at Columbia Presbyterian Medical Center, New York, April 11-15. Gado lectured on "Radiologic Evaluation of Back Pain and Sciatica," "Radiology of Cerebral Ischemia," and "Radiologic Evaluation of Hydrocephalus" for the Neuroradiology Review Course held at the Oak Brook Hills Hotel and Conference Center, Oak Brook, Illinois, April 29-30.

Louis A. Gilula, M.D., professor of radiology, co-organized the 5th International Wrist Investigators' Workshop, Paris, France, April 5, where he presented "Symptomatic Capsular Defects Seen at Arthrography." He spoke on "CT and 3-D of the Wrist," "Wrist Arthrography," and "MRI of the Wrist" at the Symposium on the Wrist, Paris, France, April 6-8. He also presented "Ligamentous Instabilities of the Wrist" at the Hospital Sainte Antoine, Paris, France, April 10. Gilula spoke on "Bone Biopsy" and "Static Instabilities of the Wrist" at the Veterans Administration Medical Center at the University of California, San Diego, May 26. He will present "Conventional Arthrography, General Aspects," "Radiologic Approach to Hand Problems," "Ligamentous Instabilities of the Wrist," and "Is This an Adequate Knee Arthrogram" at the University Hospital of Lund, Lund, Sweden, August 28-September 1.

Harvey S. Glazer, M.D., associate professor of radiology, spoke on "CT of the Mediastinum: Differential Diagnosis" and "Pitfalls in Mediastinal CT" at the Twelfth Annual Meeting of the Society of Computed Body Tomography, Washington, D.C., April 10-14. In collaboration with **Stuart S. Sagel, M.D.**, Glazer presented a refresher course on "CT of the Mediastinum with MRI Correlation" at the 89th Annual Meeting of the American Roentgen Ray Society, New Orleans, May 7-12.

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VISITING PROFESSORS & INVITED LECTURERS

Jay P. Heiken, M.D., associate professor of radiology, presented "CT Evaluation of the Ileo-anal Pouch after Colectomy" at the Twelfth Annual Meeting of the Society of Computed Body Tomography, Washington, D.C., April 10-14. As part of this meeting, he also gave a course lecture on "Diffuse Parenchymal Disease of the Liver: CT and MRI" and a workshop presentation on "CT and MRI of the Retroperitoneum." Heiken presented "Detection of Liver Metastases" and "CT of the Gastrointestinal Tract: Selected Applications" at the Kansas State Radiological Society Meeting, Lawrence, Kansas, May 6.

R. Gilbert Jost, M.D., professor of radiology, presented "Networking-Clinical Perspective" at the 5th Conference on Digital Radiology and Networking in Kansas City, Missouri, April 23-26.

Joseph K. T. Lee, M.D., professor of radiology, lectured on "CT/MRI of Pancreatic Neoplasms," "Pancreas: Normal CT Anatomy," and "Computed Tomography of the Biliary Tract" at the Caribbean Gastrointestinal Society, March 17-18. He spoke on "MRI of Kidney and Adrenal" and "MRI of Heart and Great Vessels" at the Computed Body Tomography Society Postgraduate Course,

April 10-14. As visiting professor, he spoke on "MRI of Liver with Special Emphasis on Proton Spectroscopic Imaging" and "MRI of Female Pelvis" at Columbia University, New York, April 12-13. He discussed "Retroperitoneal Disease" for the Uroradiology Categorical Course at the 89th Annual Meeting of the American Roentgen Ray Society, New Orleans, May 7-12. As a member of the faculty, he will give a presentation on "MRI of the Retroperitoneum," "MRI of the Male Pelvis," "MRI of the Female Pelvis," and "MRI of Hematomas and Fibrosis" at the Annual Emory University Imaging Conference, Amelia Island, Florida, August 14-19.

Bruce L. McClennan, M.D., professor of radiology, presented "ESWL Renal and Biliary," "LOCM—Update 1989," and "CT of Indeterminate Renal Masses" at the Texas Radiological Society meeting, Galveston, April 6-9. He presented "Acute Renal Infections" for the categorical course in uroradiology at the 89th Annual Meeting of the American Roentgen Ray Society, New Orleans, May 7-12. McClennan lectured on "Contrast Media—Practical Approaches" and "Lithotripsy—From Kidney to Biliary" at the International Special Procedures Course, Chicago, May 16-17. He also lectured on "Contrast Enhancement Techniques in Body CT" at a CT course for radiologic technologists in Lake Ozark, Missouri, June 15. McClennan presented a lithotripsy lecture entitled "ESWL—Renal and Biliary—Medical Aspects" at the National Science Foundation

Workshop on Mathematics, University of Missouri, St. Louis, June 30. As vice-chairman of the Intersociety Commission of the American College of Radiology, he will participate in the annual summit meeting entitled "Professional Relationships in Radiologic Practice: Cooperation or Competition?," Park City, Utah, August 5-8.

