# A BUSH OF TRAJECTORIES

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A faded snapshot recovered from the recesses of my mother's French desk shows a man looking down at a tiny infant, held in the uncertain way of new fathers. Because my father departed the scene sometime during the first months of my life, I think of this picture as one of the last times we saw each other for eighteen years. Had he not left, my trajectory would have been very different. Perhaps I should say my trajectories, because they have branched like a bush.



**Early years**

My roots, then, are entirely about my mother. She was the middle child in an Irish brood of seven, living on a marginal dairy farm in a small town in the Genesee River valley about 40 miles south of Rochester, New York. Her mother died when she was 15, and I infer that she and her two older sisters cared for three younger brothers. I know nothing more of her childhood and but little more of her life prior to my birth in 1932. I think she and her siblings attended the local high school. She married in her early twenties and lived with my father in New York City for 11 years, during which time she recovered from both malaria, then still possible to catch in the Hudson Valley, and tuberculosis.

At age 35, finding herself divorced and with an infant child, she started college. She later referred to that period simply as "Columbia," but I have discovered Columbia Teachers College was where she earned a bachelors degree.

Mother always claimed to be 3 years younger than she really was, and she even convinced the State Department when she got a passport. I discovered this deception only after her death, when I found her birth certificate in her safe deposit box

My earliest memories during the first 5 years of my life are an apartment on about 121st Street, several blocks below the Riverside Church, and playing in the park near Grant's Tomb. Kindergarten and first grade were in Rochester, while mother studied organic chemistry and microbiology at the University. I had a couple of delightful summers in a rural town near my mother's birthplace, staying with the family of her youngest brother, the local postmaster. Once a week I made a pilgrimage to the local soda fountain, where with my weekly fifteen cents from my mother I could indulge in a "black and white": a scoop of chocolate ice cream topped with marshmallow sauce snuggling up against its vanilla mate decked out in chocolate.

After Rochester, mother and I moved to College Park, Maryland, where she finished a doctorate degree in microbiology at the University of Maryland. This was a new environment. I have a vivid memory of the sweltering August day we arrived in Washington DC, and how the fountains outside Union Station were alive with children, all Black, escaping from the heat. This was 1939, and although Maryland was

still a segregated state, very much in the tradition of the old South, my mother had her own views, usually unspoken, about how one should behave.

We rented a cottage on the edge of town, streets not yet paved, and she hired a woman from Lakeland, the segregated area even further into nowhere, to clean house and be around for me after school. I remember my panic the day I swallowed a piece of ice that lodged in my esophagus, and how that gentle woman, seeing I could breath, put her arm around me and assured me it would soon melt.



But this part of the story is still about my mother. It was a good trek to the campus, and she bought a car, a plain vanilla Chevy. When she got back from the University at the end of the day, she would always put Agnes in the car and take her home. I once asked my mother why she did this, as the distance was not great, and she said "We've both been working all day, and she's just as tired as I am." Sometimes I rode with them; Lakeland seemed to my young eyes to be on another planet.

Only once do I remember my Mother saying anything on the subject of race, and that was to express outrage when in 1939 the Daughters of the American Revolution refused to permit Marian Anderson to sing before an integrated audience in Constitution Hall. As a naïve child I wondered how women in such an illustrious sounding organization could be so mean.

In the 1940s College Park and the University of Maryland were just finding themselves. Small boys could roam with abandon and explore the woods and fields beyond the town. Some got into minor forms of trouble such as tripping the trolley cars that ran out from Washington, bringing them to a stop. I observed this with admiration, but adventures like that lay beyond the bounds of my timidity. (This was not the Chicago technique reported by Joe LaPalombara of blowing a car wheel off the tracks with a tuna fish can of gun powder. The suburban Washington sport was more benign. The wheel on the end of the trolley pole was simply knocked of f the power line with a homemade Argentine bola consisting of a short piece of rope with a stick of wood tied to each end.)

