Charles DuBois Coryell: A Daughter's Perspective. Julie E. Coryell

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[Slide-1-title]

To honor my mother whose favorite poet was Emily Dickinson, I quote the first two verses of Poem Number 258:

> There's a certain Slant of light,
> Winter Afternoons --
> That oppresses, like the Heft
> Of Cathedral Tunes --
>
> Heavenly Hurt, it gives us--
> We can find no scar,
> But internal differences,
> Where the Meanings, are.

[Schleissner photo CDC-1954 -2] To lose my father when he was age 58, caused deep grief, akin to Heavenly Hurt. It was like a tsunami following the desolation of my mother's death at age 50, five and a half years earlier. Who would guide me, mentor me, delight in me as Charles clearly did? The occasion of this celebratory centennial Symposium has brought deep healing, in the kindling of friendships, memories, and new learning. To Bill and Barbara Walters, and to Walt Loveland I am deeply grateful. And editing Charles' *Reminiscences*, the nine sessions of oral interviews for Columbia University Oral History Research Center, that he recorded on Joan Bainbridge Safford's initiative the summer of 1960, provided a reservoir of memories, friends, and affirmation. [Howard Gest-3]

In 2010 I found Howard Gest via his article on the Scientists' Petition for a demonstration of the bomb (http://sites.bio.indiana.edu/~gest/hgSzilard.pdf). He went joy riding with Charles the Christmas Eve night I was born. He was working on an Homage to Charles for this Symposium when he suffered a seemingly mild stroke and died 11 days later on April 24th. Howard embraced me, encouraged me, sent me all kinds of sources. I honor his spirit and care with which he documented information and explored the most difficult issues of atomic energy. He, together with Oak Ridge Fission Products Group members, Lionel Goldring and Jack Siegel, answered many questions, as it was all secret!

Chiefly from his *Reminiscences,* I discern four aspects of his formation: his family and early fatherhood, his education at Caltech, his post-graduate years, and teaching at Deep Springs College. [Parents-4]]
+He liked to say he was conceived in Omaha, Nebraska and born in Wilmar, near Alhambra, a semi-rural community about eight miles from downtown Los Angeles to William Harlan Coryell and Florence Cook Coryell. Like many men of his generation who entered science, solitude, practical work, care of animals, curiosity in childhood framed lives of creativity and research. [Slide-5] The newborn Charles survived on goat's milk, later harvested walnuts, tended chickens, milked Daisy the cow, while reciting to her Latin declensions. He worked in a bank for weekly pay of a $5 Eagle gold coin. This sparked his lifelong interest in coins and the history they tell, and of element 79, Aureum, for its stability and variety of colors. He grew up Episcopalian and served at age 14 as Sunday School superintendent. His family, though poor, valued education. Mr. Bragg, his high school chemistry teacher recommended he go to Caltech. At age 18 he married Meta Seward and fathered Patricia Louise. [Patty-6] She trained him as a parent. Though separated from her by divorce, he never lost his love for her.

+At Caltech, he began freshman year with a research project under Arthur Amos Noyes, [slide-7] studied with Don Yost, E. H. Swift, Arnold Beckman, met Miles Sherrill, James Franck, and collided with Albert Einstein in a Caltech steam tunnel. He graduated as a married student in three years. At Caltech, he consciously rejected anti-Semitism.

+ Professor Noyes offered him an opportunity to study in Germany his junior year, but Charles requested to postpone it to his first year of graduate school. Dependents were not allowed, so he borrowed money to take Meta traveling with him in the summer. She returned home for his tenure of study at the Technische Hochschule in Munich, 1933-34. [Slide-8, lab on left, CDC skiing in Austria to right] Charles wrote, "I got a lovely multi-cultural bilingual education." And exposure to virulent anti-Semitism and Germany "girding for war." On his return, he was A. A. Noyes' last PhD student. He received the subpoena for divorce the day of his thesis defense. [Slide 9: CDC and LCP] Funded by a Rockefeller Foundation grant to apply chemical principles to molecular biology, Linus Pauling accepted Charles as his post-doctoral fellow to work on the magnetic properties of the heme portion of hemoglobin. [slide-10-"The Horrendous Tale of Blackbeard, the Blood Pirate," p. 1] Charles reports: "In 1935, starting in May, I was working for the princely sum of $1500 and I've never had a more happy scientific life than in the three years beginning then. I was full-time research with a much more frequent personal participation of my research supervisor. [Slide 11-Horrendous Tale, p. 2]] Pauling was warm and effervescent, with a good sense of humor and treated me as a younger brother. I also got to know the Pauling family and babysat for them."