M. Victoria Marx, M.D., assistant professor of radiology, spoke on "Radiologic Intervention for the Acute GI Hemorrhage" at the St. Louis Society for Critical Care Medicine, St. Louis, June 13.

G. Leland Melson, M.D., professor of radiology, spoke on "Color Doppler Sonography: Basic Principles and New Applications" at a meeting of the St. Louis Area Sonographers, St. Louis, April 20.

Tom R. Miller, M.D., Ph.D., associate professor of radiology, spoke on "Three-Dimensional Filtering and Display" at the annual meeting of the Eastern Great Lakes Chapter of the Society of Nuclear Medicine, Niagara Falls, Canada, April 28-29.

William A. Murphy, Jr., M.D., professor of radiology, moderated a scientific program, "Skeletal Radiology I," with Raymond A. Gagliardi, M.D. at the 89th Annual Meeting of the American Roentgen Ray Society, New Orleans, May 9.

Daniel Picus, M.D., assistant professor of radiology, presented "Thrombolytic Therapy" at the University of Washington, Seattle, March 28-29. He lectured on "New Technologies for the Nonsurgical Treatment of Peripheral Vascular Disease" at Medical Grand Rounds, Washington University School of Medicine, St. Louis, April 1989. In collaboration with **M. Victoria Marx, M.D.** and **Bruce L. McClennan, M.D.**, Picus presented "Intracorporeal Electrohydraulic Lithotripsy for the Management of Biliary Stone Disease" at the Second International Symposium on Biliary Lithotripsy, Vancouver, British Columbia, Canada, April 23-26. In addition, he presented "Introduction to Guidewires and Catheters for Use with Flexible Endoscopy" for the course and laboratory session on "Frontiers in Endosurgery: Flexible Endoscopy and Endosurgical Techniques" at Washington University School of Medicine, St. Louis, June 1989.

James A. Purdy, Ph.D., professor of radiation physics in radiology, presented "Three-Dimensional Treatment Planning in Radiotherapy" at the Texas Radiological Society Meeting, Galveston, April 7.

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Joseph L. Roti Roti, Ph.D., professor of cancer biology in radiology, lectured on "Effects of Heat on Nuclear Protein," at the Institute of Biophysics and Radiobiology, University of Hamburg, West Germany, May 18. He spoke on "Mechanisms of Heat and Radiation Interactions," at the Institute for Medicine, Strahlenphysik and Strahlenbiologie, University of Essen, Essen West Germany, May 16. Roti Roti presented "Mechanisms of the Interaction of Hyperthermia and Radiation" at a symposium sponsored by the Committee of Medical Physics of the Polish Academy of Science, Warsaw, Poland, May 9. In addition he gave the same talk at the Institute for Molecular Biology, Jagiellonian University, Krakow, Poland, May 11. He presented "Mechanisms for Heat-Induced Cell-Killing" at the Norwegian Radium Hospital, Department of Biophysics, Oslo, Norway, May 22. At the State University of Groningen, The Netherlands, Roti Roti presented "Mechanisms of Heat and Radiation Interactions," May 23, and was an outside examiner for the Ph.D. defense of Harry Kampinga on May 26.

Stuart S. Sagel, M.D., professor of radiology, spoke on "CT of Asbestos-Related Pleural Disease" at the Society of Computed Body Tomography meeting, Washington, D.C., April 10-14. He presented "CT of the Pleura," "CT of Abdominal Lymphadenopathy," and "CT of the Adrenal" at a course on Advances in CT and MRI at the University of Michigan, Ann Arbor, April 26-28. Sagel, in conjunction with **Harvey S. Glazer, M.D.**, presented a refresher

course on "CT of Mediastinum with MRI Correlation" at the 89th Annual Meeting of the American Roentgen Ray Society, New Orleans, May 7-12.

Marilyn J. Siegel, M.D., professor of radiology, spoke on "MRI of Pediatric Bone Marrow" at the Society for Pediatric Radiology Meeting, San Antonio, Texas, April 6-9. She presented "CT of the Pediatric Mediastinum," "CT of the Pediatric Pelvis," and "Bone Marrow Imaging," at the Society of Computed Body Tomography in Washington, D.C., April 10-14. She also organized the "Case of the Day" exhibit at the 89th Annual Meeting of the American Roentgen Ray Society, New Orleans, May 7-12.