The War came. Mother received her doctorate and was hired as an instructor to teach microbiology at the University of Maryland. We lived comfortably, now in a somewhat larger rented house, but mother let a room to a student to supplement her income. She was important in keeping the University's teaching program in microbiology alive until the end of the War. But with no future for her there, she took a research position with the Department of Agriculture at Beltsville, Maryland—her first real professional job, age 48 by my reckoning. In time she rose to Supervising Bacteriologist and Chief of Laboratory. In 1959 she moved to the National Heart Institute, and in 1963 left laboratory work to become Executive Secretary of a study section in cardiovascular disease at the National Institutes of Health. That is a PhD-level position responsible for organizing the peer review of grant proposals.

Mother found this a satisfying move. I think she had really wanted to become a physician; I know she would have been happy had that been my choice; and I know

she enjoyed working with the physicians who reviewed grant proposals in their areas of expertise.

I have told you this much about her, partly as tribute to a woman who had taken on difficult odds during the depression and carved a place for herself through quiet determination. Of course I had no real appreciation of this at the time, so it is important to me to be able to share it now. She subtly influenced my trajectory, sometimes without my realizing it until well after the fact.



One more word about her: She never once mentioned my father. In fact, she made it clear that she didn't want to answer any of my inevitable questions. None of her brothers and sisters or my father's half-sister, my aunt Margaret, ever mentioned him in my presence. Only as an adult did I realize that my Aunt Margaret lived a kind of double life, keeping in touch with her brother, while remaining close to my mother and me. I have learned only recently from my younger half brother that our paternal aunt had never really warmed to my father's second wife.

Aunt Margaret had a tiny, charming summer home in Redding, Connecticut, next to and dating from a colonial-era lime quarry. This was another rural paradise for me when a small child. The house was built on a slope at the very edge of the old quarry, and my 2nd floor bedroom had a door that opened directly to the outdoors. Foxes lived in the quarry. I found this place enchanting.

**My father.**

One evening while we were living in Rochester and I was listening to *Henry Aldrich* on the radio, someone, perhaps a baby sitter, maybe my older Rochester cousin, told me "Your father wrote that. That's his program." (Koerner Fellows may comprise the only group I now know for whom that sentence holds any meaning. As a reminder, every program opened with Mrs. Aldrich calling "Henreee, Henry Aldrich," and Henry answering with a squeaky "Coming, mother.")

When I was 8 or 10 and came across a photograph and a profile of my father as part of a family with other children, my mother took the magazine and refused to discuss it. In retrospect, cocooning herself from her past betrayal was her way of going forward. This produced a private vacuum for me that for several years in my late teens became increasingly difficult.

Perhaps I should tell you just a bit about my father, if only to suggest how my trajectory could well have been very different, with New York and Los Angeles as key locales and a different set of parental models. Clifford Goldsmith, orphaned at 10, spent his subsequent childhood in the same town as my mother. He had one year of college before moving to New York City to study acting, but his professional success began when he was nearly 40. He wrote a Broadway play, *What a Life,* which had 538 performances during 1938 and 1939. The radio show about the Aldrich Family morphed from the play. It ran on the radio, with its last four years on television, from 1939 to 1954. It was a gentle situation comedy built around the passing troubles of a

teen-age boy, and it was very funny. But with no heavy psycho-drama, no real crime, it is clearly now the stuff of yesteryear.

I began to know my father a bit when I was 18. He had a gentle, courtly nature, and his sense of humor was reflected in his writing. His only comment about my mother was to say he hoped I would understand some day. I did not pursue the matter, and I am not sure there are explanations for affairs of the heart. But there are many things I now wish I had asked him—about their lives as children and their lives together during the 1920s.