After the divorce was complete, Charles met Grace Mary Seeley, from Colorado Springs, while she was visiting her Aunt Marion with a relation to chemist Frank A. Long. [Slide-12] From a deeply conservative family, Grace Mary had also experienced at age 18, the traumatic death of her mother. They had been shopping on the afternoon of

November 4, 1932, not long after Grace Mary's graduation in June from high school. Grace Louise began coughing and in 15 minutes died in Grace Mary's arms, attributed to a collapsed aorta. Her father, Frank, had co-owned the Lucky Guss goldmine in Goldfield at 9,000', higher than Cripple Creek, and made and lost two fortunes. Denied the opportunity to attend nearby Colorado College where both her older brothers graduated, Grace Mary mourned her life-long as Caroline Bird describes in her book about the Depression, *The Invisible Scar* (1966). Grace Mary belonged to a poetry circle and Charles boasted she had more poems in print, 13, than he had papers, though with marriage she ceased to publish. She wrote witty letters and poems to my freshman year in high school on her black and gold Remington portable, when they bought a teal-colored Olivetti Lettera 22 [slide-13]. Joan Safford used the same model to type up her interviews. In 1959 they bought me a chartreuse one, the laptop of its day. In his third post-doctoral year, Grace Mary from Colorado and and Charles from California, traveled by trains to marry in Flagstaff, Arizona, December 2, 1937.

+The fourth major influence on Charles' way of teaching developed from his relation with Deep Springs College. [Slide-14 territory-Deep Springs Valley just under the horizon beyond Pine Lakes] Founder L. L. Nunn, who made his fortune providing electricity to Telluride, Colorado, offered young men rugged Western life with Eastern academic excellence. Neville Sidgwick, Oxford physical chemist, visited Telluride House and Deep Springs which led to Charles' recruitment via James Conant and Linus Pauling. [Slide-15, CDC, NVS, GMC] Charles recorded: "the students paid no tuition, they went for three years for two years of college credit, they had to help run the ranch. They learned about range problems, to work in the kitchen, the laundry, the garage, and ride herd. I liked the idea of putting substantial responsibility on young people. There was an argumentative environment up there, as the students had to criticize the mistakes they made. I liked the idea of treating students as equals." Charles also learned

at Deep Springs College, to organize 3-hour lectures, long-distance supervision and research-oriented coursework. With his appointment as assistant professor in the Fall of 1938 at UCLA he left Deep Springs. By May 1942 Herbert McCoy and Frank Spedding recruited him to the Manhattan Project, the Metallurgical Lab at the University of Chicago. [Slide 16-Jones Hall, University of Chicago]

Charles' experience at Deep Springs informed his rivalry with Glenn Seaborg in Chicago, his recruitment style and preference for what he called "Quaker democracy." [Slide 17- Jones Hall Foyer]

"We had seminars every Wednesday afternoon and every Saturday afternoon. We worked a six-day week, and many weeks we worked four or five nights. I lost thirty-five pounds in the first six months of the job. At these seminars, we were learning radioactivity, teaching it to ourselves.[Slide 18- Life Magazine photo of GTS and Periodic table, ~1945] Seaborg gave a lecture series every Tuesday night, for a lot of people, a fairly good lecture series. I offered to take the notes, and this way I would learn everything he gave. I would then work that night until about three, and then I would talk to Edward Teller (1908-2003) the next day... This set of notes was used for a long time for training. It was declassified at the end of the war.

"Outside of that, we got things out the hard way. It turned out like Deep Springs. You give the young men responsibility and incentive, and there's just no limit. The situation put so many demands on people, that chemists that I hired that I thought from my academic experience would just be middle-road chemists developed sparks of leadership. If they didn't have imagination, they developed solidity. And their relative position in chemistry was greatly elevated in this atmosphere.