Eric D. Slessinger, M.S., instructor in radiation physics in radiology, presented "Clinical Low Dose Rate Remote Afterloading" at the 1989 CMS Monulex Users Group meeting, Mallinckrodt Institute of Radiology, St. Louis, April 28. As lecturer and workshop co-leader, he presented "Quality Assurance for Low Dose Rate Remote Afterloading Devices" at the Remote Afterloading: State of the Art Brachytherapy meeting, Dearborn, Michigan, May 6.

Yvonne C. Taylor, Ph.D., assistant professor of cancer biology in radiology, presented a poster entitled "Cell Shape as a Mediator of Radiation Sensitivity" at the 37th Annual Meeting of the Radiation Research Society, Seattle, Washington, March 18-23.

Patrick R. M. Thomas, M.D., associate professor of radiology, presented "Adjuvant Radiotherapy and Chemotherapy in Carcinomas of the Stomach, Pancreas and Rectum: Data of GITSG" at the Rothenberg International Symposium of Radiotherapy and Chemotherapy, Erlangen, West Germany, June 21-24.

Michael W. Vannier, M.D., professor of radiology, presented "3D-Display in Surgical Planning" at the Institut fur Mathematik and Datenverarbeitung in der Medizin, Hamburg, West Germany, June 29. He also spoke on "Visualization of Volumetric Information" at The Optical Society of Greater St. Louis, St. Louis, July 18.

Jerold W. Wallis, M.D., assistant professor of radiology, presented "Production of Three-Dimensional Displays by Surface and Volume Rendering in Nuclear Medicine" at the National Computer Graphics Association meeting, Philadelphia, Pennsylvania, April 19. He presented "Three-Dimensional Display in Nuclear Medicine" at the 24th Annual Meeting and Exposition of the Association for the Advancement of Medical Instrumentation, St. Louis, May 15.

Michael J. Welch, Ph.D., professor of radiation chemistry in radiology, co-chaired a session on "PET Neuropharmacology: Other Neurotransmitters Systems" and spoke at the public round table session "PET Based Human Neuropharmacology" at the First San Raffaele PET Workshop: Neuroreceptors, Milano, Italy, April 24-26. As honorary president and invited speaker, Welch presented a review lecture on "Positron Emission Tomography—Present Status and Future Perspectives" at the Fifth Symposium on the Medical Application of Cyclotrons, Turku, Finland, May 31-June 3. In addition, he lectured on "Imaging Techniques with Chelates of Indium and Gallium" at the Fourth International Conference on Bioinorganic Chemistry (ICBIC-4), Cambridge, Massachusetts, July 24-28. Welch will present "Clinical Prospects of New Radiolabelled Agents in PET" at the Fifth European Conference on Clinical Oncology, London, England, September 6.

Anthony J. Wilson, M.D., assistant professor of radiology, presented "Imaging the Shoulder" at the Greater St. Louis Society of Radiologists, St. Louis, March 21. He also presented "Imaging the Knee" at the 89th Annual Meeting of the American Roentgen Ray Society, New Orleans, May 7-12. He will lecture on "Musculoskeletal MRI" at Charles E. Still Hospital Continuing Education, Jefferson City, Missouri, September 14.

FYI

SYMPOSIA

SOCIETY OF NUCLEAR MEDICINE

The following Mallinckrodt Institute staff members participated in the Thirty-sixth Annual Meeting of the Society of Nuclear Medicine, St. Louis, June 13-16.

ORAL PRESENTATIONS

Andrea H. McGuire, M.D.; **Alan P. Lyss, M.D.;** **James W. Brodack, Ph.D.;** **Mark A. Mintun, M.D.;** **Carla J. Mathias, B.A.;** **Barry A. Siegel, M.D.;** **John A. Katzenellenbogen, Ph.D.*;** and **Michael J. Welch, Ph.D.,** "Positron Tomographic Assessment of 16- α -[F-18]-Fluoroestradiol (FES) Uptake in Metastatic Breast Carcinoma: Effect of Anti-estrogen Therapy." *Department of Chemistry, University of Illinois, Urbana.

Marc E. Shelton, M.D.; **Mark A. Green, Ph.D.*;** **Carla J. Mathias, B.A.;** **Michael J. Welch, Ph.D.;** and **Steven R. Bergmann, Ph.D., M.D.** "Microsphere-like Retention in Isolated Hearts of Copper-PTSM: A Potential Generator Produced Tracer for Measuring Blood Flow with PET." *School of Pharmacy, Purdue University, West Lafayette, Indiana.