**Education Years**

When I was 12 I spent a couple of weeks at a camp on Chesapeake Bay. I was fascinated by the teeth of Miocene sharks that washed out of the Calvert Cliffs. Why so many teeth and no sharks in the cliffs? Sharks have no bones to fossilize, but their teeth are deciduous, and they make a lot of them. So teeth could be found on the beach with every tide. Here, quite unexpectedly, I also became fascinated with birds. When I came home I could hardly wait to get a pair of binoculars. I found a pair of used 6 x 30s at a military surplus store in downtown Washington, and I used them for years until I could afford something better.

I attended a public high school in Hyattsville, Md. I had a biology teacher, a small, crippled man, whose passion for the subject further opened my eyes to the world of organisms. I also had a pair of history teachers who left me with a lasting fascination for the past. For algebra I enjoyed the best math teacher I ever had. And I learned the seemingly now-lost art of diagramming sentences.

But there was a flip side to the school. The trigonometry teacher almost killed my budding interest in math. The chemistry teacher—who doubled as the assistant principal and was a living example of one who had ascended a couple of rungs above his level of competence—told us the black, cardboard box, approximately a cubic foot in size and labeled 22.4 that he had inherited from his predecessor, contained 22.4 molecules of air. And I had an English teacher who used the Reader's Digest as her window on literature, leaving my mother somewhere between anguish and despair.

My mother had great faith in the power of education, and she made it clear she did not want me to join most of my college-bound classmates at the University of Maryland. I had no disagreement, and I filled out applications to Harvard and Cornell. The Yale application struck me as fussy and intrusive, and having done two already, I never finished it, but the cream-colored paper with blue lettering looked sort of special.

Fortunately, I had my choice, but I visited neither, and I had no idea what I was doing. I opted for Cornell, partly because of an emotional tug for rural upstate New York and partly because of its fame in ornithology. The latter proved vastly overrated. My sophomore year I had a rented room just off campus where the landlady did not complain about my pet flying squirrel, and I could see pileated woodpeckers from my

window. I loved Cornell's setting, with the quadrangle's sweeping view of the distant ridge to the west, the deep gorges cut through Devonian rocks by creeks dropping from the hills into Cayuga Lake, and I particularly enjoyed courses in botany and geology.

Biology then had an incoherent presence at Cornell, split between the Faculty of Arts and Sciences and the School of Agriculture. The Zoology Department still seemed to think it was teaching first-year medical students. Even Professor Adelman's gastrulating before the class with his cloth models did not excite my interest in embryology. Everything seemed descriptive. I found the greatest pleasure in physiology, where we at least learned how things worked and not just what they looked like under the microscope. I formed no class identity and did not bother to go to my graduation.



I was happiest outdoors. During high school I had developed a passion for hiking and camping with friends along the Appalachian Trail in Shenandoah National Park. During collage I spent my three summers working as a park naturalist with the National Capitol Parks component of the National Park Service. Every day I commuted by trolley from my mother's house in College Park to Ford's Theater. At that time it was an empty space, with a small office on the 2nd floor for three full time ranger naturalists. I would pick up a car and drive to Great Falls on the Potomac. Here the river cascades from the rocky edge of the Piedmont Plateau onto the coastal plain. There was then, and is today, a small history museum run by the National Park Service, sited in an old tavern by the tow path and one of the locks of the Chesapeake & Ohio Canal. It's a delightful spot. My job was to open the panels on a small outbuilding where I and a helper had assembled some snakes, frogs, lizards, salamanders, deer mice, flowers, nuts and leaves—in short, whatever local flora and fauna we could get our hands on. These things were placed on outside counters and served as talking points for interested visitors, especially children. I would also lead groups out on the boardwalk to the falls and talk about the trees, the canal, whatever birds were singing, and the local geology. This was fun, and it kept me outdoors. Never good at small talk, here I could hold forth on things I knew and cared about.

