FAMILY FRIENDS & PHYSICS

TED GEBALLE

CREDITS

INTRODUCTION

You, my children, grand and great grandchildren, nieces and nephews, and friends were interested in my early life and you wanted to know more when we took that bus ride around my San Francisco haunts on my 90th birthday. So now during my 96th trip around the sun I invite you, from Gordon to Ezra and others still to come, to take a virtual bus ride with me from San Francisco, to Berkeley, to Bell Labs, to Stanford and finally to the shores of Pescadero where, thanks to Sissy's optimistically long-range plan, I will end. Along the way I will be only somewhat chronological, I will skip around as my memory dictates. Not everything will interest you—just jump off or on the bus as you like.

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SAN FRANCISCO, CALIFORNIA

GROWING UP I HAD THE RUN OF THE CITY AND
ROAMED ALL AROUND BY FOOT, BIKE & TROLLEY.
I WOULD SIT BEHIND THE MOTORMEN
ON THE MUNIS AND WATCH THEM RACE
THE MARKET STREETCARS ON THE INSIDE TRACKS.

EARLY DAYS

MY CHILDHOOD

I was born on January 20, 1920 at Children's Hospital in San Francisco where my mother was born 26 years earlier and where son, Ernie, and granddaughter Lizzie, were born 48 and 64 years later. My parents named me Theodore because my father was a great admirer of President Theodore Roosevelt. As a young lawyer in Redding, California, Dad went around giving speeches for Roosevelt before I was born. As for Henry, my Grandma Geballe was Henrietta and my Grandpa Geballe's middle name was Henry. I can't claim to have been an easy child. Aunt Marion, my mother's younger sister, told me I had a temper tantrum at age two, ripped off my bonnet and threw it out of the baby buggy into the middle of the four streetcar tracks on Market Street.

One early memory is waking up from my nap furious when I became aware that I had been left behind with our nice Italian maid, Palmera, while my older brother, Ron, and my parents went to the top of Mount Tamalpias on an "iron horse" steam engine. Tamalpias looked pointed from my window, and when they returned I asked Ron if he could sit on the point. Everybody laughed and that made things worse. Ron and I were two years apart and I tried to keep up with him. At breakfast I sat opposite him. When Ron used his right hand I used my left. My parents thought I was imitating him and persuaded me to switch hands. I became semi ambidextrous—right-handed when it comes to writing, eating and playing tennis, left-handed when throwing, and left-footed when punting. Maybe that is why I didn't inherit my mother's good sense of direction. When I get out of a strange elevator I have a 50% chance of heading the right way.

Ron was born in Redding with a large black birthmark, feared to be cancerous, on the right side of his forehead. Only two decades after the Curies discovered radioactivity in Paris, the hospital in rural Redding had a source, but evidently not much experience. Doctors burned off Ron's mole plus the underlying flesh down to the bone, leaving a vulnerable scar. That

WITH BIG BROTHER RON

THE GEBALLE FAMILY AT 5245 CALIFORNIA STREET WHERE I LIVED WHILE AT SUTRO SCHOOL AND PRESIDIO JUNIOR HIGH

"1,2,3, HIKE!"

didn't prevent me from punching him when we roughhoused. Once when the grownups left us alone, I turned to Ron and said, "Now we can fight it out." As usual, he defended himself without hurting me. I comforted myself with the threat, "Wait until you're 72 and I'm only 70!" We reenacted that fight in 1990 in Seattle, Washington.

Another time I picked up my little rocking chair ready to bash Ron, and shouted, "I'm the king of England!" Hearing the ruckus, my Dad rushed in saying, "If you're the king of England, then I'm the queen of Egypt!" He took me over his knee and spanked me. As far as I can remember that is the only time I was spanked, but the king/queen repartee became a family legend.

We grew up in the Richmond District, which is in the northwest corner of San Francisco, bordered by Golden Gate Park to the south, the Presidio and Golden Gate to the north, and the Pacific Ocean at the western edge. Here are things that I remember from childhood:

Playing outside until dark on the days when my Dad was traveling up and down the Sacramento and San Joaquin valleys selling to family-owned shoe stores (not the "rival" chain stores), while Ron stayed home helping our mother.

Leaning over the back staircase and shouting to the garbage man the important news (according to four-and-a-half-year-old me), "My parents have been married 10 years, 10 long, happy, married years!"

Playing a wrestling sort of game that we called tackle football on the small front lawn of our house at 427 12th Avenue.

Learning to dog paddle while my mother coaxed me in the Western Women's Club swimming pool, and afterwards consuming a delicious roast beef sandwich with plenty of gravy at the nearby White House department store.

Picnicking at Searsville Lake with the Harry Geballes and catching pollywogs in the muddy water with cousins, Miriam and Bea. It is now off limits to the public and is part of Stanford's Jasper Ridge Biological Preserve where John Fox and I take our freshman seminar on a highly regarded field trip.

Spending one summer in Los Gatos to cure my bronchitis. It seemed to work until we ran into San Francisco fog on the way home. I let out a deep cough and my mother followed with a deep sigh.

Learning to like dogs (we didn't have one) and dislike cats when my Dad read us *The Bluebird of Happiness*.

Walking with my Grandpa Glaser around the coast from Sea Cliff to Sutro Baths and the Cliff House at Land's End.

Learning about fractions before first grade by following batting averages in the sporting green of the *San Francisco Chronicle*. I knew when Earl Averill hit two for three he was batting .667.

Playing street hockey on roller skates on 12th Avenue—taking time outs when we spotted an automobile. One time I was in such a hurry to play that I didn't change out of my new corduroy school pants and ripped them when I took a good spill. I tried to mend the hole with a Band-Aid. Instead of scolding me my mother said she hoped I had learned a lesson.

Crossing wide Geary Boulevard on 12th Avenue to get to school quicker than crossing at 13th Avenue where my mother had led the PTA effort to place a traffic officer.

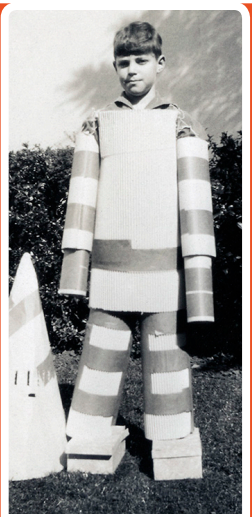
Being quiet in restaurants because we were told Jews shouldn't be conspicuous, but there I was in the school yard telling a playmate from the "Home," a nearby Catholic orphanage, "I am an American first, and a Jew second, and that is the very best that anyone can be!"

Learning my first dirty joke from another boy from the Home: "A boy was walking home from school, stubbed his toe and shouted, 'Aw shit!' Just then he spotted a priest nearby and quickly added, 'and two makes eight.' " I liked the joke because of the naughty word and the quick wit.

Finding it confusing that, when we assembled for the pledge of allegiance in the morning, the principal was called Mister Ant when he was a woman. By second grade I found out that her name was Miss Durand.

Playing the part of "milk" in the school play. My teacher advised me to say my one line much louder so I could be heard. I shouted, "Out, out, bad coffee!" so loudly that the audience laughed, and milk won the day.

Going to my first football game in Berkeley at age six and taking the Golden Gate Ferry and Southern Pacific train with my Dad to what was then the



ON A SUNDAY WALK WITH GRANDPA GLASER

CLOSE COUSINS RON, BEA, MIRIAM AND ME

MY COSTUME FOR A SUNDAY SCHOOL PARTY

MY SIXTH GRADE CLASS. I'M IN THE TOP ROW, SECOND FROM THE RIGHT;- CARL FOORMAN IS STAND-ING ON THE RIGHT HOLDING A BOAT

new Memorial Stadium. I cheered for Cal while they lost to St. Mary's 7 to 26. I learned early to "wait until next year."

Finishing first in an arithmetic contest. The teacher had us go to the blackboard and rattled off a bunch of numbers for us to write down and then add. I did the addition in my head as she was talking and just wrote down the answer. Classmates told me I had cheated by not following the rules.

Listening to my favorite teacher, Miss Sayles, read Dr. Doolittle stories to us in fourth grade.

Being the teacher's pet in 6th grade. Miss Burke would excuse me from class to get her a hamburger for lunch at the corner store because I knew all the words to "I Love You, California." I can still sing them.

Losing the debate in which I took the affirmative side, "Resolve that the United States should recognize the Soviet Union." Posters showing rosy-cheeked Russian women working happily under the Five Year Plan influenced me. Carl Foorman took the isolationist side and won the debate. He remained a close friend for the next 80 years. We had many happy times together in school, on dates, in the army, and raising our families. He was an only child and I liked to go with him and his parents to Carmel on spring vacation. Carl liked to come over for dinner and join in our wide-ranging topical conversations.

Gathering around the piano after dinner. My mother, a good sight-reader, would play and we would sing. Gilbert and Sullivan songs were and still are favorites. I was also fond of *Carry Me Back to Old Virginny*, *My Old Kentucky Home*, and other Stephen Foster spirituals. Now the words have been altered to be politically correct but I think the originals faithfully convey the humanity.

Learning that my Dad had lost a lot of money when the stock market crashed in 1929. I tried hard to help. I said I'd like to become a fisherman, "Because you don't have to pay anyone for the fish." Over spring vacation I somehow found a "job" with a florist on Clement Street helping to sell Easter lilies. At the end of the week I used my earnings to buy a beautiful lily for my mother. I didn't understand why she was not overjoyed when I gave it to her and soon found myself enrolled in Sunday school at Temple Emanuel.

Delivering the *Saturday Evening Post* with Norman Rockwell covers and stories by Clarence Budington Kelland and Octavus Roy Cohen. Eventually I had enough customers in the Richmond District to earn a sturdy Schwinn bike, which I could ride to Presidio Junior High on 29th Avenue. I also sold handkerchiefs to my *Post* customers and others. This happened through the courtesy of my Aunt Alice's brother, Alfred Kohlberg, who owned a factory in China that made beautiful embroidered handkerchiefs everyone admired. Alfred later became a strong right wing supporter of Chiang Kai-shek and

We lived a block from Lincoln Park where the golf course had spectacular views of the Golden Gate. We watched the bridge being built From the fourth hole. Grandpa Glaser pointed out how many tiny wires, strung back and forth between the suspension towers, supported the bridge—an example of "united we stand," he said.

tangled with Ron over loyalty oath issues at the University of Washington. Ron was hosting an International Physics meeting there. Outstanding Soviet physicists had been invited and the right wingers were trying to exclude all communists from the campus.

Working in the stock room at the Glaser Shoe Company during some Christmas vacations. Compared to Ron, who my parents thought was more interested in music and books than in making a living, I was the entrepreneurial one. When I went to Berkeley and discovered real science I think my parents were surprised by my academic choices. My Dad would have been happy for me to take over the family business.

Moving into a less expensive flat at 441 33rd Avenue after the stock market crash, which left my Dad owing money that took him many years to pay back. But life there was even better. I had a garden where I grew vegetables. Our kind neighbor, Edna Wolff, showed me how to defeat hungry snails with used coffee grounds. We walked over sand dunes and picnicked on the beach.

Getting up at 4:30 a.m. on weekends to sign up my Dad and Uncle Harry for a starting time at the Lincoln Park municipal golf course. I played there during high school days with Warren Berl and Sherman Selix who were much better and shot in the 70's, and with Art Cerf who was in my league. We shot in the low 100's on a good day. I liked football, tennis, basketball, and swimming, but thought there was too much standing around in baseball

Worrying during the summer of 1930 when Ron had to stay in bed while the surgeon at UCSF grafted tissue from his stomach to his wrist and then from his wrist to his forehead to cover his scar.

Getting mad in seventh grade when my Presidio Junior High classmates teased me chanting, "Theodore, Theodore!" I stood up and yelled, "The next person to call me Theodore is going to get a sock in the nose!" The response, of course, was a chorus of

Theodores. That was my last temper tantrum and my first lesson in public relations.

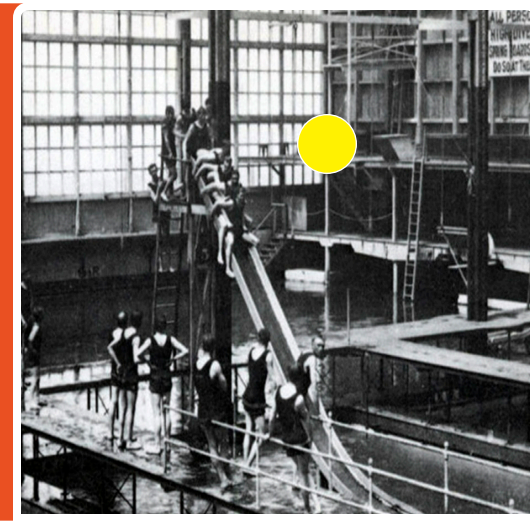
Following Ron into Boy Scout Troop 17 and making new friends from other schools. Walt Miller became my best friend, and remained so for the next eight decades. The troop was nonsectarian, but mostly Jewish. We met at Temple Emanuel. I started high school at Lowell where my Dad, Uncle Harry, Ron and Miriam had gone and the Geballes were well known. The Lowell building was soon shut down for earthquake proofing. We were sent to Galileo High for half-day sessions with Galileo students going in the morning. It was more than I could take to see Walt, Carl, Ed Nathan and other friends leaving school with a free afternoon ahead just as I was arriving for classes. I defied our family tradition and transferred to Galileo. Walt became my roommate for all four years at Cal.

Having an unusual scoutmaster whose real name was Arthur Myer but we called him Pie. He was the first Eagle Scout in California and faithfully commuted from his Berkeley home to open Troop 17 Friday night meetings promptly at 7:17 p.m. Most of us can still recite: "A scout is trustworthy, loyal, helpful, friendly..." He took us on hikes, campouts and swims to Sutro Baths. We city boys experienced the great outdoors, poison oak and all, at Camp Royaneh, the scout camp in Cazadero. Pie would shake me out of a sound sleep at 5:00 a.m. to go on a bird hike. I remember the rude awakening more than the birds we saw.

Coming down with typhoid fever, an almost unknown occurrence in San Francisco back in 1934. By a process of elimination the culprit was identified as firewood contaminated by city sewage discharged into the shallow ocean at Baker's Beach where we had had a Troop 17 cookout. Our house was quarantined. I developed a high fever and still remember how good it felt to my parched mouth when intravenous feeding was initiated. When I finally gained enough strength to get out of bed my feet were so tender that I learned the true meaning of "walking on pins and needles." Ron came home from school and played with me almost every afternoon.

OUR TROOP VISITED ANDREW ROWAN, THE SPANISH-AMERICAN WAR HERO. HIS 1899 MISSION WAS TO DELIVER A MESSAGE TO CUBAN REBEL LEADER, CALIXTO GARCIA. NO ONE KNEW GARCIA'S WHEREABOUTS, BUT WITH INITIATIVE AND SELF-RELIANCE ROWAN ESTABLISHED CONTACT. HE WAS EULOGIZED IN A POPULAR ESSAY, *A MESSAGE TO GARCIA* AND HIS STORY WAS TOLD IN A 1936 MOVIE.

AT SUTRO BATHS THERE WAS A HOT POOL, AN ICE POOL, AND A HUGE SALT WATER TANK. WE WOULD SWING OUT ON A ROPE AND DROP INTO THE ICE-COLD POOL TO PROVE SOMETHING, I'M NOT SURE WHAT.

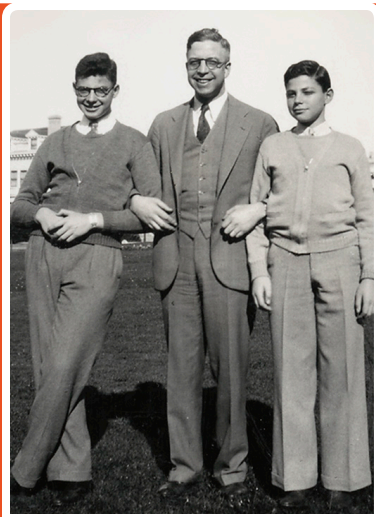


Moving to 1800 Franklin Street partly because there was an elevator in the building and my doctor, Ed Solomon, a friend of my Dad since their own Lowell High days, was concerned about not taxing my heart while I recuperated.

Staying awake the first night listening to the pulley rattling outside my window as it guided the cable up the steep Sacramento Street hill. It never bothered me again. However, the cable car tracks did pose a challenge on wet days when I was learning to drive. It required a deft touch to move our Desoto up the slippery tracks without riding the clutch. If you don't know what the latter means, you probably don't know what a slide rule is either. Today you don't need to know either but, for 16-year-old me, they were both important.

Taking the train across the country in 1935 to attend the Boy Scouts' national jamboree in Washington, D.C. I made it as far as Henry Ford Hospital in Detroit, Michigan where I may have received special treatment because someone told them I was Ford's grandson. They extracted fluid from my spine and determined I had a light case of infantile paralysis. I was hospitalized for a week, and was able to return with the scouts on their way back to San Francisco.

Walking across the Golden Gate Bridge in 1937 on opening day with my girlfriend, Barbara (Babs) Shainwald. We had good times growing up together inside and outside of Galileo. Her folks had a great place on the California side of Lake Tahoe where I learned to water ski. Sissy's brother, Dan, was a guest there too, but at a different time. Babs' mother was anorexic and demanding. Babs knew instinctively how to avoid trouble but her two younger sisters didn't; they were treated badly, which made me uncomfortable. Babs went on to Stanford and after we "broke up". She later married Ernie Rogers. He had been my patrol leader when I joined Troop 17 and we were friends. In later years our families would get together for summer visits when we were at Glenbrook in Lake Tahoe and they had a home in nearby Fallen Leaf Lake.



WITH RON AND DAD

RON AND I IN TENNIS WHITES, WITH MOM

ON OPENING DAY I WALKED ACROSS THE GOLDEN GATE BRIDGE WITH MY HIGH SCHOOL GIRLFRIEND, BABS.

ISIDOR GEBALLE IN 1883

BROTHERS OSCAR (LEFT) AND HARRY

THE MEDINA, NEW YORK, HOUSE

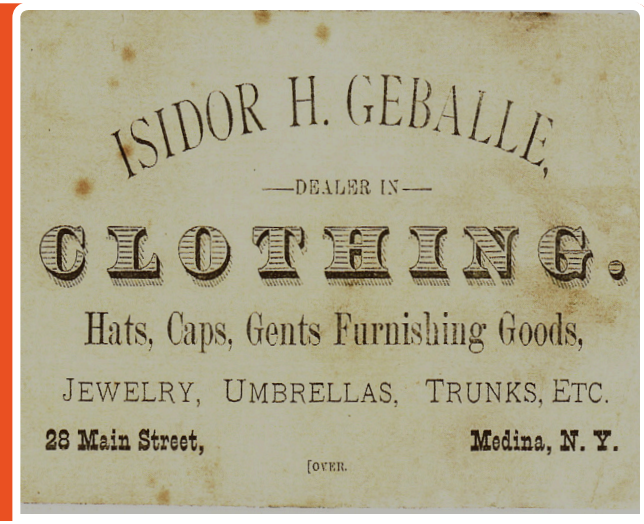
FAMILY HISTORY (1846–1920)

Both of my grandfathers emigrated to the US from Posen, then part of Prussia. The Geballes came from the Polish side of the Polish/German divide in Posen and the Glasers came from the German. Grandpa Geballe maintained little contact with Posen relatives but thanks to distant cousin Friedrich Geballe we know something about them. We had no knowledge of Friedrich until after World War II when Ron and Tom Geballe exchanged letters with him. Friedrich had survived the war as an engineer in Haifa, Israel and after the war returned to Hamburg, Germany. He wrote that Zwi Hirsch, a teacher in Posen, chose the surname Geballe when Posen became Prussian in about 1795, and Jews were required to select family names. "The name Geballe may be based on the Hebrew word *Gewulim*, meaning 'those who live on the border,' or on the Arab word *Djebalin* meaning 'those who live on the mountains,'" Friedrich wrote, saying that Zwi had three sons, Julius, Isidor, my grandfather, and Lippmann. At Duke Medical School Adam met Marie Grauerholz, a great granddaughter of Lippmann, who was only vaguely aware of her Jewish roots. She told Adam that Lipman (her spelling) had worked as a tailor, changed his name to George Balle, married a schoolteacher, and moved to South Carolina.

Grandpa Isidor Geballe was born in 1846 in Ritschenwalde, Posen. He emigrated to the United States, landing in New York City, and soon moved upstate to Rochester. He peddled goods on a wagon, eventually settling in 1875 in the small town of Medina where a lot of Poles lived along the Erie Canal. There he founded a clothing and furnishings store and a year later married Henrietta Lesser, the sister of his first wife who had died. She was born in Philadelphia in 1858 and told me she remembered watching Union soldiers marching down Market Street during the Civil War. Her father, Hertz, moved the family to

THE MEDINA GEBALLES

FRONT, LEFT TO RIGHT: ISIDOR, HENRIETTA AND PAULINE; BACK: HARRY, SELMA, LOUIS AND OSCAR



ADVERTISEMENT FOR MY PATERNAL GRANDFATHER'S STORE IN MEDINA, NEW YORK

Rochester where he had a buttonhole manufacturing business. Isidor and Henrietta had three sons, Louis, Harry and my Dad, Oscar, and two daughters, Pauline and Selma.

My Dad was born on June 23, 1891. In the late 1970s he wrote in his memoir, "There were only three Jewish families in Medina so we had no congregation, no Sunday school. None of us children were confirmed or barmizvah'd (sic), as that would have required going to Rochester or Buffalo for preparation (40 miles away). But we did learn plenty from our father about Jewish history, customs and religious observances." Dad continues, "We always received and gave Christmas presents… stockings were hung on the mantel… It was a very nice gesture on the part of our parents and did us no harm. We never thought of it as a religious holiday. We had our Chanukah with the candles and the prayers."

The family kept a pony and raised chickens. At the turn of the century Isidor rode in one of the first automobiles in Medina in the Fourth of July parade. He owned the first phone in Medina, mainly used to announce when he was coming home for meals. When the Bell Telephone Company came to sell stock in a long distance telephone system, he and the other town fathers calculated there wouldn't be enough trees to make the telephone poles, and declined to invest.

Isidor died in San Francisco six months before I was born. Dad said Isidor spoke excellent English without an accent and wrote beautifully. His evidently not so subtle humor may have been passed down to me. One of his favorite jokes became a family legend: "Why is the Fourth of July?" That question would get a puzzled look until he added, "and 'l' is the third of July." He also liked the song, *I want to go to Morrow and get back to Day* (two stations on the railroad). One of my high school favorites was, "Knock, knock. Who's there? Highway cop. Highway cop who? Highway cop early in the morning." Ha, ha. I raised my hand and asked our pretty Econ teacher, "Miss Watts, I don't understand supply and demand. Consumption be the matter with me?" No ha ha, but I think I got a

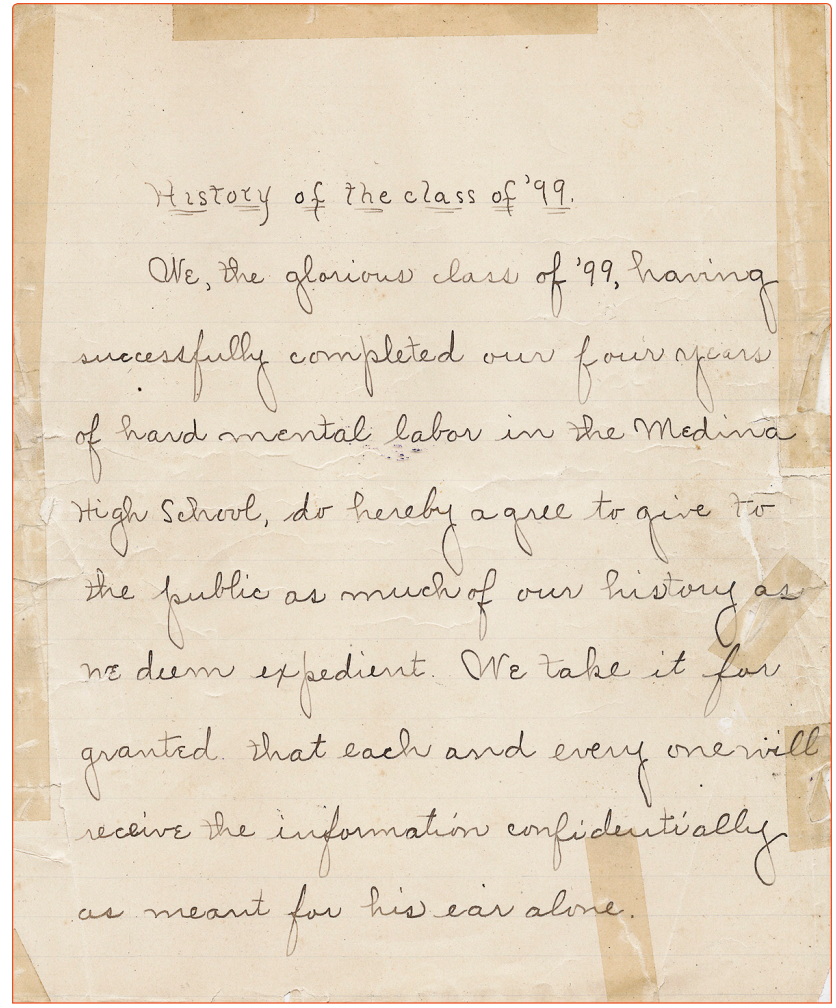
smile. I have opened my talk at a crammed Physics meeting with this line I picked up in a public speaking seminar at Berkeley: "I feel like an Egyptian mummy up here today, pressed for time."

Aunt Pauline's humor is evident in her valedictorian speech at graduation, " It seems incomprehensible to us, that we, entitled to special honor as the last class of the nineteenth century, should have been treated like any ordinary class by the board and faculty… We tremble to think what the future of the Medina High School will be without our inspiring presence and influence."

Aunt Pauline went on to earn a degree in Chemistry at Smith College and became a well-known high school chemistry teacher in Portland, Oregon. Uncle Louis worked in Rochester at a bank, but the dream of California brought the rest of the family west in December of 1904, traveling by train to San Francisco with Grandma hiding her pet canary. The family moved to a house at 2170 Post Street across from Hamilton Square, and Harry and Oscar went to Lowell High.

After the earthquake of 1906 the family fled the house for good, camping out for a couple of nights, then moving in temporarily with Aunt Jessie Lesser before settling down in a house on 18th Avenue in the Richmond District. Dad graduated from Lowell in 1909 where he was casually acquainted with Sissy's Dad.

My mother, Alice Glaser, was born on January 18, 1894, the oldest of her siblings, Walter, Helen and Marion, and until the end she was the glue that kept the family close. Her father, my Grandpa Glaser, had a strong but amateurish interest in science to go along with a strong classical education at the gymnasium he attended. He told me he left Posen at 18 because as a Jew he couldn't be an officer in Bismarck's army. Grandpa came right to San Francisco where he had cousins and got a job installing glass panels in Sutro


History of the class of '99.

We, the glorious class of '99, having successfully completed our four years of hard mental labor in the Medina High School, do hereby agree to give to the public as much of our history as we deem expedient. We take it for granted that each and every one will receive the information confidentially as meant for his ear alone.

I still have Aunt Pauline's notebook with the first page of her high school valedictorian speech from 1899.

After the big earthquake in April of 1906 Harry wrote to brother Louis:

Oscar and I were awake early and laughing when with a terrifying rumble and grumble and roar—the earthquake started. We were shaken as a dog shakes a rat; the globes on the gas jet crashed to the floor, the bureau came to my bed to say 'Good morning' but the bed, with its amazed and trembling occupant, was trying to send the bookcases into the middle of next week…. Our room was filled with fallen pictures, bric-a-brac etc., while outside the north window we could see a house cracked from its foundations and leaning on two neighbors. Laughing like fiends we ran downstairs and tumbled into a soaking kitchen with the tea-kettle on the floor and the gas stove trying to get into the hall. The kitchen pantry looked like—well as if children had thrown every kettle and pot in wild confusion on the floor…The plaster was off the kitchen ceiling, the piano and bookcase had tried to shake hands having lost every ornament they ever possessed while the dictionary stand had rid itself of its burden and lay peacefully on the floor…. (The house) came forward about six inches and fell westward until it struck the next house. Chimney's (sic), inside, are down and the kitchen floor is liable to go thru at any minute." They walked downtown where Harry wrote he "saw houses flattened and our famous and beautiful City Hall in ruins. I saw the Emporium, 'Calif's largest, America's grandest store' go down in the prettiest fire I ever witnessed." The family fled the house for good and camped out for a couple of nights, then moved in temporarily with Aunt Jessie Lesser before settling down in a house on 18th Avenue in the Richmond District.

Baths when it was being constructed. Grandpa described taking my Grandma Flora by horse and buggy to Lick Observatory on Mount Hamilton for their honeymoon. They moved to St. Helena, as San Francisco's summer fogs were not good for Flora's health. She had contracted flu during the epidemic after World War I.

Alice was sent to Elmhurst Ursuline Academy, a school run by Catholic Sisters in St. Helena. As one of two Jewish girls there she was excused from the religious parts. She played tennis with a nun who held her racquet in one hand and her habit in the other. In 1947, after the war, I drove mom and Grandpa Glaser back to their old haunts in St. Helena. When we stopped by the Academy a nun came out and said, "Why Alice Glaser, how nice to see you." I don't think mother had been there since she had moved back to the city and attended Girls High where the fight song was "Needles and pins, needles and pins—Girls High always wins." She carried a love of the countryside, the hills, trees, and fences all her life.

