

Following the Light: Opening Doors to Science in Tunisia

Zohra Ben Lakhdar



When I was young, everyone around me said that science was a field for men to pursue and that it was too difficult for women. They said there was a fundamental intellectual difference between men and women, and between girls and boys. The assumed role of women in society was to take care of the family. I did not accept these notions. I liked mathematics and all of the sciences, especially physics. It became my goal to show, through my own example, that I could do science as well as men could.

I attended primary school in the 1950s in the cities of Mahdia and Jemmal, where the highest level of education available to girls resulted in a "certificat d'études primaires." This is like a high school diploma, except that it marks the completion of primary school only. I know of no other girl, besides myself, who was in school with me at the time who even received that "diploma." There were few girls in the primary school I attended—less than about 25 in the first year—and only 6 of us made it all the way through to complete our education.

Nobody even thought about going to secondary school, which required traveling 25 kilometers to the nearest big city, Sousse. With no buses or cars around, this was a very long and difficult trip. Most girls went just to primary school for a few years, and then got married, usually at around the age of 15 years.

Marriage was by far our primary concern. That was what society expected of us. Our lives couldn't have been farther removed from science and technology. And that was true not only for girls. There were no Tunisian engineers, professors, or doctors in the country at all during that period. All of these professionals were French. One early source of inspiration for me was the importance my parents placed on the value of education. But even my father used to assume that his boys were the ones who could succeed in technical areas. He wanted his sons to be engineers. "Power is with science, and with people who are good in mathematics," he told them. Boys had power and opportunity by nature. I could see that women would have to earn their place in a man's world. This only fueled my

desire to achieve the same scientific education and status as men and to open ways for other women to do the same.

There were good reasons to work toward this goal. As a child, I was dazzled by the power of science. I witnessed amazing feats, some of which took place in my own home. A French surgeon had saved my mother's life by performing open-heart surgery on her. The contraceptive pill was providing women with the power to decide when to have children and take on the rigors of raising a family. Men alone would no longer be the only ones with those powers. I witnessed the establishment of the industrial production of chicken: food for everyone! "Yahya el Elm," said my mother each time I tried to explain these things to her. That's essentially a tribute that means, "science be praised."

In 1956, when Tunisia gained its independence from France, women were granted equal rights with men under the law, and education became a primary issue in governmental politics. My family moved to Tunis, the nation's capital, a city now with a population of more than 3 million. There, I succeeded in entering secondary school. I spent 6 years in the best school for French and Arabic studies for women. I earned my baccalaureate (first part) with the best

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Series editor,
Ivan Amato

Zohra Ben Lakhdar Tunisia



It has been almost 30 years since Zohra Ben Lakhdar received her appointment as a professor of physics at Tunis El Manar University in Tunisia. Now director of the Department of Physics' Laboratory of Atomic-Molecular Spectroscopy and Applications, she does both theoretical studies of the spectral properties of matter and applied research and development in several areas, including optics-based pollution monitoring. From her primary-school days onward, Lakhdar has had to battle political, social, and cultural obstacles as she muscled forward toward her lifelong goal of becoming an active and productive member of the global scientific community. After earning her Ph.D. in atomic spectroscopy from the University of Paris VI in 1978, she turned down offers to work in relatively luxurious conditions overseas and instead returned to Tunis University, where she has remained ever since. She has authored numerous papers and textbook chapters, advised and mentored many students, and was a founding member of the Tunisian Optical Society. In 1994, she was elected to the Islamic Academy of Sciences and since 2001 has been an associate member of the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy. She also has organized and/or chaired international conferences and workshops in laser physics and related fields. Earlier this year, she was honored by being named a winner of the 2005 L'OREAL-UNESCO Award for Women In Science.

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results at the national level. Unfortunately, though, this school had little to offer in the sciences. If I was going to become a scientist, I would have to take extraordinary steps.

Joining the Boy's Club

One important step that I took was to prepare for my baccalaureate (second part) in mathematics at Sadiki College, the best men's school in Tunis and one that was known particularly for its strengths in physics and mathematics. Nobody advised me to go there, though many were quick to tell me it would be too difficult for a woman. Yet, because of my strong academic record and because women now had equal rights with men under the law, girls also could gain access to Sadiki. Even so, other than myself, only one other woman attended the school. My parents were proud of my grades, which were very good, and I earned my degree in mathematics in 1963.

