

Chapter 14 **Falling Stardust**

Some strong pressure is certainly at work. ..this is a critical time for him, a lesser climacteric--a time that will settle him in that particular course he will never leave again, but will persevere in for the rest of his life. It has often seemed to me that towards this period men strike out their permanent characters; or have those characters struck into them...then some chance concatenation, or some hidden predilection (or rather inherent bias) working through, and the man is in the road he cannot leave but must go on, making it deeper and deeper (a groove, or channel)...

Stephen Maturin--

in *Master and Commander*, p. 181

--by Patrick O'Brian

At forty years of age my personality was reshaped by events almost volcanic in their eruptions. Subsequent events flowed down the channel that was formed, and, like water through a volcanic caldera, carved that groove deeper. During this 1975 eruption I was similar to Captain Jack Aubrey, Maturin's fictional colleague, also no longer young but not yet old. Much naiveté and insecurity had been dealt with, and without recognizing the urge I was seeking new identity and new scientific mission--some goal to take me beyond being the formulator of nucleosynthesis systems. Stumbling upon this channel would give me a new character and a new career as a meteoriticist. My new scientific adventurousness was reinforced by the directions of subsequent work. It may be that it can not have given me a character for which I had no hidden predilection.

I can not judge how my hasty remarriage entered among the forces in my impending transformation, but I think it may have been a factor. Near the end of summer 1970, just one year after the breakup of my marriage, I had met a beautiful young woman on Jesus Green in Cambridge. From one vantage point Annette Hildebrand was a simple German girl from the Schwarzwald (the Black Forest in southwestern Würtemberg), but from a different vantage point she was a bundle of adventurous uncontrolled emotion. She was attending an English language school in Cambridge, one among the dozens of European girls that flock to the summer language schools that are a cottage industry in Cambridge. Unknown to me because I did not proceed slowly enough to find out, she was also looking for a new exotic life away from the Black Forest. I on the other hand was looking for sexual love, looking as only one who has felt himself long starved does, giving that pursuit top priority. It was my weakness, to dive right in.

After some later romantic visits to the Schwarzwald, I invited Annette in spring 1971 to join me in Cambridge during the summer and fall of 1971. This was to be my first sabbatical leave from Rice University. Annette was enthusiastic about living together and obtained a student admission into an English school for foreigners. I had retained for a second consecutive year the townhome at 8 St. Clements Gardens, a row of eight brick terrace homes on the eastern side of Thompson's Lane, a short two blocks between St. Johns College and Park Parade on Jesus Green. A photo can be seen at <1970 Clayton residence>. It was then owned by the Bursar of Emmanuel College, who lived on the ground floor and rented out its top two floors. Except for unanticipated stress that my

hasty invitation to Annette injected into my Cambridge life, this was a charming residence for those seven months. This townhome is now out of private hands because the entire row of eight houses was purchased by Trinity Hall College as a hostel for their students. Cambridge University owns a great deal of Cambridge. The reader may sense the risks that I was taking.

Despite seven months of evidences that Annette harbors irrational thoughts and emotions, I was smitten by her loving sweetness toward me. We had become lovers at once during our meeting on the previous summer, and thereafter I found myself in that constant tension between clinging to her devotion to me, which was stronger sexually than I had experienced with Mary Lou, and silent warnings to extricate myself, not only for my benefit but also for hers. It was not a period of decisiveness in me. That story, its evidences of inappropriate behavior, its passion, its irrational reactions, do not bear retelling. Some resolution one way or another about the continuity of our love had to be made, and, as I returned to Rice University in December, I chose to follow my heart rather than my best judgment. Indeed, my best judgment was deactivated by Annette's presence. I longed for a passionate loving marriage, so I chose to believe that I would find it here, where the clinging of love was so strong. In an act of faith I believed that this young woman would bloom in her confidence in a setting of committed love, not only toward me but also toward the intellectual life that she had never had. After another winter visit to her home in the Black Forest, which was enchanting, we were married in summer 1972 before both sets of parents and her large cohort of brothers and sisters in a ceremony in the protestant church in St. Blasien, high in the Black Forest. In fall 1972 I brought her home with me to Rice University, where I had already taken up a residential appointment in an apartment in Wiess College, one of seven residential colleges on the Rice campus. The Master welcomed Annette into that position with me, so that is where we set up home.

Scientific Transformation

This huge change in my life set the stage for my scientific transfiguration, which would become more fundamental and long lasting than the reader might suppose. An inner eruption began with a radical scientific idea and festered on my indignation at the resistance of others to that idea. A new scientific persona was established by the scrimmage. The idea itself, that interstellar grains of solid material, dust grains older than the Earth, had survived the formation of our solar system 4.5 billion years ago, was not solely mine. One finds brief casual mentions of that idea; but I became its formulator and developer scientifically for the first 25 years of what would become a scientific revolution. I put scientific flesh on those bones. I presented calculations for a scientific hypothesis having specific testable consequences. Doing so differs greatly from casual mention of a possibility.