ELMHURST URSULINE ACADEMY, ST. HELENA; AUNT HELEN THINKS ALICE IS THIRD FROM THE RIGHT, SECOND ROW FROM THE BOTTOM

THE KING AND THE BOOSTER PLAYBILL

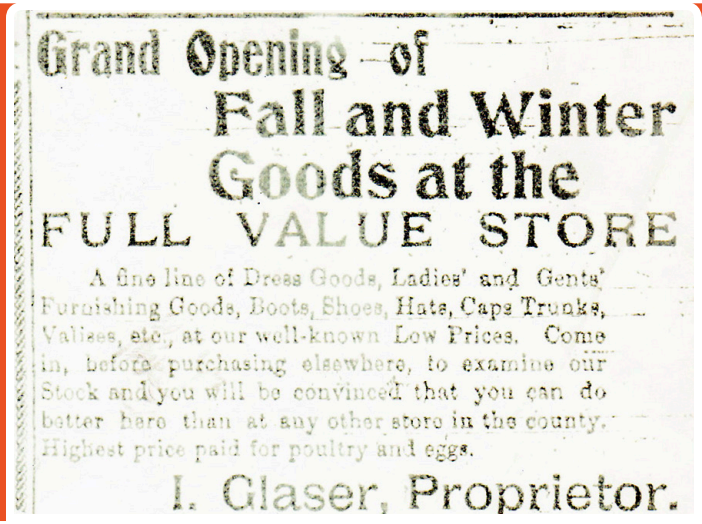
MY PARENTS WEDDING ON AUGUST 16, 1914 AT THE CALIFORNIA CLUB IN SAN FRANCISCO

THE SAN FRANCISCO GEBALLES: FRONT, LEFT TO RIGHT, ISIDOR, SELMA, HENRIETTA; MIDDLE, ALICE KOHLBERG GEBALLE (*LITTLE ALICE*), PAULINE, ALICE GLASER GEBALLE (*BIG ALICE*); BACK, HARRY, LOUIS AND OSCAR

In 1912 when Alice was 19 and Oscar 21, they met in rehearsal of the Council of Jewish Juniors production of *The King and the Booster*. Sometimes they were the last two to leave and they got to know each other as they walked home together. They were teased, "Alice baked a chocolate cake for Oscar's sake." They went hiking in Marin County, picnicking and watched baseball games together. Dad remained a fierce Giants fan.

Dad went to Hastings College of the Law, part of the University of California. After graduating in the class of 1913 he and brother Harry opened an office in the Phelan Building on Market Street with sister Selma covering office duties. But it didn't do well and Dad and his bride followed her uncle, Carl Shirek, to Redding where Dad opened his law office. They raised chickens and made life-long friends. Dad wrote, "I successfully defended a man accused of being insane, and when I saw him next day he said he was Jesus." In another case Dad won a verdict for a client accused of thievery who then ran off without paying him. Becky Hayden, a college friend of Phyllis', told us Oscar Geballe was famous in the Office of Price Administration during World War II for being ***the*** person who returned unused gas rationing coupons.

Mother contracted undulant fever probably from drinking unpasteurized milk. When Grandpa Glaser and Uncle Walter offered Dad a partnership in the wholesale shoe company they were establishing, my parents decided it would be a good time to return to San Francisco. Dad became the mainstay of the Glaser Shoe Company and stayed there until after mom died and he retired. He had his priorities—I heard him tell a customer to put out his cigarette and not to smoke in the office—yet the business grew and moved to 63 First Street off of Market Street. There were tensions afoot. Grandpa Glaser had many outside interests and was not contributing to the business. He was drawing a significant salary. Dad would have preferred to invest in the company. But with my mother's understanding peace was maintained. Grandpa set up a woodworking shop in the stock room complete with power tools. He made excellent bookcases for all the grandchildren. I took mine to Berkeley and used it throughout college.


Grand Opening of
Fall and Winter
Goods at the
FULL VALUE STORE

A fine line of Dress Goods, Ladies' and Gents' Furnishing Goods, Boots, Shoes, Hats, Caps Trunks, Valises, etc., at our well-known Low Prices. Come in, before purchasing elsewhere, to examine our Stock and you will be convinced that you can do better here than at any other store in the county. Highest price paid for poultry and eggs.

I. Glaser, Proprietor.

AN AD FOR GRANDPA GLASER'S "FULL VALUE STORE" IN ST. HELENA

UNCLE WALTER AND DAD OUTSIDE THE ORIGINAL GLASER SHOE COMPANY IN SAN FRANCISCO

Mother and her sisters seemed more like girls than adults to eight-year-old me when they joked and giggled during the 1928 summer we lived together in a big house in Burlingame. Then one night I woke up and they were all sobbing—their mother had died.

Grandpa Glaser never remarried. I had sumptuous Sunday breakfasts with him downtown at the Union League Club followed by nature walks around the Golden Gate. He liked to go to the movies. Deanna Durbin was his favorite because she had it all—Jewish, beautiful, and a lovely singing voice. I think he went to all of her movies more than once. He also loved his weekly pinochle game with Rube Goldberg's father. When I went to Temple with him he sat in the front row, chanted and fell asleep, and then would tell the rabbi how much he enjoyed the sermon. During the summer I spent in Long Beach with the Steinaus (Aunt Helen, Uncle Edgar, Shirley and Alan), Grandpa visited and took me to Griffith Observatory in Los Angeles. This was in 1936 when the Nazis were preaching Nordic superiority but not yet practicing genocide. He asked our blond guide, "You're Jewish, aren't you?" The young man replied, "Yes." Later I overheard a friend ask why he had answered yes. The guide replied that he just wanted to make the nice old man feel good.

After Grandpa Glaser suffered a heart attack he temporarily moved in with us to recuperate. During a heated dinner conversation I said, "Don't be silly, Gramp." That was too much—he turned red in the face, stood up to his full 5-foot plus height and angrily retorted, "Don't call me silly!" My mother later explained to me his Germanic upbringing was much stricter than ours. When it got so Grandpa couldn't continue living in the Union League Club his children located a French family to take care of him. Rather than resenting being moved he told me he was looking forward to it because he would have a chance to brush up on his French.

Grandpa had maintained contact with his family back in Germany. After the Nazis took over and when it was still possible for Jews to get out, we were able to bring his cousins to the Bay Area after assuming financial re-

17

My great grandmother, Rosalie Shirek, left her home in Germany to live with my parents in St. Helena. She expressed her home sickness in her poems, here translated from High German by Aunt Helen. She wrote the first poem about my mother, the second after a visit to Germany.

Don't despair. Shall I despair? No.
Although my heart is breaking I will not despair.
I pray lovinwgly to God above me.
He comforts me and gives me a daily bread.
I live now in St. Helena
and enjoy Alice Glaser's company.
She is so dear and kind
and cares about her grandmother.
She tells me to stay and never leave her.

It was good to be home
and sit around the dinner table.
But it was not my house any more.
I felt I had to go back to San Francisco.
I needed to be with my husband and my children.
It was time to say farewell.
My body was trembling
having been in my hometown again.
I stood at the gravestones of my beloved ones,
What I had wished in my dreams came true
And I wanted to rest there forever.
Alas, it was not to be, I had to tear away.
I hope that on earth I will find this joy again.

What will it be like for our families in the future? I hope our visions and choices turn out to be as wise as our grandparents' were. We have already spread out from the Bay Area Oasis and found new homes in the north, east, south and west. Jet travel and the information age assure that no one has to face the disconnection that Rosalie endured. We are enjoying a golden age of acceptance and assimilation. Is it naive to think this golden age will endure? Possible crises looming in the next century including overpopulation, water, energy, pollution, disease, global warming, and unsuspected ones arising from the present fluid societal changes, frequently call for scapegoats. Jews are conveniently available. Last time that happened people who considered themselves to be completely assimilated ended up in concentration camps. The Jewish heritage of our family is inclusive. The marriages and adoptions in our middle generation have added strength and talents to Geballe-Glaser genes. I hope the Jewish heritage in some form does not disappear.

sponsibility. I was shocked to see the ugly scars on an older cousin who had been whipped. A Shirek cousin about 10 years older than I stayed at our house for a while. My Mom impressed upon me how well he was brought up when she pointed out, "See, when he takes his pants off he hangs them up in the closet." Mom, as a member of the Council of Jewish Women, spent many mornings on the docks meeting refugees as they debarked, helping them get settled and making good use of the German she had learned on her Grandma Shirek's knee.

Grandpa Glaser had eight grandchildren–seven boys and Shirley who was beautiful and loved by all of us. Ron and I were the oldest. December 25th was Grandpa's birthday and we always had a family celebration. When Grandpa wanted to name one of us he would start with Ron and then run down the list chronologically until he got to the grandchild he had in mind.

We spent lots of time with the Harry Geballes because Uncle Harry and Dad were close brothers. Cousins Miriam and Bea were like sisters. Sunday dinners were often spent together at Girard's, an inexpensive, delicious, family-style French restaurant in downtown San Francisco. I salivated watching the waiter tenderize the abalone which he pounded with a large wooden mallet. The adults would go home and play bridge. I kibitzed and became a pretty good bridge player. I didn't keep it up because at college science took over.

CELEBRATING GRANDPA GLASER'S BIRTHDAY ON DECEMBER 25TH

On Uncle Harry's birthdays he would recite John Greenleaf Whittier's *Snowbound* recalling The Blizzard of 1888, the year of his birth, beginning,

The sun that brief December day
Rose cheerless over hills of grey

and after 32 stanzas ending,

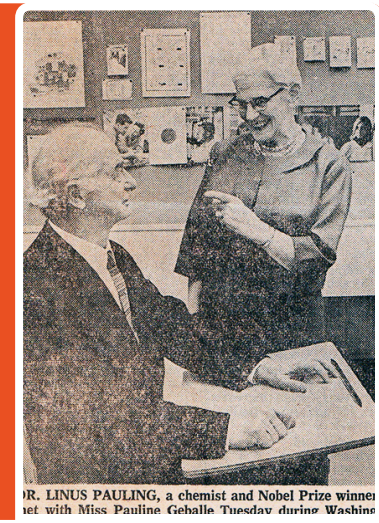
The traveller owns the grateful sense
Of sweetness near, he knows not whence
And pausing, takes with forehead bare
The benediction of the air.

He would then continue with *The Cremation of Sam McGee* and we all joined in with, "It's the first time I've been warm."

Miriam and I surprised him once by reciting the whole poem as a birthday present. Dad, as befitting his life-long affection for baseball, would offer *Casey at the Bat* starting with, "The Outlook wasn't brilliant for the Mudville nine that day," and ending sadly, "There was no joy in Mud-

RON AND TED IN SELMA AND CHARLIE'S ORCHARD IN LOS GATOS

FROM A NEWSPAPER ARTICLE: *DR. LINUS PAULING, A CHEMIST AND NOBEL PRIZE WINNER, MET WITH MISS PAULINE GEBALLE TUESDAY DURING WASHINGTON HIGH SCHOOL'S 60TH ALUMNI REUNION. MISS GEBALLE, 85, SAID SHE REMEMBERED PAULING AS 'THAT SHY LITTLE BOY WHO WAS IN ONE OF MY CHEMISTRY CLASSES MORE THAN 50 YEARS AGO.'*


DR. LINUS PAULING, a chemist and Nobel Prize winner
met with Miss Pauline Geballe Tuesday during Washing

ville—mighty Casey had struck out."

I was 10 when Aunt Selma and Uncle Charlie Gaffney were married at Grandma Geballe's house on 17th Avenue. They had no children and were especially good to their nieces and nephews, Miriam, Bea, Ron and me. Having a Catholic in the family was new but everyone approved. Neither Charlie nor Selma was religious. They lived on a ranch in Los Altos and commuted by electric streetcars all the way to their government jobs at Fort Mason in San Francisco. I was fascinated to watch the chickens racing around after Uncle Charlie chopped their heads off for Sunday dinner. The beautiful apricot orchard we romped around in is now asphalt pavement and houses. Aunt Selma moved into a retirement home in Los Gatos after Uncle Charlie died. Sissy and I celebrated her 90th birthday with her many friends. When she got up to thank us she said, "I want to be around as long as the elevator runs upstairs." I agree.

Aunt Pauline also had no children, but she had her nieces, nephews and students. She taught high school chemistry with enthusiasm. In his biography Linus Pauling recalled having Miss Geballe as his science teacher when he was a 12 year-old freshman. "I can remember her carrying out an experiment to show the pressure of the atmosphere. She had a Log Cabin Syrup can with a little water in it. She boiled the water for a while, screwed the top on, and then let it cool and it collapsed." Another of her former students, John Galt, later became a good friend at Bell Labs. Aunt Pauline came to visit us every summer. She taught me my first chemistry lesson:

Johnny was a chemistry student
Johnny is no more
For what he thought was H_2O was H_2SO_4.

THE CAMPANILE ON THE CAL CAMPUS
BERKELEY, CALIFORNIA
BERT MYERS, A SHERIDAN FRIEND, TOOK THIS PICTURE WHICH HANGS IN MY STUDY. LATER WE WERE IN THE SAME ORDNANCE TRAINING PROGRAM.

CAL & THE WAR YEARS

SCIENCE & COLLEGE

I went to Berkeley mid-year just before my 17th birthday. I learned more in the first weeks of freshman Physics than I did in a year at Galileo because we started from principles rather than formulae. It was new to be treated as an adult and make my own decisions. But I soon found there was a price to pay. The line to register and pay the $26 fee (that's what tuition cost then!) was extremely long. When I finally got to the front of the line I was sent all the way back to the end by the sadistic registrar because I hadn't entered San Francisco as the county of my residence—I had only filled in the city box. I happened to sit near Dan Koshland in the large Chem auditorium listening to Professor Hildebrand's famous Chemistry 1A lectures. We ended up studying together. Dan was funny and smart and when he invited me home to San Mateo one weekend, I was glad to accept. I met his sister, Sissy, who was going to San Mateo High, and I noticed something special. I eagerly accepted an invitation to go back. Later I asked Dan if he thought it was all right for me to ask Sissy to the Scabbard and Blade military ball at Cal. He parlayed this into claiming he deserved credit for our marriage because he'd offered me five dollars to take his sister out.

Following Ron, I moved into Sheridan Hall, a student-run co-op that was part of the UC students' Cooperative Association. It was open to all, regardless of race or color, not a common practice in those days. I was invited to join the chemistry fraternity but when I let the brothers know I was Jewish, the invitation was discreetly withdrawn. Sheridan's room and board was affordable because we each put in four hours of work every week to run the place. There were 70 of us, mostly from California. We hired a cook and did everything else ourselves. On my Saturday morning breakfast shift we set the tables by tossing dishes Frisbee-style from the kitchen to the dining room. We got good enough so the number of broken plates was acceptable.

Summer jobs were scarce in 1937 and 1938 during the Depression. A friend and customer of Dad's, Frank Dunn, part of a large Irish family, owners of a shoe store in Stockton, got me a job picking apricots and pruning peaches on a ranch in the valley. The ranch foreman told me the owners planted crops

THE SHERIDAN GOVERNING COUNCIL IN 1939 INCLUDING ME, FRONT ROW, SECOND FROM LEFT

that matured successively to extend the growing season and give more work to migrant workers. Some pickers came from the dust bowl of Oklahoma, the Okies made famous by John Steinbeck, and some were loners who lived in the Sierras most of the year panning for gold. They came to the valley in summer to add to their meager supply of cash and to gain weight. I saw one thin fellow eat a dozen soft-boiled eggs for breakfast, without pausing. The pay was 25¢ an hour, but it included all the healthy food you could eat and clean bunks. I started at seven in the morning, facing a row of trees as far as I could see. Armed with heavy ladders, we picked until five. I didn't mind

the severe valley heat but had to pace myself to avoid eating too many sun-warmed apricots.

Two pickers were assigned to each row. I was paired with an Okie boy my age. We were supposed to leap frog as we moved down the row. After a while my "partner" jumped ahead two trees. The boss noticed the gap and criticized me for being slow. When I tried to explain, the boy came over and punched me right in the eye. It was so unexpected I didn't even see it coming but I fought back until we were pulled apart. When I showed up at the Dunns' that weekend with a shiner, I rose in their estimation. They gave me a raw steak to put on my eye, and after the swelling went down, I spent the rest of the weekend reading *Gone With the Wind* which had just come out.

The next summer jobs were still hard to come by. I went back to the ranch and Walt came with me for a month. After work we cooled off in the San Joaquin River, listened to soap operas and talked. We roomed for four years without ever fighting, mainly because of Walt's good nature and great sense of humor. It didn't hurt that his mother, Flo, sent us delicious chocolate cakes. Walt was a good playground athlete but didn't make the freshman basketball team. He turned that athletic minus into an academic plus with a short story for his English class. It ended, "Our star fouled out. The crowd was silent. I was the last player on the bench. The coach walked over to the bench and looking me straight in the eye said, 'Get up Miller, I'm sending in the bench.'"

I played intramural basketball, football and tennis on Sheridan's teams (not particularly well, but had fun winning and losing). Tennis, continued throughout my life. When Walt, Sissy and I drove to Pasadena to watch Cal in the Rose Bowl in 1949 we stopped whenever we saw a tennis court. Walt and I jumped over or crawled under fences and played one game of a travel-

Ron turned me on to science. I played with his chemistry set and nearly started a couple of fires in our living room. We stayed up late listening to a **CRYSTAL RADIO SET** Uncle Walter brought back from his World War 1 navy days. We tuned it randomly by scratching the point of the "cat's whisker" (a metallic spring) over the surface of the black crystal. That mysterious happening was my first encounter with solid-state physics, but I don't recall wondering how it worked. Galileo High School graduate, Joe DiMaggio, hitting balls over fences meant more to me than Galileo Galilei dropping them from a tower.

ing set. Others may have the record for the set with the longest duration, but I claim the record for the set with the longest distance. When we couldn't find a court we stopped and used the center lane of the highway as a virtual net. Later I played singles with Arthur Kornberg until we were well into our eighties. As our court coverage diminished our science coverage on the bench increased, but we kept on until shortly before Arthur died.

Sissy came to Cal as a freshman the year Dan and I took Bacteriology. Yvonne Cyr, a bright, beautiful freshman, sat between us and we became friends (a friendship that turned into a second happy marriage for Dan).

After class we rushed to meet Sissy on the Wheeler Hall steps to go to her history class to hear Professor Kerner's lecture. The Germans had just invaded Russia and the panzers were advancing east hundreds of miles every day. The pundits were predicting the imminent fall of Russia, but not Kerner. He gave us hope, and he was right. Sissy moved from the boarding house where she was living with my cousin, Shirley Cerf, to a place across the street from Sheridan. We talked, walked and bonded on our way to campus.

I took Soil Science 114 from Professor Jenny and talked about becoming a soil scientist when Sissy and I roamed together in the Berkeley Hills. That dream nearly materialized when, preparing for life after the then compulsory retirement age of 65 at Stanford, I thought about growing artichokes in Pescadero. But in Dick Cheney's words, "things happen." The retirement age was raised and finally abolished. At the same time an unexpected family of superconductors, with record high transition temperatures, was discovered in Switzerland opening up an exciting frontier to explore.

TWO UNDERGRADS ENJOYING THE BERKELEY HILLS AND EACH OTHER

CALLED TO DUTY

MOTHER AND SON

What I learned in physical chemistry inspired me, in my junior year, to attempt to measure the heat of vaporization of electrons from a heated tungsten filament. I was encouraged by Bill Forsythe, the grad student supervising the lab. My experiment failed, but failure can be good. It led directly to my becoming a research scientist as an undergraduate and emerged much later as an idea for a novel heat engine in my emeritus days.

Bill took me to the basement of Gilman Hall where he was doing his thesis with William Giauque. Professor Giauque was investigating the third law of thermodynamics and wanted more accurate values of the heat capacities of metals than those obtained using the approximate theory of Debye. He offered me the opportunity to measure the heat capacity of gold using an ingot he purchased from prize money given to him by the Ingersoll Rand

"Theories can come and go but a good experimental result is forever." — Giauque

Corporation. I grew the gold into a single crystal using the Bridgman technique—melting it in a carbon crucible and slowly cooling it from a small tip at the bottom. I had automated the rig so I could go home for the weekend because I had a date and wanted to borrow my parents' car. I took off for San Francisco on Friday afternoon leaving the gold on the concrete floor in the middle of the open laboratory. Fate was kind and Bridgman was right; when I returned on Monday morning I found a solidified single crystal. The study required making all-night experimental runs and Sissy fortified me with evening milkshakes.

Giauque was original in both science and life. I was told that when he became a young faculty member he decided on the optimum distance he should walk each day. He divided it by four (he walked home for lunch), drew a circle around his lab, and where it intersected with a suitable home, he purchased it and lived there for the rest of his life.

As a public land-grant university, Cal required male students to take two years of infantry Reserve Officers' Training. I took an alternative four-year option offered by the Army Ordnance department. It avoided mindless marching, parading and standing at attention and instead had subjects with content like strength of materials, ballistics and the chemistry of explosives. I was paid for training at summer camp in Fort Lewis near Seattle. The liberal faction at Cal was pacifist and against the military being on campus. We had lots of political "bull sessions." I felt crushed when an "isolationist" friend at Sheridan defended Hitler, saying he was not all bad because he had improved the German economy. I was sensitive to the criticism that the Jews weren't able to defend themselves and was eager to fight Nazis.

I was called to active duty a week before graduation and found myself sitting idly in the Presidio wondering how the graduation was going. Finally, a month later, I reported to Aberdeen, Maryland as a second lieutenant for the officer's training program.

Several years later, when I was in the South Pacific, my mother was riding on a San Francisco streetcar when she noticed a serviceman with an ordnance insignia on his lapel. She asked him if he knew me. "Yes," was the improbable response. Abbott Goldberg and I had met at Aberdeen when I signed for the company property he turned over to me. So began a lifelong friendship. After the war Abbott became an outstanding judge with great wit and a gentle sense of humor. Governor Edmund Brown named him chief deputy director of the Department of Water Resources, later saying, "Your eloquent presentation of fact made it easy for me to make decisions…There wouldn't be a California Water Project if it hadn't been for Abbott Goldberg."

I am not sure how and when Sissy and I knew we going to be married, but my leaving for the short training period in Aberdeen, Maryland provided the impetus. We told our parents. Mine, who loved Sissy from the start, were overjoyed. And so were Sissy's. Her father pulled out a can of V8 juice

to toast us and asked me, “Are you sure you’re not making a mistake? Phyllis is very attractive and you want to make sure you pick the right sister.” Then he offered me an automobile as an engagement present. Sissy came to visit me in Aberdeen and stayed at the Inn in Havre de Grace, Maryland, but being engaged didn’t permit me to go upstairs to her room. So we took the train up to White Plains, New York and stayed with Lucile Heming and her children who had been a happy part of the gang at the Cooks’ house in Tahoe. Aunt Lu, a long-time friend of the Koshland’s, became Sissy’s stepmother after Sissy’s mother died.

THE WAR YEARS

I was assigned to the 25th Ordnance Company and sent to Fort Warren in Cheyenne, Wyoming. I had five days leave to get married and return for duty. I planned to stop overnight in Reno, Nevada, but ended up driving non-stop to San Francisco in 22 hours. We were married on October 19, 1941 in the Koshlands' living room. Walt and Carl were already in the army and couldn't come. Ron was my best man. Great Aunt Bertha, Grandma Glaser's charming sister (we have one of her paintings), was late and Sissy's Dad quipped, "She almost didn't make the wedding list, and now she is almost not making the wedding." I was in too much of a happy daze to remember much of the ceremony. The *San Francisco Chronicle*'s society photographer doctored the photos so that our grandparents had no wrinkles.

READY TO DRIVE OUR WEDDING PRESENT, THE DODGE

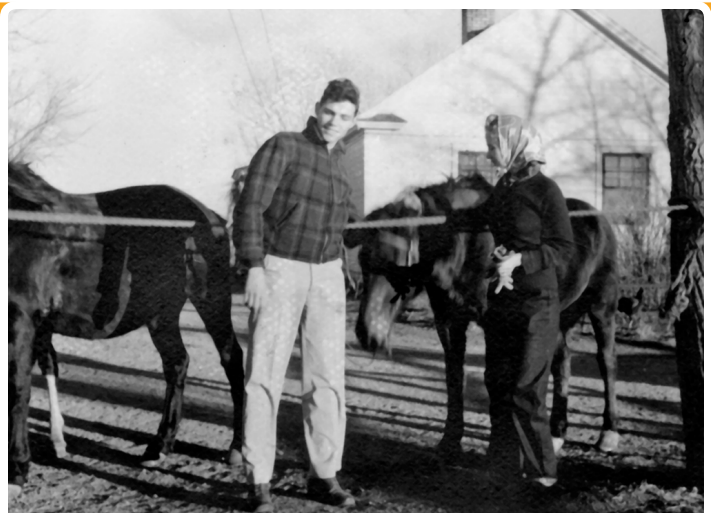
THE PHONE WAS IMPORTANT ON OCTOBER 19, 1941, AND STILL IS

SISSY AND WALT

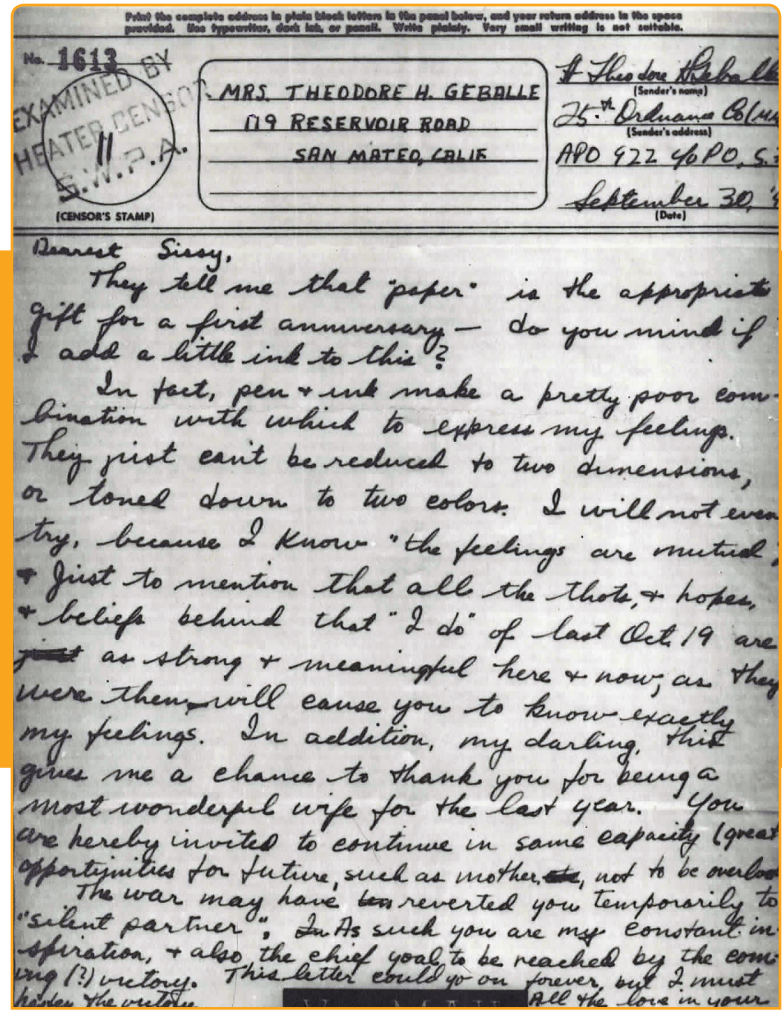
On our short honeymoon trip back to Wyoming we stopped at Las Vegas which wasn't a gambling mecca then, but was close to the Hoover Dam, a recent engineering marvel. Sissy had her favorite lunch, a cheese sandwich on white bread and a glass of tomato juice while I gawked at the huge generators. I wanted to take a short detour to see the spectacular scenery, but Sissy balked; she hates steep edges. We learned to compromise, which meant we didn't take the detour. In Cheyenne we rented our first house, an old structure. We went to a local store to buy essential furniture. As we were leaving Sissy turned to the sales guy and asked, "Who could possibly want those ornate couches?" He replied, "The Jews." "Not all," she assured him.

Pearl Harbor caught us, along with most Americans, by surprise. Sissy and I had been horseback riding in the hills on December 6, 1941. On the 7th I was stiff and sore and nursing a cold when Sissy rushed in to tell me that Pearl Harbor had been bombed. At first I thought she had been listening to an Orson

Wellsian soap opera on the radio, but not for long. Our company received orders to move without delay to Fort Lewis in Washington. Thinking we were urgently needed to defend the coast, we drove recklessly through a blinding snowstorm. Some of our 6x6 vehicles crashed and I had to stay overnight with them in Pocatello, Idaho. When we, the 25th Ordnance Maintenance Company (MM), arrived at Fort Lewis, nobody had heard of us. We camped on the muddy shoulder off of Rt. 101, then a narrow two-lane highway. Sissy was able to join me later and we rented a place in a motel just off the highway. She learned to play poker with a guy across the highway while I learned almost nothing. One night we had dinner at the parents of Irv Robbins and his attractive sister, Shirley, whom I had met during my ROTC summer camp. When we sat down to eat there was an awkward lull in the conversation, which I gallantly tried to fill. Finally I was asked to stop talking so they could say their prayers. Their father owned an ice-cream store that Shirley's husband and brother later grew into the well-known Baskin-Robbins chain.



I was transferred to the 84th company and shipped overseas in March, 1942. I wanted to go to Europe, but was sent to the South Pacific, without a Nazi in sight. Sissy and my Mom drove the Dodge to San Francisco in a snowstorm, getting there just in time to see me off. We set out through the Golden Gate in a convoy of three ships, the Queen Elizabeth, the President Hoover and the Mariposa. All were too fast to have destroyer escorts so we just zigzagged across the Pacific. The Queen Elizabeth had started on the East Coast. She was too big to go through the Panama Canal and the soldiers were so crowded in the long voyage around the Cape to San Francisco and on to Australia, that many were sick upon arrival. Those of us who left San Francisco on the Mariposa had been inoculated for yellow fever with serum that was contaminated with hepatitus B virus. When we landed in Melbourne, soldiers from both ships were evacuated back to the States. I was startled to see that my stools were white, but I recovered after a short stay in the hospital.