I will share one story that has to do with a minor and diverting trajectory of its own. One summer we had a beautiful king snake about 18 inches long, decorated with a chain of yellow links on its jet black body. It was wonderful because I could let children hold it with no fear it would misbehave and bite. One day, having shown it to a group of children and their parents, I was standing, holding it in one hand near my waist while continuing a conversation. I suddenly realized it had poked its head between the buttons on my fly and was making its way into darkness. A gentle tug and it bent its head around a button and resisted. However, I was not keen on letting it have its way on the remote chance it came across something that reminded it of a small, edible mammal. What to do? I terminated the conversation as nonchalantly as possible and retired around the back of the display building, hoping no children would follow, where in some privacy I might b e able to feed it through and down my leg or recover it from the top without having to take my pants off.

When I left Cornell, I went immediately to Harvard to work with Donald Griffin. Griffin had been at Cornell but left before my senior year. Griffin and Robert Galambos had discovered how bats use high-pitched cries to echolocate, and he was also interested in how migrating birds navigate. He was my door to Harvard.

I spent the summer working with common terns. These birds make long migrations to the Southern hemisphere, but they nest both on the east coast and around the Great Lakes. Griffin was curious to see what would happen if we took birds from each population and released them from a large, cleared area somewhere in between, which turned out, on my suggestion, to be the little-used airport at Cortland, NY.



The question was simple: could the birds quickly recognize the direction they would need to take to get back to where they were nesting? What happened? All the birds went southeast, which is probably a good strategy if you find yourself blown inland during a hurricane. This was fun, but I couldn't see how, with the limited technology then available, we were going to learn much about avian navigation.

In my second year at Harvard I moved to the laboratory of George Wald. He had discovered the critical role of vitamin A aldehyde (retinal) in vision. I had taken a seminar with him and found it was not known whether this molecule played a similar function in insects as well. This was particularly interesting because vitamin A is not required by insects. Wald suggested I try to find out, but he did not then mention he had tried without success. I did succeed, but only after using the heads of a couple of thousand honey bees for each experiment. I also found that most of the retinal was bound to a light-sensitive, soluble protein, which I took to be the first known insect visual pigment. That interpretation turned out to be wrong, but the real role of this protein as a retinal photoisomerase is no less important, because it completes the visual cycle for the bee and in a way that is very different from the cycle in vertebrate eyes. I have the satisfaction of knowing that the best work that exists on this protein and its role in the bee's vision was done by one of my graduate students years later here at Yale.

While still a graduate student I did some work with an electron microscopist at the Marine Biological Laboratory in Woods Hole, showing that arthropod photoreceptors are not modified cilia, as they are in vertebrates, but are compact arrays of microvilli of the cell membrane.

After my PhD I had three years as a Junior Fellow of Harvard's Society of Fellows. That was, and still is, a very special honor, but in those days it was an all-male conclave still in the hands of some of the most conservative members of the Harvard professoriate. It had its own meeting quarters with regular dinners that I later came to realize were modeled on the Oxbridge senior common room, complete with a wheeled, Sterling salver that rolled around the table with after-dinner decanters of port and Madeira. On appointment, each Fellow was presented with a silver candlestick, engraved with the Fellow's name and date of appointment. If having a pair seemed more useful, a matching candlestick was available for purchase. As I recall,

this item was a copy of a French candlestick of singular, albeit mysterious importance to Lawrence J. Henderson, the first chairman of the Senior Fellows.

The last year of the appointment I spent in the Biophysics Department at University College London, recording with microelectrodes from the connections between nerve endings and the muscles they stimulate. This was then a relatively new technique that had not yet arrived in the Harvard Biology Department, and it has been very important in understanding how nerve cells communicate with each other.



In 1961 I came to Yale as Assistant Professor in the Zoology Department.

I am going to say but little more about my work on early events in vision; it kept me in research support, and it moved among insects, crustaceans, and birds. Initially my approach was through biophysics and biochemistry, but ultimately it circled back to include behavior and the color vision of hummingbirds and budgerigars. However, I think this group will be more interested in some different branches on my trajectory.