Marc E. Shelton, M.D.; **Mark A. Green, Ph.D.*;** **Carla J. Mathias, B.A.;** **Carla J. Weinheimer, B.S.;** **Howard L. James, B.S.;** **Michael J. Welch, Ph.D.;** and **Steven R. Bergmann, Ph.D., M.D.,** "Measurement of Regional Blood Flow Using Copper-PTSM and Positron Emission Tomography (PET)." *School of Pharmacy, Purdue University, West Lafayette, Indiana.

Stephen M. Moerlein, Ph.D.; **Allan Daugherty, Ph.D.;** and **Michael J. Welch, Ph.D.,** "GA-68 DTPA-VLDL: A Potential Radiopharmaceutical for PET Quantitation of Tissue Low-Density Lipoprotein Receptor Activity."

Marc E. Shelton, M.D.; **Carmen S. Dence, M.S.;** **Dah-Ren Hwang, Ph.D.;** **Michael J. Welch, Ph.D.;** and **Steven R. Bergmann, Ph.D., M.D.,** "Enhanced Extraction of [F-18] Fluoromisonidazole by Jeopardized Myocardium Assessed with PET."

Carla J. Mathias, B.A.; **Yizhen Sun, Ph.D.*;** **Michael J. Welch, Ph.D.;** **Judith M. Connett, Ph.D.;** **Gordon W. Philpott, M.D.;** and **Arthur E. Martell, Ph.D.*,** "Br- ϕ -HBED: An Improved Bifunctional Chelate for Radiolabeling Antibodies." *Department of Chemistry, Texas A & M University, College Station.

Sue L. Madsen, M.A.; **Michael J. Welch, Ph.D.;** **Christopher J. Bannochie, B.A.*;** **Arthur E. Martell, Ph.D.*;** and **Michael Brown, research lab technologist,** "In-vitro/In-vivo Behavior of EHPG Complexes with Metal Ions." *Department of Chemistry, Texas A & M University, College Station.

Carla J. Mathias, B.A.; **Michael J. Welch, Ph.D.;** **Mark A. Green, Ph.D.*;** **Andrea H. McGuire, M.D.;** **David J. Perry, C.N.M.T.;** **Marcus E. Raichle, M.D.;** **Lennis L. Lich, B.A.;** and **Kurt R. Zenn, D.V.M., M.S.**,** "PET Cerebral Blood Flow Imaging with Copper-labeled-PTSM." *School of Pharmacy, Purdue University, West Lafayette, Indiana; **University of Missouri, Columbia.

Stephen R. Moerlein, Ph.D.; **David Parkinson, Ph.D.;** and **Michael J. Welch, Ph.D.,** "Preparative Synthesis of High Effective Specific Activity I-123 SCH-23982 for D-1 Receptor-based SPECT Studies."

Martyn G. Pomper, B.S.*; **Monica J. Kochanny, fellow in Department of Chemistry*;** **Andrea M. Thieme, undergraduate student*;** **Kathryn E. Carlson, M.S.*;** **Henry F. van Brocklin, M.S.;** **Carla J. Mathias, B.A.;** **Michael J. Welch, Ph.D.;** and **John A. Katzenellenbogen, Ph.D.*,** "Imaging Agents for Brain Corticosteroid Receptors: Synthesis and Tissue Distribution of Fluorine-18 Substituted Corticosteroids." *Department of Chemistry, University of Illinois, Urbana.

Henry F. van Brocklin, M.S.*; **Martyn G. Pomper, B.S.*;** **Carla J. Mathias, B.A.;** **John A. Katzenellenbogen, Ph.D.*;** and **Michael J. Welch, Ph.D.,** "17 α -Ethinyl-11 β -Substituted, Fluorine-18 Labeled Estrogens Improved PET Imaging Agent." *Department of Chemistry, University of Illinois, Urbana.

Paul L. Chesis, B.A., and **Michael J. Welch, Ph.D.,** "Sex Dependent Differences in N-3-(F-18)-Propyl Deprenorphine Distribution and Metabolism."

POSTER PRESENTATIONS

Robert P. Quarles, M.D.; **Mark A. Mintun, M.D.;** **Kenneth B. Larson, Ph.D.;** and **Marcus E. Raichle, M.D.,** "Dynamic Modeling with 0-15-Water and C-11-Butanol for Quantitation of CBF with PET."

Stephen M. Moerlein, Ph.D.; **Michael J. Welch, Ph.D.;** **Carla J. Mathias, B.A.;** **Gregory S. Lannoye, Ph.D.;** **Lennis L. Lich, B.A.;** and **Marcus E. Raichle, M.D.,** "Single-Pass Extraction of I-123 Labeled Amines in Primate Brain."