Print the complete address in plain block letters in the panel below, and your return address in the space provided. Use typewriter, dark ink, or pencil. Write plainly. Very small writing is not suitable.

No. 1613

EXAMINED BY HEATER CENSOR S.W.P.A. 11

(CENSOR'S STAMP)

MRS. THEODORE H. GEBALLE
119 RESERVOIR ROAD
SAN MATEO, CALIF.

Lt Theodore Geballe
(Sender's name)
75th Ordnance Co (MM)
(Sender's address)
APO 922 % PM, S.F.
September 30, '43
(Date)

Dearest Sissy,

They tell me that "paper" is the appropriate gift for a first anniversary — do you mind if I add a little ink to this?

In fact, pen + ink make a pretty poor combination with which to express my feelings. They just can't be reduced to two dimensions, or toned down to two colors. I will not even try, because I know "the feelings are mutual" + just to mention that all the thots, + hopes, + beliefs behind that "I do" of last Oct 19 are just as strong + meaningful here + now, as they were then, will cause you to know exactly my feelings. In addition, my darling, this gives me a chance to thank you for being a most wonderful wife for the last year. You are hereby invited to continue in same capacity (great opportunities for future, such as mother, etc, not to be overlooked). The war may have reverted you temporarily to "silent partner", In As such you are my constant inspiration, + also the chief goal to be reached by the coming (?) victory. This latter could go on forever, but I must hasten the victory. All the love in your

SORE AFTER HORSEBACK RIDING ON DECEMBER 6, ONE DAY BEFORE THE DAY THAT LIVES IN INFAMY

MEMBERS OF THE 25TH ORDNANCE COMPANY (MM), ACTIVATED AT ABERDEEN, MARYLAND; I'M THIRD FROM THE LEFT IN THE FRONT ROW

A V-MAIL FOR SISSY ON OUR FIRST WEDDING ANNIVERSARY

ON DUTY IN AUSTRALIA IN 1943

Australia was unprotected. Its own army was in Northern Africa fighting General Rommel's army in the desert. So we Yanks got an especially warm welcome—which was soon worn out. Our small company was spread around the periphery of Australia from Perth to Cairns and was responsible for maintaining antiaircraft artillery of World War I vintage. Surprisingly, the artillery was effective. Instead of strafing at low levels as the Japanese had been doing regularly on moonlit nights, they came in at 20,000 feet where their bombing was woefully inaccurate.

I was transferred farther north to Cairns by train. In the middle of the night, between Melbourne and Sydney, we had to transfer our gear from cars that ran on wide tracks to a train running on standard rails. The next day we stopped outside of Brisbane while the crew took its tea break. Cairns was a pleasant rural town in the midst of sugar cane fields. Chewing stalks is hard on the teeth and that kept local plumbers busy extracting teeth as part-time dentists. In June the Battle of the Coral Sea was a turning point—the Japanese navy was defeated for the first time. The local Cairns newspaper

announced the victory: "An Australian corvette accompanied by units of the Allied fleet defeated the Japanese navy." The war in South Pacific became a lower priority than that in the European theater, and for me, a long period of boredom ensued.

I was transferred to our detachment in Port Moresby, New Guinea and flew up in a DC-3, piloted by a crew fresh from the States. I knew something was wrong when we reached the New Guinea coast and turned left, heading into Japanese-controlled Hollandia. I rushed to the cockpit and warned the green crew. They made an abrupt 180-degree turn and landed safely in the grassy field at Port Moresby. I soon came down with dengue fever. I was flat on my back for a few days, but was lucky to find a copy of *War and Peace* in the hospital library. Living conditions in Port Moresby were primitive. I wrote letters in bed protected by mosquito netting. All news was censored. I couldn't write about where I was or what I was doing. We still have the letters stored in boxes.

Supplies brought by ship were transferred to makeshift barges in the bay and unloaded on the beach. Sometimes food was limited but there were always plenty of cigarettes, labeled "Lucky Strikes goes to war." I was annoyed and hungry, and finally started smoking instead of giving away my allotment of two packs per day. I kept that habit until my last summer in grad school. I was at Lake Tahoe and the smoke made my sore throat raw. I just stopped and never started again. But I continued to enjoy a good cigar, and probably still would if the habit weren't offensive to others. A good Havana cigar with a shot of Scotch sets the stage for a friendly, chauvinistic male retreat.

There was little combat in Port Moresby, but we fought jungle rot, mildew, fungus, mosquitoes and boredom. I respected our commanding officer, Major Short more than most of the commanders I knew, but he gave us a strange briefing one morning and later was taken away in a straight jacket. We had only light contact with the enemy, but plenty of contact with the natives. The children's bellies were badly swollen. Malaria was rampant. We slept inside nets, but that didn't prevent me and many others from getting malaria. The mosquitos were picking up malaria from the natives and then infecting us. Later that population was relocated beyond the flight range of the Anopheles mosquitoes and troop infection rates dropped. As far as I know the high water mark of the Japanese campaign in New Guinea was when they sent one hundred planes to bomb us in broad daylight and we had to scramble for cover. Their timing couldn't have been worse for me because I had scheduled a routine maintenance procedure and our anti-aircraft battery was inoperative. Fortunately I had gone through channels and obtained approval. I wondered if the timing was more than just coincidental. In the later stages of the war we finally received modern electronic fire control equipment. It came in boxes labeled "Bell Laboratories." If those boxes had also come with instruction manuals we might have won the war sooner.

My malaria reccurred and I was sent to the hospital in Cairns. During times of high fever and chills a sweet young nurse, Sally Swain from North Carolina, took care of me. I liked her a lot but couldn't convince her to do anything more than be a good friend and go to camp movies with me when I got better. I took Atabrine and Plasmoquine anti-malaria pills and turned yellow. There was no sign of home leave and no end in sight. Letters and packages of food and supplies from Sissy, family and friends helped keep up my moral, but sometimes it took months for the mail to find me. That was a long time to wait to find out the score of the Big Game. We corresponded mainly by V-mail (Victory mail), which took weeks instead of months because full-sized letters were reduced photographically and sent by air. On March 28, 1944 I wrote Sissy, "The army has kept me busy lately. The major has been transferred, with the result that I'm the ord officer here now. An imposing title for a small job, but it's kept me hustling and appeals to the sense of 'power' (ask DEK Jr.) to be wholly in charge of something. But it's my love

that appeals more than anything, and that's you honey."

I was restless and desperate to get back to my wife. When a call came for volunteers to be trained as Air Force pilots back in the States I volunteered. My request was not approved, maybe because I was so far away. George Cooper, a friend from Sheridan Hall days who had gone through Ordnance training with me, was Stateside at the time. He was accepted and became a highly decorated war hero. We have stayed connected and I buy wine from his family vineyard in Saratoga. Sissy, not exactly an expert, is not as enthusiastic about the wine.

Instead, I was sent to Mindanao in the Philippines where I was surprised to see a Singer sewing machine in almost every primitive shack. This was shortly after General Douglas MacArthur "returned." That transfer gave me enough points to be rotated back to the US. The ship I returned on carried civilians who had just been liberated from Japanese prison camps. They had been ill treated, were scrawny, undernourished and not friendly with each other. They must have had to compete for survival essentials. Bert Myers, another Sheridan friend in my Ordnance training program, did not survive. He was an only child and Walt and I kept up with his devastated mother after we learned he was a casualty of the Death March. Bert had written me a letter in November, 1941 saying, "The Americans are now having intercourse with too many of the native women and one of these days a native is going to pull out his 'Bolo' (knife) and hack up a few American soldiers." Corregidor Island was the American army's last bastion, and after it fell to the Japanese, General MacArthur pledged his famous "I shall return." He was a hero back in the States, but not to the civilians I met in Melbourne who had been evacuated from Corregidor just before it fell. Their friends had been left behind while MacArthur's personal possessions were evacuated.

I hadn't seen Sissy for 37 months when I finally cruised back through the Golden Gate and landed on Angel Island. She was on the San Francisco side when I phoned to tell her I was home. She was so happy talking on the phone that I had to hang up on her to catch the ferry to San Francisco. I cannot describe how awesome it was to be together again. We were sent to Santa Barbara for a few glorious weeks of rest, reentry and rehabilitation. I was still yellow from the anti-malaria meds.

I then received orders to report to Vancouver Barracks on the Columbia River near Portland. The war was still on and we were shipping supplies to the Pacific in preparation for the invasion. As part of my duties as captain I read intelligence reports. They contained grim estimates of the enormous casualties to be expected in the coming invasion of Tokyo. I was greatly relieved when the two atomic bombs (of which I had no prior knowledge) were dropped and the war ended. In spite of the Monday morning quarterbacking that we could have done better with the bombs, I believe that President Harry Truman's decision to drop them saved many more American and

EN ROUTE TO MINDANAO IN THE PHILIPPINES

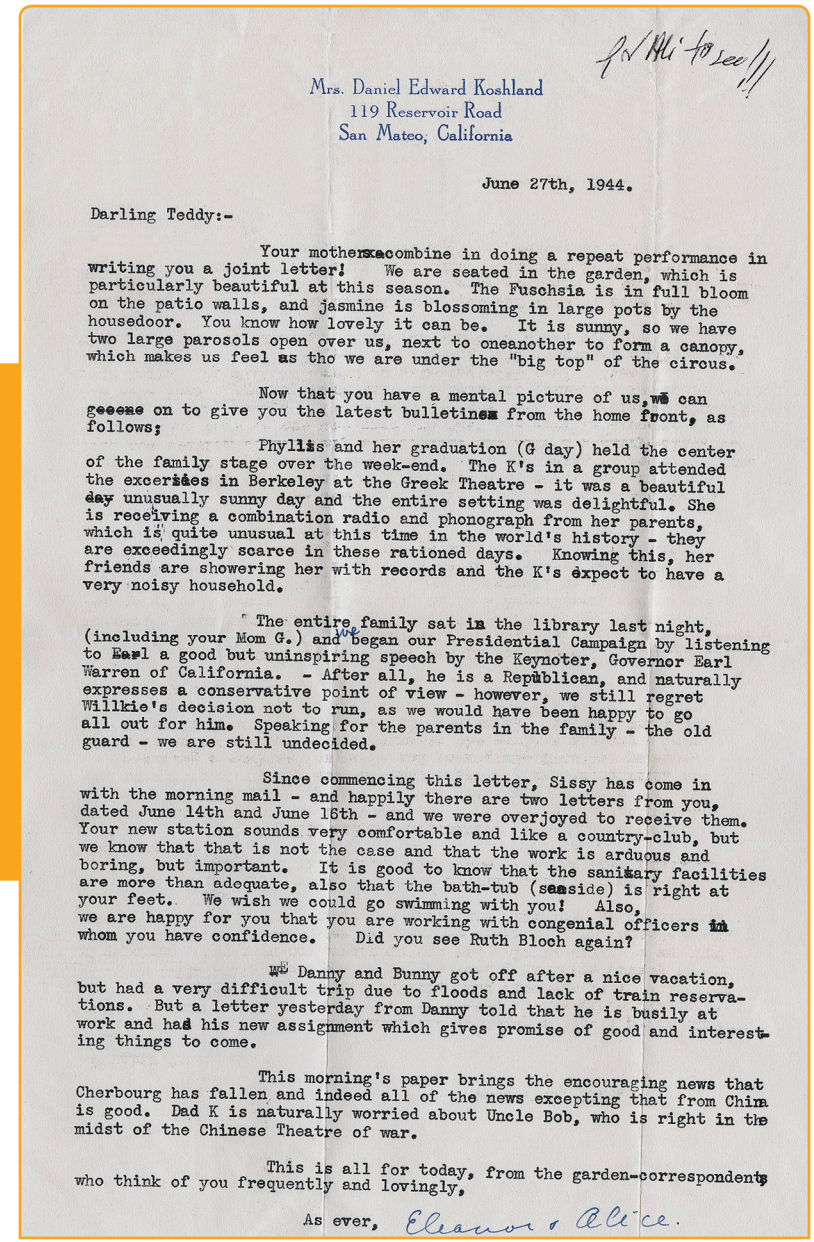
Japanese lives than would have been lost in an invasion. We stayed in Portland until the war ended. Sissy had a miscarriage and had to suffer comments from her hospital roommate who kept saying she knew Sissy was going to lose the baby.

Most of my army experience was routine. After discharge I felt I was pretty far behind in life. I had to decide whether I wanted to go back to school. We wanted to start a family and live the American dream. That's when

SISSY AND MY MOM

SISSY'S MOM AND MY MOM TEAMED UP TO WRITE ME

I wrote Giauque at Cal and he responded by offering to take me on as a grad student. I'd had no contact with science for three years, and I wasn't sure. Sissy encouraged me to try it for a year and to see what happened.



Mrs. Daniel Edward Koshland
119 Reservoir Road
San Mateo, California

June 27th, 1944.

Darling Teddy:-

Your mother & I combine in doing a repeat performance in writing you a joint letter! We are seated in the garden, which is particularly beautiful at this season. The Fuschsia is in full bloom on the patio walls, and jasmine is blossoming in large pots by the housedoor. You know how lovely it can be. It is sunny, so we have two large parosols open over us, next to oneanother to form a canopy, which makes us feel as tho we are under the "big top" of the circus.

Now that you have a mental picture of us, we can go on to give you the latest bulletins from the home front, as follows;

Phyllis and her graduation (G day) held the center of the family stage over the week-end. The K's in a group attended the exercises in Berkeley at the Greek Theatre - it was a beautiful day unusually sunny day and the entire setting was delightful. She is receiving a combination radio and phonograph from her parents, which is quite unusual at this time in the world's history - they are exceedingly scarce in these rationed days. Knowing this, her friends are showering her with records and the K's expect to have a very noisy household.

The entire family sat in the library last night, (including your Mom G.) and we began our Presidential Campaign by listening to Earl a good but uninspiring speech by the Keynoter, Governor Earl Warren of California. - After all, he is a Republican, and naturally expresses a conservative point of view - however, we still regret Willkie's decision not to run, as we would have been happy to go all out for him. Speaking for the parents in the family - the old guard - we are still undecided.

Since commencing this letter, Sissy has come in with the morning mail - and happily there are two letters from you, dated June 14th and June 16th - and we were overjoyed to receive them. Your new station sounds very comfortable and like a country-club, but we know that that is not the case and that the work is arduous and boring, but important. It is good to know that the sanitary facilities are more than adequate, also that the bath-tub (seaside) is right at your feet. We wish we could go swimming with you! Also, we are happy for you that you are working with congenial officers in whom you have confidence. Did you see Ruth Bloch again?

We Danny and Bunny got off after a nice vacation, but had a very difficult trip due to floods and lack of train reservations. But a letter yesterday from Danny told that he is busily at work and has his new assignment which gives promise of good and interesting things to come.

This morning's paper brings the encouraging news that Cherbourg has fallen and indeed all of the news excepting that from China is good. Dad K is naturally worried about Uncle Bob, who is right in the midst of the Chinese Theatre of war.

This is all for today, from the garden-correspondents who think of you frequently and lovingly,

As ever, Eleanor & Alice.

GRAD SCHOOL& BABIES

We found a great house at 2573 Buena Vista Way in Berkeley within walking distance of campus. I had some reentry adjustments to make. When a raccoon kept us awake night after night rattling around in our basement heating ducts I took out my service revolver and shot it. There were several themes in our lives. We were raising kids, doing research, and making up for the lost years with our families, friends and ourselves. In 1947 Gordon was born at Mills Hospital in San Mateo because Sissy was apprehensive after her miscarriage in Oregon. She had confidence in Dr. Ollie Holmes, who practiced at Mills, and was a friend of her father's. Walt and I sat outside the delivery room, on edge and drinking Scotch, until the good news finally came. Things went so well that Ali was also born at Mills, in 1949. Adam, however, was born at Alta Bates in Berkeley, in 1951. Miss Bates, an old lady at the time, sat on a stool guiding the elevator manually up and down until it was level with the floor. Gordy and Ali walked with me outside the hospital to wave at Mommy's window. Later I waited around the hospital and, since the baby didn't seem to be coming, I left. When I got home the phone was ringing and I raced back for Adam's birth.

We found peppy after-school babysitters, Mei-Hua and Claire Sha, 14 and 12 year-old neighbors. They became part of our circle of friends and today Claire still keeps in touch but, sadly, Mei-Hua died a couple of years ago. We also found a lovely, intelligent and cheerful Japanese woman, Harue Yamanchi, to help with the house and children. Alison had never been treated so tenderly as when Harue brushed her hair. Harue must have been interned with her husband and sons during the war but I never heard a word of complaint.

READY FOR GRAD SCHOOL

OUR GROWING FAMILY OF GORDON AND ALISON IN BERKELEY

GORDON GETS A PHYSICS LESSON FROM DAD

I took the 4 a.m. shift when Gordy woke up. I was so concerned about keeping his bottle sterile that I didn't always secure the nipple properly. He had to work extra hard to get his milk and, who knows, it may have been character building. I balanced him on one knee and a science book on the other. I did my share, or maybe even more, of the diaper changing except for one stretch. I was playing football when Sissy came by with Gordy in the baby buggy to see if I was ready to go home. "One more play," I said. That turned out to be one play too many. I broke my finger, the hospital had to saw off my wedding ring, and I couldn't do the dishes or change diapers for three weeks.

FACING SOME OBSTACLES: A CRACKED FINGER AND CRACKED CALORIMETER

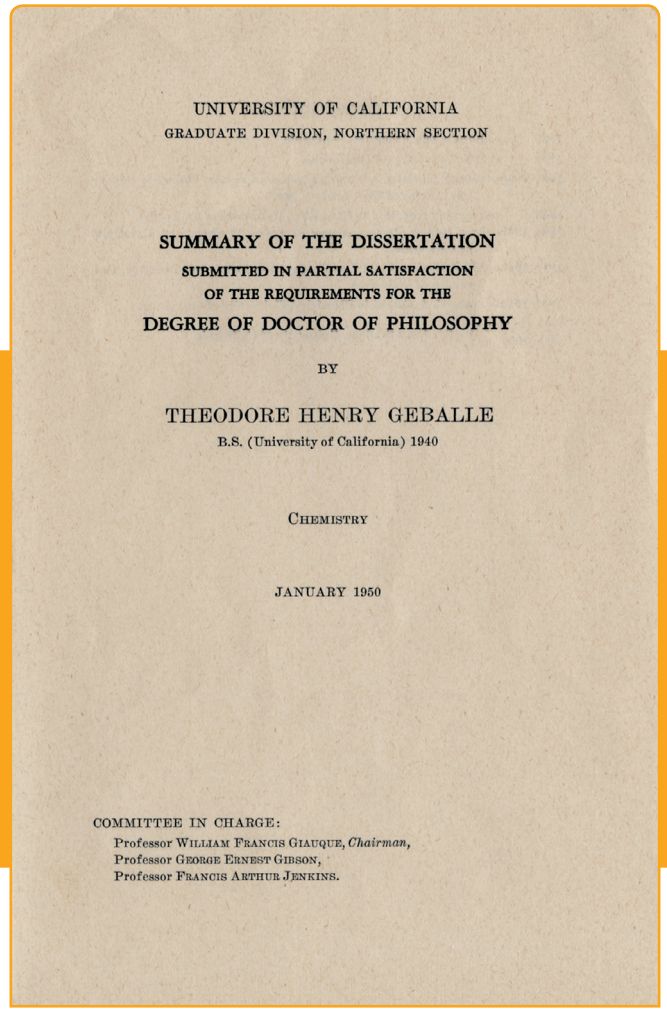
SUMMARY OF THE DISSERTATION

THE COPPER SULFATE CRYSTAL (ACTUAL SIZE) I GREW USING ALAN HOLDEN'S INSTRUCTIONS; AFTER GIAUQUE DIED AND HIS LAB WAS CLEANED OUT, IT WAS SENT TO ME; TOO BAD THEY DIDN'T SEND THE ONE I MADE FROM SOLID GOLD

IN PROFESSOR GIAUQUE'S OFFICE WITH DAVE LYON , 1949

Two notable events occurred in 1949-50. Giauque was awarded the Nobel Prize and I was awarded a Ph.D. for my thesis, *Thermodynamic and Magnetic Properties of Single Crystal Cupric Sulfate Pentahydrate Below 4° Kelvin*. How did I come to pick copper sulfate for my thesis? Transition metal ions have both a positive electric charge and a magnetic spin. I chose copper salts because its spins are simple. In the library I found an article about two British crystallographers who had just worked out the crystal structure of $CuSO_4(5H_2O)$, an important input for my experiment. It is a common salt and has been used for centuries as a fungicide. At "high" temperatures (in my case 1 degree above absolute zero, minus 454 degrees Fahrenheit) its spins point in random directions meaning they are disordered which is equivalent to say that the spin system has entropy. Giauque's Nobel Prize was partly due to his discovery of how to remove the entropy using a process known as adiabatic demagnetization. Giauque was not interested in establishing a world record low temperature—he wanted to study matter in a new regime.

Adiabatic demagnetization works like this. You cool the crystal when it is in contact with a liquid helium bath which is under reduced pressure at T ~ 1K. Then you turn on a magnetic field which causes the the copper ion spins to order. This reduces their entropy and generates heat. This is an isothermal process which boils off some helium while the crystal stays at 1K. Then you isolate the crystal from the helium bath, and turn off the field. The spins



UNIVERSITY OF CALIFORNIA
GRADUATE DIVISION, NORTHERN SECTION

SUMMARY OF THE DISSERTATION
SUBMITTED IN PARTIAL SATISFACTION
OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF PHILOSOPHY

BY

THEODORE HENRY GEBALLE
B.S. (University of California) 1940

CHEMISTRY

JANUARY 1950

COMMITTEE IN CHARGE:
Professor WILLIAM FRANCIS GIAUQUE, *Chairman*,
Professor GEORGE ERNEST GIBSON,
Professor FRANCIS ARTHUR JENKINS.

then disorder (demagnetize) and absorb heat from the crystal lattice which thus cools.

My purpose was to study the ordering of the spins. I needed a large single crystal and didn't know how but grow one. I read that Bell Labs had grown large single crystals during the war. Giauque told me to write Mervin Kelly, the president of Bell Labs, and ask him how they did it. So I did. I soon got a 5 page letter from research scientist Alan Holden who described the process exactly and it started with dismantling an old washing machine.. The essence of his letter was later published in *Transaction of the Faraday Society* and in a popular book about crystals for school children. The magnet and apparatus needed for the adiabatic demagnetization were already in place in the lab. Even so it took me 18 months to grow and prepare the triclinic

crystal—which has neither right angles nor equal lengths—something like an old wind-battered barn.

My experiments yielded an unexpected result—only half the ions ordered. Since there were two copper sites per unit cell the experiment suggested only one of the sites ordered. I later found out why when I learned about the theory of superexchange developed by Hendrik Kramers and Phil Anderson. As a result of his Nobel Prize, Giauque obtained the resources to build a new low temperature lab (now Giauque Hall) with a much more powerful magnet capable of investigating the ordering of the rest of the copper ions in my crystal. It was tempting to stay and continue exploring magnetic phenomena. In fact I was designing a new calorimeter when a conversation with Professor Ken Pitzer made me aware that it might be a good idea to move to a different place. Now I understand why this is good advice for fresh Ph.D.s. It provides exposure to new cultures and by combining the old and the new, the sum can be greater than the parts.

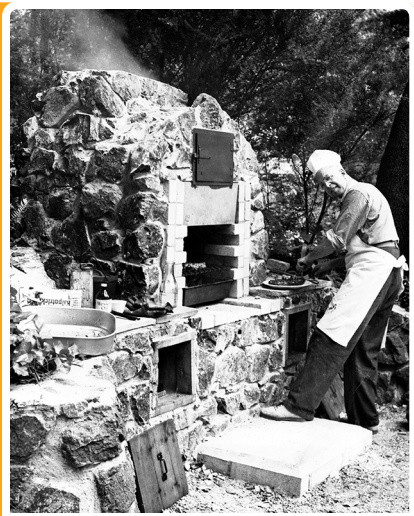
ONE OF MOTHER'S GREAT JOYS WAS THE PROPERTY SHE AND DAD PURCHASED IN SKYLONDA IN THE HILLS ABOVE WOODSIDE WHICH WAS COVERED WITH REDWOODS AND FLORA SHE KNEW SO WELL. THEY CALLED THEIR PLACE *MONTALO*, A COMBINATION OF THEIR NAMES. DAD BARBEQUED FOR THE KIDS, GRAD SCHOOL FRIENDS, AND FAMILY REUNIONS.

Each of Giauque's five students had his (there were no women) own project and we depended on each other to run our experiments. It took the better part of a day just to liquefy the helium needed to cool our samples before taking data. Liquid helium at that time was available only in a limited number of laboratories. We took time off and liquefied some for Richard Ogg, a Stanford professor. He used it to show that plant seeds can germinate after being immersed in liquid helium, thus demonstrating that life can survive in interstellar space, keeping alive (pun intended) the possibility that we are Martians.

We kept in touch as our careers took us to universities and national laboratories. Chi Ho Chu was from Mainland China and had to leave as soon as he completed his thesis, when the relations between the US and China broke down during the Korean War. We chipped in and gave him a Zippo cigarette lighter when we said goodbye on the dock, and when we returned to the lab we found he had left beautiful kimonos as gifts for our wives.

Chi Ho and his wife were separated from their children and sent to the countryside for reeducation by peasants during the Cultural Revolution. He survived this and has become a distinguished scientist. We reconnected and have played spirited sets of tennis during his visits. Dave Lyon stayed at Berkeley and became a professor of Chemical Engineering. Gene Kunzler followed me to Bell Labs and made the important discovery that Nb_3Sn could carry very large superconducting currents in high magnetic fields.

My appreciation for what was going on at Bell began when I attended Charley Kittel's course on solid-state physics during my last year of graduate school. As a visitor from Bell, who returned later as a faculty member, he established a strong condensed matter school at Cal. His class notes became the first edition of his *Solid State Physics* textbook, now in its eighth edition. A few weeks after Adam was born I went to campus during Christmas vacation and wandered into a seminar given by Homer Hagstrum. I asked Homer about the exciting semiconducting and magnetic research at Bell I had heard about in Kittel's course. The next thing I knew I had received an invitation to visit Bell. There was no formal recruiting then; it was by word of mouth.



I looked around to see what jobs were available and received four offers. Chevron would keep us close to our families and friends in the Bay Area. I was offered a position with a group engaged in developing detergents but when I was told I could have my laundry done in laboratory equipment, aka washing machines, my interest washed away. An offer came from the Naval Research Lab in Washington, D.C. General Electric in Schenectady, New York was interested in me and offered a higher salary than Bell. But new science and technological possibilities were emerging and Bell was the Mt. Olympus of what was then called solid-state physics (now condensed matter physics). Bell offered me a staff position with the promise I could choose my own research project. It seemed too good to be true, but it wasn't.

WALKING INTO ARNOLD AUDITORIUM
AT BELL LABS, SUMMIT, NEW JERSEY
I WOULD SEE ALEXANDER GRAHAM BELL'S WORDS
INSCRIBED ABOVE THE DOOR.

LEAVE THE BEATEN TRACK OCCASIONALLY
AND DIVE INTO THE WOODS.
YOU WILL BE CERTAIN TO FIND SOMETHING
THAT YOU HAVE NEVER SEEN BEFORE.


BELLLABS

THE GOLDEN AGE

There will never again be an organization like Bell Labs during the Golden Age of solid-state physics research. As the research arm of AT&T it was a closely regulated monopoly, but on Wall street it was a growth stock. I think the advances in technology pouring out of the labs increased productivity each year.

Being a staff scientist at Bell Labs was as good as it gets. We were innocent until proven guilty, meaning it was expected our research would not only be good, but would provide a bank of knowledge available for solving future technical problems. For example, purely scientifically motivated investigation of crystal field theory made it possible to identify trace metal impurities of metal ions in glass. Once identified, the impurities were easily removed.

A mile of optical fiber became as transparent as a pane of window glass and enabled the birth of optical fiber communication.

The invention of the transistor is the prime example of the research and technology coming out of Bell. There were many others including light emitting diodes (LEDs), lasers and solar batteries. Zone refining, invented at Bell, improved the purity of elements by orders of magnitude and enabled the semiconducting era and, incidentally, my research.

When the government broke up the AT&T monopoly in 1984 many of us thought it was killing the goose that laid the golden eggs. In retrospect, we were wrong. Many Bell scientists, including me, left the labs to jump-start research at major universities, and in so doing, educated new generations of condensed matter scientists. Others left with Bill Shockley to become major contributors to the establishment of Silicon Valley.

THE TRANSISTOR was invented at Bell in 1947 by John Bardeen, William Shockley and Walter Brattain and earned them the 1956 Nobel Prize. What Gutenberg's invention of moveable type in 1468 was to the book, the transistor is to the Information Age. But the first announcement of the invention had little impact. *The New York Times* reported the discovery in its radio column, underneath the evidently more newsworthy item–singer Dinah Shore would be taking the summer off.

One transistor functions like one vacuum tube and, because it is so tiny, complex circuits, with first hundreds, then millions of transistors, could be deposited on a single silicon chip. Intel co-founder Gordon Moore is famous for Moore's Law which states that the number of transistors on a chip doubles every 18 months. Today we are approaching the end of Moore's Law as applied to conventional circuits because of the finite size of the atom. But that doesn't mean the end of Moore's Law because there are quantum mechanical possibilities, theorized but not yet realized. Quantum computers, some with novel superconducting circuits, are the frontier with potential for surpassing present computers by wide margins.

THE MOVE EAST

I prepared four-year-old Gordy for our move east by telling him the best toy store in the world was in Summit, New Jersey near Bell Labs. In the spring of 1952 we bundled up our three little ones, flew to New Jersey and moved into a rental Delia Heming had found for us in Dunellen, not far from the Labs.