In September 1943, Charles went to Oak Ridge. [Slide-19, CDC's Fission Products Group members, 1945 and Oak Ridge signatures on Szilard Petition] Here are two photographs which Howard Gest sent me. From his notes Howard wrote:

"The members of our group worked on several projects simultaneously, in subgroups of two or three. I frequently worked with Glendenin especially on short-lived fission products. On a typical day, a small amount of metallic U was placed in a plastic cylinder called a 'rabbit' which was sent into a channel of the reactor for a certain length of time. The rabbit was then ejected into a tin cup attached to a 6-foot wooden pole. To minimize exposure to radiation, I would run down the hill holding the pole to the chemistry building and extend it into an open window where Glendenin waited. He would quickly open the 'rabbit' and dissolve the U in fuming nitric acid. Meanwhile, I would run to the building entrance and into the lab where Glendenin had already begun *fast* chemistry. Time was of the essence! Many of the radioactive isotopes produced in U fission are short-lived and decay quickly--within hours. We took turns running down the hill."

Howard has also written about the historic Szilard scientists' petition to request President Truman to demonstrate the atomic weapon before military use. Charles' signature, first on the page, marks the beginning of his political orientation, and advocacy. Both his interviewer Joan Bainbridge Safford and I agreed that our fathers' political activism toward nuclear arms control and peaceful uses drew our respect and gentled fears that atomic energy might be beyond human control.

Howard continued, "Several years after World War II ended, some of the basic research of the Coryell groups was declassified and published. The first paper to appear was in French for the 1948 international meeting in Paris: Isotope Exchange and Molecular Structure. [Slide-20 CDC at desk with PPR volumes, MIT Bldg 6-427, mid-1950s] Subsequently, Coryell and Nathan Sugarman assembled 335 wartime papers in the

three-volume Plutonium Project Report, *Radiochemical Studies: The Fission Products*, McGraw-Hill, 1951.

Charles stayed in Oak Ridge for the transition to Monsanto and Oak Ridge National Laboratory and joined the faculty of MIT in July 1946. He, at age 34, with William Ted Martin, 35 and Jerrold Zacharias, 41 were the first full professors appointed post-war, in Chemistry, Mathematics, and Physics respectively. My parents' life in Lexington was filled with visitors and friends, lively parties. [Slide-21 A party at home] My mother cooked "Chicken Centipede"cornmeal-battered southern-baked drumsticks, thighs and wings, which could be stretched easily to feed hungry students. With international guests and mail, and music-filled, physics songs of Arthur Roberts, Saturday broadcasts from the Metropolitan Opera, 78-rpm records including Beethoven and the Bach Organ Works played by Albert Schweitzer, our homelife oscillated between thrilling and dysfunctional as my mother began binge-drinking, perhaps to self-medicate her own moodswing. When she was well, she was a cheerful traveler, witty correspondent, hospitable hostess. [Slide-22] This picture, taken in November of 1953 in the Moore Room of Building 6 at MIT, commemorates the visit of Charles' Caltech Chemistry Professor Don Yost (center, seated). Note international members, Don Wiles from Canada, (presenter at the ACS Symposium), Gholi Bazargan from Iran, Kaya Tonguç of Turkey.

Described as ebullient, Charles identified from his undergraduate days, his boom-bust psychological cycle. [Slide 23, 1969 CDC with Russian inscription by Endre Toth on left, Ben A Shaver photo late 40's on right] He experienced periods of personal depression, discouragement, akin to "the Heft of Cathedral tunes," and periods of exuberance, high energy, and physical stamina. Glenn Seaborg, in contrast, in his autobiography co-authored with son Eric, *Adventures in the Atomic Age,* 2001, relates that in Chicago in 1942 he developed prolonged lingering flu symptoms and took up golf. Later he cultivated a habit of hiking, practical measures for self-care.

Charles plunged into war work in Oak Ridge, and under conditions of tire- and gasoline-rationing, lent his car to others rather than take excursions or more than Sundays for rest, and no vacations. In Session Five, he said, "I knew that the timing of the job and the importance of the Project were immense, and I literally feel I was within a short time of being a bottleneck of the atomic bomb." [*Reminiscences*, p. 280] During his first year at MIT, 1946-47, he gave 65 outside public lectures. In 1956, he experienced a boom and the thrilling research described by William Walters on the "r" process in the first seconds after a supernova burst. He argued vividly with Harold Urey in a seminar at MIT. He wrote daughter Patty how he wished he could simply write his results without having to face documenting and proofreading. In 1963 and 1965, he experienced two hospitalizations for manic episodes, the first during the Kennedy assassination, the second around the death of Grace Mary, just weeks before my graduation and marriage to Seelye Martin. He wound up again as his cancer took hold, but Barbara Buchman Coryell, whom he married in 1969 offered him rest at her lovely Capistrano beach home, [Slide 24] restoring his equilibrium. He was deeply affected by the emotionally cool administration of Chemistry Department Chairman, Arthur Clay Cope, and the decision catalysed by F. Albert Cotton to shift the emphasis of the department away from radiochemistry into molecular biochemistry. [In researching Charles' references, I was delighted to find that women students lauded Professor Cope's efforts to encourage and retain them in the field of chemistry.]

