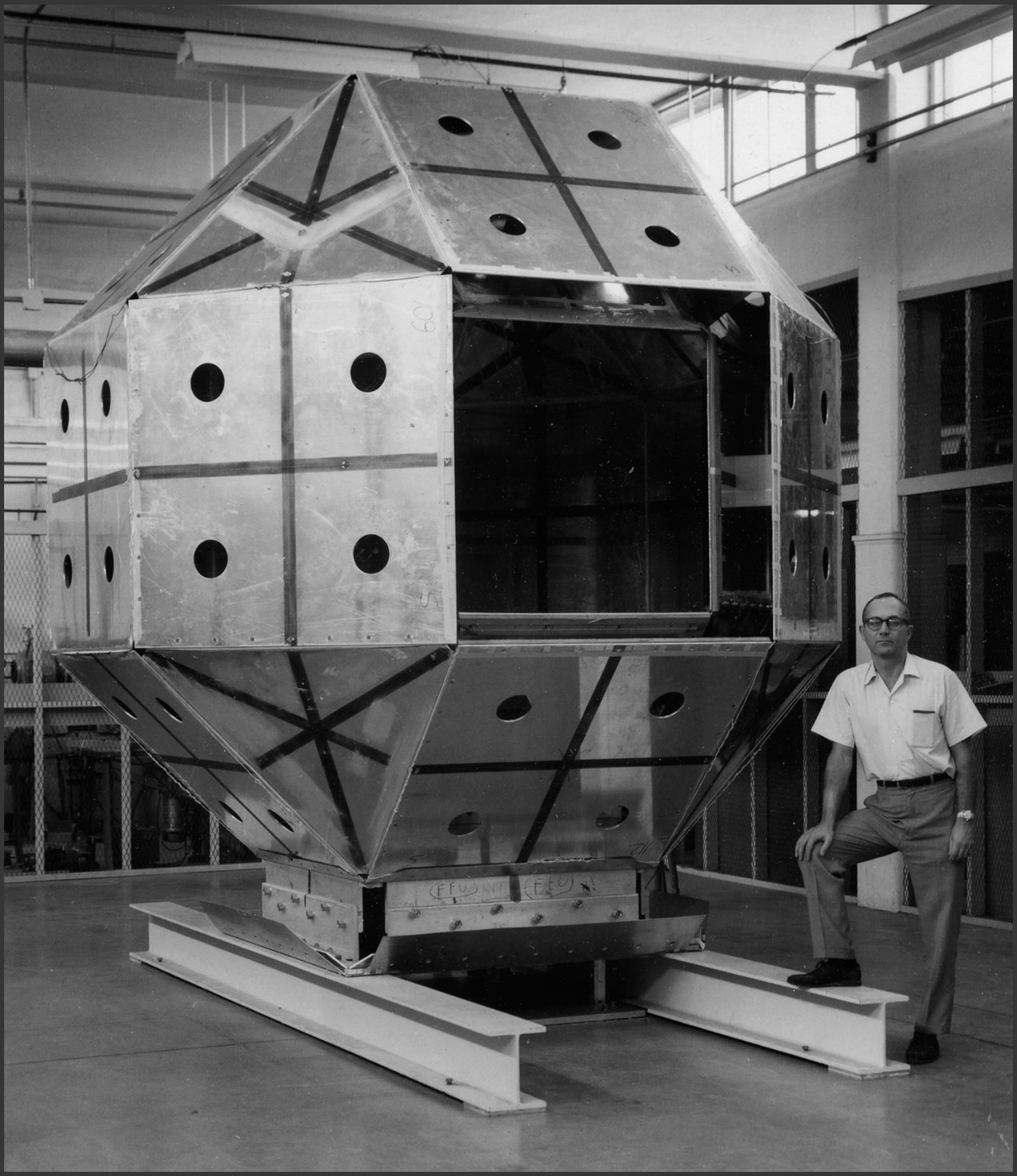
David Cohen

The Father of MEG



by Gary Boas

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COVER IMAGE: Photo of David Cohen, circa 1969, during construction of his MIT shielded room, where the first low-noise MEG was recorded using James Zimmerman's sensitive SQUID detector. The middle layer of pure aluminum is seen here. The outer layer, of moly-permalloy, is yet to be installed. Much later, in the year 2000, David joined the staff of the Athinoula A. Martinos Center for Biomedical Imaging at Massachusetts General Hospital and installed a larger, "rectangular" shielded room.

Author's Preface

As a writer with the Department of Radiology at Massachusetts General Hospital (MGH), I have had several opportunities to explore the history of radiology at the hospital: from the early days of the X ray to the introduction of functional magnetic resonance imaging (fMRI) and beyond. Of my various history projects, one of my favorites is a book marking the 20th anniversary of the Athinoula A. Martinos Center for Biomedical Imaging, a research center straddling MGH and the Massachusetts Institute of Technology (MIT)—not least because it gave birth to the work you are currently reading.

Researchers in the Martinos Center develop and apply a host of biomedical imaging technologies, including magnetic resonance imaging (MRI), positron emission tomography (PET), magnetoencephalography (MEG), and more. As it happened, at the time I was preparing the book, the center's MEG staff included David Cohen, the father of the field of biomagnetism and the inventor of MEG.

One day as I was writing, I reached out to David with questions about some of his recent work. We got to talking and I found myself wanting to know more: more about what he had achieved in his career, what had inspired him to achieve it, and what circumstances had led him to a place where he not only came up with his transformative ideas about measuring the weak magnetic signals emanating from the human body, but was also in a position where he could successfully put them into practice. Eventually, after further conversations, I proposed telling his story, from childhood to the introduction of the MEG technology that made the field of biomagnetism possible.

David and I debated the merits of my proposal. At 97 years old at the time of this writing, and with a lifetime of accomplishments to his name, he is still a modest guy. He argued that no one would want to hear his story. And even if they did, he said, telling it in the way I had proposed would give the appearance of him having an outsized opinion of himself.

I felt, and still feel, that the story deserves to be told, not least because it is more than the story of one (modest) man. It is also the story of an idea, and how that idea worked its way into scientific practice. And more broadly, it is the story of the challenges a scientist may face in navigating a convoluted funding landscape and often-thorny academic politics—even while negotiating a personal life and, more than likely, complicated family dynamics. I have never met a scientist who cannot relate to at least one of these.

So here it is. Thank you, David, for sharing your story. And thank you, reader, for joining us. I hope you find in the story the same inspiration that I have.

Gary Boas, March 2025

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Introduction

Biomagnetism is the study of the magnetic fields produecd by the body, specifically by electrical activity occurring in biological tissue, such as in the brain, heart and muscles. Launched by researcher David Cohen in conjunction with a technology he introduced—the technology that would become magnetoencephalography (MEG)—the field of biomagnetism has yielded countless insights in both science and medicine.

Not least of the insights: by enabling researchers to map activity in the brain, MEG technology has helped shed light on the nature of epilepsy and other neurological disorders and advanced applications including presurgical planning in epilepsy.

David's impact on the study of biomagnetism cannot be overstated. Even beyond launching the field, he has devoted himself fully to improving the technology, exploring further applications and supporting the increasingly active biomagnetism community, Indeed, one could say, without hyperbole, that he has lived his entire life in the pull of magnetism.

From his childhood in 1920s and '30s Winnipeg, where his uncle was an electrician and tinkerer who introduced him to the principles of magnetism via crystal set radios, to his graduate studies in experimental nuclear physics at the University of California, Berkeley, in the years after World War II; from a job as an accelerator physicist at Argonne National Laboratory to a series of academic positions; the major throughline in his life has been a fascination with the principles of magnetism and the many ways in which magnetism can be wielded.

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David introduced the technology enabling the study of biomagnetism in the late 1960s, through work he conducted first at the University of Illinois, Chicago, and then at the Massachusetts Institute of Technology (MIT). In fact, the first unambiguous demonstration of the technology, using the superconducting quantum interference device (SQUID) developed by his collaborator James Zimmerman, came at the tail end of the decade, on New Year's Eve 1969.

Having launched a new field of study based on the technology—the journal Science would later describe the New Year's Eve experiment with Zimmerman as “the birth of biomagnetism”—David devoted the next two-plus decades to developing the technology further and exploring its many possible applications.

After he “retired” from MIT in the 1990s, David joined the Martinos Center for Biomedical Imaging, where he helped establish the world-class MEG program, not least by overseeing construction of the shielded room there. (The laboratory was rededicated as the David Cohen MEG Laboratory in 2018.) He remained active in the center until relatively recently, hanging up his proverbial lab coat at 96 years old.

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David’s story is in many ways an exceptional one. Few people, after all, introduce technologies that not only advance scientific research but also contribute to the betterment of human health. In other ways, however, it is a typical one—that is, typical of the broad outlines of a researcher’s path into the sciences and toward a particular subject. As with any scientific advance, the invention of MEG was not simply the result of an arbitrary decision on David’s part to introduce a new biomedical device. Rather, it was the summation of intrinsic interests encouraged and shaped by family and friends, other lived experiences, and even historical circumstances.

In a series of conversations over the past several years, David shared much of his story and how events in the first four decades of his life led him to explore the very weak signals emanating from the human body—and ultimately become “the father of MEG.” In this work, we follow him on his journey, stopping to explore key moments in which he was faced with tough decisions, decisions that might have led him down very different paths had he responded other than how he did at the time. The story of any invention or innovation is, of course, the story of such moments.

(For reprints, email gboas@mgh.harvard.edu)

The Early Years

David was born and raised in Canada—in Winnipeg, Manitoba, in what he describes as "the coldest city in the world," though he is quick to note that he is referring to the temperature and not to the social or cultural environment.