Shortages from the all out war effort were still widespread. New Jersey Bell phoned soon after we arrived to let us know our service was being disconnected, but we could be put on a waiting list for a new connection while they checked our credentials. That went over poorly on the home front. My plea that I was a Bell employee had no traction. When I offered to pay for the long distance call we had already made to California we kept our party line.

Although Dunellen was only 25 miles from Manhattan we couldn't get the *New York Times* delivered. But we managed to get the *Times* to leave a paper for us to pick up at the town drug store. Locals couldn't imagine why anyone would want to move from California to New Jersey.

We looked for a year for a house near good schools and close to the Labs. I saw a town on the map with an appealing name and asked our real estate agent, "What about looking in Freedom Hills?" "You wouldn't want to live there, it's 99% Jewish," she responded. When I replied, "We are 100% Jewish," we were put into a different category. When we offered the asking price

ALISON, ADAM AND GORDON—THEIR FIRST SPRING IN DUNELLEN, NEW JERSEY

for a desirable place near Lincoln School in Summit a higher bid suddenly appeared. The realtor suggested we wouldn't be happy in that neighborhood anyway. Wrong. The Potters, who would have been our next door neighbors, became good friends, Gordy and Andy in school, and Sissy and Betsy while building the school library. Sissy's passion for getting kids to enjoy books has never gone away. Her job as office manager for Mrs. Rose, the editor of a local gardening magazine, provided entertaining stories more than horticultural expertise.

Finally we found a house at 204 Springfield Avenue in Summit, in final stages of construction, and purchased it directly from the builder. It was very livable and, after Howie added some features, served us well.

Summit was rich, conservative, well-run and stuffy. People voted Republican, corporate executives commuted to Wall Street on the Lackawanna Railroad (an out of proportion number of 9/11 casualties were from Summit), and stores were closed on Sundays. The public schools were good even though the mayor publicly stated that all teachers were overpaid. When a pharmaceutical company expanded and built a new research facility 28 black families were forced to move out of town. I helped Stanley Morgan, who was director of chemical research at Bell, organize the Summit Association for Low Cost Housing which, in spite of opposition, financed the construction of low cost housing for 28 families in Summit.

Through Temple and schools we met the Rothschilds and Schwarzes. Our friendships have continued through the years and the generations. We made many friends at Bell Labs. We had weekend dates with Joan and Bernd Matthias and her parents, the Trapps. Jake Trapp was a poet and the Unitarian minister. Homer Hagstrum was president of the church. I walked to services one Christmas Eve and learned Unitarians were much too liberal to be part of the church establishment in Summit. We had lively times with Floyd and June Delaney and their children. Their humor and politics were much like ours. Floyd, an Irishman felt so strongly about Israel's survival that he flew there to help defend the country.

MY RESEARCH

The research division where I worked was a 10-minute commute from Summit. When we first drove by the long, linear Bell building in Murray Hill Gordy shouted, "That's not Giauque's lab. That's Daddy's lab!" Not quite true, but from the start I felt very much a part of the place.

Research at Bell was multidisciplinary well before that was a common practice. I learned many things from chance encounters in the long corridor running between the cafeteria in one direction and the library in the other. I didn't plan to be working at the forefront of the Golden Age of Solid-State Physics with a bunch of remarkable people from all over the world, but it happened.

The culture was uninhibited from top to bottom. When Bernd Matthias wanted to visit his friend from Zurich college days he told Jim Fisk, the Labs President, that he had confidential information from an old school friend that the Russians were experimenting with ESP and if successful it would put AT&T out of business. Bernd offered to fly over and find out. Jim's reply, "Thanks Bernd for offering, but it really isn't necessary. We already know about it and are developing a system that can jam theirs." I ran into Jim at Newark airport during one Christmas vacation when Gordon was flying in from Berkeley. I was wearing a massive wig to match Gordon's very long hair and drew a lot of curious stares. But not from Jim. I went up in his estimation.

My first big decision in 1952 was to choose a department. After vacillating between working with Joe Burton on semiconductors, sharing a lab with Frank Morin, or studying superconductors in Stanley Morgan's department and sharing space with Bernd, Jim Fisk advised me to start with semiconductors. So I did, and have never regretted the decision.

Joe, a highly capable scientist in his own right, helped me get started. He obtained a zone refined, pure single silicon crystal grown in the Metallurgy Department so I could begin my research on the low temperature thermal and electrical properties of silicon. To make a preliminary check of my newly constructed calorimeter, I measured the crystal's thermal conductivity at room temperature and found a disconcerting result. It's magnitude was twice as large as given in the standard tables. After eliminating all the errors I could think of, I arrived at the pleasant conclusion that it was because my crystal was more perfect than any previous state-of-the-art crystal. The needs of semiconductor technology had led to dramatic advances in crystal growth. At Cal I spent more than a year growing the copper sulfate crystal needed for my thesis research. At Bell I was just handed the high purity, well characterized single crystals I needed. It was awesome.

Outside of work Joe and I played in tennis tournaments. He was quiet, capable and polite and had a wicked overhead smash. Sissy had her hands full restraining Gordy, Alison and Adam, my boisterous rooting section.

I developed a plan for determining electronic band structures of semiconductors by measuring thermoelectric (Seebeck) voltages. I explained my plan to Conyers Herring when I met him but failed to convince him. He noticed a fundamental flaw in my model. But I learned something. It's valuable

to listen to theorists but that doesn't mean you shouldn't try experimenting when you are exploring in a new parameter space.

Our conversation started a cherished collaboration. Conyers soon recognized that the unexpected huge increases in the thermoelectric power of high-purity germanium I had found at low temperatures could be due to interactions between lattice vibrations (phonons) and electrons of similar size that conserve momentum while transporting heat down the imposed thermal gradient. This is known as "phonon drag" and is discussed in textbooks. Herring's model made predictions I could, and did, verify. For example I found a much larger thermal conductivity at low temperatures in isotopically enriched Ge than in ordinary Ge. Could this purely scientific result lead to any practical application? Well, maybe. A similar result at room temperature has been found in isotopically enriched diamonds at General Electric. The increased thermal conductivity means that optical devices made from carbon 13-depleted diamonds are more resistant to damage from high powered lasers. Whether this is important in the market remains to be seen.

Bruce Hannay, my second boss, was a fine scientist and a good administrator. He was instrumental in leading the transition from vacuum tube to semiconductor technology after the invention of

When I told Sissy's Aunt Ruthie that I was working with a superconductor she thought I was referring to Seiji Ozawa (then conductor of the San Francisco symphony) but super here means the ability of a metal to carry an electrical current without any loss. Its electrical resistance at a low enough temperature is truly zero, and that is super. Superconductivity and Magnetism are in some sense sister quantum phenomena, but magnets exist well above room temperature and their behavior is familiar. Superconductivity is not so familiar because, so far, it occurs only at temperatures well below those found in the coldest places on earth. Greeks theorized that the attraction lodestone rocks found in Magnesia (hence the name magnetism) had for one another was sexual. Today we have a better theory and understand why if you put a magnet on your refrigerator door it will be there tomorrow, or forever if left undisturbed. Similarly we know why, if you put a loop of superconductor in which current is flowing, it generates a magnetic field. If you put the superconductor on the refrigerator door and keep it cold enough the current will continue to flow tomorrow or forever because the resistance is zero. That is just one of its amazing properties.

SUPERCONDUCTIVITY was discovered in 1911 by the Dutch physicist Kamerlingh Onnes. He observed the electrical resistance of pure mercury disappeared abruptly while it was cooling in a bath liquid helium which boils at -450 degrees F, only a few degrees above absolute zero. Two decades later an equally startling quantum phenomenon was discovered: if a superconductor is cooled in a magnetic field under some conditions it will spontaneously expel the field inside it when it becomes superconducting. Other strange quantum phenomena that followed have led to new science and new applications.

If we had room temperature superconductivity maybe the applications would be as numerous as they are for magnetism. Many of us are trying hard to find the promised land of room temperature superconductivity. I am optimistic it exists but I am not sure the discovery will happen in my lifetime.

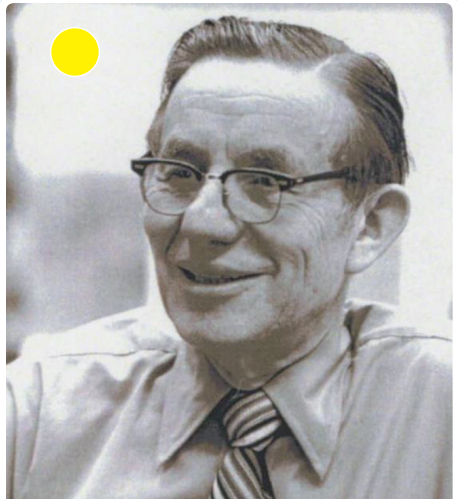
the transistor. He gave me a batch of carbon fibers left over from the tube days. In them we discovered superconductivity in intercalated graphite compounds. It opened a new field of two-dimensional superconductivity that has been a rich source of new physics ever since.

Bruce and his wife, Joan, had daughters who were our kids' ages and we picnicked at their place in the country. Bruce was our travel agent when we went to Spain in 1962. He booked us at the Parador where the King and Queen had stayed. The magnificent Prado in Madrid I vaguely remember, but reading the *Tales of the Alhambra* in the Alhambra is unforgettable. Our rental car got stuck in first gear and I was frustrated trying to explain this in in my limited Spanish at the repair shop. When I finally yelled, "el shifto!" I communicated.

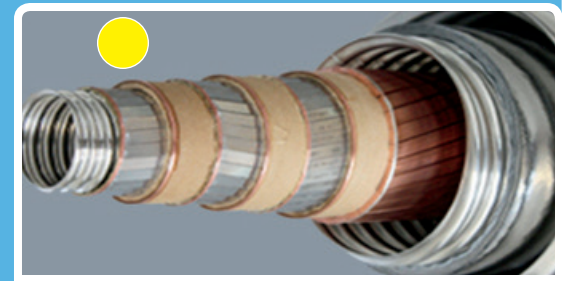
When I decided to work on superconductivity I moved from Bruce's semiconductor department to Sid Millman's Physical Research Department and became the sub-department head in low temperature physics. Sid was my boss for the rest of my time at Bell. He was the opposite of demanding, consistently taking on most of the administrative tasks so that I, and the other sub-department heads, my friends Phil Anderson, Homer Hagstrum, Conyers Herring and Al Clogston, were free to do research.

Sid had emigrated to the United States from Russia at 18. He attended tuition-free courses at City College New York and supported himself as an ironworker. After a year at Columbia University taking the graduate courses required to teach high school, he was unable to find a teaching job, so he stayed on at Columbia doing research with Professor Isaac Rabi. That resulted in some of the work for which Rabi received the 1944 Nobel Prize in Physics and for which Sid earned a Ph.D. and a job at Bell. In his other role, as Director of University Relations at Bell, Sid created win-win situations by supporting scientists who left Bell to become professors at major research universities and they, in turn, often sent their brightest graduate students to Bell. ~~That is what happened in my case.~~

In the last stage of his life Sid and his wife, Dor-



SID MILLMAN'S INVENTION OF THE RISING-SUN MAGNETRON MADE MORE PRECISE RADAR POSSIBLE AND LED TO HIS BEING RECRUITED BY BELL LABS WHEN THE WAR ENDED. BEFORE IT HAD NOT BEEN THE PRACTICE FOR INDUSTRIAL LABS TO EMPLOY JEWS. THE CHANGE IN POLICY OPENED THE DOOR FOR MANY OUTSTANDING SCIENTISTS, INCLUDING SURVIVORS OF THE HOLOCAUST, AND IS ONE REASON BELL BECAME THE WORLD'S PREMIER CENTER FOR SOLID-STATE PHYSICS RESEARCH.



SUPERCONDUCTING CABLE

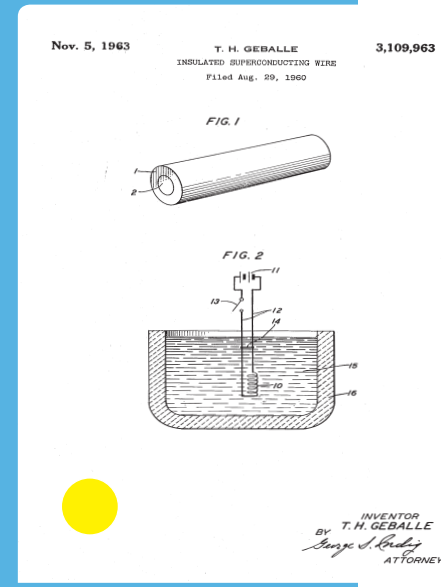
othy, moved to Walnut Creek, California to be close to son Michael and his family. This gave us an opportunity to stay in touch. Sid reached out in a new direction and established the Millman Respite Center at the Contra Costa Jewish Community Center. It serves seniors of all faiths and backgrounds. In a typical Millman touch the center offers an educational program.

Sid enjoyed a long, productive life filled with science, music, family and a deep appreciation for the country that took him in. Every year he and his family celebrated the anniversary of the day he landed at Ellis Island.

Bill Baker, the research vice president at Bell and Sid's boss, had an uncanny memory and could quote verbatim from our earlier conversations. Sometimes he was vague, purposely I think, when discussing future plans. This challenged me to come up with the best possible approach I could think of, hoping that was what Bill had in mind. Bill was committed to keeping my sub-department intact so that materials preparation was an integral component of our research. This was contrary to the then popular approach, elsewhere, of forming large departments to concentrate on crystal growth. There are merits in both strategies, but the small, closely coupled sub-departments such as mine, were what made Bell so productive.

After five years probing deeply into semiconductors I joined with Bernd Matthias in searching for new superconductors. Bernd and I were very fortunate to have George Hull, Vera Compton, Ernie Corenzwit and Lou Longenotti as a dedicated team to make, characterize and measure samples using simple but reliable methods. The work led to discoveries for which Bernd and I received the Oliver Buckley prize of American Physical Society.

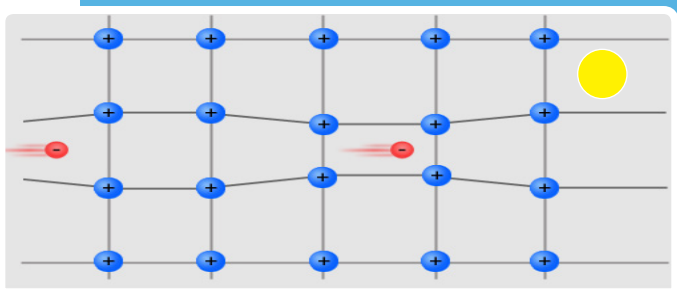
Once, when we happened to meet Bill Baker in the hall, Vera denounced the US policies in Vietnam in no uncertain terms. Bill, who was an influential science advisor to Presidents Johnson and Nixon, told her to be patient.


Nov. 5, 1963 T. H. GEBALLE 3,109,963
INSULATED SUPERCONDUCTING WIRE
Filed Aug. 29, 1960
FIG. 1
FIG. 2
INVENTOR
T. H. GEBALLE
BY George S. Hobby
ATTORNEY

When I joined Bell I was given $1 as compensation for any future inventions. Did Bell receive a full return on that dollar? My most used invention stabilizes superconducting wires by coating them with a copper sheath that can shunt very short bursts of current that might be caused by lightning or other instabilities.

From the patent: ...the gold, silver or copper insulating coating is a better conductor than the superconducting materials in their normal state. Accordingly, if such materials should revert to their normal state during operation, the current will automatically be shunted through the path of least resistance, which is the metal insulation. This protects the coils from destruction due to inadvertent overloading, whether due to exceeding critical field or rise in temperature.

This is known as cryogenic stabilization and is universally used in all superconducting magnets, such as MRIs—but only after my patent had expired.



The "isotope effect," the square root dependence of the superconducting transition temperature (Tc) upon the isotopic mass provided a key clue that led Bardeen, Cooper and Schrieffer to the discovery of the theory of superconductivity, **THE BCS THEORY**, which had eluded the world's leading physicists for four decades. It showed that the repulsive Columb force that keeps negatively charged electrons apart are overcome by the response of the positively charged lattice ions. The negatively charged electrons attract each other forming superconducting pairs. A simple explanation is that the negative charge of one electron attracts an excess of surrounding positive ions. The electron moves away rapidly and the paired electron moves in and senses the excess positive charge thus reducing the repulsive electron interaction.

By today's standards I was a typical male chauvinist. I would ask Betty Wood, a prominent crystallographer and former president of the American Physical Society, to take time from her research to escort wives of visiting AT&T executives. When Vera let me know that she should not be asked to do a housekeeping chore that was not her job, I didn't react. I know better now.

After John Hulm discovered superconductivity in V_3Si, Bernd, reasoning from the Periodic Table, soon discovered Nb_3Sn, a new compound in the same family. We found Nb_3Sn to have a record high transition temperature–just above 18K. This eventually led to the manufacture of superconducting cables with widespread applications in medicine, energy and transportation.

Rudi Kompfner wanted to test Nb_3Sn as a possible shield for the amplifiers to be used in the transcontinental network. At the time however, the physics community believed, incorrectly, that superconductivity in transition metals and compounds like Nb_3Sn was due to very thin sponge-like filaments being incapable of carrying useful amounts of superconducting current. But Rudi's question led to an unexpected discovery with significant technological breakthroughs. See Unexpected Discoveries

I was focused on what seemed to be the fundamental problem—what were (and still are) the mechanisms responsible for superconductivity. We noted that the "Isotope Effect," the dependence of Tc upon isotopic mass of the superconductor, had only been established for non-transition metal elements like tin. We obtained isotopes of Ru-99 and Ru-104 from the Oak Ridge National Laboratory in Tennessee and found no measurable dependence of Tc upon isotopic mass, which was seemingly at odds with the then simple version of the BCS theory. See BCS Theory

For a few weeks I was in a state of euphoria thinking we had found evidence of a different pairing mechanism. But when I walked into Phil Anderson's

office I found out otherwise. Our results was of fundamental importance, not because it showed a limitation of BCS, but just the opposite. It confirmed the Anderson-Morel model that there is an additional mass dependent contribution to Tc in RU. It approximately cancels the original BCS isotope effect. Even though we didn't find evidence suggesting a new pairing mechanism, we did find evidence for the Anderson-Morel model, so I feel very good about our contribution–and I am still searching for new pairing mechanisms.

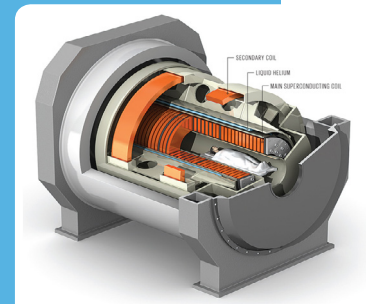
Phil's input had been valuable in interpreting my experiments, starting with my thesis. His theory of super exchange accounts for why I observed that only half of the copper ion spins ordered when I applied the highest magnetic field then available at Berkeley.

Gene Kunzler built the sensitive laboratory we used to investigate thermomagnetic properties of semiconductors. To do this we mounted properly doped germanium thermometers in a strain-free configuration. They were two orders of magnitude more reproducible than any previous. We made a number of these thermometers and distributed them to colleagues at other labs.

We had been friends with Lois and Gene Kunzler since graduate school. My glowing reports of life at Bell lured them east. They stayed with us in Dunelllen when Lois was pregnant and the 102° weather made it essential to find a fan as there was no air conditioning then. Most of the stores were sold out but we finally found one. They moved to an old farm where Gene used skills acquired from growing up in rural Utah to rebuild equipment, raise crops and entertain our children with cross-country Jeep rides.

John Galt and I joined forces in acquiring a state-of-the-art high field magnet from Francis Bitter at MIT. It generated fields as high as 88 kilogauss,

UNEXPECTED DISCOVERIES are sometimes made in response to technological needs.



Rudi Kompfner asked me to help investigate using Nb_3Sn wires as shields for the three level microwave amplifiers (masers, the acronym for microwave that preceded laser for light) to be used in the transcontinental microwave communication system then being designed.

I realized that producing long lengths of wire needed advances in metallurgy. Morrie Tannenaum, Director of the Metallurgy Department (now Materials Science) took up the challenge and the research was undertaken by Gene Kunzler, Jack Wernick and Ernie Buehler. They developed a clever way to make wire out of brittle Nb_3Sn and, in doing so, made a totally unexpected discovery. Contrary to the "sponge" theory, the wire carried large supercurrents in high magnetic fields. Superconductors could be used to construct coils that produced large volume high magnetic fields. Anyone who has had an MRI body scan has been inside a superconducting magnet.

about six times greater than iron magnets. Giauque, at Berkeley, was concerned that the heat generated in the large copper coils would not be carried away uniformly and would cause randomly fluctuating magnetic fields. However, Galt found the magnet functioned beautifully and observed cyclotron resonances and collective modes of electrons in bismuth, carbon, and other metals and semiconductors, advancing theoretical understanding. Later he and Conyers investigated the mechanical properties of the tin whiskers that caused failures in switches used to operate the phone lines (before the transistor era). They found the whiskers had so few defects that they were stronger than steel. A commercial negative became a research positive.

The Geballe-Galt connection was established long before Bell. John was in Aunt Pauline's high school chemistry class in Portland. At dinners and social events I could see why he was one of her very "favorite former students." John had crisp, well-thought-out positions on almost everything. His wife, Maggie, was warm and natural and a doer. She might be out digging fence post holes when I visited. She was genuinely fond of our children and Adam was happy she took one of Eve's litter.

Surendur Puri, a Columbia grad student was, in effect, my very first student since he did all his research with me using the Bitter magnet to investigate thermomagnetism in addition to magnetoresistive behavior in semiconductors in high magnetic fields where classical theory failed. Herring's theory motivated this novel thermomagnetic approach.

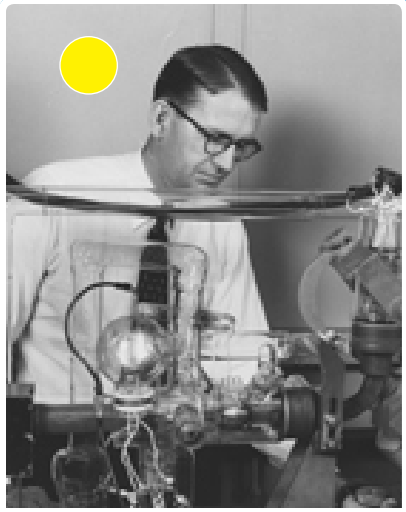
Sissy, Ali, Adam, and for part of the time Gordon, and I spent three exhilarating summers at UC San Diego in La Jolla when I took over from Bernd while he was in Los Alamos. The young campus was growing but the faculty was still small and informal. The town fathers had been conservative. Visitors like J. Edgar Hoover were welcomed until they realized such practices were at odds with establishing a first-rate university. Walter Kohn became the head of the Physics Department and recruited an outstanding faculty including Harry Suhl, George Feher and Bernd from Bell. I worked with groups of students, postdocs, visitors and interested faculty, and, of course, Bernd. We particularly enjoyed knowing Willy Zachariasen, a leading crystallographer from the University of Chicago who had a wry sense of humor and Leonard Schiff and Bill Little from Stanford. In spite of the many attractions, when Walter offered me a faculty position there, I wasn't prepared to leave Bell.

ONE MEMORABLE HIGHLIGHT FROM A SUMMER IN LA JOLLA WAS WATCHING ADAM, A PALE EASTERNER, WIN A TENNIS TOURNAMENT WITH CONSIDERABLE HELP FROM HIS OPPONENT'S VOCAL TENNIS DAD WHO KEPT YELLING AT HIS SON.

During my time at Bell I recruited graduates from Cal, Stanford, UC San Diego and the University of Washington. In addition to the recruiting it was a great way for me to keep up with ongoing science and meet promising scientists. Happily, but not coincidentally, the trips west often coincided with the weekends of the Cal/Stanford football games.

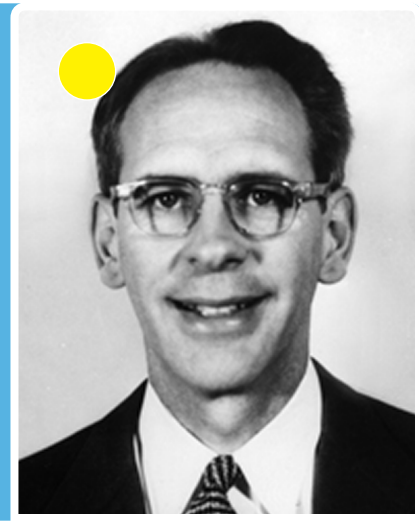
BELL FRIENDS

We came together from all over the world, without our extended families, so we became a new close family. Most of the Bell families we knew had kids and we shared carpooling, school events and weekend expeditions. Our science and social lives were interwoven. When we scattered, particularly after the Bell system broke up, we stayed in contact. Today, alas, I too often read about those friends in the obituary columns.



HOMER HAGSTRUM DISTINGUISHED HIMSELF IN BOTH THEORY AND EXPERIMENTS IN ADVANCING THE FIELD OF SURFACE PHYSICS.

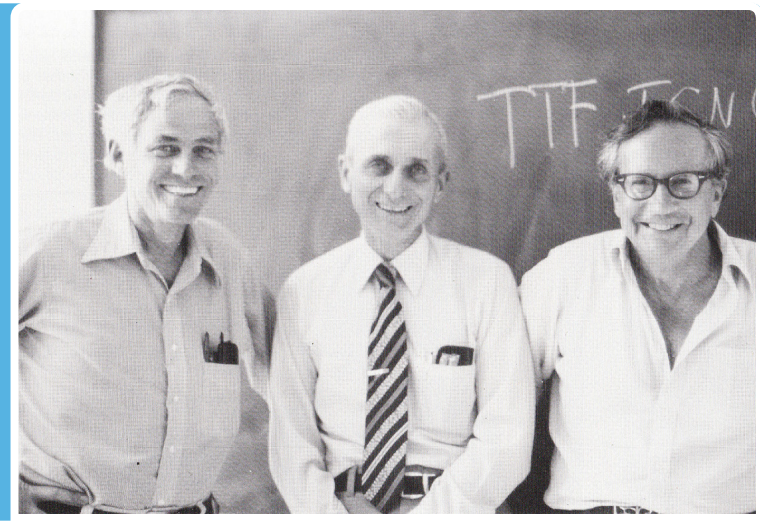
CONYERS HERRING WAS A MAJOR CONTRIBUTOR TO THE DEVELOPMENT OF MODERN SOLID STATE PHYSICS IN THE 20TH CENTURY STARTING WITH HIS DISCOVERY OF THE ORTHOGONALIZED PLANE WAVE METHOD FOR CALCULATING THE ENERGY BANDS IN SOLIDS. HIS CREATIVE REVIEWS ON MAGNETISM AND THERMIONIC EMISSION BECAME STANDARDS IN THE FIELD.



Homer Hagstrum grew up in Minneapolis in a strict Swedish Lutheran family. The modern world opened up to him after he left home to go to the University of Minnesota. When he went to see his first movie his mother cried. He discovered his love for classical music "ushering under Ormandy." We have several sculptures by Bonnie, his talented wife, who was my mixed doubles tennis partner. Even icy Highway 22 didn't prevent us from driving to Carnegie Hall to listen to the Philadelphia Orchestra. One weekend our families went off for snow play in the Poconos. We got there without getting into an automobile. We just walked out the door of 204 to the train station with our gear on our backs. We climbed on the Phoebe Snow and went rolling through a landscape of barns, villages and churches from New Jersey to Pennsylvania. The skiing wasn't great which was no problem for non-skiers Sissy and me, and Bonnie and Homer were good sports. Gordy, Ali, and Adam bonded with Melissa and Jonathan and we all remain close. After Homer retired the Hagstrums moved to Palo Alto. Homer, who was a leading surface physicist, died before he had a chance to set up a lab in California. I went with Bonnie to pick out a simple memorial stone that she placed in the old "cemetery" at our beach house.

BERND MATTHIAS' SELF-ACCLAIMED SCIENTIFIC INTUITION WAS BASED ON AN EXCELLENT MEMORY, THE ABILITY TO ASSOCIATE FACTS AND A DEEP UNDERSTANDING OF MENDELEEV'S PERIODIC TABLE OF THE ELEMENTS. HIS UNINHIBITED THINKING LED HIM TO DISCOVER A VERY LARGE NUMBER OF SUPERCONDUCTING AS WELL AS NOVEL MAGNETIC, AND FERROELECTRIC COMPOUNDS.

WITH JOE REMIKA (CENTER) AND BERND (RIGHT). JOE WAS A MASTER CRYSTAL GROWER, WITHOUT BENEFIT OF ANY FORMAL EDUCATION—EXCEPT WHAT HE LEARNED AT BELL.



Conyers Herring grew up in a small town in Kansas. When it was found that at age six he was reading well above grade level he was put into the fifth grade. He told me he never wanted to bully anyone because he knew what it felt like to be on the receiving end. He believed some things were beyond human comprehension and was comfortable reconciling his deep faith in Christianity with his scholarship. I think of him as a low-key genius with a Google-like search engine in his brain and in his famous suitcase of 3 x 5 index cards of abstracts of important papers published in science journals from around the world. The cards were actually more useful than Google because Conyers searched for quality.

Conyers regularly ran a well known Journal Club which he continued at Stanford after retiring from Bell. We organized a special one to celebrate his 80th birthday. In Frances Hellman's tribute she wrote, "I thought I was rather clever to have thought of an explanation for one aspect of my thesis. I gave the chapter to Conyers (who was on my thesis committee) to read and he promptly reached into his famous black suitcase and pulled out a card and said, 'This is known as the Soret Effect and here are references.'"

Conyers learned Russian to keep up with the outstanding theoretical work being done in the USSR during the Cold War. He was in the first US delegation of scientists to visit Russia after perestroika and lectured there in Russian. On the reciprocal visit one of the Russians told me he wished Conyers had lectured in English. "Even the janitors at Bell know quantum mechanics," another Russian said when he overheard a conversation in the hall between theorists who were wearing overalls. The Matthiases had the scientists for dinner and when Bernd proposed a vodka toast, "Here's to the Russians and the Americans," he was corrected, "We are two Ukrainians, three Russians and two Jews."