This was a degree that opened doors for me. With it, I could enroll in the Tunis University faculty of medicine, which had just been established, or in the faculty of sciences, which then was just 3

years old—the same age as the almost new university itself. I enrolled in the faculty of sciences and, because I had done well in mathematics, was awarded a grant from the government to pay for my courses. But I preferred physics, and I did my best to convince the government to let me use the grant to study physics. Of course, both fields are closely connected with one another.

This was a good time to be in higher education in Tunisia. To encourage students, the government offered each one a fellowship. This emphasis on education was still so new in the 1960s, however, that there weren't yet many students at the university level, particularly in physics or mathematics courses. Other than the two Tunisian staff members with Ph.D.'s, all of the professors were French. The country was proud of its first university students, especially of its science students. In 1963, there were only about 200 students in the science faculty, and only five of us were women.

Most of the students planned on becoming secondary school teachers. This was crucial for the country, as one of its goals was to build a self-sustaining educational system that, in time, could produce scientists and engineers. When it came time for me to graduate, how-

ever, I wanted to continue my scientific training. As it turned out, an opportunity arose for me to do so.

At the end of each academic year, in June, a professor came from France to supervise exams and to validate our diplomas. Each year, the Tunisian government awarded fellowships to the best three to five students to continue their studies at universities in France. In some cases, top students could use their fellowship to pursue basic research in France.

In 1967, I was selected by the university for the opportunity to go to France to study for a Diploma of Further Studies (*Diplôme d'études approfondies*, DEA). That year, the professor who came from France to validate our



Pollution patrol. The author uses laser-induced fluorescence analysis to detect pollutants in plant tissue.

diplomas happened to be from the Université Pierre et Marie Curie, Jussieu (Paris VI), where he was a director of the Atomic Spectroscopy Laboratory (LSA), which was part of the physics department's Laboratory of Research (DRP). As it turns out, when I went to Paris, I ended up studying atomic spectroscopy at the LSA. I was close to the Sorbonne, the Collège de France, and the Ecole Normale Supérieure! For me, it was another world. I was in the world of atoms—the building blocks of matter—and of stars, and of cells! I was in a world of scientists! It was a world I hoped more Tunisian girls would now think was within their reach.

Each Tuesday, I went to the Collège de France and sat in on the quantum mechanics courses taught by Claude Cohen-Tannoudji. He led us into the atomic world step by step. He helped me to develop a deep love for the physics of atoms and to appreciate the simple beauty of this realm. Through him, I was exposed to the research of the Kastler-Brossel Laboratory where Alfred Kastler did much of the work on the interactions of light and atoms that led to the development of the laser and for which he earned the Nobel Prize in 1966. It was exciting to be so close to such momentous places and events in science.

At the same time, I was struck by a curious irony surrounding the technological feats of the era. For example, during the Apollo 11 mission in 1969, the entire world watched on television screens as Neil Armstrong became the first person to walk on the moon. Yet no one had ever photographed an atom. An image of an atom, free and in a stationary position, would be in hand only 20 years later. I found it amazing that exploring the world of atoms was in some ways more difficult than setting foot on the moon!

By 1971, I had earned my next degree. My thesis work focused on using spectroscopy and spectral analysis to deduce the potential of different atoms to interact with one another. All of my subsequent scientific work has emerged from this training. I am fascinated by what makes different substances take on different shapes and how substances undergo phase transformations.

I brought these experiences and my expanded knowledge back to Tunisia where I became only the second Tunisian woman to work as an assistant on the staff of the science faculty. I spent 3 years in this position, but I was unable to conduct my own research. For that, I needed a doctorate. So I returned to France, to the University of Paris VI. Following a 4-year period of study, during which I finally earned my "Doctorat d'Etat," my then-new husband, also a doctor of physics, and I both received offers to stay in France and build our careers there. That was tempting for both of us, but we chose to return to Tunisia to help plant scientific seeds, where we knew there were too few.

In 1978, I again found myself on the staff of the science faculty at Tunis University. This time, I joined as a professor of physics. I began working toward having my own research laboratory, so that I could offer my students the same opportunities that I had in France. It marked a new phase of my career.

It was a very big step for me, but each subsequent step—getting computers, software, and additional training, for example—has posed new challenges. It took 10 years for me to publish my first paper. Now my work includes theoretical studies of optical phenomena related to atoms and molecules, as well as the detection of air pollutants, using the technique known as tunable diode laser absorption spectroscopy (TDLAS); of water pollutants, using laser-induced breakdown spectroscopy (LIBS); and of pollutants in plant tissues, using laser-induced fluorescence (LIF).