His parents had made their way to Canada from Ukraine: his father from Odessa, his mother from Kiev. His father, Benjamin (Ben), emigrated at about 18 years old at the turn of the 20th century, traveling with his two cousins. Seeking to escape conscription in—and mistreatment by—the Tsar's army in pre-revolution Russia, which had been responsible for incalculable violence against Jewish soldiers and communities, they crossed Europe and boarded a ship to Canada. His mother, Lillian (Luba), fled Ukraine in 1914 with her mother, father, brothers and sisters, because of anti-Jewish pogroms there and elsewhere in Eastern Europe. Both families entered Canada in Halifax, a port on the Atlantic coast of Nova Scotia, crossed yet another continent and eventually settled in Winnipeg.

Figure 1: David's father, Benjamin (right), and his two cousins upon arriving in Winnipeg, circa 1912.

Nestled in a patch of land at the confluence of the Red River and the Assiniboine River, Winnipeg was the capital of the province of Manitoba and the "Gateway to the West" during a period of westward expansion in Canada. It was also home to the largest concentration of Ukrainian immigrants in the country. After the Canadian Pacific Railway reached Winnipeg in 1885, the Department of Interior launched a campaign to encourage prospective homesteaders to settle the western prairies. Posters started appearing across Europe touting the Canadian west as the “New Eldorado” and offering “free farms for the million[s].”

The campaign attracted Eastern Europeans especially, and while many used Winnipeg as a jumping-off point for a broader expansion into the West, many others settled in the city itself. By 1914, when David’s mother and her family arrived in the city, the permanent Slavic population in Winnipeg, including Jewish immigrants from Ukraine and elsewhere, was growing rapidly.

David’s parents and their families built new lives there. Ben drove a taxi and worked for a local meat company, hauling carcasses on his back. Luba’s father became a peddler (“he knew horses,” David says) eventually opening his own grocery store. Ben and Luba met in Winnipeg and fell in love, but Luba said she wouldn’t marry him unless he became “respectable.” So Ben learned a trade: building tufted furniture, particularly sofas. After some early success, they wed in 1920. Their marriage certificate lists his occupation as “upholsterer.”

The young couple eventually made a home for themselves, mostly at 353 Aberdeen Ave., in “a Slavic part of Winnipeg,” David says. In fact,

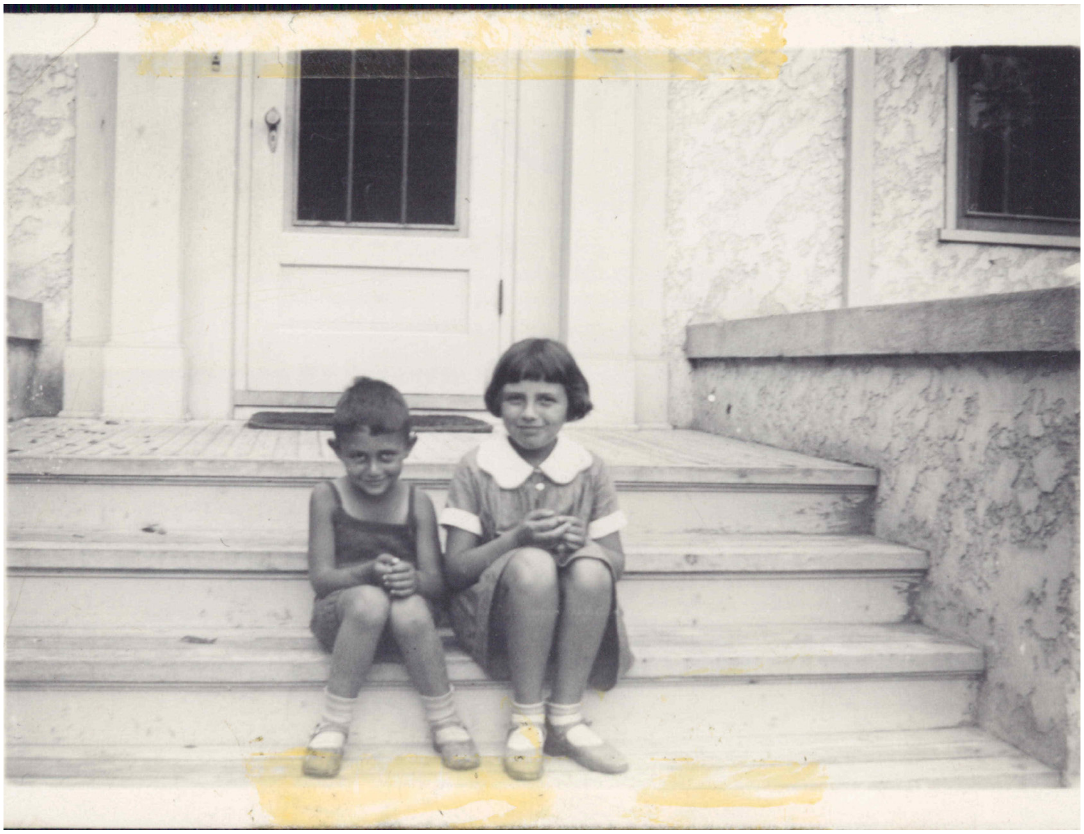


Figure 2: David and his sister, Miriam, on Aberdeen Ave.

the North End of Winnipeg, which included Aberdeen Ave., encompassed one of the largest and most significant Slavic enclaves in the city, extending from the Canadian Pacific railyards to Inkster Blvd. in the northern reaches of the city. Before long, Ben and Luba started a family. They welcomed a daughter, Miriam, in 1924. Three years later, David arrived.

Ben joined the labor movement in Winnipeg, and his involvement deepened as time marched on. The movement was affiliated with the Workmen's Circle in New York, a mutual aid society established in the 1890s to support the millions of Eastern European Jews fleeing pogroms and immigrating to the U.S. The society offered social assistance programs including health care and unemployment relief, organized dances and other social events, and more; it was "home, family, doctor, friend, insurer, provider of husbands and wives and everything," as Dr. Barnett Zumhoff, then-president of the organization would explain in a 1985 interview with the New York Times.

The Winnipeg arm of the Workmen's Circle was a Socialist labor group associated with the I.L. Peretz School, named for the Jewish-Polish writer Isaac Leib Peretz, a social critic and a promoter of Jewish non-conformism. Founded in 1914, the school was a secular, Yiddish-speaking school in the heart of the Jewish community in Winnipeg's North End. In the 1930s, it was the largest Jewish day school in North America. It has always retained its reputation as one of the most progressive and most innovative institutions of Jewish learning on the continent.

Ben was one of the founders of the Peretz School and, in 1922, was involved in moving the facility and its ever-growing student body to a new location at 418 Aberdeen Ave., only a block away from the Cohen's home. David remembers it being a hub of activity when he was a child. "My life centered around the Peretz School," he says. Not only with respect to the education provided and the social events it sponsored, but also in terms of the secular, socialist ideals it promoted. For example, because the Jewish religion itself was not favored, neither David nor many of his friends in the school had a bar mitzvah. On the other hand, he recalls singing "The Internationale" and other revolutionary songs with his classmates.

Less than two miles east of the school was David's grandfather's store at 719 Alfred Ave. The building that housed the store also served as a home for most of his extended family, with as many as seven people, including uncles and aunts as well as his grandparents, sharing the space behind the shop. So it's no surprise that many of David's earliest memories also revolve around this location. "When it snowed, my mother pulled me on a sled back and forth between home and the store," he says. "And in the summer, my grandfather took me on his horse and wagon as he peddled his stuff."

The Streets of Winnipeg

As often happens in first-generation immigrant families, not least because of the dramatically different experiences between parents and children, David developed a worldview largely incompatible with the one his parents espoused. "My culture was the streets of Winnipeg," he says, "and their culture was Workmen's Circle Jewish." Almost inevitably, the two cultures clashed. When they did, David found solace and a sense of belonging among the neighborhood kids. "All the guys up and down the street were not close with their parents; we were close with each other."

"My friends saved my life," he says. "I had a group to hang on to."

David's bond with his friends was based on a shared "us against the world" mentality, a group identity forged not only in conflict with their parents but also in earlier scraps and scuffles with kids from neighboring streets. "In an immigrant city like Winnipeg," he says, "clubs were based on ethnicity. There were Italian clubs, Polish clubs. We were a Jewish club with 18 kids, and we all stuck together because we had been chased down the street so often when we were young, before high school."

He describes the group as his "gang," and paints a picture of his early life not entirely unlike a Bowery Boys film, with a group of street urchins living a life of petty crime. "We got into trouble," he says. "We ran down the street and got into fights and things like that. And when we were very young, I think we stole things." Like all good gangs, they came up with a name—'the Canucks'—and even had sweaters with the name specially printed on them.

But the full story of David's adventures with his North End pals is so much richer than this cursory reading would suggest. They loved sports and played hockey and rugby on the streets. As they got older, they developed shared interests in chess, music and—notably—science and technology. "We matured together," David says. "We went from a gang of kids being chased down the street to an ongoing sports club, to a rather intellectual group of guys who read books and built radios, telescopes and model airplanes."

Uncle Louie's Gift

David's primary field of inquiry in those days was radios, particularly the "crystal set" radios of the day, which worked by converting the energy in the electromagnetic radio waves to something you could hear on headphones.

His love of the technology—and his fascination with the principles of electromagnetism—was initially sparked and endlessly encouraged by his Uncle Louie (Louis), his mother's brother, who had emigrated from Ukraine with her and the rest of their family. By now, David's grandfather had opened his grocery store. Louie, a self-taught electrician who earned a living wiring some of the earliest homes in the region to have access to electrical power, lived behind the store with his parents and siblings and maintained a workshop of his own in the basement. When David and his family came to visit, he would let him explore the workshop and tinker with what he found there.

"He had a lot of electrical gadgets, and he liked to teach me things," David says. "He got me interested in crystal sets when I was six or seven years old. I knew then what I wanted to do with my life; I loved electromagnetic things from the word go."