It is not simple to do justice to the many facets of Bernd Matthias, but since he was a major influence in my career, I will try. Bernd learned to survive by his wits after his mother helped him get out of Nazi Germany. He earned his Ph.D. at ETH, the MIT of Switzerland, investigating ferroelectricity,

which then led him to the US. He told me his mother phoned to tell him the Nazis were coming and he never saw or heard from her again. When he traveled the first thing he unpacked was a picture of his mother. He could find common ground with almost anyone, partly because he communicated in many languages, and partly because of intuition. If there is an opposite of autism that would fit Bernd.

We shared a lab at the end of the first floor of the long building. To save time we left the window open and would climb through it when we came back in the evenings. The friendly Irish guards knew what we were doing and winked. Saturday mornings we spent in the Bell library pouring over journals from around the world. Ms. Werner, the librarian who was from Estonia, would translate Slavic language papers for me when the graphs looked interesting.

Bernd's charm made him a favorite of the Bell wives. When a cab driver in Chicago asked him, "Where to?" Bernd answered, "It doesn't matter, they want me everywhere." He was as uninhibited in his lifestyle as in his science.

Bernd and I went to the International Low Temperature Conference in Paris in 1955 and saw the city emerging from World War II. As we roamed the Left Bank I found a Chagall print of a rabbi I liked and Bernd jumped in and bargained gleefully over the price. The print now hangs in our Eucalyptus office. Connie Wolf, the director of the Cantor Museum at Stanford, assures me that only the original can bring to the viewer its special quality. She may be right but, when I look at the rabbi in Chagall's print, the memory of that trip stirs something in me.

Just before flying home at the end of that conference I had dinner with Harold Sheeline at a three star restaurant. Harold was a long-time Bay Area friend of Sissy's, a highly respected chemical engineer, and a welcome guest on Summit weekends where his wit, humor and playful repartee with Gordy, Alison and Adam made him a family favorite. The vintage red wine we ordered was carbonated and spoiled and I refused to accept it. Harold loyally backed me, and we joined the ranks of ugly Americans. Upon our return Sissy picked us up at Idlewild (JFK today) and we were no longer ugly.

Long after I had gone to Stanford, and Bernd and I were no longer working together, I was perceived as half friend, half competitor. He accused my former student, Frank DiSalvo, of helping himself to some of his ideas. This paranoia might have been due to Bernd having to survive on his own in his early days. It didn't bother Frank who, with colleagues at Bell, was verifying the existence of a new state of matter, charge density waves, that had been predicted but not observed in more than one dimension. When Frank was ready to leave Bell, where his work involved chemistry related materials research, I tried to interest Stanford's Chem Department in him, but was turned down with, "How can you expect a physicist to teach a freshman course in chemistry?" Well, Frank ended up at Cornell doing just that and was awarded a prize for teaching it so well.

Bernd said he was never going to grow old and he didn't. He died suddenly in his sixties. We had a memorial service for him on the beach. George Feher looked up in the sky and down at the sand, and said, "Bernd, wherever you are, up there or down there, it was good knowing you."

John Hulm and Bernd, as young scientists at the University of Chicago, were encouraged by Enrico Fermi to search for new superconductors. There was no satisfactory theory of the phenomenon even though the best theorists had been trying to find one for the half century following Onnes's discovery. I suspect Fermi felt new superconductors might provide new clues. For instance, why is good metal copper not superconducting while bad metal copper sulfide (CuS) is? That approach has stayed with me and provided a

JOHN HULM DISCOVERED NEW CLASSES OF SUPERCONDUCTORS INCLUDING V3SI WHICH INTRODUCED THE A15 STRUCTURE AND PAVED THE WAY FOR DISCOVERING NEW SCIENCE AND TECHNOLOGY. FOUR OF MY STUDENTS, FRANCES HELLMAN, KEN KIHSTROM, RAYNIEN KWO AND DAVID FELDMAN BASED THEIR THESES ON EXPERIMENTAL INVESTIGATIONS INSPIRED BY JOHN'S WORK.

stimulus for my research.

John left Chicago to join a potent group of young scientists at Westinghouse Research, where he remained for the rest of his career. I got to know John, and his irrepressible wit and humor, particularly well during the blizzard of 1953 which hit Pittsburg during a meeting of the American Physical Society. What could have been a logistical nightmare was, in John's words, "a jolly good time." He became Director of Research and, after I went to Stanford, I became a consultant. I stayed with the Hulms and particularly enjoyed consuming large quantities of imported British cheese while we gossiped in the evenings.

When I was still at Bell, Bernd, John and I worked together. It is a tribute to John's sense of fair play, that what might have been an unfriendly rivalry, was the opposite. It was a warm, friendly and intimate competition that ignored corporate guidelines as unpublished results traveled back and forth. John investigated Bernd's conjecture that the BCS Theory in 1957 was inadequate to describe anomalous superconducting properties of transition metal alloys. John thoroughly enjoyed finding that the anomalies were due to trace impurities and were in accord with BCS. ~~I discovered that by removing trace iron impurities Molybdenum became superconducting.~~ Bernd kept on looking for exceptions. John's careful investigations of transition metal alloy superconductivity provided inputs for the construction of superconducting magnets. John needing MRI scans after he suffered a debilitating stroke, reminds me of the parable of the coming back of the bread that is cast upon the water. Unfortunately the research needed to restore damaged nerves and muscles is yet to come.

John' father had been a British Railway conductor and John had a lifelong love affair with railroads. I was on sabbatical in Cambridge and John was the scientific attaché to the US Embassy in London, when we were on our way to the airport to visit colleagues in Germany. I discovered I needed a passport and there wasn't time to go to Cambridge to get mine. No problem. John just phoned the Cambridge Station and arranged for Sissy to give my passport to the conductor on the next train who handed it to me at the London station in time to catch our plane.

We were with Phil Anderson and his wife, Joyce, on many occasions in New Jersey, New York, England, Spain and France. One summer evening in New York, after an off-Broadway play, we sat on an unlit pier with our feet dangling over the East River while Joyce sang uncensored versions of songs made famous by their college friend Tom Lehrer. It's worth listening to the censored, but still clever, songs he sang at Carnegie Hall. On winter weekends our three kids went ice-skating with their Susan and Phil. When I moved back to California, and returned to Bell as a part-time staffer, I stayed with the Andersons and enjoyed swimming, drinking cranberry juice and gin, and solving the world's problems.

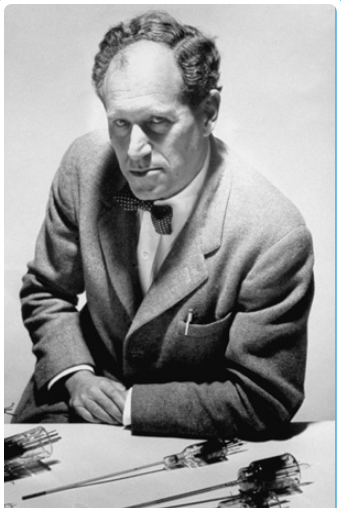
PHIL ANDERSON MADE MAJOR CONTRIBUTIONS AND BECAME ONE OF THE LEADING PHYSICISTS IN THE LAST HALF OF THE 20TH CENTURY.

BILL MCMILLAN DEVELOPED A METHOD FOR OBTAINING MICROSCOPIC ELECTRON-PHONON INTERACTIONS FROM EXPERIMENTAL TUNNELING DATA THAT ADVANCED THE FIELD. PHIL ANDERSON CALLED BILL, "THE ABLEST CONDENSED MATTER PHYSICIST OF HIS GENERATION."

Phil teamed up with John Rowell and found that a supercurrent could flow right through an insulating barrier separating two superconductors at zero applied voltage. This must have happened countless times before but was easily discounted because it could be explained by there being superconducting shorts through the barrier. However, they observed marked variations in the current in the presence of weak magnetic fields that could not be explained by shorts but had been predicted by Brian Josephson, then a graduate student of Phil's at Cambridge. This opened up a vast new field of Josephson Junction science and technology. John spent a year at Stanford and introduced us to superconducting tunneling spectroscopy, the valuable technique Bill McMillan and he developed for studying phonon spectra involved in the pairing of electrons that causes superconductivity. Mac Beasley's students and mine, Dave Rudman, Raynien Kwo and Ken Kihlstrom, used this knowhow in their theses.

Bill McMillan and his wife, Joyce, came from small town Arkansas backgrounds. Bill was a young and brilliant theorist. He had a twinkle in his eye, a distinct lack of pomposity, and a bad stammer that didn't hold him back. An errant automobile hit him when he was biking alone on an empty rural highway, ending the life, at 49, of what would have been one of the foremost scientists of our era. The series of papers he wrote with John Rowell are the gold standard. Bill's wife was a talented crystallographer and, as I found out, a formidable tennis player.

Rudi Kompfner was born in Vienna and, as a young boy, was separated from his family and evacuated to a host family in Sweden. Rudi was educated as an architect in Vienna, escaped to England before Hitler's Anschluss and was interned as an alien on the Isle of Man. He learned enough physics there, from fellow internee Klaus Fuchs, and others, to go to university and obtain a Ph.D. He invented the traveling-wave tube which had an important application for the war effort. Bell recognized his contribution and recruited him after the war. Rudi became a Director in Communications at Bell and oversaw the Echo Satellite program, the first demonstration of transcontinental microwave communication. This was accomplished by reflecting



RUDI KOMPFNER WAS TOLD BY THEORISTS THAT THE TRAVELING-WAVE TUBE AMPLIFIER HE CONCEIVED OF WOULD NOT WORK. HE BUILT ONE, IT WORKED AND BECAME WIDELY USED IN RADAR COMMUNICATIONS SYSTEMS. HE ADVISED STUDENTS, "LISTEN TO THEORISTS BUT DON'T BELIEVE THEM."

GEORGE FEHER DEVELOPED THE ELECTRON-NUCLEAR DOUBLE RESONANCE (ENDOR) TECHNIQUE WHICH PROVIDES QUANTITATIVE INFORMATION ABOUT THE BEHAVIOR OF ELECTRONS AND NUCLEI IN SOLIDS. LATER AT LA JOLLA (UCSD) HE DEVELOPED SPECTROSCOPIC TOOLS AND THEIR APPLICATIONS TO SOLVE PROBLEMS IN BIOCHEMISTRY AND BIOPHYSICS.

microwaves off the surface of a NASA balloon, requiring the construction of an exceptionally sensitive horn antenna. This antenna, left over from the NASA experiment, was a key element in one of the great scientific discoveries of the 20th century in cosmology. Penzias and Wilson, used it to detect the three degree Kelvin radiation left over from the Big Bang.

When we visited the Kompfners at the Jersey shore we noticed that some books on their shelves were upside down. This was a signal that they had been read and we were welcome to take them. Rudi's architectural training stayed with him. When he retired he came to Stanford. He noticed that extra large dining tables in the faculty dining room caused people to raise their voices, then positive feedback from other tables made the loud noise even louder. The simple solution—smaller tables. His charming woodcut of an Austrian village hangs in our home.

George Feher grew up in Prague. He disregarded his father's advice to stay put while the Nazi threat grew and hitchhiked with high school friends around the Mediterranean to Palestine while his father spent the rest of the war hiding in a barn. Much later it was disclosed George had wired the star atop the King David hotel in Jerusalem so signals could be sent to the underground in plain sight of the unsuspecting British forces. After George flunked the Bible test needed for admission to grad school in Israel he was admitted to Berkeley and his outstanding thesis led to his being recruited by Bell.

George and I enjoyed competitive sports as well as science. One hot and humid summer day my marathon tennis set with George seemed unending. George, a high school swimming star, suggested we decide the match by racing across the nearby lake. He was always just a bit ahead, so I swam harder, and so it went until he finished, a foot ahead of gasping me. George now plays high stake poker games on TV but I doubt if he toys with his opponents.

Mike Pollak was raised in Prague but managed to leave and obtain a Ph.D.

BOB SCHRIEFFER, WITH BARDEEN AND COOPER, DISCOVERED THE BCS THEORY THAT EXPLAINED SUPERCONDUCTIVITY FOR WHICH THE THREE SHARED THE NOBEL PRIZE.

before coming to Bell as my postdoc. We seized on Phil Anderson's comment, that as a consequence of Feher's ENDOR study, there should be a frequency dependent contribution to the conductivity of silicon when properly doped and Mike and I found it. We presented the work at a semiconductor conference in Prague during the Prague Spring of 1968. Mike conversed freely with strangers when we roamed the city by tram. A special performance of Dvořák's opera, *Rusalka*, dedicated to our conference, was a highlight. Mike's mother, a high school English teacher, showed me the old Jewish cemetery that the Nazis preserved as a record of what they had expected to be a bygone race. She was visibly relieved when Mike was able to return the US without being detained.

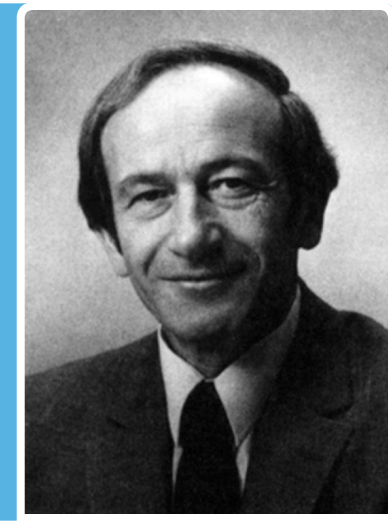
I drove from Prague to Paris with Pierre Aigrain, then a professor at École Normale Supérieure and a valued summer visitor at Bell. Later he became Secretary of Research in the French Academy of Sciences. During our drive there were signs of the devastation left by World War II everywhere. We got a firsthand impression of food shortages and rundown buildings in our overnight stay at a farmhouse where we were taken care of by friendly farm girls. The trip seemed short because Pierre was knowledgeable and our discussions were lively. One of his observations was, "Each country has only a few special years in which students will work their hardest. In France they are in the first grades, in the US they are in grad school."

Sissy joined me in Paris and we drove with Dick and Dodie (Rhoda) Goldman in their Citroën to Athens and then flew to Israel. Dick always wanted to be seated at the best table. We gleefully enjoyed being "trapped" (Dodie's word) overnight in a three-star hotel during a severe rainstorm. In Jerusalem I got into a good-natured argument with Mayor Teddy Kollek who claimed there were Jewish vice presidents at Bell Labs. I offered to bet my wife against a thousand-year-old vase in his office that there were none and I would have won. This was the year before the '67 war, when the Israelis would win all of Jerusalem. The border between the Arab and Israeli controlled sectors ran down the middle of a street. Children played happily while armed guards from both sides watched from rooftops. Only one bus a week was allowed to bring supplies to the Hebrew University campus on Mount Scopus.

Bob Schrieffer was a regular visitor to the Labs. Years later, in 1975, we were part of a delegation to China sent by the State Department shortly after Nixon normalized relations. We were all justifiably exhausted from our month-long trip, but Bob, perhaps overly conscientious, kept rewriting our report, determined to make it perfect. When he visited Stanford the dean gave me permission to explore offering him a faculty position. Bob responded in a dignified cold sweat, saying he couldn't accept because he was taking medication for a mental disorder. Later he became the director of the newly formed Theoretical Institute at UC Santa Barbara and it functioned exceedingly well right from the start. Tragically, when he was off his medications, he ended up in jail after crashing into a truckload of field workers. He retired in Florida and left the world of physics.

WALTER KOHN REMARKED ABOUT BELL, "I OWE TO THIS INSTITUTION MY GROWING UP FROM AMATEUR TO PROFESSIONAL." LATER, AT UC SAN DIEGO HE DEVELOPED AN ACCURATE AND WIDELY USED METHOD FOR CALCULATING ELECTRONIC PROPERTIES OF COMPOUNDS, FOR WHICH HE WAS AWARDED A NOBEL PRIZE IN CHEMISTRY.

SOL BUCHSBAUM STARTED AS A RESEARCHER AT BELL, INVESTIGATING INTERACTIONS OF MICROWAVE RADIATION WITH SOLID-STATE PLASMAS FACILITATING A WHOLE ERA OF LIGHTWAVE COMMUNICATIONS. HE WAS A NATIONAL LEADER WHO SERVED AS A SCIENCE ADVISOR FOR FOUR PRESIDENTS.

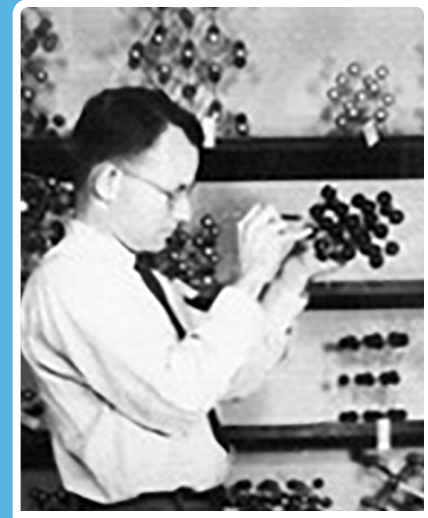


When Austria was annexed by Hitler Walter Kohn was parted forever from his family and evacuated through Kindertransport to Great Britain. He educated himself in a Canadian detention camp and was admitted to the University of Toronto, graduating at 22 with a Gold Medal in science and math. That gained him admission to Harvard Graduate School where he obtained a Ph.D. in Physics.

Walter visited Bell during the summers for 13 years, working with Phil Anderson, Conyers Herring, Gregory Wannier, and particularly Quin Luttinger, a visitor from Columbia. Walter made a special effort to instruct me about the origin of effective masses seen in phonon spectra now known as the "the Kohn Effect." When we were in California during the summers his family stayed in our Summit house and took good care of our dogs.

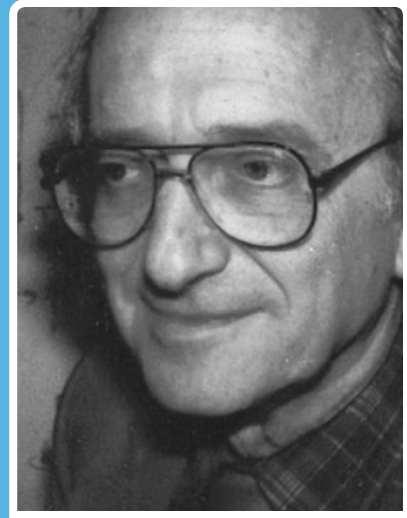
We all had to sign loyalty oaths at Bell during the McCarthy days. Walter, after his traumatic experiences in his early years, was too principled to sign. However Bell management found substitute phrases that satisfied both him and the McCarthyites. The New Jersey Security Department posted signs telling us to be vigilant and "to challenge all strangers." Bob Shulman ripped one off the wall and gave it to a visiting Russian as a souvenir.

Sol Buchsbaum is another scientist who fled Europe and came to Bell, contributing to its eminence. In 1941, two years after the Nazis invaded Poland, Sol's father was "removed" leaving behind thirteen-year-old Sol, his mother and sister. At his mother's urging he fled barefoot from the Warsaw ghetto and never saw his family again. He found refuge in a Catholic orphanage, became an altar boy and learned Latin. After the war he emigrated to Canada, taught himself English and obtained his high school equivalency. He won a scholarship to McGill University and graduated with a Gold Medal award in Mathematics, Science and Physics, then obtained a Ph.D. in plasma physics from MIT. Sol went on to become an influential executive at Bell and a national leader in the field of plasma physics. He taught me the ins and outs of nuclear fusion and he and Phyllis named their son Adam, after ours.



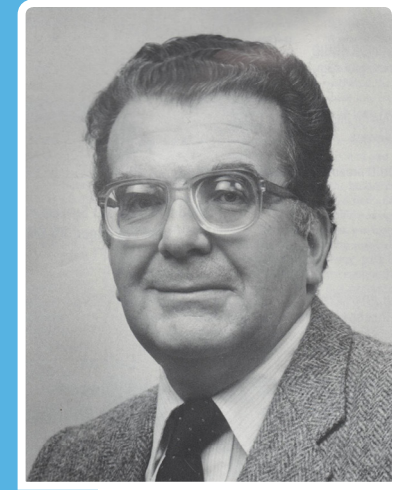
Peter Wolff's models explained the magnetic properties of dilute solutions of iron and other 3d metals in 4d and 5d metal alloys observed by Matthias and coworkers. He explained surface-enhanced-Raman scattering and with Phil Platzman modeled the scattering of light by quantized solid-state plasmas.

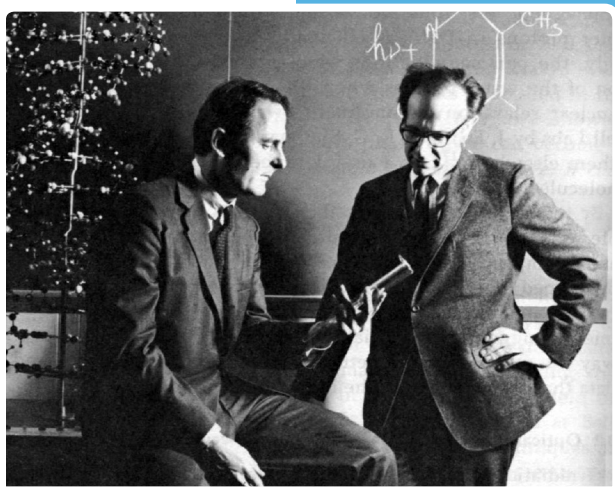
Peter Wolff and I shared a nostalgia for our Berkeley days. Peter was not only a theorist with whom I could discuss magnetism and optical properties during leisurely noon-time walks around the spacious Bell grounds, but he understood people very well. Cathy, his wife, grew up on a farm in Arkansas. She felt city people were disconnected from cycles of birth and death, while she took them in stride. She painted and occasionally exhibited modern art in her home. I didn't always appreciate the art but I did appreciate the good meals she served on holidays. The Wolffs went to MIT and I stayed with them during visits to the Magnet Lab. Peter and I had many spirited tennis games.



Harry Suhl was another European-trained theorist attracted to Bell. He developed theoretical techniques for understanding magnetic interactions including the Kondo problem. He said, as the Cold War was thawing, he'd never go to Russia until there was a Moscow Hilton. Sissy concurred and appointed herself chairman of the Harry Suhl fan club.

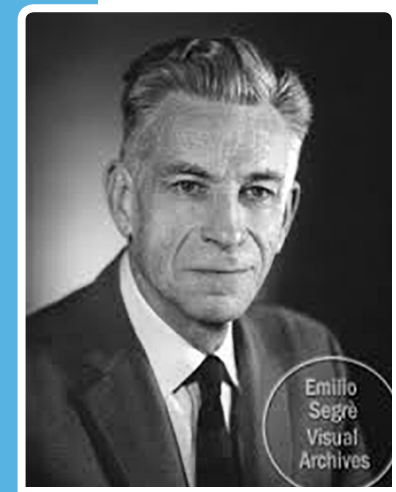
John Rowell was at Bell for more than 20 years. He was a major player in the field of superconducting tunnel junctions based on the experimental proof (with Anderson) of Josephson tunneling, leading to the most sensitive known detectors of electromagnetic radiation. In 1984, when the AT&T monopoly was broken up, John went with Bellcore, the research arm of the operating companies. At that time I was at Stanford but continued my contact with John as a consultant at Bellcore. But the synergies that had made Bell Labs so special no longer existed. When on sabbatical at Stanford John introduced the McMillan-Rowell program for obtaining electron phonon parameters from tunnel junctions. Three of my students used this research in their theses.





Later John became CEO of Conductus, the start-up of Berkeley and Stanford professors funded by venture capitalists who encouraged us to find commercial uses for the newly discovered high Tc cuprates. See Woodstock and Beyond, Conductus

Robert Shulman (left) and J. Terry Eisinger



The freedom at Bell allowed Bob to use his expertise in Nuclear Magnetic Resonance in semiconductors to solve problems in molecular biology. He carried this approach to the medical school at Yale, where he and Gordon have occasional contact and a warm relationship. Terry Eisenger's departure from Austria paralleled that of Walter Kohn's. I was fascinated by his credible linking of the *Fall of the Roman Empire* with lead poisoning from the lead linings of the famous aquaducts. Is there any parallel today? Think Rachel Carson, DDT and *Silent Spring*.

Alan Holden developed new ways of growing crystals and passed this along via his books and talks. He owned an early Volkswagen and claimed, "My idea of an automobile is something that will get me from here to there. I don't need bells and whistles. Period." I think of him when I read his son Stephen's film and music reviews in the *New York Times*.

FAMILY LIFE

Shortly after we moved to 204 Springfield Juanita Blair answered our newspaper ad. She became a part of our family for the next 15 years. Initially she told us she would be glad to clean the house but, "I can't help with the children. I have no experience taking care of children." A few weeks later Sissy and I needed a babysitter and Juanita agreed to stay with the kids. She turned out to be a lovely, caring person and a great cook.

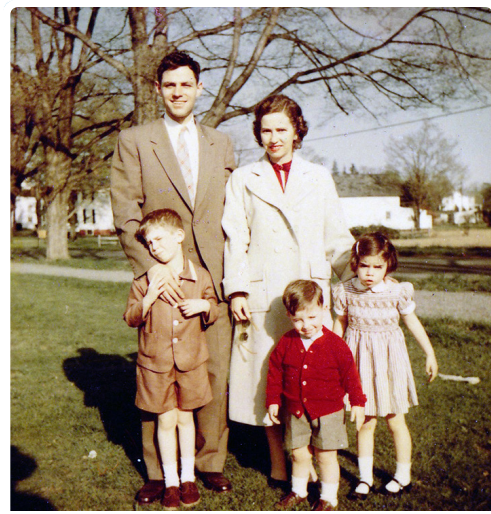
Juanita and Adam shared adventures in his preschool days while Sissy was busy with Gordon and Alison and then school friends. Getting out of the car one day the carpoolers looked Sissy in the eye, politely saying, "Thank you for the ride, Mrs. Geballe." Gordy had coached them, either to tease or to please his mother, I am not sure which. Later our kids walked the mile to Lincoln Elementary unless the temperature dropped below 14* F.

Our next-door neighbors on one side, the Nawiaskys, had managed to leave Germany before Pearl Harbor. Faddy had been a high level chemist at the IG Farben chemical company and became head of its US subsidiary, Agfa-Ansco, in Summit. They floated across the Atlantic in the luxurious Hindenberg dirigible, complete with a grand piano in the lounge. On a subsequent trip the Hindenburg was destroyed in a sensational explosion while landing in New Jersey. The disaster was originally blamed on the hydrogen gas that lifted the lighter than air craft but was later proven to be due to the flammable sealing varnish on the skin.

Mrs. Nawiasky treated the children to home-made pfannkuchen, and Faddy, who had retired, painted a portrait of Ali. Our neighbors on the other side, the McGraths, were kind enough to forgive our dog, Eve, when she ran off with their beefsteak dinner. There were no fences in the grassy back yards and our children roamed freely. One time Adam came home on his own, across several yards, for a quick diaper change, then rushed back to the birthday party for Ali and Gordon's school friends.

The first warm weekend we found an uncrowded lake where the children splashed and swam. The next week, when we went back, we couldn't even find a place to sit–the season had officially opened.

Architect brother-in-law Howie drew up plans that turned the middle bedroom at 204 into a study. The wchildren and I studied there, side by side, at built-in bench-type desks, doing homework and science. I told Ali her science teacher was incorrect when he told the class that the Fahrenheit temperature scale was named after Mr. Fahrenheit and the Centigrade scale was



A YOUNG FAMILY IN SUMMIT

A SUNDAY OUTING TO VALLEY FORGE WITH MY DAD

named for Mr. Centigrade. That motivated me to take an active interest in the education of science teachers that has stayed with me throughout my days at Bell and Stanford.

When we introduced Adam to his preschool teacher he said, “Mrs. Smith. That’s a funny name.” In a test he was shown pictures of the Mona Lisa and a laughing clown and picked Mona Lisa as the happier one. During the relaxation period he fell asleep.

Adam learned how to fish on Indian Guide outings. As “Little Tahoe” and “Big Tahoe” we met with eight classmates and their dads at each other’s houses and made new friends. The large talking stick, that had to be passed around and held by anyone who wanted to talk, was effective. Today, in my hearing challenged senior years, I capitalize on that idea by asking people in gatherings at home or school to use my high tech electronic talking stick.

Adam pined for a dog. We went to look at a Springer Spaniel but she had folded eyelid and we decided not to take her. On the way home Adam looked so sad we turned around. We named our new dog Eve and she too became part of the family.

We ate dinners together and cleaned up together until Alison’s ultimatum,“Well, which do you want me to do, my homework, or the dishes?” Ali didn’t mind being different. She “liked Ike” Eisenhower for president when the rest of us were for the eloquent Adlai Stevenson. Her classmate and friend, Susan Murphy, took her swimming at the country club and Ali learned the world was not perfect–Jews were not allowed to join. A few years later we were asked to join the Clearwater Club and did.

One Saturday on our way to Hyde Park we stopped for a football game at West Point and watched the Army vets trounce Nebraska. Wild cheering from the home crowd found Adam crying for the underdogs. On the tour of Franklin Roosevelt’s house the guide assured us that FDR’s study was exactly as he left it. Alison’s emphatic response, “He left the lights on,” brought down the house.