**The Lecturers' Affair**

In 1972 I became Chairman of the Biology Department. Biology had been formed by the amalgamation of Botany and Zoology six years before. On assuming this role, I was the youngest full professor in the Department, and that may have contributed to a brash act—a thorn on one of the branches of my bushy trajectory. I knew at the time I was making trouble for myself, but I also knew it was trouble that needed to be made. For reasons you will shortly come to understand, it has nevertheless been a source of lingering discomfort for me, and it is with some misgivings I share it now. But it is important because it is a part of Yale's history.

At that time there were three women in the department with the title of Lecturer. All were supported entirely from research grants and had written the proposals themselves. Two had come from the Botany department. All were, in effect, independent investigators, a term of art in the holding of federal grants. My predecessor as Chairman, Clem Markert, had been concerned that such individuals have some kind of affiliation with a member of the faculty. Or to put it in is most pragmatic terms, the space committed to such independent investigators had to be carved out of the space allocated to regular faculty. This had caused trouble in one instance, but that member of the faculty had left Yale.

I saw a deeper problem. These three Lecturers were routinely asked to contribute lectures in courses on subjects they presumably knew more about than anyone else on the scene, to teach laboratories, and even to serve as members of PhD committees. This was done out of a well-meant feeling of community, but it seemed to me to be at heart an exploitive practice, following all too naturally on having women as graduate students, then doing absolutely nothing to try to place them in academic or other positions. Of course, holding those NIH or NSF grants committed Yale to provide facilities to the grant holders but not to contribute to their salaries. There was an ad-

ditional factor. Two of the three women were wives of faculty in the Biology department. More troublesome, one of them was my wife.

Putting this to the department as an improper way for the University to behave therefore put my whole argument on dangerous ground. I put it to the department anyhow. I said I had no solution, and should not be part of one. I said I planned to leave the country for two weeks—in fact I went to Jamaica with a marine biology class. I asked Ed Boell to act informally as chairman in my stead. I had a faint hope the Department could formulate a plan to address the situation, but I also knew we might have to leave Yale. Having already encountered a nepotism rule at the University of California, I did not relish this outcome.



Even my faint hope was of course naïve. A direct solution to the problem was a challenge to the entire appointments process, and this was recognized by everyone from the Administration down, including me. One colleague whom I greatly respected told me that the challenge was not in the institution's best interests. Another even asked me if I really thought women should be members of the faculty. Others quietly seemed to get the point, but my sense is that no one was comfortable.

To make a very long story short, wheels did turn, albeit slowly and independently: one of the marriages ended in divorce, and the Lecturer moved to an important position with the National Science Foundation where she had a successful, although somewhat different career. Another found—with some important help from at least one senior member of the faculty—a tenured position at a state university where she became a distinguished member of the faculty and continued to obtain research support for the rest of her career. The third received tenure at Yale through a drawn-out process that preserved the Administration's sense of propriety. Despite everything, I was appointed to a second term as chairman.

There is an interesting historical footnote to this story. My predecessor as chairman had stirred up the larger community of ecologists. Or perhaps it would be more accurate to say that one or two of the tenured individuals who left Yale during his period as Chairman—one of whom I alluded to a few moment ago—were spreading the word that Yale was hostile to ecology. Consequently the Department was finding it difficult to recruit new junior faculty in this area. I proposed we make a new start with a senior appointment, and suggested a woman I thought might be available. After the traditional vetting, the appointment was made. It was also the case that she was a survivor of a situation at an eminent state university analogous to that of the three Lecturers, but she had resolved her problem through legal action. She therefore arrived at Yale ready to erect her defensive quills at the slightest sign of untoward patriarchy.