Michael J. Welch, Ph.D.; **Carla J. Mathias, B.A.;** **James W. Brodack, Ph.D.;** **Henry F. van Brocklin, M.S.;** and **John A. Katzenellenbogen, Ph.D.*,** "Tamoxifen Therapy and In Vivo Determination of Estrogen Receptor Concentration with ¹⁸F-16 α -Fluoroestradiol-17 β (FES)." *Department of Chemistry, University of Illinois, Urbana.

FYI

APPOINTMENTS/ ELECTIONS

Dennis A. Moore, Ph.D.; **Ramunas J. Motekaitis, Ph.D.*;** **Arthur E. Martell, Ph.D.*;** and **Michael J. Welch, Ph.D.,** "A New Amino-thiol Ligand for Radiopharmaceutical Use with Indium and Gallium."
*Department of Chemistry, Texas A & M University, College Station.

Stephen M. Moerlein, Ph.D.; **Gregory S. Lannoye, Ph.D.;** and **Michael J. Welch, Ph.D.,** "No-carrier-added Radiosynthesis of I-123 Labeled SPECT Cerebral Perfusion Agents."

Stephen M. Moerlein, Ph.D.; **Gregory S. Lannoye, Ph.D.;** **Dah-Ren Hwang, Ph.D.;** and **Michael J. Welch, Ph.D.,** "No-carrier-added Synthesis of ω -(F-18) Fluoropropyl Preclamol: A Potential Radiopharmaceutical for Mapping Cerebral Sigma Opiate Receptors."

Stephen M. Moerlein, Ph.D.; **Gregory S. Lannoye, Ph.D.;** and **Michael J. Welch, Ph.D.,** "No-carrier-added Synthesis of N- ω -(F-18) Fluoroethyl SCH-23390: A Potential Agent for Mapping Cerebral Dopamine D-1 Receptors."

NORTH AMERICAN HYPERTHERMIA GROUP

The following Mallinckrodt Institute staff members participated in the North American Hyperthermia Group 1989 Hyperthermia School: Clinical Aspects of Hyperthermia, St. Louis, June 12-16.

PRESENTATIONS

Robert J. Myerson, Ph.D., M.D., "Clinical Experience with Deep Hyperthermia."

Bahman Emami, M.D.; **Carlos A. Perez, M.D.;** **John Konefal, M.D.;** **Robert J. Myerson, Ph.D., M.D.;** **Leonid Leybovich, M.S.;** and **William Straube, B.S.,** "Thermo-radiography of Malignant Melanoma."

Bahman Emami, M.D.; **Carlos A. Perez, M.D.;** **Robert J. Myerson, Ph.D., M.D.;** **Victor A. Marcial-Vega, M.D.;** **William Straube, B.S.;** **Debra Von Gerichten, R.N.;** **Leonid Leybovich, M.S.;** **Seymour Fox, Ph.D.;** and **Mary A. Lockett, M.B.A.,** "Irradiation and External Hyperthermia in Treatment of Head and Neck Cancer."

Gilbert H. Nussbaum, Ph.D., "Fundamental Concepts of Electromagnetic Heating."

Andrei Laszlo, Ph.D., "Heat Shock Proteins and Thermotolerance."

Carlos A. Perez, M.D.; **Bahman Emami, M.D.;** **Robert R. Kuske, M.D.;** **Ned Hornback, M.D.*;** **Thomas Pajak, M.D.*;** and **Pedro Kasdorf, M.D.**,** "Irradiation and Hyperthermia in the Treatment of Recurrent Carcinoma of the Breast in the Chest Wall MIR and RTOG Experience."

*Radiation Therapy Oncology Group, Philadelphia; **Consultorio de Oncologia y Radioterapia, Montevideo, Uruguay, South America.

Carlos A. Perez, M.D., "Clinical Cooperative Studies with Local External Irradiation and Hyperthermia."

Joseph L. Roti Roti, Ph.D., "Biological Basis of Hyperthermia."

Bahman Emami, M.D., professor of radiology, was elected to a two-year term as Councilor in Medicine, and to a one-year term as chairman of the Educational Committee of the North American Hyperthermia Group.

Louis A. Gilula, M.D., professor of radiology, was appointed chairperson of the Ad Hoc Advisory Committee on Convention Planning for the International Skeletal Society. He was also appointed a member of the Awards and Future Planning committees of the International Skeletal Society. Gilula served as co-chairman of the Sixth International Wrist Investigators Workshop held in California on May 15.

Jay P. Heiken, M.D., associate professor of radiology, was appointed to the Credentials and Membership Committee at the annual meeting of the Society of Computed Body Tomography in Washington, D.C., April 9-14.

