2011 PRIESTLEY MEDAL
ACS honors Ahmed H. Zewail P.12
I am honored and gratified to receive the Priestley Medal. This highest honor of the American Chemical Society comes from a society I have been associated with for decades and with which I continue to have strong relations, not only as a member and fellow, but also with its institutions, the board of directors, the society journals, and the superdynamic Executive Director & CEO Madeleine Jacobs. Recently, Madeleine asked me to preside over the 44th International Chemistry Olympiad, and as many of you know, when Madeleine calls you with her typical affection and enthusiasm, you simply cannot say no!

When ACS was established in 1876, its founders were luckily unaware of, or perhaps chose to ignore, the words of the sage Thomas Jefferson, who in 1809 wrote in a letter to his nephew, “If you are obliged to neglect any thing, let it be your chemistry. It is the least useful and the least amusing to a country gentleman of all the ordinary branches of science.” Jefferson went on to promote the virtues of farming over chemistry! Fortunately, many people have not shared Jefferson’s preference for farming, including a certain graduate of the Oregon Agricultural College by the name of Linus Pauling. Linus famously said, “Chemistry is wonderful! I feel sorry for people who don’t know anything about chemistry. They are missing an important part of life, an important source of happiness, satisfying one’s intellectual curiosity.” Pauling received the Priestley Medal at the age of 83, so make sure to live long!

For all awards, I believe the personal satisfaction one feels in receiving them comes from the recognition by one’s peers and from the history of the award itself. The medal I am receiving carries the name of Joseph Priestley, a great figure of the 18th century who achieved scientific immortality for his discovery of oxygen. As important, Joseph Priestley was also a minister who fought for educational reform and personal liberty at a difficult time when Europe was infected by religious fanaticism. In 1794, he emigrated from England to America, where he became a friend of Jefferson, who sought his advice on plans for founding the University of Virginia. Priestley’s move to America is telling of the great opportunity this country has offered to immigrants, including myself.

Following the ACS announcement early last year, I received a large number of congratulatory notes from friends and colleagues around the world, but the scientific contributions cited for the award would not have been made without the dedication of a large number of research scientists, postdoctoral fellows, graduate students, administrators, and staff. To all of them, I am grateful.

I would also like to take this opportunity to salute my colleagues who are being hono-
MAKING DREAMS. At the age of 16, I was among the millions around the world who were astounded by a dream in the making. On Sept. 12, 1962, at Rice Stadium, President John F. Kennedy said, “We choose to go to the moon. We choose to go to the moon and we intend to win.” These historic wordschanged the course of space exploration and much else as well. In a thousand years from now, American civilization will be admired for, in addition to its founding Constitution, the 1969 landing on the moon and the beginning of space exploration, just as we still pay tribute to ancient Athenian democracy and marvel at the pyramids of Giza.

President Kennedy was in the right place and the right time to set forth this audacious vision for a nation. Similarly, for individuals, dreams are defined by one’s vision, from intuition or insight, and by the place and time where one lives.

In my case, my parents must have anticipated my thirst for knowledge and decided that chemistry, as a science, had its roots in ancient Egypt. Some historians believe that the word “alchemy,” from which “chemistry” is derived, is a corruption of the word khemia, which literally means “the black land,” an ancient name for the land along the banks of the Nile, where the flooding river would transform the color of the soil during inundation.

EVOLUTION OF DREAMS. My first dream at the age of 15 was physically dynamic. I was curious about how a solid—wood—produces a gas that can be lit with a match. To investigate, I built a glassware apparatus in my bedroom and carried out an experiment to observe the burning of wood. My apparatus collected the resulting gas, which I duly lit with a match. This activity, of course, made my mother very unhappy. But I did not worry about such details because I was driven by the curiosity of a schoolboy’s mind. I was not thinking of Michael Faraday’s search for the origin of combustion in his famous lecture, “Chemical History of a Candle.” Neither was I aware of Lavoisier’s use of a “burning glass” on various substances or even Priestley’s discovery of oxygen, although I knew that oxygen existed.