DAN, SISSY AND KIDS, IN OUTFITS FROM LEVI’S NEW ORANGE,LEMON AND LIME COLLECTION, ON A VISIT TO SHIRLEY AND BERN SUGERMAN IN GLADSTONE, NEW JERSEY

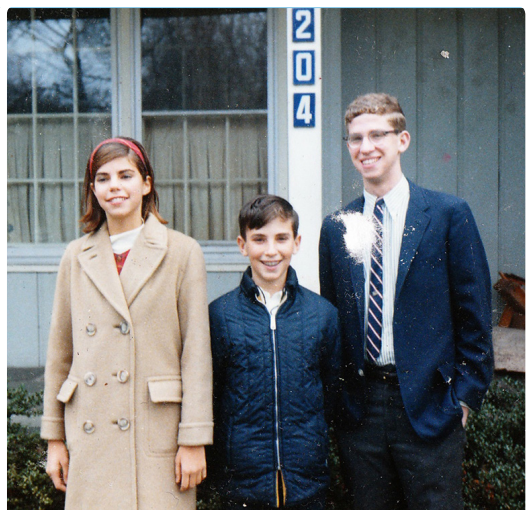
WE BRED EVE SHE HAD HER PUPPIES RIGHT UNDER ADAM’S BED

ALISON WITH EVE’S PUPPIES

Another weekend we took our three into Manhattan and met the Dan Koshlands and their four, for lunch and the Broadway musical, *The Fantastics*. Dan, driving with little time left before curtain, turned on to a snarled crosstown street with no theater in sight. "Just as I thought," he said, "it's not on this block."

We drove to Cornell one Thanksgiving, where Dan was on sabbatical, and started a tradition of celebrating Thanksgiving together, which continues today.

When Gordy left for his freshman year at Berkeley he complained, "Why did you just take us to the tourist places? Why didn't we see the real Manhattan?" Sissy and I did enjoy the choicer parts of New York City—food, concerts, theater, wandering into Rizolli's bookstore at midnight and the museums. We weren't aware of the great art that was being created until later when we found the Franz Kline painting, *Hoboken*. Sissy and I both liked it and l like it even more hanging in our living room where I can watch it change character as day turns to dusk. It will eventually go to the Cantor Museum.



Sissy's Dad came to visit shortly after we moved and I took him to Bell Labs. We innocently skipped the signing in procedures and just walked in through a side door to my lab. In the cafeteria we sat with some of my colleagues. Frank Morin, my lab partner, was discussing space travel (well before Sputnik) and how to colonize planets. I'm not sure if Dan thought we were forward-looking or wild-eyed. But I knnow he wasn't impressed with sleeping in our basement playroom with the noisy furnace going on and off all night. He managed one night then checked into the local Suburban hotel. Earlier my mother had stayed in the basement with no complaints, but with plenty of sleeping pills. Mom and Gordy went with me to Philadelphia by train, and while I gave my first talk on my Bell work at Penn, they took in historic sites.

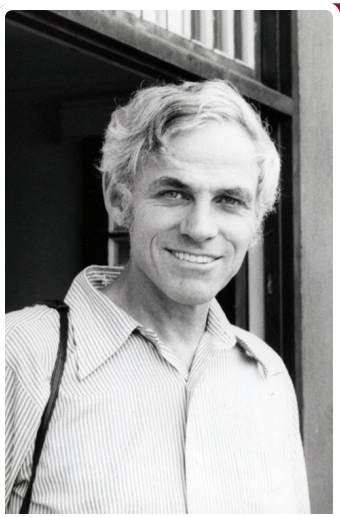
Back in San Francisco Mom told her doctor, Art Cerf, she had gone to have her hair done and didn't remember doing it. Tests showed she had a brain tumor. In 1957 we left Gordy and Ali with the Matthiases at our house and flew to San Francisco with Adam. Mom was flat on her back on a gurney when I saw her. She looked up and smiled and her last words to me were, "You've had a haircut." We had been in the waiting room at UC Med Center on Mount Parnassus, looking out the window at the Golden Gate for eight hours, when the doctor came to tell us he had successfully removed the tumor but a blood vessel had burst. Mom lasted a few days, unconscious, and died, leaving a big hole in my life.

Sissy and I got to know the Schwarz family through school, civic and temple activities. When I saw young Stephen walking to Lincoln Elementary School I never imagined he would later become such a major part of our lives. When Stephen's brother John decided to enroll at Stanford his father worried that John might not be able to find bed sheets. Stephen stayed east and graduated from Brown. He obtained his JD from Columbia and became an attorney in the US Department of Justice before moving west to become a law professor at USF and later at UC Hastings. His books on the legalities concerning non-profit foundations are widely used throughout the country. When we sought legal advice from him on financial matters we got much more. He organized our Eucalyptus office which handles family finances for three generations. His sophisticated humor is an added bonus.

OUR HOUSE ON KINGS MOUNTAIN ROAD
WOODSIDE, CALIFORNIA
LIFE ON THE SAN ANDREAS FAULT
IS NOT ALL BAD


STANFORD

BACK TO ACADEMIA

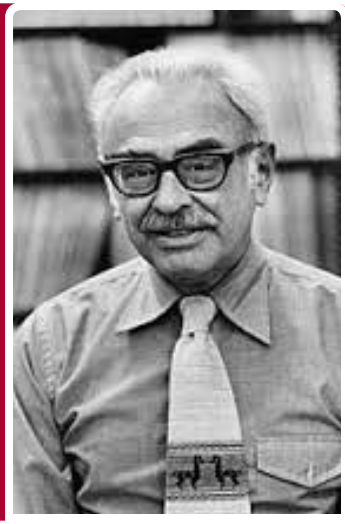


READY FOR A NEW CHAPTER

The position as the head of the Physical Research Department at Bell opened up 16 years into my time there. The laboratory director, Addison White, and his wife, Betty, invited Sissy and me for dinner. He told us that after considerable deliberation he had decided to appoint Al Clogston for the job rather than me. Sissy burst into tears simply because I was not the first choice. I hadn't even been aware that I was being considered and was not unhappy because I felt Al was a better choice. Had I been appointed I would have likely declined the job at Stanford that Marvin Chodorow offered me just a few weeks later.

Marvin was a professor in the Physics Department. His colleagues were not enthusiastic about expanding into solid-state physics due to a lack of foresight,I think. However, they did agree to support one faculty appointment. Marvin found two candidates at Bell—Art Schawlow, later to share a Nobel

MARVIN CHODOROW FOSTERED STANFORD'S GROWTH INTO SOLID-STATE PHYSICS



Prize with his brother-in-law, Charles Townes, for the invention of the laser, and Cal Quate who was doing comparably outstanding research in acoustics. Marvin couldn't decide between them. Provost Fred Terman solved the dilemma by creating a Division of Applied Physics. Art was appointed to the Physics Department and Cal to the new Division.

Recognizing the need for a materials physics component in the Division, Marvin flew back to Bell, this time to recruit me. I think Cal was instrumental in arranging that. Marvin stayed overnight with us and Sissy still wonders how we could have let him sleep on the uncomfortable folding couch in our study. We were all younger back then.

The continuing research opportunities at Bell were difficult to part with. When I asked Sid Millman if he thought I could maintain a connection with Bell, he responded, "First decide if you want to leave Bell for Stanford. If the answer is yes, then we can discuss possible future arrangements."

I accepted Marvin's offer. Bell and Stanford generously agreed that I could maintain a small part-time staff position at Bell. Later, when the government split up the AT&T monopoly, I stayed with John Rowell's laboratory at Bellcore, the research arm of the operating companies.

The new Applied Physics Division where I ended up was housed in the Microwave Lab where Marvin, W. W. Hansen, Ed Ginzton, John Shaw, Gordon Kino and Tony Siegman were pioneering in microwave and acoustics. A collaboration with Henry Kaplan in the medical school led to a widely used electronic accelerator for treating cancer, the prototype of which is in the Smithsonian Institution. The Stanford Linear Accelerator Center (SLAC) evolved from the Microwave Lab.

WOODSIDE & ADOPTIONS

It is not surprising Sissy and I returned to the Bay Area in 1968. Just a few years earlier her brother Dan, and his wife, Bunny, had faced a similar choice—whether to remain at Brookhaven and Rockefeller University in New York, or to return to Berkeley. They chose Berkeley after Dan remarked to Bunny, "At my age men either change jobs or wives. Which do you prefer?"

Sissy and I were in our late forties. Both of our mothers had died. We liked the idea of being closer to our fathers and the rest of our families. And we were ready to move back.

Alison, just graduating from Summit High, chose Michigan over Stanford when she heard I was going to Stanford. That choice had a profound effect on Gordon's life. When his adventurous four years at Berkeley in the heyday of Mario Savio and the Free Speech Movement came to an end, Gordy set off to go around the world. He stopped at Ann Arbor to say goodbye to Alison, met her good friend Shelley, and never left the country.

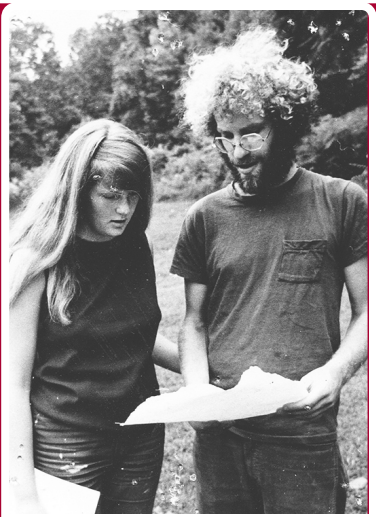
In 1970 Adam was also accepted at Stanford. After extracting a promise his mother would only communicate by penny postcard during his freshman year, he accepted.

Richard and Dodie Goldman made our move west easy by inviting us to stay in their Atherton home while we looked for a place near Stanford. The town of Woodside appealed from the start. Sissy's cousin Peggy, and husband, Bill Lowe, long-time Woodside residents, introduced us to their friend, Lorraine Thackery, a well-connected real estate agent. We searched for months without success.

WOODSIDE HOUSE, CIRCA 2015

SHELLEY AND GORDON. ALI AND GORDY WENT TO WASHINGTON, D.C. TO PROTEST THE VIETNAM WAR. WE HEARD ABOUT THIS WHEN SHELLEY PHONED. "MRS. GEBALLE, YOU MIGHT LIKE TO KNOW THAT TWO OF YOUR CHILDREN HAVE BEEN ARRESTED." ALISON LATER PARTICIPATED IN A CLASS ACTION SUIT AND WON AN AWARD FOR THE VIOLATION OF HER CIVIL LIBERTIES.

MONICA, JENNIFER, ERNIE



"I returned from a week of work at Bell and Sissy said to sit down, she had something to tell me."We are going to adopt."

Then in a chance encounter with another agent we saw 259 Kings Mountain Road, which was not yet on the market. The owner, Ira Coburn, was a retired Marine Corps General who had built airstrips in the Pacific. He and his wife were deciding whether to remain in Woodside where he was upgrading the house, or to opt for a traveling lifestyle. We liked everything we saw and I think our enthusiasm helped them decide. Ira continued improving the house, landscape and cottage right up until the contract was signed. Now, a half century later, it is evident he built well; things work just as well now as they did then. The flowers in the pots he insisted on leaving for us still bloom.

When Sissy mentioned adoption I immediately liked the idea. We had raised our three biological children in a comfortable tract house in suburbia and were moving into a new place with lots of room to play, swim, and roam around the redwoods. I asked the San Francisco Public Welfare Agency if my being 48 would disqualify us and was told, "We don't mind doing the unusual, but we don't do the impossible." They insisted on meeting privately with Gordy, Ali and Adam before qualifying us. So we had to wait until summer for our Michigan freshman to come home.

The adoption agency didn't want Monica exposed to any further trauma. She had been abruptly removed from her Sonoma home without being able to say goodbye to her foster family, when the social worker found her wandering alone in the street. They didn't want her to suffer another possible rejection. So we followed instructions to walk unobtrusively by the park where she was playing and knew she would be just right for us. We were naive in

thinking that tender loving care would soon help Monica and her inner fear remained for a long time. We could scarcely leave her side for the next year without causing screams of anxiety.

We adopted Jennifer thinking it would be nice for Monica to have a playmate her own age. Jennifer also had a rough beginning and had been in a foster home. When we picked her up she marched bravely out of the place with her earthly belongings slung over her shoulder, and without looking back, simply said, "Hasta la vista."

Ernie came to us at three, close to the same age the girls were when we adopted them. He had lived with a foster family that loved him but couldn't afford to keep him. For us it was an unplanned and very welcome adoption.

Sissy and I are often credited for doing something noble by raising Monica, Jennifer and Ernie, but such thoughts didn't enter my mind. Sissy likes children much more than committee meetings and I enjoy being a parent. When we visited friends our age and saw orderly living rooms I thought how dull it is to find something in the same place in the evening where you had left it in the morning. And we could afford help. Tord Claeson, a Swedish colleague who had come to this country as an exchange student (staying in touch through the years with his American family in Placerville, California), arranged for two capable Swedish girls, Victoria and Emma, to spend successive years with us, and they nicely filled the generation gap between us and the children. Victoria, now an M.D. in Sweden and with children of her own, keeps in touch.

We became primary parents once again when Monica and Nelson were unable to take care of their children. Stephanie came to live with us when she was three months old and Samantha came when she was two days old. We were fortunate to have Edith Alvarado who helped them grow up from their early years to adulthood with love and understanding. We made new friends as the children went through the Woodside schools. Stephanie and her friends, the Feeny sisters, came to me one March 21, while Sissy was visiting

back east, to remind me that grandma had promised we could get a new dog when spring came. “Can we get the one we just saw at the toy store?” Stephie asked. Jessie Feeny added, “If you do that, Mr. Geballe, it will be the finest thing you have ever done.” We got Missy and she howled at night letting us know there was bloodhound in her mix. Later Stephie helped me reach my peak on the dance floor when we were the second to last remaining couple in the sixth-grade dance elimination contest.

I was disappointed we couldn’t get the girls to sit down and talk with us at dinner. They preferred to carry their plates back to their rooms to watch TV. So the girls had to find their way into adulthood more or less on their own, but I think they always knew we would be there when they wanted us.

In all our child rearing we have been blessed to have had Harue in Berkeley, Juanita in Summit, and Edith in Woodside.

ERNIE

WITH STEPHANIE AND SAMANTHA AT ERNIE’S WEDDING IN 1996

SAMANTHA

EDITH

APPLIED PHYSICS

People frequently ask about the difference between Physics and Applied Physics. My answer is that they overlap considerably. Where Physics concentrates more on large-scale (the universe) and small-scale problems (subnuclear particles) Applied Physics tackles intermediate scale problems often encountered in the real world. The Division of Applied Physics (composed of plasma, solar, microwave, acoustic, and accelerator physicist-engineers) filled a gap between pure physics and engineering. Walter Harrison, Arthur Bienenstock and I were recruited to bring in materials science and solid-state physics. The division offered popular graduate courses, research opportunities, and became a regular department in the Humanities and Science School.

I followed Cal Quate as the chair of Applied Physics. Realizing that many incoming students weren't sure which professors would best mentor their theses, I introduced a system which allowed the students to rotate through different groups during their first year. This was beneficial because it helped students and faculty find a good fit and provided a great way for students get to know each other, paving the way for future collaborations.

I enjoyed the challenges of our growing department and working with Paula Perron, the department administrator. She handled personnel affairs with wit and wisdom and so efficiently she didn't need an assistant. Instead of rewarding her, the Stanford bureaucracy turned down a promotion because she was "not supervising anyone." After I left the department grew even bigger and she did get an assistant and was promoted.

Marsh O'Neill, who administered the Microwave Lab where the department was located, always seemed to know how to find simple solutions to administrative bottle-necks. I told him that Microwave was no longer a relevant name for the laboratory since most of the faculty was engaged in optics, acoustics, low temperature physics and materials physics rather than microwaves. Marsh advised me to see Vice President Ken Cuthbertson. I did. He asked what would be an appropriate name. I suggested Ginzton, and that was that.

Ed Ginzton had done so much for Stanford including designing the Microwave Lab building, which he proudly told me cost only $25 per square foot to build. The U-shaped, one story building surrounded a beautiful little courtyard designed by Thomas Church. My office door opened right onto the courtyard where I ate lunch and had talks with students, faculty and staff.

Walter Bond, upon retirement from Bell and with encouragement from me, came to Stanford where he continued to improve high precision X-ray diffractometers and to teach in the Ginzton Lab. He broadened my understanding of transition metal oxides. He discovered that what had been considered to be a second structure of the element tungsten (incorrectly named beta tungsten) was actually an A15 structure (the same family as Nb_3Sn) stabilized by undetected oxygen impurities and was superconducting. Trace amounts of oxygen impurities have macroscopic effects but they are difficult to detect. On the social side Sissy and I enjoyed hearing about Walter and Eunice's African adventures. They had no children and a large part of their estate was left to the Ginzton Lab library.

The Stanford faculty was strengthened by additional appointments from Bell. Gerald Pearson and John Linville (EE) came before I did. I recruited

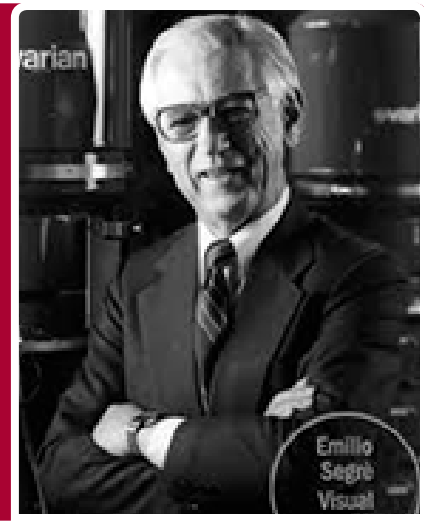
Conyers Herring (Applied Physics), and helped in the recruitment of Art Schawlow, Bob Laughlin and Doug Osheroff (Physics).

Student Rick Greene wanted to learn more about solid state physics after he had just completed his thesis in optical studies with Art Schawlow. As Rick put it, "So here was Ted with a completely empty lab in an old World War II building with no air conditioning with a new postdoc who knew nothing about experimental materials research." With other eager grad students we transformed that empty room into a productive laboratory. We continued exploring two-dimensional metals (that is metals that are highly conducting in two dimensions but not in the third) such as $NbSe_2$ which, at Bell, we had found to be superconducting. We were soon rewarded when Dick Klemm, an undergraduate, reported on a new kind of chemical reaction in which organic molecules would intercalate (slip in) between the highly conducting layers of TaS_2. Armin Weiss, the German chemist who co-discovered this reaction, implied that intercalation might have played a key role in the formation of life itself by pointing out, that according to most of the world's religions, the origins of life began in clay, also a layered structure.

Our goal, more modest than understanding the origins of life, was to discover new superconductors, and we did. Seb Doniach and his student, Jay Lawrence, provided the underlying theory. I had met Seb when we jointly organized a research conference on magnetism and enticed him to join our department.

We wanted to see how the Tc of TaS would respond when it is made more two dimensional by inserting molecules between the conducting layers. Fred Gamble, who had been working with my group as part of his thesis in chemistry, continued that research in Synvar, a Bay Area start up company, and obtained exciting results. In my office during a meeting with Synvar to discuss patenting these unusual compounds, the phone rang. It was Sissy telling me Adam had broken his ankle. I told her I had a room full of people and couldn't come to the hospital. Adam, the patient, flourished, the patent did not; but the research did thrive and for our work, Bernd and I were awarded the important *Oliver E. Buckley Condensed Matter Prize* named after a former president of Bell.

ED GINZTON WAS RAISED IN RUSSIA AND MANAGED TO ESCAPE TO CALIFORNIA WITH HIS PARENTS. I HIGHLY RECOMMEND READING HIS FASCINATING AUTOBIOGRAPHY (I HAVE A COPY AND IT IS AVAILABLE IN THE APPLIED PHYSICS OFFICE). HE BECAME AN UNDERGRAD AT BERKELEY BEFORE GOING ON TO STANFORD TO OBTAIN A PH.D. IN PHYSICS.HE WAS THE DIRECTOR OF SLAC AS IT WAS BEING ORGANIZED UNTIL BEING CALLED AWAY TO BECOME CEO OF VARIAN ASSOCIATES.



When I reported the magnetic behavior of these dichalcognides, Mac Beasley, then a postdoc at Harvard, came up after my talk and told me I had misinterpreted some of our results. He was right, so I recruited him. We worked together and attracted students who liked being involved in all aspects of their research from its conception to the synthesis, measurement and interpretation of the results. They called themselves the Ted-Mac Amateur Hour, although it took them five years or more to complete their theses.

Bob Hammond, a senior scientist with an interest in superconducting trans-

mission lines, joined our group and added expertise in and understanding of thin film depostion. We could then make new structures and investigate relationships between composition, structure and properties. These relationships are often the harbingers of new avenues for physics and also can be a bridge to new technologies.

Mac, Bob, and I and our students teamed up with Cal Quate and Andy Phillips to investigate the use of Nb3Sn in superconducting power transmission lines. Even after including the need for operating at low temperatures, the bench-top results we obtained exceeded the performance of the best copper lines.

The technology exists for superconducting electrical power lines. I think a good fit would be to use them to bring more power into cities like New York, Tokyo, London and San Francisco as the demand for electricity grows, for instance to charge electric vehicles. Existing copper cables in underground lines could be replaced by superconducting cables that can carry as much as five times the power without having to tear up the streets.

But the market for superconducting power lines has not yet developed. Reliability is all important. A PG&E engineer told me that PG&E's idea of innovation was to install a new system that a sister utility was already using. So far superconducting technology has entered the commercial market only when there is no alternative conventional method available. Where the market has developed is in the use of the MRI. In my graduate days at Berkeley cryogenics was learned by apprentices in low temperature laboratories, and now the cryogenics for operating MRI scans in hospitals is done by simply pushing a button. This is something I couldn't have imagined while working in Giauque's laboratory at Cal.

An international collaboration between Europe, the US and Japan to create

HEAT CAPACITY (the heat required to raise the temperature in a sample by one degree) measurements provide valuable insights into superconducting, magnetic and other thermodynamic properties. Measuring the quantity of heat that actually goes into a sample and excites its molecules and atoms (degrees of freedom) is a challenge because some of the energy supplied can be radiated or conducted away. In 1959 Richard Feynman in a famous talk, *There's plenty of Room at the Bottom*, showed there is room on the head of a pin to print the entire *Encyclopedia Britannica*, but we aren't there yet. There is plenty of room for scaling down sample sizes for making measurements of properties on ever smaller samples.

Three generations of our family have taken up the challenge for scaling down but are still far from Feynman's limit. For my Ph.D. thesis I resorted to the then standard strategy of using a large crystal in which the number of atoms that radiate on the surface is small compared to those radiated inside. It worked, but I had to pay a price—it took me a year to grow the needed single crystal. This strategy would be impossible to employ with micro sized materials used today.

At Stanford my talented students developed a new calorimetric technique. We didn't measure temperature differences in the traditional way. We measured the sample's temperature relaxation to a given pulse of heat. This method made it possible to measure a

small amount of material contained in a thin film. The relaxation method was taken over by Quantum Design Company in San Diego who developed our technique into a commercial product now used throughout the world.

At her lab in Berkeley, Frances Hellman (and first learned how to make heat capacity measurements in my lab , amd incidentally happens to be Sissy's cousin) has taken the next step in scaling down to nano-sized particles by developing extremely delicate substrates possessing very little added heat capacity.

The third generation is grandson Zachary Geballe who recently received a Ph.D. in geophysics at Berkeley. He has designed, built and is testing an apparatus to measure heat capacities in a diamond anvil cell at extremely high pressures at a wide range of temperatures. The volume of material in the diamond cell requires another step down in scaling. The sample is in direct contact with the calorimeter meaning that most of the heat does not go to the sample. His solution, for this seemingly impossible task, is to modulate the heat input at constant frequency and to extract the heat capacity of the sample from the third harmonic.

If this apparatus works it will open a wide variety of pressure and temperature investigations, including those of interest in superconductivity. Who knows, it might lead to a grandson/grandfather publication!

a plasma hot and dense enough for nuclear fusion is underway in France. This, in effect, would generate a tiny bit of the sun too hot to be contained by any known material. However a large superconducting magnet can form a "bottle" that could contain it. If the prototypes are successful (a big if) fusion energy could supply energy needs for thousands of years. While our generation may be using resources in an unsustainable way, we are also trying to find solutions for our grandchildren and beyond.

The exciting new science and technologies that have been discovered following the Bardeen Cooper Scrieffer (BCS) theory are far more than I cover here. But one example of the extreme sensitivity of superconducting devices is that researchers can detect a single neuron firing inside the brain by observing the faint electromagnetic signal it generates outside the brain using an array of superconducting quantum interference devices (SQUIDS). The ultimate aim is to make circuits so powerful they might rival the human brain.

One of my outside activities included becoming a member of the National Academy of Sciences. The NAS, established by Abraham Lincoln, provides reports on what is actually known about the underlying science of complex issues upon the request of government agencies that have to make policy decisions.

Shortly after the big gas shortage in 1973 I was appointed to the NAS Corporate Average Fuel Efficiency (CAFE) panel headed by Richard Meserve and charged with establishing reasonable limits for raising the average mile per gallon. I learned a lot and contributed a little as testimony was taken. We found if the best practices, already in use in some places, were used everywhere, there would be no gas shortage. However it would take time to replace the gas guzzling cars. We noted the lines at gas stations were longer because drivers kept their gas tanks full, rather than because there was a real

shortage. We suggested that a rapid reduction in gas consumption could be effected, in a tax neutral way, by adding the cost of liability insurance at the pump. But this didn't fly because rural places objected. The Saudis kept the gas prices from escalating as high as they could have, recognizing as their Minister Yamani observed, "The Stone Age did not end for lack of stone, and the Oil Age will end long before the world runs out of oil."

The Cultural Revolution was still in full swing when I flew to China in 1975 with a delegation of solid-state physicists arranged by the State Department shortly after President Nixon established relations with China. Our schedule was intense, filled day and night with lecturing, touring, enjoying hospitality and exposure to propaganda eulogizing Chairman Mao. Physicists showed me modern texts they had managed to obtain, translate and were ready to release as soon as sanity was restored. Had the Cultural Revolution persisted for much longer the links to western science maintained by the older generation would have died and China would have not been able to make its rapid recovery. I was brainwashed enough to believe that Mao would go down as one of the most influential leaders of the 20th century.

Here are some of my impressions:

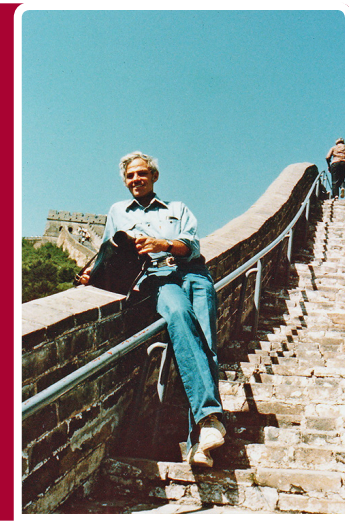
Overhearing a young boy, who stared at us as we walked down the street, say to his friend, "They must be Albanians." (The Albanian Embassy was the largest one in Bejing.)

Driving full speed through the crowds with our drivers honking their horns to warn people to clear the way causing me to wonder if there were any deaf people still alive in China.

Feeling uncomfortable with sumptuous banquets, elegantly presented, in a country short on food. The gentleman on my left informed me that, "Chinese food should be judged by sight, smell, taste and sound," just as the sizzling rice soup arrived.

ASKING AND ANSWERING QUESTIONS AT THE INSTITUTE OF PHYSICS OVERSEEN BY MARX, ENGLES, LENIN AND STALIN, AND BY CHAIRMAN MAO ON THE FACING WALL

AT THE GREAT WALL



In 1976, while still department chair, I became Director of the **CENTER FOR MATERIALS RESEARCH**. CMR came about because Washington recognized that the United States was not strong in materials research and needed incentives for developing more of it. Most new compounds were made in Germany, France, England, Austria and Japan. I think ten universities were funded by National Science Foundation in an effort to close the gap. By the time I was in charge, we were getting about $3 million a year to support University wide research in materials science. It provided individual SEED grants to pursue early research in special cases that had potential great merit, but were not far enough along to obtain funding through typical Washington channels. It encouraged faculty in different departments with common interests to get together. It wasn't top down. It funded central facilities which acquired and operated equipment too expensive for single faculty members, and gave students training in them. CMR was a very effective way of strengthening materials research and I enjoyed administering it.

See Oral History, Appendix

WITH CMR STAFF, CIRCA 1980

Listening to a student at an engineering university tell us that his welds developed bad cracks until he went up on the hill, pulled out Chairman Mao's little red book and solved the problem.

Being taken into one of the recently discovered Ming tombs that was being carefully reopened. Hearing statistics about the exploitation of the builders of the tombs while noting how exquisite the ancient artifacts were compared to the modern ones.

In 2003 I met Jochen Mannhart, the conference chairman, at a superconducting conference at the University of Augsburg in Germany. We became friends which led to his taking a sabbatical at Stanford. We discussed building a novel thermoelectronic heat engine based on ideas I had learned from Boris Moyzhes, taking me all the back to my undergraduate failed attempt to measure thermionic emission of electrons from solids. Boris was the head of the physical chemistry department at the University of Leningrad before he was able to leave Russia and settle with family already in the Bay Area. He came to Stanford regularly, published papers based on his expertise in physical chemistry, and unfortunately died before could get support for working on the heat engine. But Jochen, a director of the Max Planck Institute of Solid State Research in Stuttgart, does have the resources. His deeper analysis looks promisingand his group is constructing a test model we believe will lead to significantly more efficient heat engines. He has kindly included me as co-inventor and Stanford as a participant in the patent application.

A CAMBRIDGE SABBATICAL

In 1975 Sissy, Monica, Jennifer, Ernie and I went on a six-month sabbatical to University of Cambridge in England after I was given a Guggenheim Fellowship. Nobel Prize winner Sir Nevill Mott welcomed us with an invitation to his home specifying both the when-to-arrive-time and the when-to-leave-time. We had tea in the garden under spreading lilac trees.

I used the time to complete my portion of the book *Long Range Order in Solids* Bob White and I were writing based on the graduate course we had been teaching.