William H. McAlister, M.D., professor of radiology, was elected second vice-president of The Society for Pediatric Radiology. He will assume the presidency at the annual meeting in Stockholm, Sweden, in 1991.

Daniel Picus, M.D., assistant professor of radiology, was appointed editor of the *Society of Cardiovascular and Interventional Radiology Newsletter*.

James A. Purdy, Ph.D., professor of radiation physics in radiology, was reappointed vice-chairman of the American Board of Medical Physics.

Joseph L. Roti Roti, Ph.D., professor of cancer biology in radiology, was named co-chairperson of the Local Arrangements Committee for 1990 in addition to being appointed to the Journal Committee of the Cell Kinetics Society. He was appointed to the National Institutes of Health Reviewers Reserve for 1989-1993.

Larry D. Schertz, M.D., chief resident in diagnostic radiology, was elected chairman of the American Association of Academic Chief Residents in Radiology for 1989-90 at the Association of University Radiologists meeting, Seattle, Washington, May 21-25.

Donald R. Stone, CPA, business manager for the Department of Radiology, was elected president of the Greater St. Louis Chapter of the Healthcare Financial Management Association.

Michael J. Welch, Ph.D., professor of radiation chemistry in radiology, was appointed to a one-year term as chairperson of the Diagnostic Radiology Study Section for the Department of Health and Human Services, National Institutes of Health.

FYI

TECHNOLOGIST NEWS

Donald R. Bernier, C.N.M.T., R.T., chief technologist, has been reappointed a member of the Committee on Nuclear Medicine Technology of the Commission on Human Resources, American College of Radiology.

Sharon Albertina, R.T., technical supervisor, was reappointed a Technologist Representative to Mallinckrodt's Radiography Program Advisory Committee for 1989.

Lori Brooks, senior radiography student, was appointed Student Representative to Mallinckrodt's Radiography Program Advisory Committee for 1989.

Cynthia K. Daniels, R.T., B.S., was promoted to the position of Assistant Program Director in Radiography effective March 1.

Jo Ann Johnson, A.R.T., medical coder, was elected secretary of the Missouri State Tumor Registrars Association.

Michael Kleinhoffer, R.T., special procedures technologist, was appointed Technologist Representative to Mallinckrodt's Radiography Program Advisory Committee for 1989.

Johnnie B. Moore, R.T., B.S., was promoted to the position of Radiography Program Director effective February 1.

Pat Sheeley Piatchek, A.R.T., assistant coordinator for medical records, was elected parliamentarian of the Missouri State Tumor Registrars Association.

Michael D. Ward, R.T., M.Ed., chief technologist and director of technical education, has entered the Ph.D. program in academic administration at St. Louis University.

Marguerite C. Schneider in memory of Richard J. Dammkoehler

Joan Harlan

Sara Winburn and Joe Nearn in memory of Houston Baxter Winburn

Vina S. Eggers and Samuel and Melba Eggers in memory of Houston Baxter Winburn

Margaret Sachs

Mr. and Mrs. Steve Collison in memory of Eleanor Sipes

Mr. and Mrs. David Morotz, Erican and Bryan in memory of Henry Hennenhoefer

Robert Blatz and family in memory of William J. Blatz

Mr. and Mrs. Louis Clark in memory of Judy Reedy

Kirkwood Lodge #484 A.F. & A.M. in memory of Maurice C. White

Elizabeth Szczepan in memory of Lowell Stambaugh

Judith R. Hanners in memory of Ruth Collier

Mary T. Kessler in memory of Ruth Collier

Dorothy M. Kampe in memory of Ruth Collier

Mr. and Mrs. Russell Pfeifle in memory of Howard Pickering

The Staff of Salon Christa in memory of Ben Smith

Mr. and Mrs. Odell Frye in memory of Vincent Hable

Betty Meeks in memory of Ann Wurth

Laurie A. Walters in memory of Ann Wurth

Linda M. Bober in memory of Ann Wurth

Frederick Hermann

Margaret A. Kiefer

Mr. and Mrs. Gary Rosenthal in memory of Sue Brotherton

Neal J. and Joan P. Farrell Foundation

Virginia and Edwin Wheeler in memory of Kristen Dietz

Mr. and Mrs. F. A. Hermann in memory of Louis Hager

Ceiling Components and Implant Offices in memory of Delbert Inman

Crestwood-Sunset Hills Welcome Wagon in memory of Kay Smith

Sylvia Schachter in memory of Anna Dubinsky

Defense Contract Audit Agency McDonnell Aircraft Company in memory of Laura E. Andre

Mrs. Edward J. Schnuck in memory of Barbara A. O'Leary

CIC NEWS

The Cancer Information Center is cosponsored by the Mallinckrodt Institute of Radiology and the Barnard Free Skin and Cancer Hospital at the Washington University Medical Center.