Louie eventually became a dentist; Ben lent him the money to go to dentistry school. In 1939, when David was about 12 years old, Louie was drafted into the Canadian army, where he served as a dentist during World War II. By the time he returned to Winnipeg, in 1945, David was in college. They saw little of each other in later years, but the early lessons David learned from Louie, and the passion for science Louie instilled in him, never left him. Today, David describes his uncle as "the biggest influence in my life."

As for "the Canucks," David's boyhood gang, they partly stuck together through their college years and well beyond, never losing sight of their shared intellectual interests. In the late 1970s, they held a reunion in Winnipeg, where they reminisced about their younger days and caught up on what everyone had been doing since they were last all together. Most of the group were now doctors, professors or scientists. David, too—by then, he was an MIT researcher and the inventor of an intriguing new biomedical imaging technology. In one way or another, everyone in his gang had achieved a degree of professional success.

Of course, it wasn’t always a smooth road getting there, not least for David. Indeed, before he could become the father of MEG and biomagnetism, or even begin his graduate studies in physics—the foundation of his later work with biomagnetism—he had still-more challenges to face at home in Winnipeg.

The High School and College Years

David's father was thriving in his furniture-making business, so in about 1938 he decided to move his family to a new, more affluent area of Winnipeg, a neighborhood now known as Luxton. "When I was about 11 or 12, we moved from the immigrant neighborhood to a swankier nearby area," David says. "We had servants in the house, and I had my own laboratory in the basement." The environment, it seems, could not have been nicer. The family's new home, at 18 Cathedral Ave., sat on a relatively large plot of land overlooking the Red River.

Moving house meant David also switched schools, leaving behind the parochial Yiddish school he had attended since he was a young child and joining St. John's Technical High School, part of the public school system in Winnipeg. St. John's was "marvelous," he says, not least because it offered robust programs in both science and music. "We spoke mathematical languages. We could understand Newton's law in high school."

David especially credits two of the teachers at the school with providing a foundation for

Figure 3: David outside his family's elegant new home on Cathedral Ave. on the banks of the Red River.

much of the work he would later pursue. Mr. Johnson taught him about heat and thermodynamics, for example, as part of the physics curriculum at St. John's, giving him a strong theoretical grounding in phenomena that had intrigued him since he was a child. And Mr. Silverberg gave him the necessary background in math to tackle the many physics problems he would encounter both at St. John's and later in life.

Inspired by the teachers, he would conduct all manner of experiments outside of school as well. He recalls, for instance, filling a glass pipe with water and a small mass and dropping it from Redwood Bridge in Winnipeg into the Red River below. A couple of guys in a boat on the river took photos of the pipe as it fell, capturing the effects of weightlessness inside the pipe. "It was a very early space experiment," he says.

High school life wasn't only about the sciences, though. David belonged to a chess club at St. John's, and he played violin in the school orchestra. Early on, he and his friends developed a love for the comic operas of Gilbert and Sullivan, so they were delighted when the school staged a performance of H.M.S. Pinafore.

Overall, he says, in terms of both academics and extracurricular activities, he could not have been happier during his high school days.

Still, he was eager to move on, to learn more, especially about physics, an area he wanted to pursue as a career. When he was 16, he decided he was ready to go to college, a year or two earlier than he might have otherwise—then, as today, Canadians typically started college at 17 or 18. His father felt he was too young to be on his own, though, so he told him to attend a local university and live at home. "So, I was

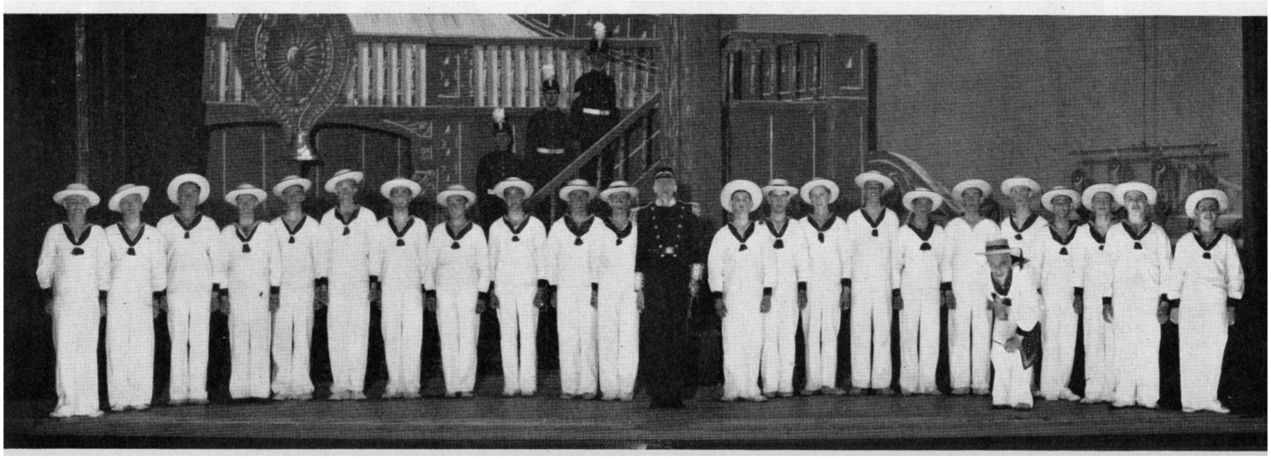


Figure 4: The boys chorus, including David, in his high school's production of H.M.S. Pinafore.

forced to go to the University of Manitoba," David says.

David had never been close with his father, not least because of their divergent views on the value of an education. His father saw education mostly as a means to an end, a stepping stone on the way to establishing a trade and earning a good living. David, with his insatiable curiosity about how the world worked, saw it more as an end in itself. In short, he wanted to be an academic. Disagreements over attending the University of Manitoba had underscored their differences and further strained their relationship. And yet, as high as tensions were when David started classes, things were about to get worse.

During his university years, his father suffered a heart attack and had to stop working, spurring yet another difficult conversation. "He said, 'I want you to leave school and take over the family business,'" David recalls. "I told him I had no interest at all in doing that. And he said, 'What? I'm offering you a small factory and you can be in charge if it.'" David remained unmoved, though. In the end, his father sold the factory and retired.

David thinks his parents were hurt and even resentful because he didn't want to take over the family business. Certainly, he says, "things occasionally got unpleasant." But they did eventually come around. When David moved on to graduate school, they helped him with tuition and even came to visit him. "They didn't quite understand what I was doing," he says, "but they knew something good was happening. It was the best I could have asked for—they recognized the value of what I was doing and how much it meant to me."

First, though, he had to be accepted into graduate school. Back in Manitoba, he applied himself to earning the best marks possible to position himself for life beyond that university. Still, when a friend who had gone to the University of California, Berkeley, suggested he apply there, he scoffed at the idea. He couldn't imagine Berkeley, "one of the finest physics schools in the world," accepting a student from an agricultural school in western Canada.

He must have underestimated the value of his experiences thus far, and not counted on the praise in the reference letters from his instructors in high school and at the University of Manitoba. When he finally applied to Berkeley, he was accepted, and was even awarded a scholarship to attend.

The Graduate and Postgraduate Years

Going from the University of Manitoba to the University of California, Berkeley was, for David, as it would have been for anyone in the late 1940s, when he arrived on the Berkeley campus, "a bit of a culture shock."

Then, as today, Berkeley was very much a center of intellectual activity in the U.S. This was especially true in the Department of Physics. And the crown jewel of the Physics department was the Lawrence Laboratory (later the Lawrence Livermore National Laboratory), where David would work.

The Lawrence Lab was founded in 1931 by Berkeley professor Ernest Lawrence, the physicist responsible for the invention of the cyclotron. In the late 1920s, seeking to build a compact particle accelerator for use in high-energy physics, Lawrence devised a circular chamber that used electromagnetic fields for confinement. The 'cyclotron' took advantage of its circular design, in which particles cross the accelerating field repeatedly, to maximize the energy output. Lawrence would later win a Nobel Prize in Physics for the invention.

Lawrence was an advocate of "Big Science" and, by the end of the decade, had assembled a large team of top physicists. Following the outbreak of World War II, he and his group focused their attention on military research. In 1942, they started working with the Manhattan Project developing the atomic bomb. Lawrence's friend Robert Oppenheimer led the work conducted at the newly launched Los Alamos National Laboratory in New Mexico. Lawrence himself stayed in Berkeley and worked out a means for electromagnetic enrichment of uranium, an integral part of the successful completion of the weapon.

After the end of the war, many of the scientists who had worked at Los Alamos and contributed to the development of the atomic bomb moved to Berkeley, where they continued their nuclear research while also teaching in the department. It was the beginning of the Cold War, with growing tensions and an escalating arms race between Western powers and the Eastern bloc, and the Berkeley campus became a focus of ongoing debate about the development of nuclear weapons.

Such was the backdrop when David began his graduate career in 1949—though, as he explains, Cold War concerns weren't top of mind for him and other students. "Among the senior staff, it was very political. Many were against the idea of always making bigger and better bombs. As students, we watched and listened, but we didn't get involved. We were too busy."

To be sure, the students faced intense pressure on the academic front. "It was high stakes," David says. "Berkeley was a world center of particle physics and there was a sense that the most important advances in the field were happening all around us." Even today, 75 years later, the word he uses most often in describing his graduate school days is "fear … F-E-A-R." Students in the Physics program were endlessly afraid of failing exams, of washing out, of not measuring up. David recalls a friend in the department succumbing to the pressure during an exam. "He got so scared, he cracked up and had to be carried out and sent home," David says.