I was merely following my intuition, which led me along the simple path of discovery: I must have been intrigued by a natural phenomenon, “light from combustion,” and then asked a simple question, “Why?” and designed a direct experiment. I recall explaining the results to my fellow pupils, and I think I convinced many of them to see the beauty of simplicity in a scientific inquiry. Beautiful experiments and observations often appear “trivial” in retrospect, but their findings are usually of a fundamental nature.

Such beliefs have been with me all along and so has my curiosity about “changes of matter,” or in today’s language, “the dynamics of matter’s transformation,” perhaps because of what I learned early on—on a birth in a town flanked by two cities of knowledge, Alexandria and Rosetta. Alexandria, where I went to college, is a place steeped in history with its ancient library and as the intellectual home of great scientists, such as Euclid, Archimedes, and Hypatia. Rosetta is where the famous stone was discovered, with its three engraved scripts: ancient hieroglyphs, Demotic, and ancient Greek. Despite these auspicious surroundings and the commendable education I received in Egypt, my dreams were modest.

“ALMOND BLOSSOM” What do this painting by Vincent van Gogh and the nature of scientific discovery have in common? To me, the beauty of the big picture and the unpredictability of its details.

Chemistry can and should remain a fundamental science, providing new tools and defining new concepts, but with its lens focused on significant questions in emerging areas of complexity, from nanoscience to physical biology.
cilities of Lawrence Berkeley National Laboratory. While at UC Berkeley, I received an offer from California Institute of Technology. Soon, as a faculty member at Caltech, I found I was once again in the right place at the right time. The legacy of Pauling was all around, with research focused on the structure of molecules both at Caltech and elsewhere. I was in a unique position to begin research on dynamics of molecules. At the time, the concept of coherence in chemistry was foreign, and some renowned chemists, including three Nobel Laureates, did not appreciate its significance and did not see much value in it. But Caltech gave me the opportunity to be intellectually independent with plenty of room to pursue my goals. I worked with an exceptional research group, and in 1987 we published the first paper on femtochemistry, reporting on the probing, and potentially the controlling, of the coherent motion of atoms in reactions and during their ephemeral transition states. Some scientists were concerned about issues such as the uncertainty principle and the general applicability of the approach, but I have seen that after 1999 they became convinced!

In this regard, I must mention my dear friend and great supporter, the late Richard Bernstein. Dick’s unqualified enthusiasm for the development of femtochemistry, the mentoring days we spent together at Caltech when he was on sabbatical there as a Sherman Fairchild Distinguished Scholar, and the joint papers we wrote, including a Chemical & Engineering News feature article, are experiences that I treasure. Dick predicted femtochemistry would be recognized by the Nobel Prize, but sadly he died without witnessing his prophecy come true.

The Nobel Prize is a great honor, but it comes with one expectation—stop science and become an expert (or at least a pundit) on everything from the stock market to the future of humanity. People found it hard to take my desire to continue research seriously.

I had a bigger dream than femtochemistry, namely, to be able to visualize matter’s transformations, not only in time but also in space—to chart the movements of atoms in all four dimensions. Over the past 10 years at Caltech, we were able to develop 4-D electron microscopy to do just that. We now use ultrashort packets of electrons to probe systems with subnanometer spatial resolution and femtosecond time resolution. As well as opening up these extraordinary space-time dimensions to basic research, this realization of our big dream has myriad potential applications in chemical, biological, and materials sciences. None of this would have been possible without being in the right place, Caltech, at the right time, with the funding from the Gordon & Betty Moore Foundation.