CONTRIBUTIONS

Dr. and Mrs. Earl E. Shepard in memory of Mrs. Roy Gross

Mr. and Mrs. Kenrick Jones in memory of Mrs. Miriam Rose

Mr. and Mrs. Ben Cohen in memory of Sophia Crystal

Mr. and Mrs. David E. Bret in memory of Michael Bret Rennie De Penaloza in memory of Connie Foley

Mr. and Mrs. James Grevas in memory of Louis Shiska

Theresa Cissell and Mr. and Mrs. Tom Burkhart in memory of Ann Wurth

CALENDAR

April 6-9, 1989

Texas Radiological Society
Galveston, Texas

April 15-19, 1989

American Radium Society
Annual Meeting
St. Thomas, U.S.
Virgin Islands

April 23-26, 1989

Second International
Biliary Lithotripsy
Symposium
Vancouver,
British Columbia

April 23-26, 1989

Digital Radiology and
Networking Conference
Kansas City, Missouri

FYI



Mallinckrodt Institute's eighth floor is being transformed into an interventional radiology center more comprehensive than any that exists anywhere else in the country. Workers have carefully laid down lead shielding in the floor, and soon after these photos were made, the walls went up.

Steve Kohler

May 6-12, 1989
American Roentgen Ray Society
New Orleans, Louisiana

May 21-23, 1989
American Society of Clinical Oncology
San Francisco, California

May 21-25, 1989
37th Annual Meeting of the Association of University Radiologists
Seattle, Washington

May 26, 1989
Probstin Oncology Lecture
Mallinckrodt Institute of Radiology
St. Louis, Missouri

June 5-10, 1989
American Board of Radiology Oral Examination
Louisville, Kentucky

June 12-16, 1989
1989 NAHG Hyperthermia School
St. Louis, Missouri

June 13-16, 1989
Society of Nuclear Medicine
St. Louis, Missouri

June 27-30, 1989
Gilbert H. Fletcher Society
Boston, Massachusetts

July 2-7, 1989
International Congress of Radiology
Paris, France

July 16-18, 1989
Radiation Therapy Oncology Group
Philadelphia, Pennsylvania



Steve Kohler

REFLECTIONS

H E N R Y D . R O Y A L , M . D .

The costs for cleanup of nuclear waste from the nuclear weapons industry is estimated at \$200 billion nationwide. Responsible environmentalists and public health guardians know it is important not only to bring environmental and health problems to the attention of the public and the government, but also to ensure that the amount of money spent on a problem is appropriate to its severity.

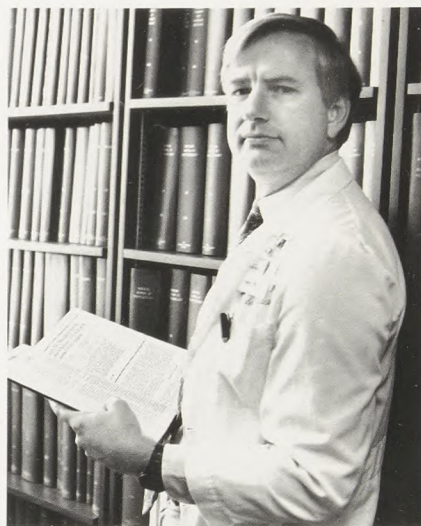
How much is the correct amount of money to spend on the nation's nuclear waste problem? The answer depends upon the available resources, an estimate of the risk, and the likely cost and effectiveness of the proposed solution. Sadly, these considerations rarely play a major role in decision-making when it involves nuclear waste. Fear and politics dominate the decision-making process.

The public is erroneously told that considerable scientific controversy surrounds the health effects of low levels of radiation. All scientists agree that high doses of radiation cause cancer and that radiation is a weak carcinogen.

Despite enormous radiation exposures, it is still 20 times more likely that a cancer occurring in an atomic bomb survivor is due to natural causes than to radiation. Contrast these effects with those of a much more potent carcinogen—smoking. If a smoker develops lung cancer, it is 20 times more likely that the cancer is due to smoking than to natural causes.

Since the effects of low levels of radiation are too small to measure directly (despite exhaustive study), scientists do not all agree about the exact risk, if any. Unfortunately, this disagreement has been irrelevant to the decision-making process since fear and politics, not risk estimates, make policy.