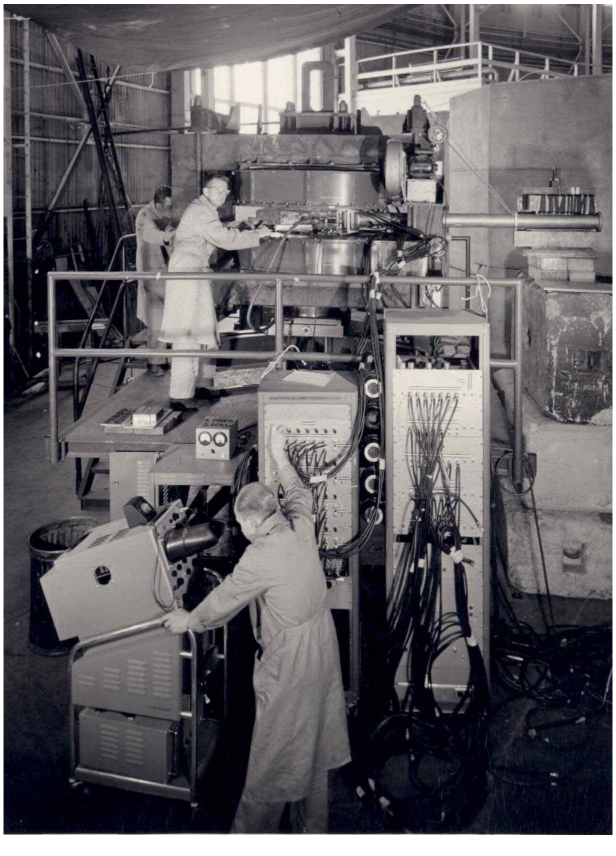


Figure 5: Three graduate students working on David's thesis project; David is in the back, looking through a large C-shaped magnet into the cyclotron behind the concrete shielding to the right.

In his early semesters at Berkeley, David enrolled in a host of graduate-level courses, including courses on electricity and magnetism, which reinforced his lifelong interest in these topics. He found, though, that because his undergraduate training in these areas was often lacking, he was struggling to keep up with the work. He sat down one day with his graduate advisor and explained that he didn't feel prepared. In response, his advisor suggested he re-take the undergraduate physics classes. So, for the next couple of years. David simultaneously pursued undergraduate and graduate courses of study at Berkeley.

This was, he says now with characteristic understatement, "hard work." In fact, it added several years to his graduate career. But he was determined to see the program through—to avoid becoming one of the many graduate students who left before completing the PhD. "I wanted to make sure I got there," he says.

Fortunately, he had support. Not least was his thesis advisor: Professor Burton J. Moyer, a high-energy physicist in Ernest Lawrence's

Radiation Laboratory who discovered the neutral pi meson. “My thesis advisor was a gem,” David says. A devoted educator as well as a brilliant scientist, Moyer encouraged David in his studies and proved a kindly and compassionate presence in an otherwise severe academic environment. “He should have kicked me out,” David says now with a laugh, “but instead, he took me under his wing. He put his arm around my shoulder and said, ‘let’s do this.’”

David wasn’t the only one Moyer helped. Moyer advised a handful of graduate students working on their theses and made sure each of them had a thorough understanding of the relevant material. “What he did was, he held seminars several times a week with a small group of us and we worked through the details of our thesis work, the physics of it,” David says. “We all had doctoral theses related to each other’s. He taught us what we were supposed to know and made sure it got into our heads.”

Moyer and Edward Teller had suggested David’s thesis topic: “Bremsstrahlung from Proton Bombardment of Nuclei.” This proved an excellent fit. The work fell squarely in high-energy physics and was in some ways related to Moyer’s own research, but it also involved magnetism, a longstanding interest of David’s from his crystal set radio days. The research thus allowed him—indeed, demanded of him—that he immerse himself in the technology of strong magnets: of how to design and build the magnets to meet his specific needs (“pair production”). The knowledge and experience he gained from this would serve him well in the coming years.

Another Lifeline

Professor Moyer played a pivotal role in helping David through the graduate program, and helping him learn to think like a physicist. But

Figure 6: David and Vivian on the Berkeley campus of the University of California. The famous “Campanile” is in the background.

what really saved his life, he says, was meeting Vivian. Vivian was a brilliant Berkeley graduate student in mathematics, and he and she had a class together. They became friendly in class and grew closer as the semester continued, eventually spending most of their time together.

On the rare free evening or weekend when they weren't studying or otherwise working, the young couple would socialize with a group of friends—"a gang of graduate students," he says, echoing the language he uses to describe his childhood friends on the streets of Winnipeg. Escaping the labs and the library in Berkeley, they would trek across the bay to enjoy a variety of spots in San Francisco. David recalls, for example, an Italian beer joint called the Bocci Ball—literally a bocci court ringed by a bar. "We hung out at the Bocci Ball, and we often went to the opera," he says. The latter was expensive, of course, so they would volunteer to work as ushers so they could attend for free.

Even more important, though, was the support David and Vivian gave each other. David was still struggling with feeling underprepared for the Physics PhD program at Berkeley. Vivian was grappling with difficulties of her own. (She got caught up in security clearance problems, David says. Her graduate supervisor was revealed to be a member of the Communist party and, in the late 1940s and early 1950s, at the height of the Second Red Scare in the US, simply working with him as an academic advisee was enough to cause turmoil in her life.) Together, David and Vivian found the strength to continue in the face of adversity. "We clung to each other for dear life. She was having her troubles, and I was having mine. We saved each other's life."

In the end, David and Vivian didn't stay together, but he credits her with helping him through one of the most challenging periods of his life.

The Journey Continues

David earned his PhD in Experimental Nuclear Physics in about 1955. It was the culmination of years of hard work and struggle, of fighting to overcome feelings of inadequacy and accepting support from those who were best able to provide it. There were undoubtedly times when he was certain he wouldn't get there, but he persevered and ultimately achieved what he had set out to do.

Of course, as many will know, finishing a PhD is only the beginning. In some ways, finding your feet in the job market and the broader science ecosystem—figuring out who you want to be as a researcher, how and where you would like to make your impact—can be just as challenging.

David's postdoctoral journey began even before he graduated. In about 1954, he traveled to Miami Beach, Fla. to visit with his parents, who were vacationing there. His plan, he says, was to spend a week or two enjoying the sun and sand while beginning to write his dissertation. Of course, as so often happens in life, events unfolded rather differently than he had imagined.

One afternoon, maybe two or three days into his visit, David wandered over to the University of Miami in Coral Gables, where he met with faculty from the Department of Physics. Impressed by his background, and intrigued by his dissertation topic, the faculty asked him to give a talk. He did, and they subsequently offered him a job. He had always been a good speaker, he says.

David and Vivian moved to Florida and he started a job as an assistant professor in physics, teaching and conducting research—and in his spare time, continuing writing his dissertation—for a salary of four thousand dollars for the academic year. ("Coral Gables was hot," he says. "And on my kind of salary you couldn't afford an air-conditioned apartment there. But you could live. We are talking about 1955.") He mostly enjoyed the work but, once again, he felt underprepared. "I really didn't understand physics as much as I should to be able to teach it," he says now. "But in teaching it, I began to understand it better."

After his stint with the University of Miami, he and Vivian moved to Quebec City, where the climate was cooler (Vivian had never liked the heat in Florida), and he took a job with the Defense Research Board of Canada. The Cold War was by now in full swing and military money was pouring into the research arena—in this case, into the development of infrared guided missiles, a new technology in the mid-1950s. David was part of a cadre of physicists enlisted to optimize the design and manufacture of the associated technologies. "For a year and a half, I did guided-missile infrared physics," he says. "I liked the work. It was far from what I had been trained to do, but it was a good experience."

Next up was a postdoctoral fellowship in the University of Rochester Department of Physics. This job was much more in line with his graduate studies. His duties at Rochester mostly involved working with the cyclotron at the university, conducting special magnets studies, and contributing to a variety of particle physics studies.

It was here where, after seven years together, Vivian decided to go back to her old life in California. Later, she established herself as a respected mathematician and devoted herself to developing high school textbooks, under the name Vivian Groza.

And that wasn't the only change. David's position at the university, as is often the case with postodoctoral fellowships, would last only about a year. As it turned out, his next adventure was just around the corner.

The Argonne Years

In 1957, David joined the Argonne National Laboratory in Illinois. Established 11 years before in 1946, Argonne National Laboratory was—and is still today—a large research and development center owned by the United States Department of Energy and managed by the local universities of Illinois. It was the first national laboratory in the U.S. In its first couple of decades, which included the years David worked there, Argonne largely focused on developing non-military applications of nuclear physics.

David worked as an accelerator physicist helping build the zero-gradient synchrotron (ZGS). The ZGS would later play an integral role in trailblazing research into particle physics. He was mainly tasked with building the magnetic devices that would be used with the ZGS. "This was what I trained to do," he says. "I started working with big magnets when I was a graduate student. Gradually, with one thing and another, I became an expert." It was, he says, his first "real" job, and a critical step on his path to inventing biomagnetism and MEG.

With a good job in a large, world-class facility, David rented an apartment in the Hyde Park neighborhood on the south side of Chicago. Hyde Park was "a grand place to live," he says, especially for a single person like himself. It was a vibrant community with restaurants, bars and countless other spots for socializing. Jackson Park and the beach were only blocks away. There was music and culture everywhere: not least, music performed by local orchestras and chamber ensembles, and folk dancing. David picked up the violin again and during summers attended chamber music camps.

The urbane lifestyle also extended to David's home, "a marvelous building called the Cloisters." Built in 1928, the Cloisters offered neo-gothic architecture and well-appointed interiors with semi-private elevators and views of Lake Michigan and the downtown Chicago skyline. "It was a gorgeous building and very distinguished living, with large fireplaces and things like that," David says. Celebrated author Saul Bellow, later a Nobel Laureate in Literature, lived above him in the Cloisters.