In this more recent endeavor, another dear friend, Sir John Meurig Thomas of Cambridge University, became an enthusiastic supporter of the new development. He appreciated early on, when some skepticism arose, the significance of 4-D real space and diffraction imaging. John is a world expert on 2-D and 3-D electron microscopy, and together in Pasadena we wrote a monograph, published two years ago, entitled “4D Electron Microscopy: Imaging in Space and Time” (Imperial College Press, 2009). Over the years, I have enjoyed his poetic perspectives on science and scientists.

**CHEMISTRY DREAMS.** So far, I have spoken about dreams in areas of particular interest to me—but what about the discipline of chemistry at large? Some in the profession think that chemistry in the 21st century is now at “the end,” perhaps only useful in service to other fields. Even more broadly, some writers of popular books have claimed the end of science! These views are shortsighted, to say the least. I believe that the opportunities for basic research in chemistry this century are more exciting than ever, provided that we do not restrict our vision to orthodox boundaries.

Breakthroughs will continue to emerge when we understand how and why systems of thousands of atoms in molecules, materials, and cells function coherently and as if with a directed purpose. In the end, we may or may not find that the whole is greater than the sum of its parts and learn how complex systems in nature produce unique behaviors describable by classical mechanics even though they are made from the probabilistic quantum world of atoms and molecules. If we resolve these profound mysteries, it will affect numerous areas of materials and life sciences, and even physics.

From my perspective, chemistry will become merely a service to other fields only if we lose sight of its primary objective. Our field can and should remain a fundamental science, providing new tools and defining new concepts, but with its lens focused on significant questions in emerging areas of complexity, from nanoscience to physical biology. The cause is helped if more champions articulate the beauty of chemistry’s fundamentals and the big picture of its mission, globally and in the U.S. We should look ahead, unswayed by pressures of fads or funding, and be driven by our own curiosity.

**CURIOSITY-DRIVEN DREAMS.** As brilliantly conveyed by Lewis Carroll in “Alice’s Adventures in Wonderland,” curiosity is the key to explorations that go beyond the “known unknowns” to delve into the “unknown unknowns.” Recently when I was on an official visit to Southeast Asia, a prime minister asked me, “What does it take to get a Nobel Prize?” I answered im-
mediately: “Invest in basic research and recruit the best minds.” This curiosity-driven approach seems increasingly old-fashioned and underappreciated in our modern age of science. Some believe more can be achieved through tightly managed research—as if discoveries are predictable. This attitude is an unfortunate misconception that affects and infects research funding.

There are countless examples of valuable breakthroughs that came from research driven by the curiosity of individuals. Perhaps the best example comes from the work done to develop the maser and the laser by Charlie Townes and colleagues. Last summer in Paris at a celebration of the 50th anniversary of the laser’s invention, Townes reminded us that he was driven at the start only by an intellectual curiosity about the microwave spectroscopy of molecules, which later led to the invention of the ammonia maser. In this odyssey, fundamental issues had to be addressed: how to enhance Einstein’s stimulated emission over absorption, how to sustain the gain, and how to “beat” the uncertainty principle and achieve monochromaticity through coherence. The laser was called “a tool in search of a problem.” No one imagined the technological impact it has today, from eye surgery to the information technology revolution.

As I mentioned at the Paris celebration, in my own career it was curiosity about questions pertinent to coherence and the uncertainty principle that brought about my group’s contributions first to femtosecond science and now 4-D electron microscopy. I doubt if the first grant proposal I wrote about coherence in dynamics, which had no immediate relevance to anything with so-called broader impact, would be funded today.

Quantum mechanics, relativity, the expanding universe, and the deciphering of the genetic code are all part of a larger pattern that I would like to call physics as the science of curiosity. This is physics as curiosity-driven science and technology has paid off for America, not only with wealth and overt power, but also with soft power, the power that sways hearts and minds. It would be wise and timely to make use of this soft power in global affairs. In today’s world, America’s soft power is commonly thought to reside in the popularity of Hollywood movies, Coca-Cola, McDonald’s, and Starbucks, but studies tell a different story. In a recent Pew Research Center poll involving 43 countries, 79% of respondents said that what they most admire about the U.S. is its leadership in science and technology. The much-praised American entertainment industry came in a distant second.