At that time the Yale College Programs of Study listed the faculty for each course with the title of Mr. or with an occasional Mrs. or Miss. One morning I had an indignant call from my new faculty colleague with a complaint—the sort of trivial issue that drives any chairman bonkers. The long-standing person in the Dean's office who did the copy editing of the course catalog refused to accept the title of Ms and was

insisting on Mrs., which was sending my divorced feminist professor up the wall. I did my best, only to hear the explanation that "Ms was not in the Yale tradition." By that point *I* was climbing the wall, and I relayed this nonsense to the Dean. That is the back-story for why all titles vanished from the course catalog the following year.

#### Branching Trajectories 1: Biological Roots and Gruter

Some time in the 1980s I attended an informal, ongoing luncheon seminar organized by a member of the economics department. His motive was to see if anything in evolutionary theory might be relevant to economics. He was probably disappointed, because the meetings went in an unexpected direction. Much of the discussion hinged on readings form E.O. Wilson's *Sociobiology*, and I was surprised how almost everyone in the room totally misunderstood what they had read. Much time was spent by my trying to explain what Wilson really said. Prompted by this experience I wrote a little trade book called *The Biological Roots of Human Nature*.



This in turn led to an invitation from the Gruter Institute, a small non-profit outside of Palo Alto, CA. The founder was a remarkable German woman who came to this country with her physician husband at the end of WWII. She had been forced into the Hitler youth movement as an adolescent, studied law during the War, and had also been influenced by the ethologists Lorenz and Tinbergen. Until her death about a decade ago, she was concerned with the nature of justice. She was convinced that from an academic perspective, law would be enlightened, perhaps enriched by an evolutionary perspective of why people behave in ways they do. At the time we met, she was starting to sponsor annual seminars for lawyers – mostly academics from law school faculties – and inviting biologists to talk with them. I was honored to participate and attended her June meetings in Squaw Valley for a number of years. Teaching these young law professors was a stimulating experience. They were bright, inquisitive, interested, and importantly, brought with them significant life experience. One outcome is that a professional society of academic lawyers grew out of this initiative. A second outcome is that I am second author on a couple of papers in law journals: one, with a judge on the biological origins of punishment; the other, a major piece in the Columbia Law Review on the multi-layered causes of behavior.

The judge and I also have an on-line debate about affirmative action. I spent an evening at his house the day the Supreme Court rendered a decision on *Grutter v. Bollinger* about the admissions process at the University of Michigan Law School. We disagreed about the decision, but I had had too much of his wine to stay on top of the argument. We subsequently decided to put our dialog together, which we did through an exchange of emails, in the course of which I went to the horse's mouth and read the Court's decision. To simplify a bit, Judge Hoffman argues that quotas are unconstitutional, and I argue that what is really going on has to do, not with quotas, but with two important educational issues: the need for educational diversity in a democracy and the search for talent where it has not been looked for previously. Our

mutual lawyer friends at Gruter say the debate is a standoff, which I think means it is interesting. For those who wish to see it, go to: *http://www.bepress.com/giwp/default/vol3/iss1/art1*

This topic has acquired fresh currency. The Supreme Court has just agreed to hear a new case on affirmative action, apparently sensing that they now have a majority to reverse their earlier decision that diverse student bodies provide a social good.



**Branching Trajectories 2: Educational Reform**

While I was serving on the Board on Biology and the Commission on Life Sciences, one of these working groups of the National Research Council invited some high school teachers to give us their views about the state of high school science. We heard a moving story of woe: how all the federal support for summer workshops for teacher training that had been put in place following Sputnik had vanished. These had been important in creating professional interactions among high school science teachers as well as exposure to new ideas. Why had they vanished? The Educational Directorship at the National Science Foundation had been abolished during the Regan administration. Why had this happened? I had an insight from another vantage point.

The only surviving entity from the post-Sputnik surge of interest in science education was a non-profit organization called the Biological Sciences Curriculum Study. I was on their Board at the time. They provided in-service summer workshops for high school science teachers. They also published a biology text in two versions with different emphases, but their market share was modest, consisting of private schools and some public schools where the selection of textbooks was a local affair and the wishes of teachers were honored. They had a publisher who gave them a free hand in writing the content. This was unique and essential for the survival of biology texts that included evolution.