If there was one downside to living in Hyde Park, it was the commute. Every day between the years of 1957 and 1965, David and several colleagues carpooled from the South Side of Chicago to the Argonne facility, roughly an hour's drive away. The ride was tedious at best, with the same stale jokes and the same tired observations

Figure 7: One of the ensembles in which David played while living in Chicago; David (center, wearing glasses) was a violinist. Second from the right is Lee Teng, a famous accelerator physicist.

about the landscape passing by. "Every day, when we hit the railway tracks," David recalls, "someone would say, 'Okay, guys, it's clear sailing from here on out." After a couple of years, the riders mostly stopped talking at all.

By then, the commute wasn't the only thing that was beginning to feel monotonous. David was starting to realize that his job was no longer wholly satisfying to him, that his passion as a scientist might ultimately lie elsewhere. Working as an accelerator physicist specializing in strong magnetic fields gave him both job stability and financial security, but he found that his thoughts kept drifting to another topic, one on the opposite end of the magnetic spectrum.

"I have a fancy job doing high-energy physics and working with big magnets," he says, looking back on the Argonne days. "And for some reason I'm thinking, year in and year out, wouldn't it be fun to measure very weak magnetic fields." That is, the kind of fields generated by the weak ion electrical currents in the human body.

David wouldn't be the first to attempt to record biomagnetism. In 1963, even as he was beginning to develop his own ideas, a group of researchers at Syracuse University reported that they had successfully measured the magnetic field of the human heart. In their experiments, though, in order to minimize the magnetic disturbances associated with everyday urban life, they performed the experiments in the middle of an empty field, far away from the cars, trains and countless other sources of magnetic disturbance in the city.

David had another idea: instead of escaping background noise, simply minimize it by building a magnetically shielded room. And he knew how it could be done. Drawing on his years of experience and expertise in the area, he wrote a proposal asking Argonne for support in building a magnetically shielded room.

He was sure he could make it work. "I was a shielding guy. The only difference was, where before I shielded against nuclear radiation, here I was shielding against external magnetic fields." Despite his confidence and enthusiasm, though, he couldn't convince the higher-ups at Argonne to fund the idea. If he wanted to build a shielded room to help measure the weak magnetic fields generated by the human body, he would have to do it elsewhere.

'You Must Be Some Kind of Genius'

Here is where the tedious carpool becomes an important part of biomagnetism and the MEG story. One of the other members of the carpool was Lester Winsberg, a colleague at Argonne. In 1964, Winsberg, although a chemist, was appointed head of the physics department at the new University of Illinois campus in Chicago and tasked with hiring faculty for the department. He knew David was considering a career change, hoping to pursue his idea of measuring weak magnetic fields, so he offered him a job as an associate professor with the promise of tenure. Just as important: He would provide him with funding to build his "funny shielded room."

David relates the story of how this came to pass in a typically self-deprecating fashion. "Lester Winsberg was my buddy in the carpool," he recalls. "One day he said, 'I've got a really tough problem in physics.' It so happened that I had been working on the same problem. I popped up and said, 'I know the answer to that.' And he said, 'boy, you must be some kind of genius,' not realizing I had already spent weeks getting to the answer."

Winsberg remembered this when it came time to populate the "swanky" new department at the University of Illinois. He wanted to hire people he knew, and he wanted people he knew to be sharp. "Lester thought I was brilliant," David says with a laugh, "so he made me an offer."

David was thrilled that he would finally be able to build a magnetically shielded room and thus measure the very weak signals emanating from the human body, but the opportunity to pursue his interests in biomagnetism wasn't the only reason he found Winsberg's offer appealing.

"I was not meant to be a high-energy physicist," he says today. "I didn't understand the quantum physics of those atom smashers. I was not good at it. I was frustrated because I was always going to be a second-rate high-energy physicist doing other people's dirty work for them, building machines so other people could test their ideas." Working at Argonne was a good experience for David; it added to his expertise with magnetic shielding and gave him the confidence to apply that expertise in novel ways. But ultimately, he knew, the facility was not where he belonged.

It would be a risky move, leaving a fancy job at a big national laboratory for a relatively uncertain future at a state university, but David knew he couldn't pass up the opportunity. In any event, now a single man, and with no family to support, he could afford to take a pay cut while working the long and often erratic hours of an academic. So he said goodbye to his decade-plus career as an accelerator physicist.

The University of Illinois Years

As it happened, after leaving Argonne, David had some six months to fill before he could begin work on his project at the University of Illinois in Chicago. So, in the interim, Albert Crewe, director of Argonne National Laboratory and a distinguished faculty member at the University of Chicago, took him on as a special assistant. "He was working on his own project," David recalls, "and he said, 'Use your ideas to help me with my project while you wait." The project in question? Development of the scanning electron microscope.

This work was important to David's development as a researcher—in more ways than one. Crewe had gathered around him a group of wildly talented scientists and David enjoyed getting to know "these marvelous, marvelous people." Among them was another member of "Crewe's crew": Venezuelan researcher Humberto Fernández-Morán, who in 1955 had invented the diamond knife, which was used to show microscopic photos of the brain.

Fernández-Morán also lived in the Cloisters, so he and David got to know each other socially as well as professionally. "I was a new guy in a new field of research and here was this world-famous scientist. He asked me to walk with him every Sunday afternoon and we talked science as we walked up and down the streets on the south side of Chicago. He gave me his views of science and how he did science. I learned so much from him as to how to succeed.

"He convinced me to push ahead as I wished and not to listen to the people saying, 'Oh, David, you're crazy for wanting to measure very weak magnetic signals. It can't be done.' Humberto taught me to listen to my own voice."

Finally, the time came to begin work on his shielded room, so he could start measuring the very weak magnetic signals emanating from the human body. Flush with the money allotted to him by Winsberg, he hired a group of students and university carpenters to build the room itself. He had already worked out the mechanics, he says. With no precedents in medical imaging, he had looked outside the discipline and learned of work in the field of geology. In 1962, researchers Bob J. Patton and John L. Fitch had reported a significant innovation, a magnetically shielded room they had designed and built mainly for geophysical (oil) research. This proved an excellent starting point for David, who adapted the concepts Patton and Fitch had described for use in the human body.

He also employed a different type of detector than the Syracuse team had. The latter had used two identical coils connected to one another, each with several millions of turns around a ferrite core in opposition to each other. The idea here was that currents induced by any background noise would be identical in the two coils and would cancel each other out. The magnetic field of the heart, in contrast, has a gradient over the chest, and thus would produce a net measurable signal. Still, the resulting recordings were very noisy, even after signal-averaging.

David took a different approach. In addition to reducing background noise using his now-completed magnetically shielded room, he employed a smaller coil than the Syracuse team had, and a better amplifier. Thus, he was able to record the magnetic signal produced by the heart with far less noise. The noise was still too large to allow recording of clear heart traces, but the results were encouraging enough that they warranted sharing.

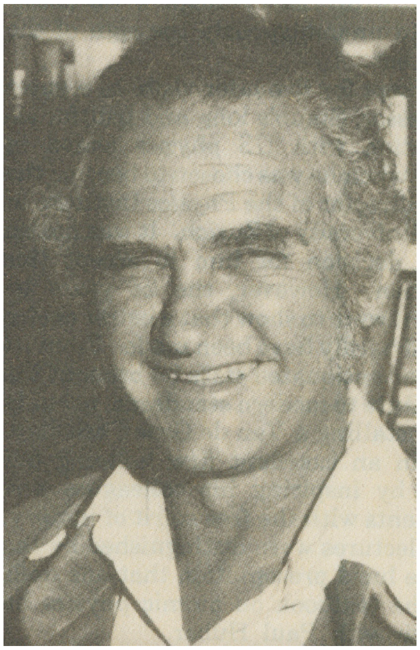


Figure 8: Lester Winsberg, carpooler who facilitated biomagnetism.

In early 1967, two years after joining the university faculty, he published a paper in the journal Science detailing his first measurements of the magnetic signals produced by the heart: "Magnetic Fields around the Torso: Production by Electrical Activity of the Human Heart." In this study, per the paper's abstract, "A search was made outside the torso for fluctuating magnetic fields produced by the heart. Detector and subject were housed in a highly shielded enclosure. Magnetic signals with amplitudes of 10^{-8} to 10^{-7} gauss were detected synchronously with the electrocardiogram, confirming previous reports."

It was an important study, and big news. Letters and phone calls started pouring in, and a number of news outlets picked it up. Not least was the New York Times, which described the work and highlighted its promise for diagnosing disease. It was still too early to assess its "long-range potential," David told the Times writer. "But it now looks, while it has not been proved, that the detection of currents by their magnetic fields does give new information about the heart's electrical activity above and beyond what one

Figure 9: Beginning construction of David's magnetically shielded room at the University of Illinois, Chicago, circa 1966. Standing in the room is David's then-colleague and pal Prof. Louis Chandler.

might get from the more routine forms of electrocardiography."

("Actually," he clarifies today, "it gives different information, eliminating the radial component of the heart's signal and emphasizing the tangential signal.")

The writer spoke with a variety of others for the article, including Dick McFee, one of the Syracuse University researchers, as described earlier. In the article, McFee made an interesting observation about the technique: that it might in fact be most useful in detecting the electrical activity of the brain.

"Bone in the skull is a good insulator of electricity, making it difficult to detect the small electrical currents within the head," he said. "But bone has no effect on the magnetic field produced by currents and this device ultimately might be of use in tracing brain waves."

Indeed, by now David was also growing more interested in measuring the magnetic fields produced by electrical activity in the human brain. This would present a bit of a challenge. He knew the magnetic field of the brain should be about 100 times smaller than that of the heart, "so it would be a tough thing to measure," he says. "I spent much of the next year figuring out how to do it."

Here again, he found help navigating the new (to him) area of inquiry. John Hughes was a well-known neurologist in Chicago and a professor at Northwestern Medical School. David doesn't recall how he and Hughes first connected but notes that in Chicago at the time there was a robust community of physicians and researchers engaged in the science of bioelectricity. Thus, word of David and his work, of "this guy doing this crazy thing of measuring enormously weak magnetic fields," could easily have gotten to the neurologist.