Charles' habit of living transparently and coherently meant there was little separation of home and work. Further, he made clear, science came first. [Slide 25, KRJ titles]

The books of Kay Redfield Jamison, first, *Touched By Fire* (1993), then her own story, *An Unquiet Mind* (1995), followed by *Exuberance* (2003), all illumine the possibly genetically-based characteristics of creative people who experience severe, even debilitating moodswing. She proposes that especially the exuberance, before it shades into dysfunctional mania, may persist genetically, for offering an evolutionary advantage for withstanding failure, for being able to seek new ventures. It is strenuous for family and co-workers. Professor Glen Gordon accompanied and supported Charles (and me) valiantly.

In the fourth year of his battle with giant cell bone sarcoma, by refusing tenure to Professor Glen Gordon, MIT moved to close Charles' Laboratory for Nuclear Science. Professors Gordon and Walters, with graduate students, post-docs and much equipment moved to the University of Maryland in August of 1970.

Charles took a scientific attitude toward his cancer, which alternately filtered into his lungs as golf-ball-like bone tumors or aspiratable sinovial-fluid-filled sacs and actively participated in his treatment. He noticed that his tissues concentrated iron while his physicians prescribed iron supplements. He traveled solo to the Middle Eastern Technical University, Turkey, and to Israel. He married Barbara and traveled with her and her mother to Moscow and Irkutsk, where her natal home is still used as an eye clinic, founded by her father who was killed by Bolsheviks as they escaped eastward on the Trans-Siberian Railway. [Slide-26, Christmas 1958 on left, Christmas 1968 on right] Not all sorrow, family life blessedly held many sweetnesses.

He delighted in the Atomic Energy Commission Award bestowed by Glenn Seaborg at MIT, in the spring of 1970,[Slides 27, 28, 29, McCormick Hall, 19 May 1970] and especially the large gathering of colleagues, friends, and company of daughter Pat. He did not fear his own death, asserting he lived three lives in one.

Charles loved aphorisms and mottos.[Mottos slide-30] My favorite among all, is "Children are the original scientists." My perspective on Charles DuBois Coryell, is defined by his fathering me and being a chemist. In the Oak Ridge reactor out of the *mother liquor* they studied *fission daughters*. He was argumentative, playful but reasoned, and egalitarian. In contrast, the mathematician Paul Erdős termed children *epsilons*, meaning a factor so small, it could be dismissed. This was not Charles' way. And there are a notable number of namesakes: Arabella Coryell Davies, Chuck Glendenin, Chip Freeman, Charlene Huber Fleming, Charlie Zoller, Jonathan Coryell Petrow, Carl and Maria Coryell-Martin.

[Slide-31] Here is a picture of the Pauling children's pumpkin, probably 1936 or 7, two-faced, "illuminated by the light of its own mind." Linus Pauling, Jr. reports that Charles befriended him during adolescence and taught him to drive. [Slide-32] "Babies test

gravity," Charles would chortle, showing pleasure beyond the patience of a stay-at-home parent, here with Julie del Marmol, youngest child of Patrick and Hedwige in Mol, Belgium, 1963. He delighted in explanations, and what we might call "repurposing." When I experienced nightmares, he would bring a wintergreen candy and the consoling advice to go back to sleep in a different position. During our family drive from Oak Ridge, Tennessee to Lexington, Massachusetts, at Kitty Hawk beach in North Carolina, to help me withstand the wait for food in the restaurant, he offered a cube of sucrose, renamed ever after, "ocean candy." Later, the tooth fairy donated three teeth we soaked in small clear glasses on the kitchen counter, one in tap water, one in vinegar, and one in CocaCola. The corrosion from the CocaCola was memorable. Grace Mary was patient, allowing space on the kitchen counter for months. However, the application did not go far enough in proper self care. Charles had gold crowns and I feel my mortality in my teeth.