The first clues that inspired my new picture were discovered by nuclear chemists making measurements of the abundances of isotopes within meteoritic rocks. Let me explain. Meteorites are large rocks that fall to earth from the sky. But they are solid collections of smaller rocks of differing characteristics. For specific chemical elements, nuclear chemists measured the relative numbers of the distinct isotopes of that element and compared those relative abundances with those on earth. Tiny differences could be seen, but they did not dissuade the notion that all components of the meteorites had been

chemically assembled from a common pool of solar gas during the formation of our planetary system. What I laid out was a theoretical map describing specific differing types of presolar solids, remnants of astrophysical presolar history, that one might look for and what their telltale isotopic signs would be. Presolar solids were not made in our solar system but instead already existed in the interstellar gas. This bold idea was radically original.

I constructed a new theoretical description of the contents of interstellar matter. I focused especially on the idea that small solid grains would condense from hot gaseous vapor within the inner shells of expanding supernova explosions, and I emphasized the isotopic signatures that these grains would carry in the interstellar medium. Incredibly, that seemingly fanciful tale later proved true, right down to numerous details. But my early predictions were resisted, sometimes irrationally and unprofessionally, because of their revolutionary nature. I was castigated openly by a few scientists at the peak of their own scientific influence and covertly by anonymous scientific referees trying to reject the papers that I wrote advancing the new idea.

. It was the nature of that resistance that enraged me, stiffening my spine.

I was not so naive as to expect that others would simply accept my ideas. Science is seldom like that. But my blood boiled at unscientific prejudices that sought to prevent their fair hearing. Scientists are not “believers”, no matter how attractive our personal wishes might seem to us to be. Popular press often wrongly suggests that one scientist believes one thing, but another believes something different. The word belief is not appropriate. Their difference is not one of belief but rather of judgment of the relative plausibility of differing proffered explanations of the facts. Scientists are pragmatists who seek the most internally consistent explanation of known facts. But prior to establishment by facts, we seldom accept a revolutionary vision. So I did not expect acceptance of my vision-- just a scientific hearing. My foray into the world of meteoritics was, by the way, given courage by Fred Hoyle’s advice to me that he found it best to change his scientific focus every ten years or so. My time had come.

The concept of this revolution interested scientists every where, because it lay in the natural history of matter, in much the same sense that cosmology, geology, evolutionary biology and anthropology busy themselves with natural history of matter and with the scientific knowing of it. The historic origin of the atoms themselves had always been my focus. What I introduced in 1974 was different--the description of solid presolar chunks of matter--atoms bound together chemically into structures like tiny rocks, or perhaps I should say “gems”. Today we hold them in our hands, in laboratories on Earth, gemlike solids that existed before there was an Earth. Today we study objects that predate our entire solar system--grains of sand prior to any terrestrial beach. But at that time presolar, solid grains were unknown. Finding them has been revolutionary because it had long been thought to be impossible—to physically hold an object older than the earth. Although astronomers had long studied, albeit at great distances and with telescopes, objects that are believed to predate the sun and Earth, those astronomical objects can not be handled, are not amenable to laboratory measurements of properties and structure. All solids on Earth and all planetary bodies and solids within them were believed to have been assembled in the early events of the formation of our solar system, or in some cases even by later processes occurring on the planets. But the time of formation of Earth, planets and sun, that time when our solar system first graced the

heavens, was regarded a veil through which we could not see. Just as the writer of Genesis could declare, "In the beginning, God created the heavens and the earth", scientists could believe, on apparently good grounds, that every solid object that we can handle was also created at or after solar birth.

I was declaring that it is not so. The veil was pierced in the mid 1970s. And the piercing of it, with the associated expansion of natural philosophy and of astronomical and geophysical sciences that accompanied this revolution, so engaged me with struggle, struggle with facts and with strong conflicting personalities, that my new persona was inexorably forged. And it was at just this point that Stephen Maturin's words could also be applied to my transfiguration from steady worker and thinker to young Turk and eventually to sage, from nuclear empiricist to radical thinker, thence to scholar and finally, perhaps, to prophet. My character accreted new characteristics. If this sounds strange, indeed it is. But the strangeness lay not so much in me as in an essentially human process. I began to think outside the box. But instead of robbing me of my humanity, the accretion of reactionary characteristics was, I believe, accompanied by increased humanity within me.