In the larger commercial market, publishers felt free to omit any science they thought would reduce their sales. This was not a trivial matter, because what came out of textbooks was determined by the actions of a few large states, notably Texas, where books for the entire state were selected at the state level by politically-appointed boards and decisions about science were censored to fit conservative religious belief. Publishers went along to keep market share, and they deemed it uneconomic to publish different editions for different parts of the country. Furthermore, they felt threatened by programs fostering science that was not in their texts. The publishing industry therefore made the case with the Regan administration that federally-supported programs for teacher training and fostering books for pre-college science education were a form of unfair competition in the free market.

It took awhile for the National Research Council (which is the working arm of the National Academies of Science and Medicine and is not a branch of the federal government) to get a backer for a study of high school science, but it happened when Purnell Choppin became the first head of the Howard Hughes Medical Institute. As a former member of the Commission on Life Sciences he wished to see the study

done, he arranged for the funding, and an interest in education remains a component of the Hughes' programs.

A committee was formed for the study, and an effort was made to appoint as Chairman a university president who was also a biologist. There were only two possibilities, and Donald Kennedy was too busy. The second agreed to serve, but at the first meeting—an open meeting with many guests from whom we hoped to learn—this individual managed to irritate every public-school educator in sight and provoked such outrage that the higher-ups at the NRC decided a change in chair was necessary. By default, the role fell to me.



The challenge turned out to be intellectually rewarding. The committee was an eclectic group of teachers, teachers of teachers, school administrators, and research faculty from both education and science. We quickly decided that high school curricula could not be considered in isolation from the earlier years. In the course of our many discussions I learned much, and I developed a great deal of respect for the educational leadership that is present at all levels in our decentralized system, if we just care to look for it. I spent the best part of a summer editing the many contributions from each member of the committee, and our report, *Fulfilling the Promise: Biology Education in the Nation's Schools,* is actually readable. More important, it had some impact. It was used for a time in teacher education. Further, we broke a cardinal rule of NRC reports: they are not supposed to recommend a future role for the NRC. But I talked with Frank Press, then President of the Academy, and argued that if the Academy failed to take a leadership role in improving science education, we could lose whatever momentum the report had generated. With his acquiescence we made the recommendation, and under the leadership of his successor, Bruce Alberts, the Academy led the way in formulating a set of national science standards. The country being what it is, only one state adopted them without change and set about their implementation. All the others felt it necessary to reinvent the wheel by writing their own standards before they turned to implementation, but they had the Academy's template to guide them.

As an aside, Governor Perry of Texas has appointed a creationist to Chair the Texas Board of Education. Perry says he does not believe the scientific evidence for either global climate change or evolution. And from his public remarks, he clearly does not understand that current law prohibits teaching the religious doctrine of creationism in science classes in public schools.

There are 10 or 12, mutually supporting Federal Court decisions in play here. Let me tell you about just one, because it is prelude to another of my trajectories. In 1987 in *Edwards v Aguillard* the Supreme Court ruled 7:2 that "creation science" was religion not science. But the capacity of the judicial mind to avoid the central issue is illustrated by Justice Scalia's dissent, with Justice Rehnquist concurring:

"…my views (and the views of this Court) about creation science and evolution are (or should be) beside the point. Our task is not to judge the debate about teaching

the origins of life [*sic*], but to ascertain what the members of the Louisiana Legislature believed"

Perhaps it is a measure of scientific literacy in high places that these two Justices found the following legislative testimony compelling:

"The body of scientific evidence supporting creation science is as strong as that supporting evolution. In fact, it may be stronger...Evolution is merely a scientific theory or 'guess.'"



