The Teacher and Mentor I Almost Had

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This book is full of reminiscences from the myriad students, disciples, and collaborators Manuel Cardona had through his long career. Unfortunately, I cannot count myself among them. I never did any scientific work for or with him—although, I came close to it, twice. Both times I chose someone else over him, and yet he later paid me back by recommending to me two of his best students, by promoting my scientific work, and, most important, with his lifelong friendship. This is how Manuel Cardona was.

In early 1978, as I was close to completing my Ph.D. and started looking at the next professional step, I wrote Cardona ("Manuel," for me, would come much later) to explore whether it would be possible to work in his group as a postdoc. I knew the name since my earlier days as a Research Assistant at Universidad Autonoma de Madrid (UAM), back in 1972–74, where he was regarded as the Spanish luminary in Solid State Physics who was still abroad. The other star, Nicolas Cabrera, had returned from America a few years earlier to lead the Physics Division in the newly created UAM. Cardona's response to my letter was cautiously positive, suggesting that we meet at the forthcoming March Meeting of the American Physical Society in Washington D.C.

It was there that I first saw him "in action," fully engaged in the Meeting's sessions, asking the deepest questions in all kinds of topics. I was most impressed by him, and I said to myself, I want to learn from him, but will he want to teach me? Our meeting went well, and he invited me to give a seminar in Stuttgart in the summer, taking advantage of a trip I had planned to participate in the International Conference of Semiconductors in Edinburgh. I started taking German classes, and by October I got Cardona's formal offer.

On my return from Europe, I had received a letter from the IBM Research Division in Yorktown Heights, inviting me to interview for a postdoctoral position. By November I was facing the dilemma of choosing between Manuel Cardona in Stuttgart and Leo Esaki in New York, not exactly an easy decision. At the end, I chose IBM's postdoc's offer, and Cardona, who knew the place well, understood and did not take it personally.

The story repeated itself 2 years later, as I now was looking for a job with longer stability. Again I approached Cardona; again he offered me a position, this time for 3–5 years; and once more I declined at the last minute in favor of IBM, perhaps

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because I preferred the comfort of the known—an institution, a country, a language—to the excitement, but also the uncertainty, of the unknown. To my surprise, Cardona, by then one of the most prolific and best-known solid-state-physicists in the world, did not take my second no as a personal affront. On the contrary, he encouraged me to pursue a career at IBM Research.

My first assignment at Yorktown Heights, back in 1979, was to study the optical properties of semiconductor superlattices, a materials concept pioneered by Esaki, Raphael Tsu, and Leroy Chang. My first paper on the subject was on an *Electroreflectance Study of Semiconductor Superlattices*. Ironically, Cardona was one of the leading experts in that technique, and I learned it by reading his papers on the subject from more than a decade earlier, and collaborating with Fred Pollack, one of Cardona's junior associates at Brown.

I later exploited electric fields in other ways to control the electronic properties of semiconductor quantum wells and superlattices, which must have got Cardona's attention, as not long after he suggested my name to one of his brightest students, Luis Viña, who was looking for a postdoctoral stay in the US. I learned of Viña's interest and immediately accepted him; since I had lost my chance to work with the master, I did not want to pass the opportunity to work with his disciple. It was through Luis that Cardona and I co-authored an article on *Resonant Raman Scattering in GaAs-GaAlAs Quantum Wells in an Electric Field*, which combined the experimental techniques he had developed with the materials I was deeply involved with. A few years later, another very smart student of Cardona's, Antigoni Alexandrou, showed interest in my group at IBM. For the second time, I quickly said yes, and had another opportunity of witnessing Cardona's indelible imprint on those he had trained.

By then, Cardona was already Manuel. We were serving in an advisory committee for the Materials Science Institutes of Spain's National Research Council that every year traveled to one of the five Institutes across Spain for a friendly review of the centers. Manuel was the president of the committee and I one of its junior members. Like years before in Washington DC, I again saw him in command, asking penetrating questions, offering plenty of advice, and even reorganizing the meeting's agenda as to spend less time at meals and more on technical discussions.

We served together in that committee for a decade, eventually he offering me to take his place as its president. His generosity toward me did not end with that magnanimous gesture. He continued to promote my name whenever the occasion arose, and his words and actions were crucial in my receiving scientific recognition.

We became and remained friends, the geographical distance, the age difference and his intellectual towering stature notwithstanding. We went out to dinner several times, and once to the theater, to a New York revival of *Death of a Salesman*, with Brian Dennehy in the leading role. Dennehy, Manuel noted, reminded him of John Quinn, his former colleague at Brown. In those occasions, we spoke about many

things: Cardona's culture was as vast as his interests; his opinions, strong but always reasoned; his conversation, fast and illuminating. But, somewhat surprisingly, we seldom discussed physics, perhaps because I never made it into his inner scientific circle. I can only wonder how much I would have learned from him had I been part of it.