Also on that drive we stopped overnight in a log cabin with an open porch in the Appalachian mountains. During a dramatic thunderstorm, he sat me on his knee on that porch, and crowed, "Thor makes thunder." Tempered with some sensible safety measures, his confident joy echoes for me to this day. Once settled at MIT and 27 Independence Avenue, he trained me as a homing pigeon, to navigate for visitors in their cars. He invited me to his office many Saturdays, to give respite to my mother, but as I grew, he involved me in titrating and timing exposures of samples for students. I was happy to have a job and to be part of the company. [Slide 33, Jack Aeby color photo of Trinity bomb test, courtesy Los Alamos Historical Museum]

In our dining room corner cabinet displayed a short, round, black screw-topped glass jar. Within, wadded in old cotton, *radiated* a treasured sherd of trinitite, fused sand from the Alamagordo blast. On the mantel sat the iconic Jack Aeby photograph along with the poem Grace Mary wrote about the gift of the print from Anthony Turkevich and Nathan Sugarman, reprinted in the book. To occupy me in museums, he taught me the iconography of saints [Slide 34] and paid me a penny's worth in the currency of the country we were in, which I had to calculate with my less-gifted numeracy, usually in my head.

The June morning we visited Hagia Sophia in Istanbul, it was deserted. [Slide-35] To teach me about pendula and the earth's rotation, six-feet tall, Charles reached the long stems of the hanging chandeliers and gently set them swinging. Observing them again in the afternoon, they were attenuated but still gliding. (I don't remember the change in orientation, but he would have.)

When quiet Seelye and I began dating, I complained that I was uncomfortable with long silences and did not want to speak up foolishly, Charles asked if I had a second-hand on my watch."Yes." "Try noting the time…and waiting until Seelye speaks." Tested on several occasions the lapsed time proved only 30 seconds! A successful social experiment.

What I most grieved after his death were our conversations. I was three when he first impressed me with the immeasurability of infinity. It challenged me in 2008 to learn the history of mathematician Georg Cantor (1845-1918) who determined there are varieties of infinity. At dinner parties at home in Lexington, Charles often posed the question, "If the Russians targeted the cement monument marking the Trinity test site, but injuring no persons, how would we respond?" Presaging Carl Sagan, he queried, how might we communicate with intelligent beings outside the galaxy? By broadcasting prime numbers, or atomic weights from the periodic table?

In my 11th year, driving somewhere, Charles spun out a logical but wrong idea about something I knew better than he. Perched on the drive shaft bump in the well of the back seat, I remonstrated and spelled out my truth. He admitted he was "fact-generating, that his idea was plausible but not true." Although the content escapes me, the incident does not, because he treated me as an adult mind afterwards.

Diverting his usual commute to MIT to drive me to my first day at Muzzey Junior High School in Lexington, Charles described to me the math, physics, and chemistry classes I would take in high school. Glad for the ride and his company, I was nonetheless terrified, and lost my breakfast on the threshold of the front door. My senior year I did

enroll in the new Physical Science Study Course physics class. The best part was working on optics and setting up folding mirrors at the top of the living room stairs to observe at eye level. We could lose ourselves in the analysis, the writing of notes…but Grace Mary was facing surgery, I had "five solids" and was co-editor of the Yearbook. The workload was unsustainable. I dropped physics, and struggled with feelings of self-assertion and woe for disappointing what I perceived as Charles' expectations for me. [Slide-36 JEC in ~1948] Later, as a parent and coach for mathematically-gifted middle and high school students, I drew on this history to respect that young people, indeed beginners, need time to think, opportunity to explore, make mistakes, and learn to cope with performance anxiety. Charles couldn't save me from anxiety, but he was frank to share his experiences and sympathy. He kept Coryell time, five minutes fast, time to pee before a lecture. And he set high expectations. But I am glad he did. People and students tend to respond.

Since March of 2007 when I undertook to edit Charles' *Reminiscences,* I have encountered the buried memories, old friends, fears about atomic energy. [Slide 37-References] I remain particularly indebted to Richard Rhodes for his Pulitzer-Prize-winning Making of the Atomic Bomb (1985), to Alice Kimball Smith, *A Peril and a Hope, The Scientists Movement in America 1945-7* (1965). [Slide-38, Cover] This work is now prepared for publication by Promethium Press, available on Amazon.com as *A Chemist's Role in the Birth of Atomic Energy* and eKindle.[Slide 38 Title Pg.]

[Slide 40. Ben A. Shaver, ~1950] Charles and I had a joke: there were places where I was *his daughter,* and as I entered college, and grew into my own person, there were places where he was *my father*. Thank you all, and the American Chemical Society for bringing us to the place where we are both.

Acknowledgements: [Slide 41]