In any event, Hughes took an interest and offered his assistance in teaching David how the brain works from a bioelectrical perspective. "He and I sat night after night talking and planning," David says. "And it worked. In 1968, I was able to measure the magnetic field of the brain. That was a really thrilling time, sitting night after night and watching the signal slowly emerge out of random magnetic noise." As with the earlier heart measurements, the signal was noisy and wasn't yet high enough for practical use, but as a proof of principle the study was an unambiguous success.

He published his findings, again in Science, in the paper "Magnetoencephalography: evidence of magnetic fields produced by alpha rhythm currents." And again, the New York Times published an article about the work.

David was thrilled with the progress he was making. His idea of measuring the very weak magnetic signals produced by the human body was proving successful. But he knew he was working on borrowed time. With a series of political upheavals in the physics department, the promise of tenure he had received when he joined the university had been withdrawn.

It started when Winsberg, the new chair who had filled out the department with his own hires, David included, essentially demoted several of the old guard in the physics faculty. "He lowered their salaries," David says, "because he thought they weren't good." Winsberg may not have realized that, by the rules of the university, faculty could vote a chair out of office. When he ruffled their feathers, they did just that.

It turned out that the dean who had endorsed Winsberg's offer to David had also left. "Suddenly I was without support," David says. The old guard who remained weren't sold on the idea of measuring very weak magnetic signals in the body. "They thought I should be doing classical physics in a traditional physics department, that I shouldn't be fooling around with this new stuff." When the time came to vote on his tenure, tenure was denied. Even amidst two big successes in measuring the magnetic signals produced by the human body, David found himself without a secure job.

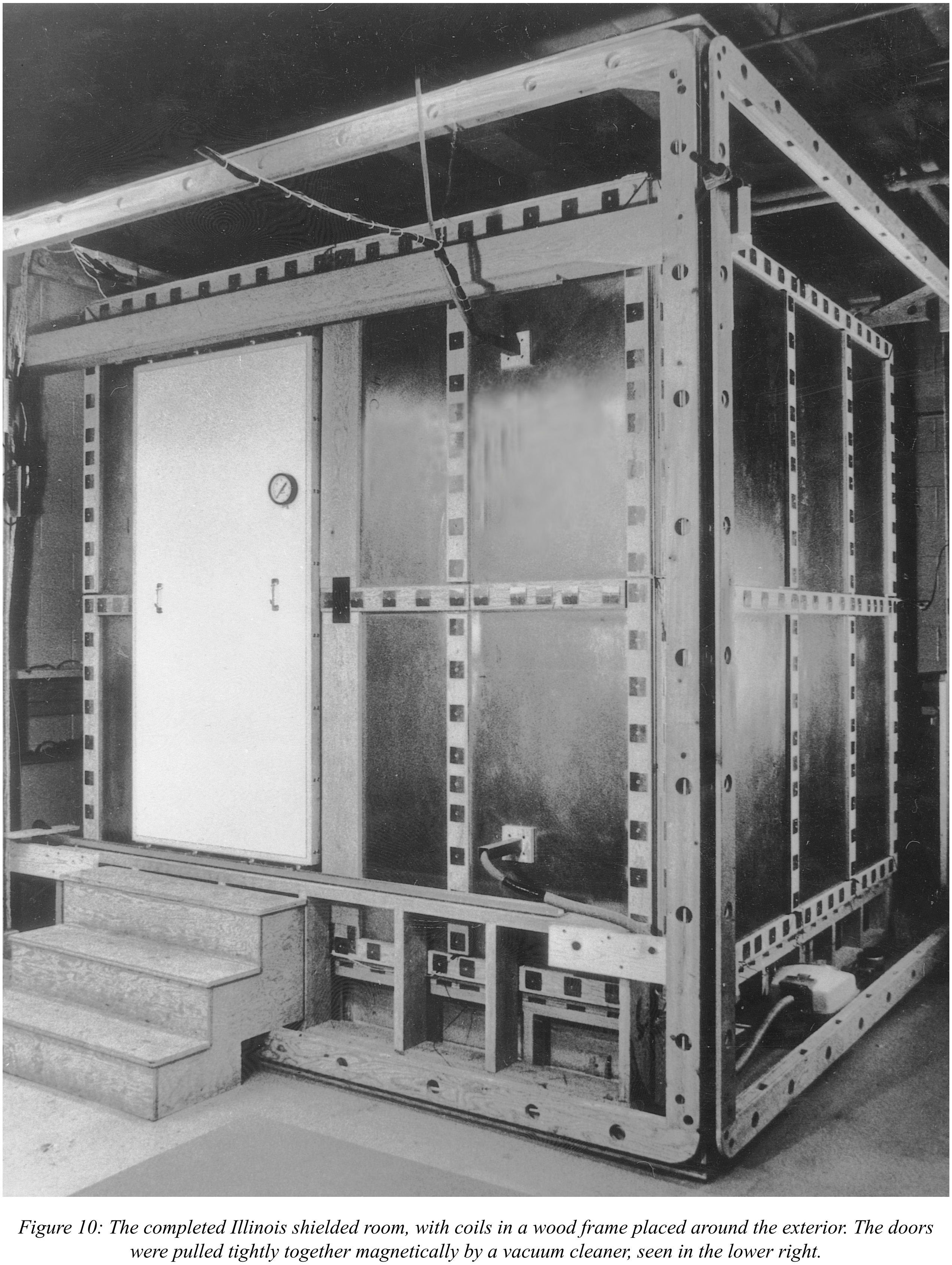


Figure 10: The completed Illinois shielded room, with coils in a wood frame placed around the exterior. The doors were pulled tightly together magnetically by a vacuum cleaner, seen in the lower right.

The Early MIT Years

With the political upheaval in the University of Illinois Physics department, David knew he would need to start looking for another job. Fortunately, interest in his work, stoked by media coverage especially in the New York Times, led to an offer from one of the top laboratories studying magnetism.

Named for a Massachusetts Institute of Technology (MIT) professor and pioneer in the production of intense magnetic fields, the Francis Bitter Magnet Laboratory at MIT was the world headquarters for basic magnetism research. "It was run by a man by the name of Benjamin Lax, a well-known solid-state physicist studying the basis of magnetism," David says. "He liked my ideas so, when he heard I was in trouble, he arranged for me to come visit. I visited and gave a talk, and he made me an offer."

At the time, MIT had two types of researchers: "soft money" faculty with no guarantee of funding and non-faculty with assured funding. Lax offered David a non-teaching position. "He said, 'come to MIT and I'll find you all the grant money you need and give you all the space you need,'" David recalls. "'You will never be a professor at MIT, but you will have everything you will ever need to do research.' Well, I grabbed this chance."

"So I came to MIT," he recalls. "My idea was to first build a shielded room which was effective enough to reduce the external magnetic field to below the level of the brain's weak magnetic field. It had to be much better than my Illinois room."

David had built the shielded room in Illinois alongside a carpenter named Carl Grundman. After he moved to MIT, he asked Grundman to come to Cambridge, Mass., to help him build a better shielded room there. The two worked well together. Also, because they had collaborated on the shielded room in Illinois, they could incorporate the lessons they had learned from that project. Helpfully, the University of Illinois allowed David to take materials from the now-deconstructed room on its campus, giving him a bit of a jump on his MIT room.

David designed the shielded room in about two months, then built it with Grundman and a handful of MIT carpenters and students. "Carl came out and he was my right-hand man," David says. "There were about eight of us in all, and it took us six months to put the room together."

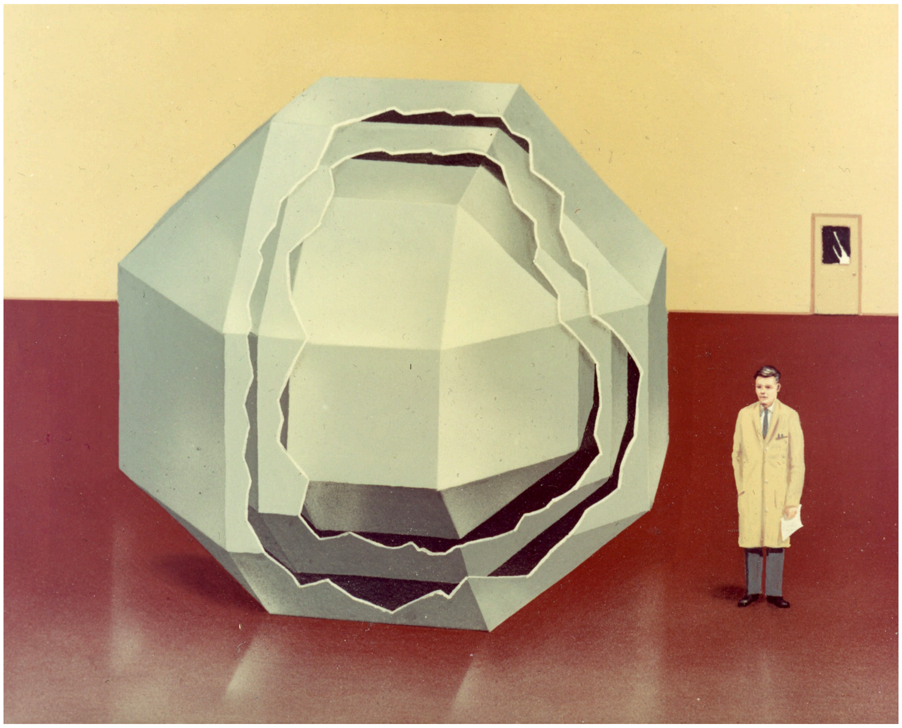


Figure 11 (top): An artist's view of the proposed MIT shielded room.

