Discurso de investidura como Doctor "Honoris Causa" del Excmo. Sr. D. Fred Wudl

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Excelentísimo y Magnifico Señor Rector, Claustro Universitario, Damas y Caballeros y amigos.

Your excellence the rector, the administration of the Universidad Complutense de Madrid, honorees, Faculty, ladies and gentlemen and friends.

I am grateful, indeed to the Universidad Complutense and its administrating authorities for their kindness in bestowing the Degree Honoris Causa on me.

Before I proceed and in response to the Laudatio by Professor Martín León, I quote the IX century inventor Alexander Graham Bell:

> "Great discoveries and improvements invariably involve the cooperation of many minds. I may be given credit for having blazed the trail but when I look at the subsequent developments I feel the credit is due to others rather than to myself."

A consequence of the nature of my field of endeavor, the research on organic metals and superconductors, was the development of interdisciplinary interactions that eventually extended to international collaborations. This was at a time when interdisciplinary research was essentially unknown; certainly in organic chemistry. It was the international interactions that landed Professor Nazario Martín León in our laboratory and ultimately to my humble participation in this ceremony. Over the years we have been privileged with receiving young researchers from various parts of Spain, the rest of Europe, South America, the Middle East and the Far East. I strongly believe that the future of research in the physical sciences is the closely-nit "globalization" of endeavors.

If in the course of performing scientific research one is blessed by Mother Nature with one discovery, one should consider oneself lucky. On occasion she bestows her grace on an individual more than once, a situation that most of us would consider to be extremely fortunate. I was handed not one nor two but at least **THREE** such "breaks". But before we discuss these, let us visit another item mentioned by Professor Martín León regarding important accidents of history influencing a career:

First and foremost I must mention, not as an evil event but as a fortunate one, the German invasion of Austria, which led to the escape of my Jewish parents from

Vienna, the “center of culture of the western world” to a tiny village in the Bolivian Andes called Cochabamba. Though at the time of its founding it was named la Villa de Oropeza; Cochabamba, a Spanish transliteration of the Quechua, Jocha Pampa, (meaning mud flats), is the name that stuck. Indeed it is a deep, flat valley (2,700 meters above sea level), where at the time of my youth, the remnant of the jocha was a muddy lagoon, the laguna Alalay, now nonexistent. So my parents went from essentially the city of enlightenment to the village of mud. However, as I remember it, the life and climate in Cochabamba were essentially those that I expected of the Garden of Eden. Cochabamba was considered “el granero de Bolivia”. So I could not have grown up in a more auspicious, beautiful place. A a significant benefit of this accident was that it resulted in my becoming, eventually, trilingual since our father insisted in maintaining all of us fluent in German. I will mention more later about the effects of growing up in Cochabamba.

Second and certainly not least, in the scientific formative years at UCLA, I had the biggest blessing of all, the occasion to meet my life partner, my love, my wife Linda Marie Raimondo. There are no words to describe the enormous sacrifice she made in staying married to a crazy, completely selfishly committed scientist.

The first blessing from Mother Nature is related Growing up in a very small community forced people to become incredibly resourceful and very open in exchange of ideas, it was a place where one needed to be inventive. I was exposed to electricity and magnetism at a very early age and was fascinated by these phenomena for the rest of my life. I made my first electric motor when I was approximately 11 years old and thought I had invented a reciprocating electric “engine” at that time; to discover, not much later, that it had already been done. So when I became an organic chemist and Linda and I were students we used to eat lunch together on one of several expansive lawns or the beautiful botanical garden at UCLA. At that point (this must have been approximately 1966) I pronounced that whoever solved the oncoming energy crisis would have the world at their fingertips and that I, as an organic chemist, was going to make the first all-organic electrochemical cell, an organic battery. Linda, much more recently, reminded me that on our first date I drew an organic polymer with electrons flowing unidirectionally (and reversibly) along its backbone (what a geek!). Thinking back, that was very naive and arrogant, indeed! Nonetheless, a few years later, though the molecule expressly designed for that purpose was NOT used to make an organic battery, it became the progenitor of the first organic metal, the organic superconductors and eventually the field currently known as Organic Electronics. The point here is that the serendipitous discovery of the high electrical conductivity of a salt derived from TTF ($TTF^{+}Cl^{-}$) took the whole project in a different direction and a new and very fertile area of research in chemistry and physics.

A second gift from Mother Nature was serendipity associated with fullerene research. A nagging, recurring problem with organic metals based on TTF was that they became insulating at a certain temperature below room temperature. This was

due to the fact that the molecule is planar. A spherical molecule would have been much more desirable. Mother Nature provided it to Kraetschmer and Huffman in the form of buckminsterfullerene C_{60}. We were able to develop all the rules that governed its chemical reactivity. Serendipity once again became important. In an attempt to produce an organic metal based on fullerene C_{60}, it was mixed with a molecule called TDAE. Instead of producing a material with metallic conductivity, it resulted in the first strictly organic semiconducting magnet. In the process of developing the chemistry of buckminsterfullerene we, in collaboration with biologists at UC San Francisco, found its first biological application in the form of an inhibitor of the HIV protease. With other important international visitors; namely (now) Professors Jan-Kees Hummelen (Groningen, Holland) and N. Serdar Sriciftci (Linz, Austria), we were instrumental in the design of the first plastic solar cells.
This blessing #2 was a double gift because at that time we had the most dedicated, most efficient and most motivated research group that included, in addition to others, Prof. Nazario Martín León, Dr. Rosario Gonzalez, Dr. Angela Sastre and Dr, José Segura from Spain.

The third present we received was also an “indirect” discovery. About eight years ago we proposed to prepare a synthetic material that was going to be as hard as diamond. Six years later (about a two years ago), though we had yet to prepare such a material, the principle on which the proposal was based lent itself naturally to the development of self-mending plastics. These are materials that when cracked, the crack can be healed completely by slight warming. Our report on self-mending has generated a new field in modern plastics that is truly in its infancy. Scientists have been inspired to develop this idea in more practical fields such as organic electronics and the automotive industry.

In summary, I have spent nearly forty years doing what I love to do and working with gifted scientists. I was fortunate to have been instrumental in initiating at least three major areas of materials science with TTF, buckminsterfullerene derivatives, and self-mending polymers.

I hope I have convinced you that serendipity and international collaboration play a very important role in scientific research; if not in all laboratories, certainly in our laboratory.

Finally, the culmination of all the help from nature, my friends and a bit of hard work is today’s honorary degree that is very close to my heart.

Thank you very much.