I also had opportunities to learn from seminars, tea time discussions and interactions with Abe Yoffe and his student, John Wilson. Phil Anderson gave a seminar in which he showed that electrons with the same negative charge, which would normally repel each other, would, in some lattices, attract each other. It is known as negative U pairing. I didn't grasp the significance at the time, but neither did Nevill Mott. Eventually I did and it has become an important part of my research. *(*SEE *WOODSTOCK & BEYOND*)

Phil was a regular visitor from Bell with joint appointment at Cambridge. He and Joyce found us a nice home on Grange Road, introduced us to Cambridge life and facilitated my becoming a Fellow of Clare Hall.

We had lunch at several colleges. At Keyes, looking down from the head table, I was surprised to see only women. The men had invited their dates and then not showed up in protest of the exclusion of women, a policy that soon changed.

Sissy walked Monica, Jennifer and Ernie, dressed in their uniforms, to the local school, The Shrubbery. The other mothers were reserved and not interested in socializing and Sissy had to learn not to ask personal questions. Jennifer, however, went on a canal boating trip with Lizzie Gough and her family and made a lasting friendship. Monica befriended the completely deaf elderly lady who lived downstairs.

We explored Cambridge as a family, walking to the different colleges and along cozy country paths to nearby villages. On weekends we drove to stately homes and churches, libraries and animal preserves. At Ely Cathedral Jennifer wandered off and we had a hard time finding her. We were concerned, but she wasn't. I had no trouble driving on the left side of the road but did manage to go head over heels into the river when docking our boat after punting on the Cam. The passengers reacted gleefully to my visual demonstration of Newton's Third Law. The boat hit the dock and suddenly stopped while I stayed in motion until my feet landed on the bottom of the muddy river.

We visited the Andersons in their Cornwall home. They took us on scenic trips along the single lane hedgerows. What sticks in my mind is nervously watching seven-year-old Ernie leaping casually over rocks by the churning sea where, by his request, we celebrated his birthday with a cookout. Joyce prepared a lunch substantial enough to help us survive the fiercely cold wind.

WOODSTOCK & BEYOND

In 1987 I was approaching the mandatory retirement age of 70 and thinking about growing artichokes in Pescadero when a short paper published by Müller and Bednorz changed everything. They were working in a small IBM Research Laboratory in Zurich and discovered superconductivity in a completely unexpected material—a ceramic compound based upon layers of copper oxide—now termed cuprate superconductors.

Two more developments changed my future. First, mandatory retirement was found to be age discrimination and illegal, and second, a group led by Paul Chu at the University of Houston, and his student M. K. Wu, discovered a related cuprate compound, made from the elements yttrium, barium, copper and oxygen (YBCO), which was superconducting well above liquid air temperatures. Such high Tcs were completely unexpected and led to the *Woodstock of Physics*, a marathon meeting of the American Physical Society in New York City in 1987, that went on nonstop until 3 in the morning. Stanford's Aharon Kapitulnik reported that well formed YBCO films could be obtained by epitaxial growth and opened the way to thin film technology.

Aharon had obtained his Ph.D. at Tel Aviv University and was a postdoc at UC Santa Barbara when Mac Beasley and I attracted him to join our group as a young professor at Stanford. His strong experimental and theoretical capabilities had an immediate impact. The heat capacity of YBCO investigated by Kam Moler, his first student, exposed the unconventional symmetry of high Tc cuprate superconductivity. He mentored many students, studying phase transitions and electronic mechanisms in amorphous and crystalline

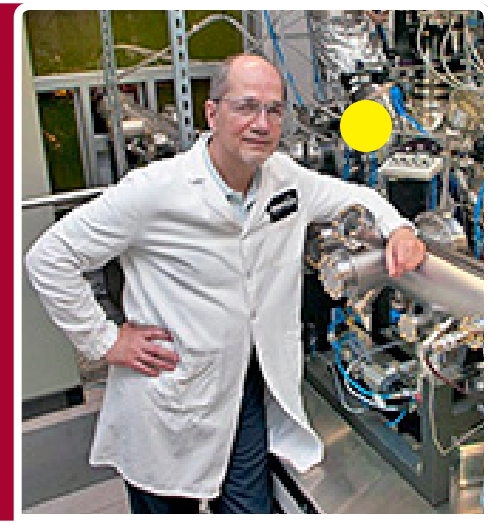
BY THE LATE 1980S HIGH SCHOOL STUDENTS COULD MAKE SUPERCONDUCTORS AT HOME WITH TC'S THAT EXCEEDED WHAT HAD BEEN POSSIBLE IN THE MOST ADVANCED LABORATORIES ONLY A FEW YEARS EARLIER. AT THE TIME OF THE FOURTH CONFERENCE, IN JAPAN, SUPERCONDUCTING DREAMS HAD MIGRATED INTO COMIC BOOKS WHICH SHOWED LEVITATED VEHICLES CRUISING OVER THE STREETS OF MANHATTAN.

CUPRATE is a generic term used by chemists to denote the valence (the positive charge on copper ions) in ionic crystals and compounds. The term high Tc cuprate superconductivity has been co-opted to refer to the special class of ceramic copper oxides which contains the highest known superconducting transition temperatures. These are 20 times higher, on the absolute scale, than Onnes found in 1911, but still colder than the coldest temperatures found on earth.

well designed thin films. These were deposited using the advanced electron beam deposition facility built by Bob Hammond, an important member of KGB, or at the magnetron sputtering facility at the vapor phase laboratory operated by Troy Barbee and Doug Kieth at CMR. Aharon later became a conscientious chair of the Applied Physics department.

THE KGB, MAC BEASLEY, LEFT, AHARON KAPITULNIK RIGHT, AND I AFTER A CONFERENCE IN ISRAEL

IVAN BOZOVIC AND I CONTINUE TO COLLABORATE IN SEARCHING FOR NEW SUPERCONDUCTING MECHANISMS IN METASTABLE OVERDOPED CUPRATES, SO FAR WITH NO SUCCESS.



Every fall Sissy and I host the annual KGB beach house party—a happy tradition run by the KGB "management." Aharon roasts a whole lamb, Hannah bakes treats, Mac brings homemade bread and we supply drinks and plenty of sand and water. It brings together students, alums, their families and lots of memories.

The excitement about cuprates continued unabated at international meetings the next year in Switzerland and the following year at Stanford, which we hosted. Cuprates were still the main topic at the international meeting in Japan in 1991. Yuri Suzuki, then a grad student, was fluent in Japanese but spoke only English at the meeting, telling me that this would give her status as a scientist, rather than as a woman, in male dominated Japan. During off hours I had a chance to play some good tennis with our hosts.

Ivan Bozovic wandered unannounced into my office having just left his faculty position in Yugoslavia and emigrated to the United States with Natasha and their two girls. I found temporary support for him to work in our lab. He soon developed a novel but simple way of separating out the high Tc superconducting particles from the rest of the multiphase samples—the only kind that were available at the very dawn of the cuprate age. He found stable support at Varian and collaborated with Jim Eckstein and grad student Darrell Schlom who was completing his thesis work. (They have gone on to be professors, Darrell at Cornell and Jim at Illinois.) They learned how to deposit films in which the structure and composition of each layer could be specified while it was growing. He is now at the Brookhaven National Lab-

I've found discovering something previouslyy unknown to mankind is a thrill even when it is a much smaller step than the one Armstrong took on the moon.

oratory where his group recently has shown that the superconductivity which unexpectedly occurs at an interface between two insulating oxides exists only in one single layer that is two layers away from the interface layer. There are many more metastable combinations yet to be explored. Might one of them be a high temperature superconductor?

I got to know Steve Kivelson walking along the shores of Bodega Bay at a workshop of theorists and experimentalists trying to identify fruitful avenues of research shortly after the unexpected discovery of 90K in a copper oxide cuprate compound. My simple approach was (and is) to find out what can be learned by comparing the magnitudes of Tcs in different cuprate structures as well how their Tcs vary with changes in composition, pressure, etc. Steve is an unusual theorist—he listens to me and to my intuitive explanations and of course I listen to him as he helps me sort out the wheat from the chaff. He, with colleagues and students, has developed exact microscope theories that expose the physics responsible for my qualitative models which then provide valuable challenges for further experimental research. I have been fortunate in the past quarter century to have had a continuous conversation with Steve in which we profit from a two way exchange of our ideas.

Steve however is more than a scientific colleague. He is a good friend. We often delve into social, political and family issues. My portrait now hanging in the McCullough building, was painted by Pam, his gifted artist wife, while their daughter Sophia entertained me with Gilbert and Sullivan solos. Steve's mother is a distinguished planetary physicist. Sissy and I often see her at at the Kivelsons happily being Paul and Sophia's grandmother, while Pam paints and Steve rushes home from his class to cooks delicious dinner.

In 2000 Ian Fisher came to Stanford, ending a long search for my replacement. Getting him here may be my greatest contribution to Stanford, and to him, too. I introduced him to Yuri, they married, are both professors in my Applied Physics department and occasionally bring two happy children to the lab to scrawl on my whiteboard.

One day, out of the blue, I got a phone call from John Bardeen asking what I thought of the Russian work that reported superconductivity in the semiconductor lead telluride when it was lightly doped with thallium. My first thought was that the signals came from an undetected impurity phase. These are not uncommon and have become known as USOs, Unidentified Superconducting Objects. But I had long ago learned to listen to John and, upon reading the Russian work carefully, I decided otherwise. With Ian and his students we found strong evidence for a new superconducting "negative-U" pairing mechanism. Negative-U refers to the response in some lattices which causes electrons to attract rather than repel each other.

I am optimistic that room temperature superconductivity will be reported at a Woodstock of the future and superconductors will be as common and as useful as magnets are today.

In true Silicon Valley fashion, venture capitalists soon recognized the unbounded potential for superconducting technologies operating at liquid nitrogen temperatures. A group of us—Mac Beasley, Aharon Kapitulnik and Bob Hammond from Stanford, and John Clarke, Paul Richards and Ted Van Duzer from Berkeley—were offered start-up funds to organize a company, **CONDUCTUS**, with no business plan other than to explore opportunities. After some time John Rowell joined as the Chief Technical Officer and brought along Bob Dynes. The freewheeling atmosphere and a talented staff led to outstanding technical achievements. The main product was a superconducting front-end receiver for wireless base stations which enhanced coverage and increased sensitivity, hence fewer dropped calls. Unfortunately the market wasn't ready for it. I believe having to operate at liquid nitrogen temperatures presented too high a barrier.

Conductus' method for producing tape is still being improved and can play an important role in future superconducting transmission lines and in some nuclear fusion reactors if and when they are needed. Conductus was eventually "merged" into oblivion but its technical achievements have survived.

For any of you who are interested in the science, see my article "Why I Haven't Retired," Annual Review of Condensed Matter Physics, Vol. 4:1-21

STUDENTS & TEACHING

Frank DiSalvo was my first student. He and Barbara already had two children and he was anxious to complete a thesis and get on with his career. He liked looking for new superconductors and found some good ones. He's an avid fisherman and found time to fish off the rocks at our beach house. He went on to Bell Labs (see Chapter 9) where he and his colleagues discovered charge density waves that had long been predicted but never before observed. He left Bell for Cornell where his group has continued to study magnetism and superconductivity in materials with novel structures. His teaching and research have been recognized by the university and he is the John A. Newman Professor and Director of the university-wide Center for Sustainable Futures.

Bob Schwall's application from a small Catholic college in Texas included a recommendation from a nun who simply said he was the best student she had ever had. I found out why. He soon made low temperature heat capacity measurements on layered compounds that accounted for why Tc increases upon intercalation. He and his wife, Linda, were happy campers at Stanford. Bob sprained his ankle when running up to the dish forcing him to stay longer at Stanford before leaving for Boston for his job at American Superconductor Corporation. A Freudian slip? After he became Vice President I was a consultant to the company as it pursued the goal of making cheap reliable long lengths of superconducting wire. Bob moved to the National Institute for Science and Technology (NIST) in Colorado and leads a group developing SQUID technology. Sissy and I attended his son Matt's wedding in Redwood City.

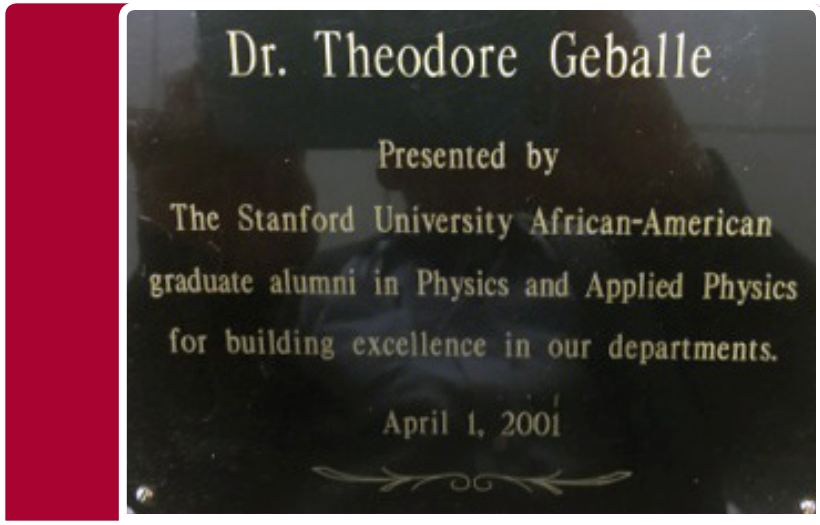
At Stanford, and elsewhere, there was, for well known sociological reasons, a dearth of black students engaged in physics. I was fortunate to mentor two,

In 2000 I was surprised to learn that the name of the Laboratory for Advanced Materials had been changed to the Geballe Laboratory for Advanced Materials. I liked it because GLAM sounds a lot better than LAM. Research led by faculty in Applied Physics, Physics, Chemistry, Electrical Engineering, Materials Science and Engineering is carried out there.

Bennett Robinson and Walter Lowe.

Bennett was married with two children and was a professional photographer when he became the first black student to earn a Ph.D. in physics at Stanford. His studies of amorphous transition metal films led to his becoming a well regarded research scientist at IBM in Yorktown. His family lived in a NYC apartment (after he won a well-publicized anti-discrimination suit) and Bennett commuted. But he left his wife and children and started a new life in Asia with a partner from a wealthy family. He became influential

in business and social circles until his life ended, suddenly and sadly. His daughter, Bahiyah Yasmeen Robinson, who never knew him as an adult, visited me at Stanford. She later wrote, "Seeing that you kept his dissertation and being on the Stanford campus brought back a flood of memories, and it took a long time to process them... I keep thinking about how excited my father would be to know about my work, and all of the great things that are happening in science and technology!... Thank you again for all of your support, and for being such a great connection to the legacy of my father! I hope one day to write a book about his life, and all the trials he overcame as



an orphan that led him to work with you at Stanford."

Walter developed a passion for physics as a graduate student. He acquired expertise, with help from Dennis McWhan at Bell Labs, in using synchrotron sources to investigate multilayered metallic films such as NbZr. His passion continued throughout his career as I found out when he escorted me around Howard University where he held a chair, while conducting research at the Argonne National Lab Synchrotron as the team leader of a beam line. Walter wanted to attract more black students into science. He wrote "I do believe that resources should flow to the early years of science education. However I feel that the question that minority kids now ask themselves is, 'Do I want to do this?' and no longer question whether they are capable or not. The internet/google then shows essentially no substantive career paths for them so the answer to the question is '…obviously no one else thought this was a good idea for a career.' "

Daniel Worledge was my final Ph.D. student. In his thesis he proposed a novel magnetic switch. I encouraged him to look for work in an industrial research lab thinking he would fit in beautifully at Bell. He came back from his east coast trip with IBM as his first choice because, as he told me, "There were no helium dewars in sight." He was more interested in the physics underlying technology than in pure research. At the IBM Watson Research Center he soon became Senior Manager of the Magnetic Memory Program that is partly carried out in Almaden, California. Daniel and Andy Kent, now a physics professor at NYU, are developing a memory using injected spin currents, rather than the customary magnetic fields, for switching the zeros and ones that make up the memory. It is faster and uses less energy than current technology and bodes well for future progress. Daniel and Jenny, and daughter Teddy and son Toby, often stop by on Sundays with lunch for us and lots of talk.

Awni Hallak grew up in Palestine where his family owned a hotel near the Old City in Jerusalem. They abandoned it and fled to the United States after the Israelis took over in 1948 and settled in Akron, Ohio where some family members who were chemical engineers worked in the rubber industry. They saved enough money to return to Israel and gain possession of their old hotel just before the 1967 war. This time they stayed. Alison and I stayed with them in 1970 (see Trips). After obtaining his Ph.D. at Stanford Awni and

his wife, Munia, and their daughters moved to Jordan where he joined the faculty of the University of Jordan. Fearing for his family he declined offers from colleagues at Hebrew University to supply the liquid helium needed for his research. Instead he moved to Saudi Arabia where he earned more money to provide for his family. Munia, who was quite modest by Stanford standards, told me how difficult her restricted life was in Saudi Arabia.

Here is an extract from a letter Awni sent me for my 95th birthday in 2015: "About 43 years ago, a young graduate student knocked on the door of the office of Ted Geballe and introduced himself as a Jordanian of Palestinian origin and expressed his wish to work with Ted on Superconductivity for his Ph.D. thesis in Physics... [Ted] said, "Awni, I am a Jew, but I am not a Zionist. Are you sure that people in Jordan will not mind if you work with me?" I said, no not at all. People in Jordan know that there are Jews living in US and we have no conflict with Jews. As a matter of fact, we used to live together long time before the creation of Israel, I mean Arabs and Jews. That was the start of a friendship that I will cherish forever… "

It has been a treat for me to teach a seminar on *Energy Options for the 21st Century* over the past two decades, first by myself and lately, with John Fox. The content changes yearly and has become more important as the dire consequences of climate warming loom. When I first ran the seminar the students were interested in the underlying physics and now they're interested in how to translate the known science into action. We would be foolish not to make better use of renewable energy to minimize the consequences of global warming.

Bob White and I co-taught a graduate course, *Long Range Order in Solids*. We wrote a book with the same name that has been well received in the United States, Europe and Russia. Lizi has a copy of the Russian translation. The book is now out of print and I've been told by a theorist in Germany that he distributes xeroxed copies to his class. He liked our nontraditional approach of first discussing the experiments and then the underlying theory.

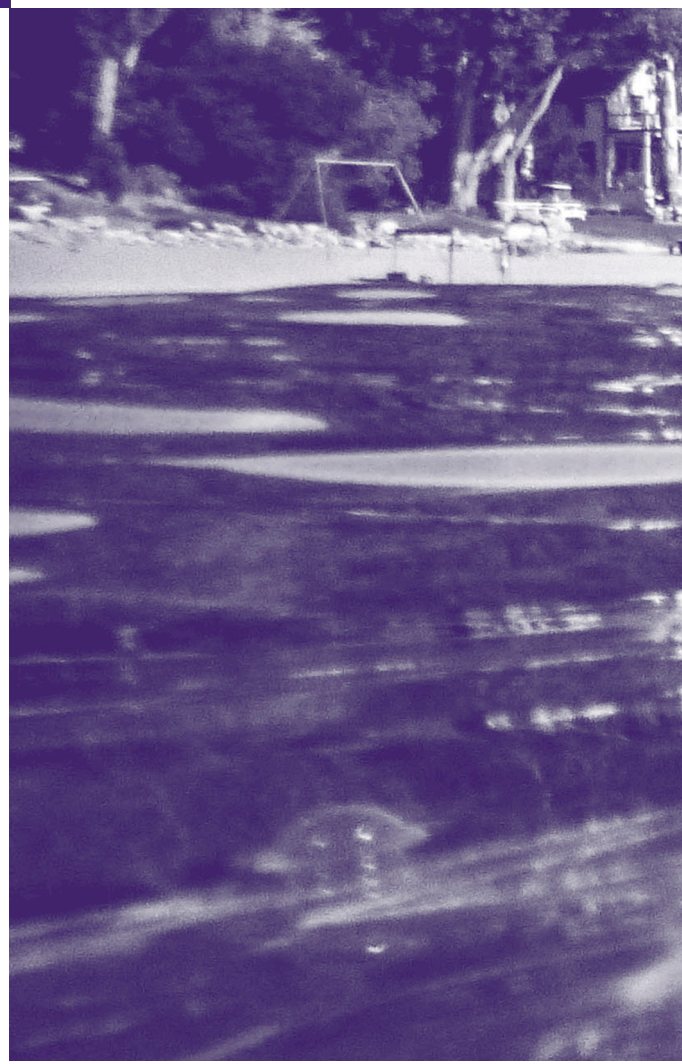
Physics has brought people from all parts of the United States and the world into my life. I am fortunate to have become good friends with colleagues, students and staff from my days at Berkeley, Bell and Stanford, and I have contact with many of them today. In no particular order, I think of colleagues outside of Stanford who are not mentioned in the text, but who easily could be. Among them are Norman Phillips, Dennis M. Whan, A. J. Jayaraman, Zack Fisk, Ali Dayem, Oystein Fischer, Doug Scalapino, Art Sleight, Laura Green, Joe Poon, Jean-Marc Triscone, Bill McLean, Gert-jan Koster, Boris Moyzhes, Kookrin Char, Dave Blank and Suichi Tahara.

At Stanford there have been more than 30 graduate students and I could fill this memoir with stories about them. These include Walter Lowe, Kirsten Luther Myers, Jeff Snyder, Raynien Kwo, Bob Zubeck (one day he said,"I won't be able to come in tomorrow morning," and when I asked why, he replied, "I'm getting married."), Ken Kihlstom, Dave Fork, Byung-du Oh, Bob Spielman, Bill Carter, Steve Early, John Talvacchio, Phil Broussard, John Benda, Joe Revelli, Steve Arnason, Jim Harper, Chris King, Sung Park, Shozo Yoshuzomi, Bob Feldman, Khiem Do and Laurent Mieville.

For a complete list see Appendix

GLENBROOK , LAKE TAHOE, CALIFORNIA

I'VE BEEN TO TAHOE EVERY SUMMER FOR 85 YEARS, FIRST AS A NINE-YEAR-OLD CAMPER AND NOW AS A PATRIARCH WITH 23 GRAND AND GREAT-GRAND CHILDREN



LATER DAYS

MORE ON FAMILY

Alice's unexpected death left Dad unprepared. He cheered up a bit when he visited us in Summit. But it wasn't until he reconnected with Helen Rosenberg Kahn—they had known each other since their school days—that Dad regained some joie de vivre. They married and spent happy years traveling to Europe and enjoying children and grandchildren on both sides of their families. When Dad's neck was fractured in an automobile accident (before headrests) he was paralyzed and bedridden. Helen didn't love him the way his Alice would have and didn't feel capable of caring for him at home. Sissy and I wanted him to move in with us, but he preferred to stay in a rest home in San Francisco where Helen could visit him. He died in 1981 and she died 20 years later.

Ron's love affair with books started early. His first six words, my mother told me, were "read about," read about" and "read about" and that is what he did for the rest of his life.

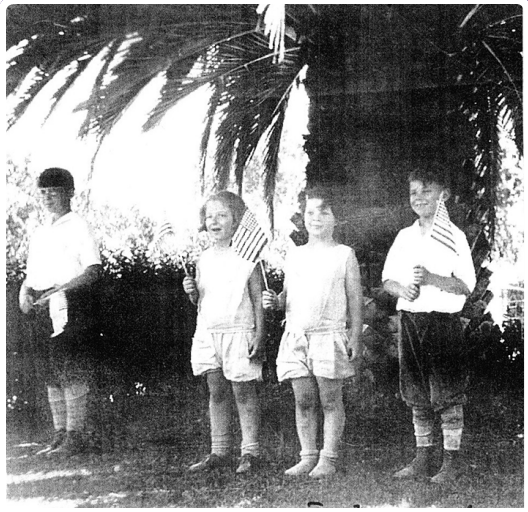
He finished his graduate work at Berkeley in 1943, went to work at the University of Washington in Seattle and remained there for the rest of his life. As a long-time professor and chair of the Physics Department he guided its growth. Ron's love affair with books led him to co-teach a physics-in-literature course with members of the English Department. After retirement Ron taught physics to exceptional 14 and 15-year-olds who had been admitted to the university as freshmen. He wrote terse reviews of science literature for the Phi Beta Kappa Society for many years.

Ron lived more than the average 80-year-old because he needed so little sleep. He enjoyed those extra hours staying up late "reading about." He spent his last night working on physics problems with his grandson, Leo.

This is how Ron introduced the concept of symmetry to the Physics/Art class he taught with colleagues from the Music and English Departments: Objects show axial symmetry when a single direction–the direction of the axis–is important such as up and down for a tree, or for falling stone. Such observations are so universal we should soon begin to relate them, if we thought a bit more about them, to these lines:

As the sunflower turns on her god, when he sets,
The same look which she turned when he rose.

They are from the song, Believe Me, If All Those Endearing Young Charms, by 19th Century Irish Poet, Thomas Moore. When my mother sang to me when I was a child neither she nor I could have foreseen that I would recall these words in a physics lecture. Why did it come to mind at this time? Because the axial symmetry of some kinds of plants is broken as they bend to the sun.



RON, DAD AND I WITH PINES OF PESCADERO IN THE BACKGROUND ON DAD'S 80TH BIRTHDAY

THE COUSINS, BEA, MIRIAM, TED AND RON HAVE KEPT CLOSE ALL THESE YEARS.

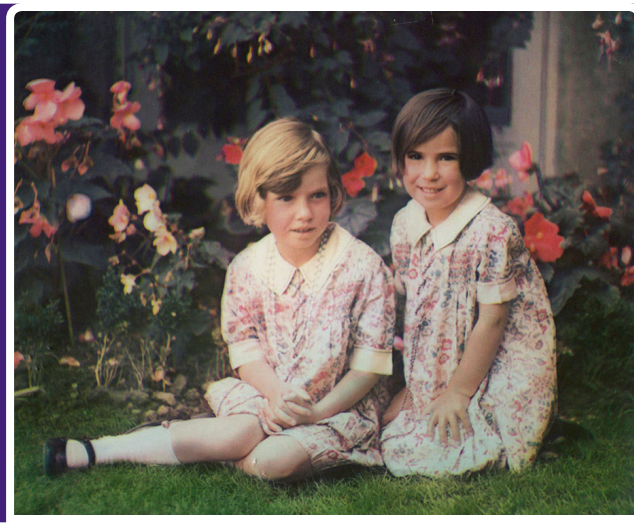
Marjorie, Ron's wife, was bright and capable but she had mental problems which was difficult for their eight children. Ron protected her and was unable persuade her to get psychiatric help. When I tried to talk to him about it he responded that some things are better left unsaid. That surprised me—it was the first time that we didn't communicate. In later life Marj became an alcoholic. After Ron died suddenly from cardiac arrest in 1998 she went to her room and stayed in bed most of the next 14 years, taken care of by Margaret, their oldest, until she died. My nephews and nieces remain close to each other and I've enjoyed keeping up them, their families and their careers.

I mentioned how Sissy's brother, Dan, was my first friend at Berkeley. The three of us ate dinners together on Telegraph Avenue on Sunday nights when there were no meals served at our houses. Sissy showed her good survival instincts by stuffing her purse with rolls before we left the restaurant.

During the war Dan worked on the chemistry of plutonium needed to build the atom bomb. After the war he made two wise and far-reaching decisions. The first was to marry Bunny, who overcame the chauvinism of the times, and became a creative immunologist. Dan's second decision was to go back to grad school in the emerging field of biochemistry. That appealed to him more than obtaining a Ph.D. in radio chemistry, which would have been quick and easy based upon his war work. Both decisions served him well, as born out by his five children and the two distinguished careers. We celebrated Thanksgiving together while both families were in the east alternating between Bellport, Long Island and Summit, New Jersey. Dan died in 2007. However the red cabbage and turkey tradition continues. New marriages bring in new participants and ever creative football games make Thanksgiving a favorite holiday. It's a chance for all of us to huddle a bit and give thanks.

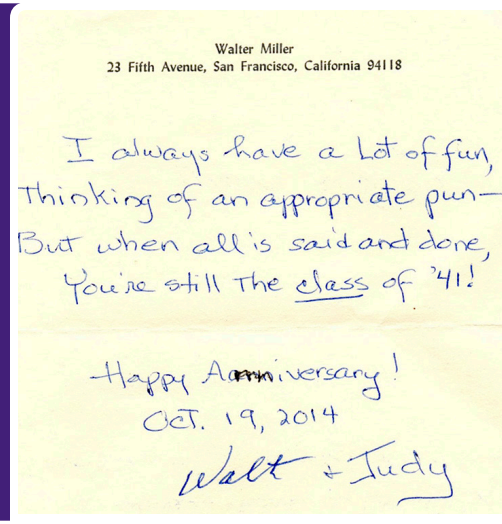
Sister Phyllis and I have a deep relationship partly because we both understand Sissy in the same way, but mostly because we like each other so much. It started back in our student days. She laughed when the door of my Dodge flung open and she almost fell out, in those pre-seatbelt days, while we were

AS CHILDREN, SISSY AND PHYLLIS WOULD SIT IN THE GARDEN AND RECITE POETRY TO EACH OTHER. THEY CALL EACH OTHER EVERY DAY.



driving to a Cal-USC basketball game. Her screaming at the USC coach, Sam Barry, did not prevent Cal's losing, but did affect Mrs. Barry who was sitting nearby. Phyllis's only fault is too much generosity. I am still wearing the comfortable pajamas she gave me on my 80th birthday. She has passed this trait on to her children.

WALT AND I ROOMED AT SHERIDAN HALL. ON WALT'S 95TH BIRTHDAY, 78 YEARS LATER, I'M WEARING MY STANFORD/CAL HAT. I CAN WEAR IT AT STANFORD BUT I'M NOT SURE IT WOULD GO OVER SO WELL AT BERKELEY.



When we told Sissy's Grandma Haas that we were engaged and she replied, "But you are so young," "We'll outgrow it," I said, and we have. The more I found out about Sissy the more I liked. We don't agree on all issues (in the political arena Sissy's opinions, in my view, actually often make sense) but what is important is that our values are the same.