Figure 12 (bottom): David (right) with Carl Grundman. In the background, a student assistant silver-plates aluminum sheets.

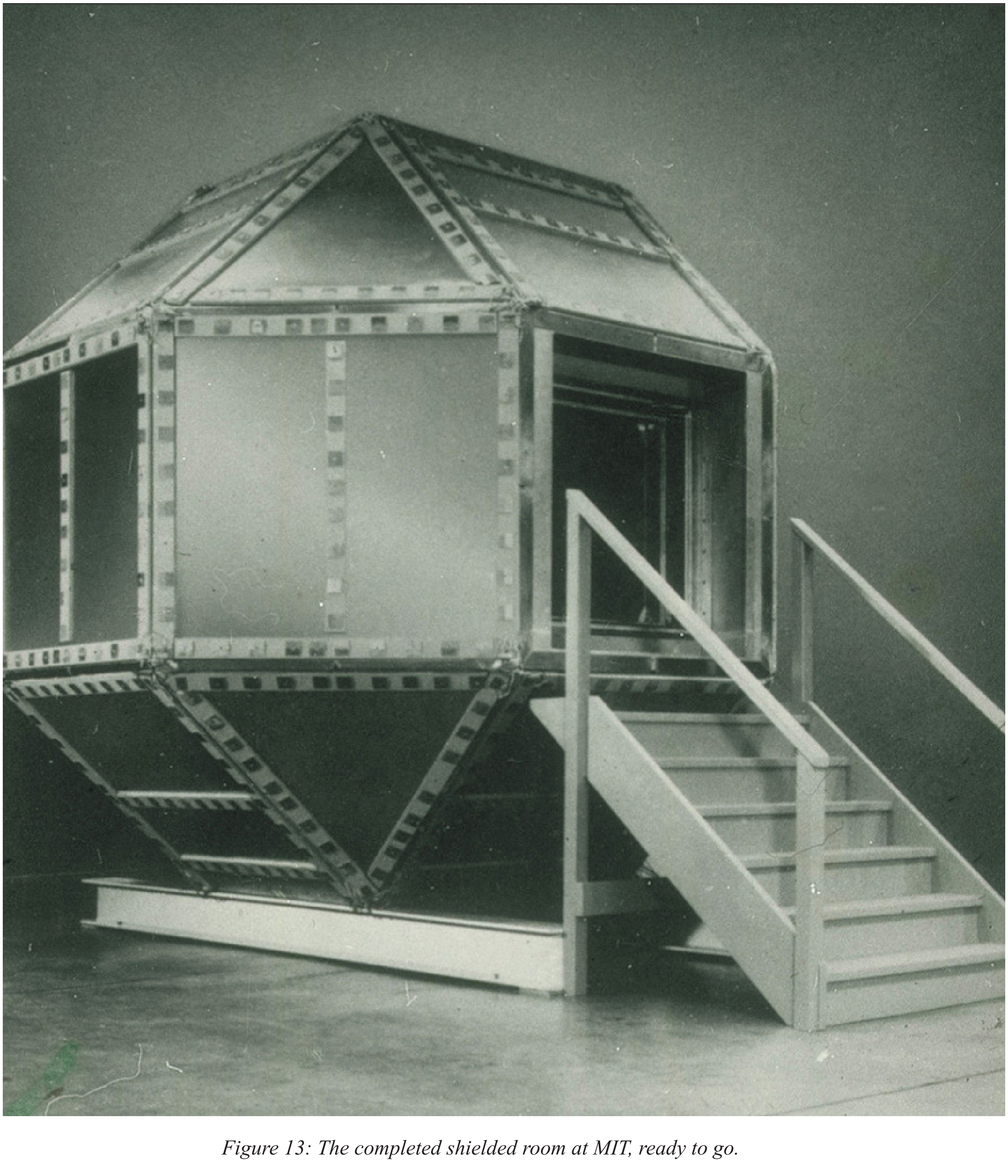


Figure 13: The completed shielded room at MIT, ready to go.

The room was in the shape of a 26-sided sphere called a rhombicuboctahedron. "There are physics reasons why a sphere makes a very good magnetically shielded room, as opposed to a cube," David says. "Twenty-six sides was just the engineering solution." The room had three ferromagnetic layers with two layers of aluminum, with the latter joined together with silver plating. The MIT students were especially adept at completing the latter. "They were all engineering students and good at that sort of thing."

David completed the shielded room in 1969—a pod-like structure with a stairway descending from an open panel on the side, it looked like something out of a science fiction movie—and started using it to measure the weak magnetic fields emanating from the human body. The room did an excellent job of keeping out any external magnetic fields—David estimates that it was ten times more effective than his shielded room in Illinois—but the copper coil-based detector he had developed was still noisy.

To address this problem, he turned to James Zimmerman, who had invented a superconducting quantum interference device (SQUID) several years before, when he was a researcher working with Ford Motor Co. (In those heady days, large corporations like AT&T and IBM as well as Ford were happy to maintain in-house labs conducting research with no obvious financial or commercial benefit to them.)

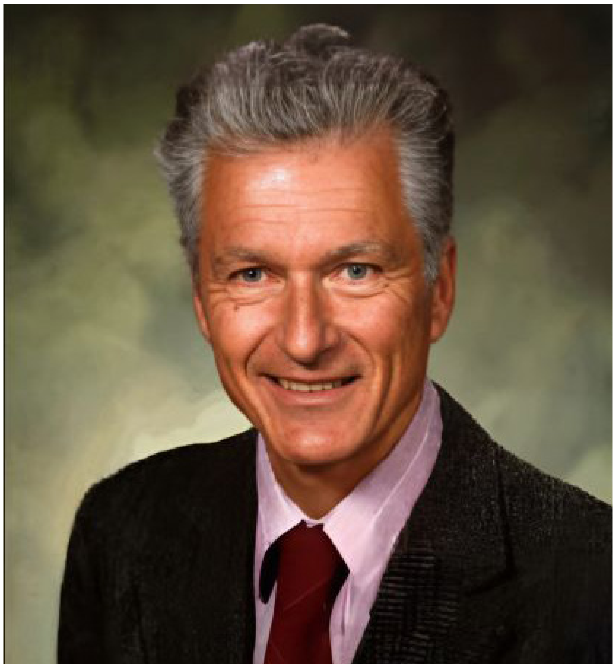


Figure 14: James Zimmerman, inventor of the SQUID.

The introduction came by way of Ed Edelsack, a U.S. Navy funding officer who had recently awarded David a small grant. The Navy was also funding Zimmerman in his work and Edelsack suggested the two should meet. In a 2004 retrospective about his biomagnetism work in Boston, David described what happened next.

"Ed put me in touch with Jim, and it was arranged that Jim would bring one of his first SQUIDs to my lab at MIT, to look for biomagnetic signals in the shielded room. Jim arrived near the end of December, complete with SQUID, electronics, and nitrogen-shielded glass dewar. It took a few days to set up his system in the shielded room, and for Jim to tune the SQUID. Finally, we were ready to look at the easiest biomagnetic signal: the signal from the human heart, because it was large and regular. Jim stripped down to his shorts, and it was his heart that we first looked at."

The results were nothing short of astounding; in terms of the signal measured, they were light years beyond anything David had seen with the copper coil-based detector. By combining the highly sensitive SQUID with the shielded room, which successfully eliminated outside magnetic disturbances, the two researchers were able to produce, for the first time, clear, unambiguous signals showing the magnetic fields produced by various organs of the human body. The implications of this were far reaching, with potential for a wide range of both basic science and clinical applications. David didn't quite realize this at the time, but he and Zimmerman had just launched a new field of study, biomagnetism, one that would pay large dividends in terms of the potential benefits it could bestow.

Having demonstrated the efficacy of the new approach, which he had been thinking about and plotting for the better part of a decade, and which was rooted in his literally lifelong fascination with the principles of magnetism, David switched off the lights in the lab and he and Zimmerman went out to celebrate. It was December 31, 1969. The thrill of possibility hung in the air as they joined other revelers to ring in a new decade—indeed, a new era.

Where did they go? "I think I took him to a few New Year's Eve parties," David says. A few? "Well, you know, Cambridge is a swinging place."

The answer prompts another question. A rhetorical question, perhaps, but one that still bears asking, especially given the decades of seeking, striving, learning and living that had made him who he was at that moment: a kid from the streets of Winnipeg who, through hard work and singular determination, had earned a place in academic research and turned an idea that many had dismissed as pure fancy into a reality, a reality that would have a significant impact in the years and decades to come.

Q: So it was a pretty good day, overall?

David responds with a hearty laugh. "Yes," he says. "A very good day."

Epilogue

The story of biomagnetism didn't end with that one experiment, of course. The next step was for David to tell the world what he and Zimmerman had achieved. In the early days of the new decade, he wrote a paper announcing their success. "Jim happily reviewed it and agreed to be co-author," David wrote in his 2004 retrospective. "In my enthusiasm, I also included Edelsack's name, as the facilitator."

The publication of the paper, in 1970, was a watershed moment. Nearly 20 years later, in 1989, the journal Science described it as the 'birth' of biomagnetism, citing the interdisciplinary appeal of the technology, which led to the emergence of a new field and a new community of researchers encompassing physicists and psychologists, epidemiologists and computer scientists. "The main point," David wrote in 2004, "was that a new physics system (SQUID plus shielded room) was now available for a new, low-noise type of measurement, so that biomagnetism now had a reason to grow."

And grow it did, not least through David's own work. In the first years of the 1970s, he and his group at MIT reported the first clear direct current (DC) signal from the heart, the first clear signal from skeletal muscle and, "more dramatically," he says, the first clear MEG signal over the head. Next, he turned his attention to the lungs, exploring the "dust clearance rate" in the lungs of normal subjects vs. those of a small group of smokers (ultimately revealing a possible mechanism of lung cancer in smokers, and thus incurring the wrath of the tobacco industry).