Sweeping generalizations about the risks to the public from nuclear waste is difficult since



Patti Gabriel

potential risks to the public will vary from site to site. However, a few truths are evident.

First, radiation is everywhere. Knowing that radioactive elements are present is not sufficient information to predict their threat to the public. We must know the method of exposure, the amount of exposure, and the chemical and physical form of the radioactive waste.

Second, we treat the risks from radioactive waste much differently than risks from other non-radioactive sources. Driving and the use and abuse of tobacco, alcohol and drugs affect the health of our children much more than exposure to radioactive waste.

Third, we view radiation exposure to different sources differently. The average radiation exposure of the U.S. population to radon in their homes is at least 200 times greater than the average radiation dose from nuclear waste. Ironically, the cost effectiveness of radon abatement programs (which are simple and effective) are questioned while the cost effectiveness of nuclear waste policies (which are complicated and less effective) goes unchallenged.

The fact that so few anti-nuclear activists are expressing much concern about the radon problem is one indication of the political nature of the nuclear waste problem. Clearly, if the

health of the U.S. population were their true concern, activists would be up in arms about the radon problem. Two political factors have influenced their choice of nuclear waste as a battlefield.

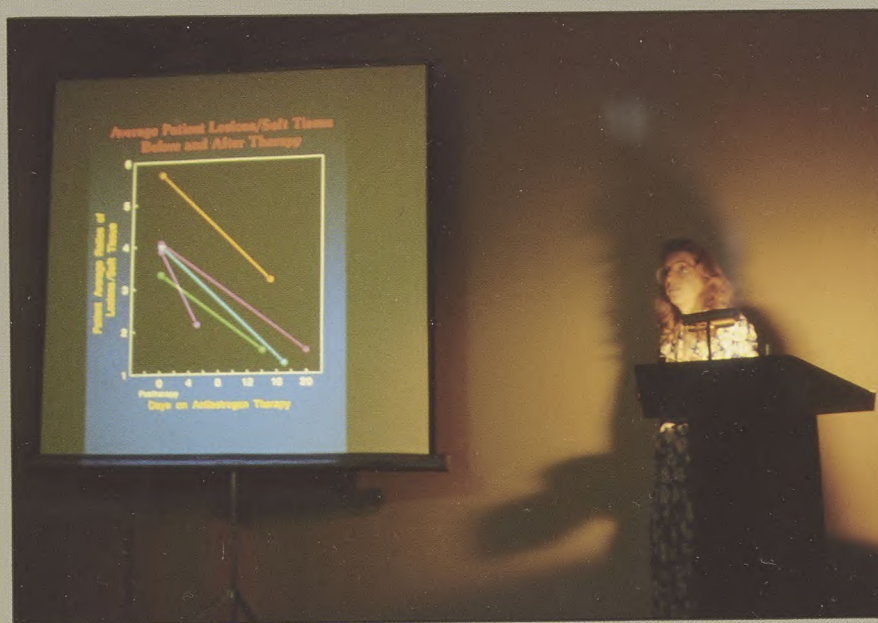
First, with nuclear waste, they are powerfully aided by the "Not In My Backyard" (NIMBY) mentality. Preferred but illogical solutions for nuclear waste almost always involve attempting to clean the present site (an impossible task) only to dump the waste on another pristine site.

This approach is not environmentally sound (two contaminated areas now exist); it is not economically sound (it is usually the most expensive solution); it is not good health policy (the dose to the cleanup workers will be much greater than the dose to the public); but, it is politically expedient (unless your community was selected as the new waste site).

The second political factor is that nuclear waste is a by-product of the nuclear industry whereas radon is nature's by-product. By making the nuclear waste problem appear to be insolvable, the nuclear industry is weakened. A fatal blow to the nuclear industry would achieve the ultimate political goal of many anti-nuclear activists, namely nuclear disarmament. The merits of this political goal should be discussed openly and should not be accomplished through subterfuge.

Concern about the national deficit has made us realize that our financial resources are limited and that funds must be spent wisely. Fear and politics cannot be allowed to continue to dominate society's decisions about solutions to the nuclear waste problem. □

Editor's Note: This article is an edited version of Dr. Royal's commentary which ran in the February 24, 1989 issue of the St. Louis Post-Dispatch.



Robert Knudsen

Andrea H. McGuire, M.D. explains her research on estrogen-receptive breast cancers at a press conference held during the Society of Nuclear Medicine's National Meeting in St. Louis, June 13-16.

FOCAL SPOT

MALLINCKRODT INSTITUTE OF RADIOLOGY

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OF RADIOLOGY
AT WASHINGTON UNIVERSITY MEDICAL CENTER

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