Sissy's parents set a high standard by not letting Eleanor's multiple sclerosis dominate their happy marriage. Her father and mother enjoyed singing duets, even when Eleanor was lying flat on her back in bed. I remember seeing them smile at each other as they sang,"The girl that I marry will have to be as soft and as sweet as a symphony." Eleanor's courage and principles are a role model for Sissy. Eleanor once returned a present from relatives she disapproved of because they didn't help settle distant relatives who managed to get out of Nazi Germany. Sissy has inherited that same character—she acts in accordance with her beliefs.

Eleanor always maintained that she wanted to be there for her children but didn't want to tell them what to do. She was happy for them to spread their wings. Sissy has the same gift of acceptance and the capacity to be there when needed. She recognizes the needs and desires of her family and friends and finds thoughtful ways to respond—whether it's a respite weekend at the beach house, a book from her bookshelf, a meal at Duartes, or a meaningful introduction.

I wrote this for Sissy's 94th birthday.

August 14th, 2015

We've celebrated this day for many years in various ways
During the 74 years of our married days
V-mail helped during World War II's commotion
when far too long we were separated by the Pacific Ocean.

2573 was our first home and there our 3 children grew
nicely, with help from Mei-Hua, and Claire and wonderful Harue,
then east to 204, making many new friends
at Bell and Summit–the celebration never ends.
Once again west to 259, 3 new children to love and bring up
And life at Stanford overflowing our cup.

As we grow older our modus operandi differ
You, anecdotal, intuitive, mystical
Me, factual, analytic, statistical,
But the values we've shared have never changed.

You have told me more than once-in-a-while
That my brain isn't working—it's senile.
Be that correct I cannot say.
No matter what, I LOVE YOU, HAPPY BIRTHDAY.

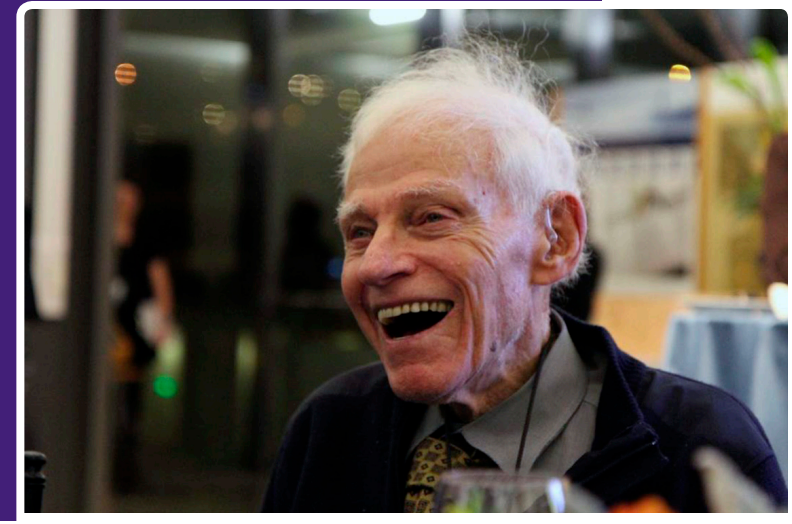
SISSY CARRIES ON THE FAMILY TRADITION BY READING
A POEM AT MY 95TH BIRTHDAY

Conyers Herring wrote a limerick for my 70th birthday, with a double entendre only a physicist could love, holes being the absence of electrons:

Septuagenarian Ted
Is known not to have holes in his head.
Since one time when his peers
Soldered leads to his ear
A minus Hall voltage was read.

For my 75th birthday we had a memorable symposium party at the California Academy of Sciences in San Francisco. Family and non-scientific friends were treated, or roped into, hearing educational scientific talks by colleagues. Ron described a sensitive thermometer invented by Galileo. It was much better than hearing stuff about me.

For my 20-year encore Sissy planned three days of reunions at Stanford, at home and at the San Francisco Exploratorium where family, friends and colleagues could recall, reconnect, meet each other and find common bonds. I think my science has been good but my real enjoyment has come from the friends and relationships I have made, and I hope those who follow me have the same experience.



TRIPS

Physics has taken me all over the world. And travel, whether for science or for fun, whenever possible, has included family.

When we were raising our children we traveled to England twice. The older bunch came with us to Oxford in 1966 and the second three, to Cambridge in 1975. See Cambridge Sabbatical When Gordy, Ali, Adam, Sissy and I went to Oxford I worked with Harry Rosenberg, and we published a major investigation of the thermal conductivity of Bell Lab's silicon crystals, with Peter Carruthers and John Ziman. The family took a scenic sail down the Thames and saw the Crown Jewels before flying on to Paris. Adam filmed Gordy and Ali with his 8mm camera in their record-breaking three-minute tour of the Louvre. Gordon and I continued east to attend a low temperature conference in Moscow. It was exciting, not only for the science (I reported on the superconducting properties of uranium) and famous Russian scientists, but also because the cold war was in full swing. The Russians were actively supporting the Viet Cong who were fighting our allies in Saigon. Gordon went off with Russian students jumping (illegally) over subway turnstiles, but fortunately there were no repercussions.

After the conference a young, attractive and well-educated Russian guide took us to see Peter the Great's Summer Palace. After walking around the scraggly lawn she asked, "Is it true in America that if you don't mow your lawn your neighbors become angry?" Gordon, fully aware that fastidious gardener James Rothschild had good-naturedly berated me for tracking weed seeds on my shoes onto his beautiful lawn, answered, "Yes." She drew herself up proudly saying, "In Russia, we don't care!" Her next question concerned the current exhibit at the Guggenheim Museum in New York. She was better informed than we were.

As often as I could I invited children, and then grandchildren, to travel to conferences with me. Alison and I went to Israel twice. The first time was for an international superconducting conference held at Kfar Giladi, a kibbutz near the northern border. Artillery coming from across the border could be heard in the distance. The only casualty was a TV set when a youngster took his father's rifle off the wall and shot the bad guy in the western he was watching. On a later trip in 1970 Ali and I stopped in Turkey to stay with Necmi Bilar who had worked with me at Stanford. I saw ancient artifacts dating from the beginnings of recorded history and then relaxed in a luxurious Turkish bathhouse. We took in more ancient sites in Greece where a friend of Auntie Ruthie took us under his wing. In Israel we stayed at a hotel run by the Palestinian relatives of Awni Hallak. See Students & Teaching His uncle escorted us around the Old City in Jerusalem where he recalled living peacefully with Jewish neighbors and running errands for them during the Sabbath. Awni's folks were gracious hosts and they would not let us pay for anything. They are Israeli citizens but are not happy about the way they have been treated.

Adam was a Stanford freshman when we went to a magnetism conference in Switzerland. He went off with the sons of Jacque Friedel while I learned more about magnetics. Afterwards we set off for a hike in the foggy Alps with Robert Bachman, my Swiss postdoc. We slept overnight on wooden benches in a tidy hut which was maintained by the honor system. We awoke early to a picture postcard morning, cleaned up and started hiking. When we came to a deep rift in the snowpack Robert and Adam jumped across. I did too, but only made it by landing on my belly. We expected to take the train back to Zurich from its highest station but when we got to the depot the train was nowhere in sight. We suspected the vaunted Swiss railroad must be late until we saw a few inconspicuous rail cars, parked on a siding, roll away right on time. And so we continued walking. When we got back to Zurich I was almost out of money (no credit cards in those days). We found a clean,

cheap Women's Christian Temperance Union hotel where we stayed warm and sober until we flew home.

In 19-- Ernie and I went to Aqaba at the tip of Israel. He went scuba diving while I stayed on dry land where I could look into Saudi Arabia and turn around and look into Egypt. Ernie didn't do so well studying the gas laws in school but easily mastered them when he needed to know about pressure and volume on his way to becoming an excellent scuba diver.

In 1999 Nick and I flew to Israel. We thought the elevator at the King David hotel was broken when we got in it because nothing happened when we pushed the button. When the elevator finally started moving on it's own it dawned on us that it was Friday night, the start of Sabbath. Israeli ingenuity made elevators that operated without having to push buttons. When we visited an archeological site (Tel Dan, if I remember) I learned that only 15% of the site had been excavated. The rest was left undisturbed for future study. Stanford colleague and professor of geophysics, Amos Nur, who was in charge of overseas studies, had plans to open a Stanford campus in Jerusalem the following year. He and I were set to explore remote caves he had reason to believe held artifacts akin to the Dead Sea Scrolls when the Intifada arose, and all plans were abandoned.

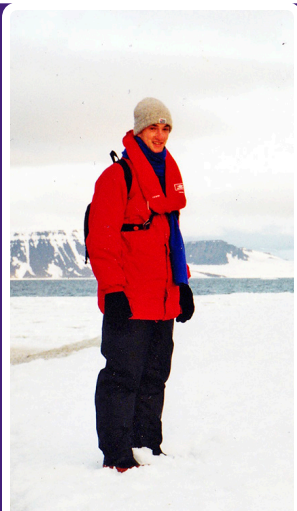
In September 2003 Nick went with me to a superconducting conference at the University of Augsburg in Germany. We landed in Munich where a friendly young French girl sold us a cell phone and took us to dinner. Later when we told Adam about it he said, "You've met a call girl!" Our visit to Dachau, as expected, was wrenching. After the conference Nick and I took the fast train to Berlin and had a 36-hour whirlwind tour of the city. Highlights were the uplifting Jewish Museum and the chilling Wannsee Conference site where the Nazi leaders formalized the Final Solution.

Not all of our trips were to conferences. In 1996 the Environmental Defense Fund (EDF) arranged a whitewater rafting trip down the Colorado River in the Grand Canyon. Gordon, Shelley, Danny, Nick and I were part of a group of 25. In late July the overhead sun turned the steep,

NICK ON THE BANK OF THE COLORADO AND GRANDPA ON THE RAFT

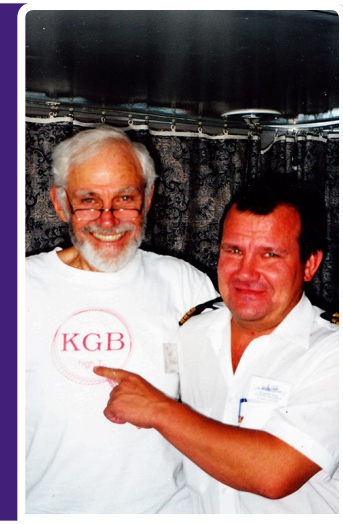
narrow canyon into a furnace. We were cautioned to drink plenty of water (a boy scout had become dehydrated and died on the trail shortly before). We were supposed to get up at 4:00 a.m. and Nick and I jumped out of bed when the phone rang for what we thought was our wake-up call. In the middle of frantically getting ready we realized it was 1:00 a.m and a wrong number. In addition to getting wet and eating good food we learned interesting geological history, evident in the cross section of the Canyon the river had carved out over millennia.

In 1997 Ben and I sailed to the North Pole on the *Sovetsky Soyuz*, a Russian nuclear powered ice-breaker. It was primarily used to supply Soviet settlements along the Arctic Ocean and was not a cruise ship. In the summer the crew doubled up to make room for passengers and earn dollars. When the GPS showed we were as close as we could get to the North Pole the crew chipped a broad hole in the ice so that Ben and others, tied to ropes, could swim over the Pole. I watched. Curious polar bears came right up to the ship—we were asked not to feed them. They are beautifully adapted to living on the ice. It's sad that they are not likely to survive when the ice disappears. A young officer told me, as we were standing on the bridge one night, that he planned to use the dollars he was earning to vacation in Germany and buy a Volkswagen. He had no qualms about going to Germany, saying, "Twenty million Russians killed by the Nazis, 20 million were killed by Stalin, and another 20 million earlier by the Czars."



BEN AND THE SOVETSKY SOYUZ AT THE NORTH POLE

EXPLAINING MY T-SHIRT TO A SHIP'S OFFICER



Nick immortalized our trip to Germany in one of his famous poems.

Congratulations on turning 85,
While maintaining a strong forehand drive.
Hardly a day of work do you miss,
And you work hard to rid Grandma Sis
Of right-wing positions–and her total reverence
For her intuitions and anecdotal evidence
Thanks for fighting that battle without a pause,
Though I fear it's likely to be a lost cause.

Thank you, Grandpa, for all that you do.
I've had so many wonderful times with you:

Rafting between the Grand Canyon's walls,
With quite a crew of enviros and Geballes,
Hanging on tight when we hit Lava Falls,
Getting confused about hotel wake-up calls.

In Israel the year before the intifada,
We had so much fun, from that kibbutz to Masada,
From Jerusalem to Tel Aviv,
And extensive tours from our great guide, Ziv.
Despite having been to many a mellow Seder,
We were baffled by that Sabbath elevator.
And, as far as I can determine, we
Did pretty well on the trip to Germany.
I liked meeting people there, from Jochen to Rick Greene,
From Tord and Madeleine to Amandine.
In Munich, you were as appeasing as Chamberlain,
Next, Augsburg was quite pleasing, then came Berlin.
For a day, at least, "Ich bin ein Berliner."
That lovely hotel served us a great dinner,
And I'm glad Libeskind's museum design was a winner.

So many great places we've managed to roam,
And we also have great times at home,
About which I could write a tome,
But it's past your birthday, so I'll end this poem.
Happy birthday, Grandpa!

ps. You can print this out to let Grandma read it,
But make sure Charlie doesn't eat it.

pps. Acknowledgements:
My dad contributed the "forehand drive" line.

GATHERINGS

I fell in love with Lake Tahoe as an eight or nine-year-old when I went to camp and waded sure-footed from the sandy shore into the clear, cool water and started dog paddling. Tahoe has remained a magic place for me ever since. When my parents visited Camp Tawanga they came with a case of fresh oranges as a treat for me and my tent mates. I was disappointed because other parents showed up with cookies and candy. But apparently I wasn't homesick–they had find me to say goodbye.

The first time I hiked up Mt. Tallac, the highest peak at the lake, I was dehydrated but made it to the top. I've climbed it many times since. Once I vividly remember looking back and seeing Bobby Friedman precariously perched on a steep ledge, not knowing how I could ever face Phyllis and Howie if their son slipped.

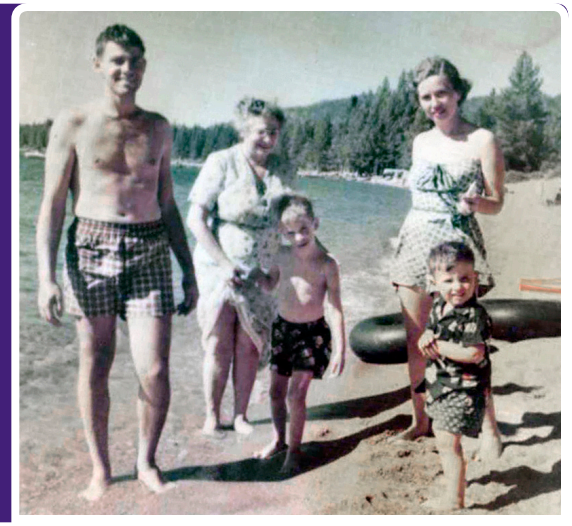
The summer of 1934, while I convalesced from typhoid fever, Mom and I vacationed at the Al Tahoe Resort at the southern end of the lake with the Harry Geballes and cousins Miriam and Bea. I remember just having fun swimming and playing games with them.

During the summers of '39 and '40 Sissy and Dan invited me to spend what turned out to be fabulous weeks at Tahoe at Peter Cook's (a business friend of Dan, Sr.) home in Zephyr Cove. Peter had a special ramp built so Eleanor, Sissy's Mom, who had multiple sclerosis, could roll down to the beach in her wheelchair join the fun. Amid the wide-ranging discussions–serious about the war clouds looming over Europe, and funny about ourselves–Sissy and I found time to be alone. We read Thomas Mann's Joseph in Egypt out loud and instructed Phyllis to knock before she opened the door.

Sissy' s family had a long tradition of going to Tahoe from the time her grandmother traveled by rail from San Francisco in a Southern Pacific car

SISSY WITH GORDON AND ALI-GO-BOOM AT ZEPHYR COVE, TAHOE

SISSY AND I WITH MOM AND THE TWO BOYS.



A typical scene from the 1970's. Today 16 grandchildren and 7 great-grandchildren and their families are invited to Tahoe every summer. Sissy and I rent three houses and after that it all works without any planning from us. The kids take care of the logistics—who stays where, who shops and who cooks for the 20 or so who sit down for meals. The family hikes up Shakespeare continue.

A growing number of grandchildren, circa 1990

that was detached from the transcontinental train at Auburn and shuttled to the door of the genteel Tahoe Tavern.

During our Summit days Sissy and the children flew west for the summers. They shared cabins at Zephyr Cove with Phyllis and her three. Howie and I joined them for three weeks. During my bachelor time back in Summit I had plenty work, played lots of tennis and had many dinners with the Rothschilds (with gobs of Mrs. Prince's super fresh corn), the Andersons, the Clogstons and the Wolffs.

Alison, learning to walk on the beach, shouted "go-boom" gleefully as she landed on her butt after a dozen or so steps and earned the name Ali-go-boom. As was the custom we made sure the kids spent plenty of time in the sun. Poor red Gordy suffered when we covered him with mineral oil at night. When we stopped at the Nut Tree Inn, on our drives back to San Mateo, Howie livened things by offering a prize to the first of our six tired, sunburnt children who could cry the loudest and was met with a combination of tears and laughter.

Young Adam found a job at Tahoe cleaning out horse stalls at the stables across the street and this may have bonded him with horses. When he was in high school, and we moved to Woodside, he finally got a horse of his own. Smokey was a gift from Grandpa Koshland, contingent on Adam building a barn, which he did with major help from a retired carpenter. Adam spent his summer before starting Stanford in construction on the Friedman's new house near Zephyr Cove.

ERNIE'S PHOTO OF GLENBROOK FROM SHAKESPEARE SHOWS WHAT WE APPRECIATE ABOUT THIS BEAUTIFUL BAY AT TAHOE. IN THE EARLY DAYS WE STAYED AT ZEPHYR COVE WHEN IT WAS QUIET AND FAMILY-ORIENTED. WHEN IT BECAME TOO BUSY FOR US WE FOUND GLENBROOK AND IT WAS EXACTLY WHAT WE WANTED. NOSTALGIA AND YUMMY MILKSHAKES BRING US BACK TO ZEPHYR COVE ONCE A YEAR. MONICA, JENNY AND ERNIE FELL IN LOVE WITH GLENBROOK, SPLASHING AND SWIMMING AND ROAMING. THE SPLINTER LADY, ADEPT AT REMOVING SPLINTERS, WAS ONE OF THEIR FAVORITES. I WAS FASCINATED TO SEE GENERAL ULYSSES S. GRANT'S SIGNATURE ON THE FIRST PAGE OF THE LEDGER AT GLENBROOK, FROM THE DAYS WHEN IT WAS A LUMBER CAMP. BILL BLISS, FROM THE ORIGINAL GLENBROOK FAMILY, HAS PRESERVED ARTIFACTS WHICH MAKE THOSE OLD DAYS COME ALIVE.

THE KOSHLANDS AND GEBALLES ON MT. RAINER IN THE 50S

ADAM, GORDON AND I AT YOSEMITE

BELOW:

JOSH AND ALISON WITH WILL AND KAYLEE (IN ENGLAND)

BEN AND RACHEL SHAI, AVI, MICAH, EZRA

DANNY, LINDA AND MILLIE

Howie had purchased enough land for two houses at Tahoe and offered Sissy and me the second plot. Gordon cautioned me, "You and mom should do it for yourselves, but shouldn't count on us kids going there every year."

ADAM AND CAROL WITH NICK, ZACK AND CORIE AT TAHOE

ERNIE, JENNY (MCCORMAC), NATALIE, BRANDON, MANDY AND ROXY ON SHAKESPEARE IN 2012

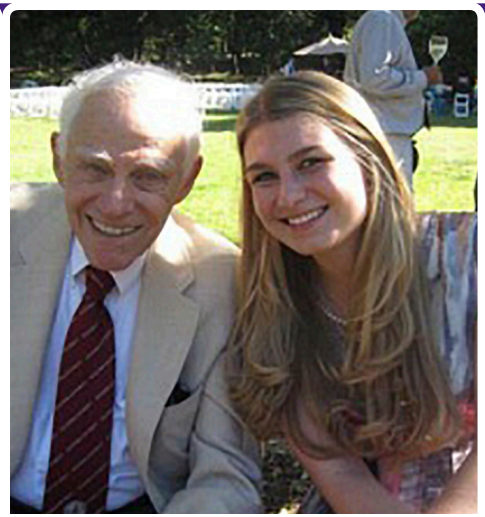
ALISON WITH LIZZIE ON THEIR 2015 TETON ADVENTURE

SAMANTHA'S PORTRAIT OF SIMON AT GLENBROOK

JENNIFER & ABIGAIL, CALEB AND ELEANOR AND POSSIBLY JEFF

We decided not to build, but we still go every year and, as it turns out, the kids and their children do too.

As I was preparing to go to China in 1975 the Hilgards told me they and the Villards were putting their Pescadero beach house on the market. We had been there and fantasized about owning it some day. I was too preoccupied with the China trip to think about Pescadero but, when I returned a month later and casually told Sissy the place was for sale, we jumped into action. Fortunately it had not been sold and soon it was ours. Pescadero has taken over as our family gathering place. It's available to family and friends year round for weddings, picnics, birthday and holiday celebrations and student parties.



We have had no trouble finding caretakers. Our first was Logan Payne, the young daughter of neighbors, with the abandoned Saint Bernard puppy she found, Honey, as co-caretaker. Honey loved jumping into the ocean from the rocks and when she barked at whales swimming close to shore on their way north for the summer I marveled that mammal species were communicating. Logan soon left for New York to develop her artistic talents but has returned to Pescadero and we are closer than ever. She has been working closely with me on this memoir.

Honey was buried under a memorial rock on a section of old Highway One that runs through the property. It's a short distance from the small cemetery where Sissy and I will end. I don't think you could find a more appealing graveyard.

Jake Crawford is our current caretaker and has been for many years now. He has the additional responsibility of welcoming family members and friends to Pescadero. They have to "book" in advance—the demand is so high.

Whether we're in the cove on a fine day, sitting on the deck looking for whales, or in the living room on a stormy day watching the surf, it's a spectacular scene. It is priceless to be in a completely different environment close to home–to wake up at sunrise and see the rays reflected from the breaking waves and watch long lines of pelicans, in formation, flying by. Marvin Chodorow's comment was, "Its nice if you like that sort of thing."

WITH THE SIX CHILDREN CIRCA 1990

STEPHANIE WITH ME

SAMANTHA WITH SISSY

APPENDIX

CURRICULUM VITAE

THEODORE H. GEBALLE

Born January 20, 1920, San Francisco, California
Primary and secondary education, San Francisco, California

UNIVERSITY OF CALIFORNIA, BERKELEY CALIFORNIA

1941	B. S. in Chemistry, summa cum laude
1945–49	Ph.D. in Physical Chemistry
	Thesis title: *Thermodynamic and Magnetic Properties of Single Crystal Cupric Sulfate Pentahydrate Below 4° Kelvin*
1950–52	Research Associate, Low Temperature Lab

MILITARY SERVICE

1941–45	US Army Ordnance, 2nd Lt. to Captain

BELL TELEPHONE LABORATORIES, MURRAY HILL, NEW JERSEY

1952–57t	Technical Staff
1957–68	Head, Department of Low Temperature and Solid State Physics, Physical Research Laboratory

STANFORD UNIVERSITY, PALO ALTO, CALIFORNIA

1967–90	Professor, Departments of Applied Physics and Materials Sciences
1990–present	Emeritus Professor, Departments of Applied Physics and Materials Sciences
1975–78	Chairman, Department of Applied Physics
1976–88	Director, Center for Materials Research (CMR)
1978–90	Theodore and Sydney Rosenberg Professor of Applied Physics (Endowed Chair)
	Appointments and Promotions Committee, School of Humanities and Science
	Faculty Senate (three terms), Committee on Committees
	Faculty Representative, Board of Trustees
Winter 1994	Acting Chair for Applied Physics, Stanford Physics Coordinating Committee
1998–01	Member, Advisory Board of the Humanities Center

RESEARCH ACTIVITIES

experimental studies of semiconductors, superconductor and magnetic intermetallic compounds, epitaxial growth and properties of oxide superconductors

HONORS AND AWARDS

1940	Phi Beta Kappa
1970	Oliver E. Buckley Solid State Physics Prize
1975	Guggenheim Fellow, Cavendish Laboratory, Cambridge, England
1989	First Bernd Matthias Memorial Award for High Temperature Superconductivity
1991	Von Hippel Award, Materials Research Society
1995	Bodo von Borries Lecturer, University of Tübingen, Germany
1996	Debye Lecturer, Cornell University
2004	Honorary Doctorate, Babes-Bolyai University, Romania

SCIENTIFIC ASSOCIATIONS

National Academy of Sciences
American Academy of Arts and Sciences
Fellow, American Physical Society
American Chemical Society
Fellow, American Association for the Advancement of Science
Associate Editor of Physical Review Letters, Applied Physics Letters, Applied Physics
Chair, Physics Section, AAAS
Board of Reviewing Editors, Science Magazine
American Physical Society; Council Member of Division of Condensed Matter Physics, Nominating Committee (1992)

BIBLIOGRAPHY

STUDENTS, POSTDOCS AND COLLEAGUES:

Steve Arnason,	U. of MA	Cerium Doped Buckminsterfullerene based Compounds
Phil Broussard	Covenant College	Sputtered NB/TA Multilayers
Frank DiSalvo	Cornell U.	Preparation and Properties of Layered Transition Metal Dichalcogenide Compounds Intercalated with Organic Molecules
Steve Early		Small Sample Calorimetry at Low Temperatures
Chang-Beom Eom	U. of WI	Synthesis & Properties of High Tc Superconducting Thin Films & Multiplayers Grown in Situ by 90 Off-axis Sputtering
Robert Feldman		Electron Beam Evaporation of Superconducting, A15 Niobium-Silicon
David Fork	Palo Alto Research Center	The Heteroepitaxial Growth of YBCO and Other Metal Oxides on Silicon and Gaas by Pulsed Laser
James Harper	U. of NH	Thermal Properties of Metals with Low Temperature Structural Instabilities
Frances Hellman	UC Berkeley	Specific Heat and Non-Equilibrium Aspects of Vapor Deposition Growth of A15 Superconductors
Richard Howard	Lucent Technologies Bell Labs	
Becky Howland	KLA-Tencor	Determination of Dopant Site Occupancies in Copper-substituted Yttrium-Barium-Copper-Oxide by a New Application of Differential Anomalous X-ray Scattering
Terrence Jach,	NIST	Observation of Nuclear Quadrupole Resonance with Superconducting Magnetometers
Andy Kent	NYU	Observation of Nuclear Quadrupole Resonance with Superconducting Magnetometers
Ken Kihlstrom	Westmont College	Synthesis and Superconducting Properties of Niobium Germanium
Raynien Kwo	AT&T, Bell Labs	Superconductivity of the A15 Compound Niobium Aluminum
Walter Lowe	Howard U.	Structure and Superconductivity in Transition Metal Multilayers
David Mael	AT&T, Bell Labs	Specific Heat of Novel Thin Film Materials
Yana Matsushita	Spansion Corp.	Superconductivity and Mixed Valency in Thallium-Doped Lead Telluride
Steve Meyer	Southwall Technologies	
Kirsten Myers	DuPont	The Role of Reduced Dimensionality in the New Perovskite Superconductors
Robert Norton	Picosecond Pulse Labs	Surface Current and AC Loss in Superconducting Niobium Tin
Byungdu Oh	LG Electronics, Seoul	Some Transport and Thermodynamic Properties of High-Tc Superconducting Y-Ba-Cu-O Thin Films

STUDENTS, POSTDOCS AND COLLEAGUES:

Sung-Il Park,	Natural Imaging	Superconducting Properties of Ultra-thin NB and V Films
Bob Schwall	NIS	Low Temperature Properties of Layered Transition Metal Dichalcogenide Compounds
Jeff Snyder		Magnetism and Electron Transport in Magnetoresistive Lanthanum Calcium Manganite
Steve Spielman	KLA-Tencor	Optical Tests for Broken Time-reversal Symmetry in the Cuprate Superconductors
Greg Stewart	U. of FL	I. Size Effects in Heat Capacity of Small Metal Particles II. Heat Capacity of the Systems MnBi and MnSb
Jonathan Sun	IBM TJ Watson Research Center	High Tc Superconductors: in Situ Thin Films Synthesis and Magnetic Vortex Motion-Related Dissipation Studies
Yuri Suzuki	UC Berkeley	Structure and Anisotropic Transport in YBA2CU307 and PRBA2CU307 Thin Film and Superlattices
John Talvacchio	Northrop Grumman Corp.	Critical Currents in A15 Superconductors
Daniel Worledge	IBM TJ Watson Center	Adiabatic Small Polaron Hopping and Spin-Polarized Tunneling in Perovskite Oxides
Shozo Yoshizumi	Biomagnetic Technologies	The Metal-Insulator Transition and Superconductivity in Amorphous Molybdenum-germanium Alloys
Robert Zubeck		Effects of Deformation on Mixed State Heat Capacity

SENIOR SCIENTIST VISITORS I HAVE WORKED WITH ARE:

Dave Blank from Holland, Ivan Bozovic with Brookhaven Natl. Lab., Kookrin Char from Korea, Tord Claeson from Sweden, Guy Deutscher from Israel, Oystein Fischer from Switzerland, Jurgen Halbritter from Germany, Lior Klein from Israel, Gertjan Koster from Holland, Steve Laderman from the USA, Laurent Mieville from Switzerland, Michio Naito from Japan, Bernard Pannetier from France, John Rowell from the USA, Suichi Tahara and Norio Terada from Japan, and Jean-Marc Triscone from Switzerland.