Even as David continued his development of MEG, other labs were also advancing the technique. In 1971, for example, Zimmerman built the first SQUID gradiometer, enabling biomagnetic measurements without shielding. In Finland, in about 1972, Toivo Katila and his group started exploring the potential of the technology. By 1974, they had produced the first fetal magnetocardiogram (MCG). Also by then, David had measured magnetic particles in the lung.

In August 1976, David and his group organized the first "Biomag" conference, with 23 attendees from the U.S., Canada, Finland, France and Japan representing the burgeoning biomagnetism community. Discussions at the workshop mostly centered on instrumentation and measurements of the heart. Only four or five of the attendees were directly interested in the brain, in part because of the technical challenges associated with measuring the magnetic signals associated with brain activity.

“The trouble was,” David says now, with respect to those challenges, “using the SQUID at only one location over the head wasn’t too useful. What we needed was a magnetic map over the entire head.” To this end, in the late 1970s, manufacturers working in the MEG space began to develop multi-SQUID MEG systems. By the mid-1980s, the first commercial multichannel systems were introduced. Instruments enabling whole-head measurements with the technology were constructed in the early 1990s.

This, in turn, prompted researchers to tackle the inverse problem: how to determine the location of electrical neural activity based on the magnetic signals recorded using MEG. Members of the burgeoning community of MEG researchers in several countries launched a concerted—and ultimately successful—effort to solve the inverse problem, allowing studies of many phenomena in the brain. Thus MEG finally came into its own as a means of revealing new information in the brain.

In the decades since, MEG has also been introduced into clinical care. It is most widely used today for both presurgical evaluation and surgical planning in epilepsy patients: for localizing epi-

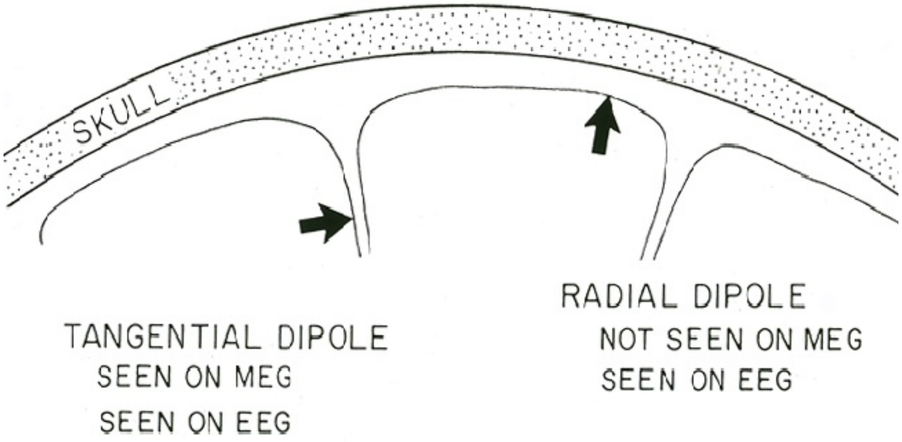
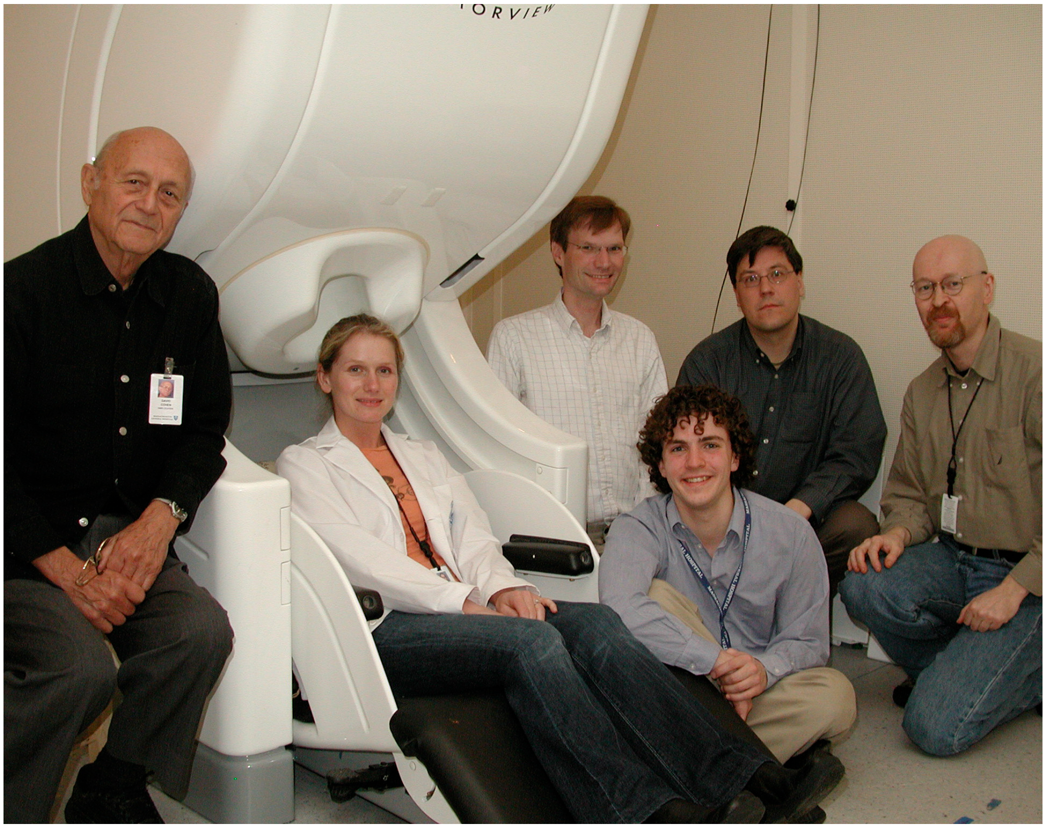


Figure 15: In later years, David would open courses he taught about MEG with the following description: The MEG sees only those dipole sources which are oriented parallel to the skull. It can be shown that the post-synaptic signals responsible for the MEG and EEG are always dipoles normal to the gray matter surface of the brain. Shown here are gyri and sulci. The MEG sees only dipoles in the walls of the sulci, but it sees these more accurately than does the EEG. However, just how much better has been a point of contention for many years.

Figure 16 (right): David during construction of the rectangular shielded room at the MGH Martinos Center for Biomedical Imaging, circa 2001.

Figure 17 (below): The staff members in charge of the completed MEG facility at the MGH Martinos Center. From left to right: David; technician Deirdre Foxe, neuroradiologist Steve Stufflebeam, technician Dan Wakeman, researcher Seppo Ahlfors, and group leader Matti Hämäläinen.



leptic discharges, determining the language-dominant hemisphere, and more. But other applications are emerging.

Clinicians are exploring, for example, the potential of the technique to aid in the diagnosis of schizophrenia. Historically, such diagnosis was based on clinical assessment and evaluation of patients' self-reported experiences, especially as their symptoms become more evident over time. As a more objective measure, MEG could offer a means to identify biological markers of the disease. Applications in autism and traumatic brain injury (TBI) are also on the horizon.

The usefulness of the MEG lies in the fact that it sees less than the EEG does, but sees it more accurately. (See Figure 15.)

David has kept quite busy himself.

In the early 2000s, Finnish researchers Matti Hämäläinen and Seppo Ahlfors moved to the Athinoula A. Martinos Center for Biomedical Imaging at Massachusetts General Hospital in Boston as part of an endeavor to launch an MEG program—adding to the center's pioneering efforts in multimodal imaging. To build the shielded room for their MEG system, they enlisted none other than David Cohen, PhD, recently retired from MIT. Joining the Martinos Center's faculty as an associate professor at Harvard Medical School, David oversaw construction of the room and, in the years and decades that followed, helped steer the direction of the MEG program.

In 2018, the Martinos Center recognized David's contributions to the center and his foundational role as the "father of MEG" by renaming the Center's advanced MEG facility the David Cohen MEG Laboratory. The rechristened facility honored an extraordinary career in biomagnetism, a career that now spanned 70 years and a few months, dating back to when he entered the graduate program at the University of California, Berkeley, in the fall of 1948.

Today, at 97 years old, David still plays an active role in advancing the field of study he launched more than half a century ago. Not least: In 2022, he established the David Cohen (DC) Biomagnetism Fellowship. This five-year postdoctoral program supports MEG researchers in developing experimental and analytical tools to measure ultra-low-frequency or direct current (DC) magnetic fields originating in the body—and in applying those tools to basic science and clinical research studies of neurological, psychiatric or other disorders.

It's a long way from tinkering with crystal set radios in a basement workshop in an immigrant community in Winnipeg. And yet, it's not a long way at all. David identified early in life an interest in the principles of magnetism and hasn't stopped pursuing this interest—this passion—in the nine decades and counting since.

Parents who could not understand his desire to pursue science. Struggles with feeling unprepared for the coursework in graduate school. The higher-ups at Argonne deciding not to fund his seemingly fanciful but ultimately fruitful ideas. And academic antagonists denying him tenure at the University of Illinois. These and any number of other challenges and setbacks might have derailed him, convinced him to give up once and for all the study of biomagnetism. But he never did.

He kept looking forward, even after, at age 42, he successfully demonstrated the potential of measuring biomagnetism with a SQUID and a shielded room, and in the process launched a new field of study, the full significance of which, for both science and medicine, has yet to be felt. Well more than 50 years later, the field—and David's impact—only continue to grow.

Figure 18: David and the next generation of MEG researchers celebrate the chiristening of the David Cohen MEG Laboratory at the MGH Martinos Center, Dec. 17, 2018. David is fifth from the left. The tallest person on the right is Sheraz Khan, David's partner in special low-magnetism technology. Photo courtesy of Dimitrios Pantazis.