One wonders what decision Justice Scalia would have reached if the Louisiana Legislature had insisted that the earth is flat. Clearly, we have a long way to go, but this is prelude to the last of my enumerated trajectories.

#### Branching Trajectories 3: Teaching Science to Humanities Students

Sometime during the George H. W. Bush administration I received a letter from a friend. He included a news clipping about the President quail hunting somewhere in Texas. When the President came out of the bush with his camouflage suit and shotgun he was berated by a group of animal rights activists, who had made sure the press was there to cover the encounter. The President was perplexed and was quoted as saying "These aren't animals. These are just birds."

The accompanying letter to me said simply "You and your Yale colleagues must be gratified to see one of your graduates making his way so deftly in such a complicated world."

I had been spending a lot of time thinking about science education, and this was a reminder that there is a problem in universities—particularly a place like Yale, where, for whatever reason, a disproportionate number of our graduates come to occupy positions of considerable importance in society. We do a reasonably good job teaching basic science to students who are headed for medical school and for careers in research. But in view of the importance of science in understanding the world, we do an unsatisfactory job in reaching the lives of undergraduates majoring in the humanities and most of the social sciences.

It was about then that I decided to create a science course crafted for students who were not majoring in one of the natural sciences, a course to fulfill one of the distribution requirements. I wanted to paint with a broad brush: to make the information relate to the world the students know and to provide a perspective they could take with them and keep discovering its implications. I gave the course the same title I used for the little trade book, *The Biological Roots of Human Nature,* and I tried to build on what I had learned teaching lawyers. In time I wrote a text in collaboration with Bill Zimmerman, who was teaching at Amherst College. This topic allowed me to range widely, from DNA to how the nervous system works, and how we are products of molecular self-assembly simultaneously tuned and shaped by environmental influences in an inevitable social system, all the product of evolutionary processes. In short, some of the features of our behavior exhibited at the species level, that is, across cultures, are usefully viewed as cognitive and emotional properties of evolved brains.

I required weekly written homework assignments, not common at Yale. I met weekly with the graduate teaching assistants who ran the mandatory discussion sections. Their role was to keep the students thinking rather than memorizing and regurgitating. This course was a fascinating challenge, particularly as many undergraduates come to Yale believing they have antibodies to science and that success in science courses is achieved by memorizing a lot of facts and technical jargon. The course had more than 200 students each year for about a decade.



In this sort of effort, evidence of minor triumphs brings great pleasure. One of the homework assignments was stimulated by my interaction with the lawyers. I told the students to imagine they are home for vacation, and an uncle—who had been an English major at Yale before law school and now serves as a Federal judge—hears you are taking a biology course and asks you to explain what on earth DNA is and does. Your charge is to write an explanation that answers his question in words he will understand. In other words, don't use technical jargon. Write it as a dialog if you wish. One young woman, an English major, wrote her explanation, not as dialog, but in iambic pentameter. She was a bit timid, and she was afraid we wouldn't like it. On the contrary, we loved it. She nailed the assignment and at the same time related it to the rest of her educational world.

One year a young woman, a sophomore as I remember, met me several times during shopping period with a wringing of hands and the repeated anguish that she was "not a science person." I reminded her there would not be a single, hypercompetitive premedical student in sight, and the class was designed for the likes of her.

She enrolled in the course, and about a year later I had an email from her saying she was so glad I had encouraged her to take the class. She had discovered that she could read the Tuesday science section in the New York Times, and furthermore, enjoy it. Notes like this are a joy to receive, for they make a career in teaching both important and wonderful.

#### Shifting trajectories

In retirement I have added a couple more branches. I have written a book for children to try to share my excitement of discovery.

And although you may not think of it as intellectual, it is part of my bush of trajectories to learn how to play golf. It may be late in career, but the starting point is so low that improvement is actually quantifiable, although marred by a capacity to lose track of the ball. I may not see it when I hit it, or it goes into the woods, or my attention drifts to a bird and I forget where it landed.