Lighting the Way

Even as I had been taking these steps to show that women in Tunisia could become scientists if they wanted to, the mind-set of

the population was hardly changing. For most people, even those highly placed in society, scientific expertise was something that belonged to Western countries. As a result, there was no scientific environment, no ambition, no motivation, and no political backing for research. Most women at the time considered it their main role to have a family and to raise children. Thinking about going abroad for research training or for postdoctoral work, ambitions that I had become accustomed to considering, were utterly foreign notions for most.

Of course, I had to work within certain constraints. Because we have not had many facilities or expensive instruments in Tunisia, for example, much of my scientific work has focused on theoretical studies of molecular interactions. Among the specific areas I have investigated are how laser-like effects and other optical phenomena could manifest in the rarified matter found in various environments in space. I have been particularly interested in atomic states, molecules, and other forms of matter that cannot be replicated in the laboratory. Only by calculating the spectrum emitted by such entities is it possible to fully analyze the light that comes into our telescopes and spectrometers.

Even though I have been drawn to many arcane subjects in physics, including atomic spectroscopy, I have developed an interest in applying science in practical ways. I have seen how climate and lack of resources can thwart the aspiration of millions and make life very difficult. One project I worked on in recent years was the development of TDLAS methods for measuring trace pollutant gases in the atmosphere, including the methane that Tunisian industries emit.

In time, my dream is to develop technologies that would make it possible to convert deserts into arable land, transform sea water into potable water, reduce the ever more oppressive heat in our countries, and find ways to increase the amount of rain in dry areas. I also have a few more mundane visions. I would like to be able to explain why straight hair becomes curly with humidity, to find the molecular mechanism underlying that transformation, and to develop a product that can transform curly hair into straight hair. Even though so many women and girls throughout Africa have

curly hair, many of them want straight hair, and they often spend a lot of time and money on this pursuit. Perhaps the most important thing I can do, however, is help to make it easier for those in my country and in other African nations to join the scientific community.

Along these lines, one of my dreams is to establish in Tunisia an international scientific center of optics and photonics (and physics education) where African researchers could easily come to study and train. My inspiration for this goal derives from the Nobel

possible for some of them to choose a career over marriage and motherhood. When I was a girl, my friends were getting married as teenagers. Now the average age of marriage for a woman is 27. Indeed, in Tunisia, both women and men now contribute equally to the development of the economy and society. As in more developed countries, these gains for women have come at a cost. Even as women have been making careers for the first time, they still bear most of the responsibility for attending to their family and raising their children.

My advice to young women scientists in my country is to persevere, to love work and to love to do good work, to be independent, to respect others but not submit to those who would stop you from achieving your goals, to be scientifically honest, and to embrace your ambitions, all the while respecting culture, responsibility to your family, and allegiance to your country.



Science huddle. Surrounded by colleagues, Zohra Ben Lakhdar analyzes water for pollutants using a technique called laser-induced breakdown spectroscopy.

Laureate Abdus Salam, whom I greatly admire. In 1964, he created the International Centre for Theoretical Physics (ICTP) in Trieste, Italy, where researchers from developing countries can spend a few months, all expenses paid, working in a stimulating environment, taking courses on subjects of their choosing, meeting other scientists from around the world, and enjoying the luxury of a rich library. I have been an associate member of ICTP since 2001.

Since the days when I was one of the only girls and women in Tunisia with scientific aspirations, the number of women involved in the sciences has been increasing, particularly in the biological sciences. Part of the reason for this is that women have become more independent, making it

There is still a long way to go before science becomes an integral part of Tunisian society. Most women do not directly appreciate the importance of, say, physics, in the caring of the family, which remains the concern of every woman. That's why most women prefer to choose a job where the holidays are the same as they are for schoolchildren. Rather than taking jobs to further their careers, per se, women take them out of economic necessity to support their families. Moreover, their own careers usually are still less important to them than are the careers of their husbands. Even for those Tunisian women who do earn a place among professional scientists, they often stop their research after obtaining a Ph.D. so that they can care for their children and family, while the men in the family continue on their career paths.

My advice to young women scientists in my country is to persevere, to love work and to love to do good work, to be independent, to respect others but not submit to those who would stop you from achieving your goals, to be scientifically honest, and to embrace your ambitions, all the while respecting culture, responsibility to your family, and allegiance to your country. Knowledge and know-how are the way of liberty and equality. Neither gender, nor religion, nor age will stand as a barrier to research in science. Yahya el Elm.

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