U.S. SOFT POWER
Respondents to a recent poll by Pew Research Center involving 43 countries overwhelmingly said that what they most admire about the U.S. is its leadership in science and technology. The much-praised American entertainment industry came in a distant second.

GLOBAL DREAMS. Curiosity-driven science and technology has paid off for America, not only with wealth and overt power, but also with soft power, the power that sways hearts and minds. It would be

COVER STORY

PREDICTION MAP

This rendering depicts the 1999 vision I envisaged for the future. Femtochemistry is branching like a mighty river to physical, organic, and other areas of chemistry, touching single-molecule-, attosecond-, and angstrom-resolution measurements along the way. The culmination is in 4-D imaging, control, and biodynamics. Much of this science has already been witnessed in labs around the world.
countries. Shortly afterward, I was appointed the U.S. science envoy to the Middle East, and I embarked on a diplomatic mission that took me back to where I came from, but now with a different dream. What I learned from touring and seeing the state of science and education in the region was cause for some alarm, but also for considerable optimism.

Education in the U.S. faces many problems. The majority of the countries I visited face similar difficulties, but they also confront much more severe troubles that impede national and global progress. Yet there are positive signs as well. Countries such as Malaysia, Turkey, and Qatar are making significant strides in education and in technical and economic development. Egypt, Iraq, Syria, Lebanon, Morocco, and Indonesia are examples of countries rich with talents—about one-third or more of their populations are under the age of 30. We should not forget that the history of human civilization began and flourished in the Middle East. Today, there are many people from these countries living in the West who have excelled in all fields of endeavor. The latent capability of the people in the Middle East and in Muslim-majority countries elsewhere lies undiminished until circumstances are suitable for its development.

I recently read an important study that left me in awe of the knowledge demo-

graphics of our planet. In “Educating All Children: A Global Agenda,” Joel Cohen and David Bloom argue that the aim of achieving primary and secondary schooling for all children is urgent and feasible, and yet more than 300 million children will not be in school in the year 2015. Every effort should be made to change this bleak picture so we may hope for a better future for our world. The soft power of science has the potential to reshape global diplomacy and at significantly lower expense than that needed for the hard power of military involvement.

**EPILOGUE.** I would like to end by stressing the virtues of dreaming the future. Dreams evolve dynamically through space and time. Being in the right place at the right time can be a matter of luck, but dreamers must also actively seek out opportunity. Dreamers must be willing, and allowed, to take risks. In our profession of scientific exploration, as in the arts, the most creative work will materialize when intellectual curiosity is unhindered by the forces of bureaucracy and weighty management. As Louis Pasteur said, “Chance favors the prepared mind,” but without the appropriate milieu, a dream cannot materialize.

This country was established as a dream, explored outer space propelled by a vision, and pursued a dream of a science policy—the “endless frontier” in the words of Vannevar Bush, after World War II. Despite current problems, the U.S. continues to lead the world through the power of knowledge. In the 21st century, America must return to its guiding principles and defining characteristics. I am hopeful that we will chart a new policy for innovation that is inclusive of international science diplomacy for partnerships in development. Some may argue that it is naïve to think of such idealistic values in our imperfect world, but the influence of science diplomacy is in the best interest of the U.S. Through the power of knowledge and curiosity, we can efface ignorance and shape a future that binds cultures and civilizations.

In his Stockholm address, the winner of the 1988 Nobel Prize in Literature, Naguib Mahfouz, reminded us of our responsibility as citizens of a world made of haves and have-nots. He said, “In this decisive moment in the history of civilization it is inconceivable and unacceptable that the moans of mankind should die out in the void. ... Today, the greatness of a civilized leader ought to be measured by the universality of his [her] vision and his [her] sense of responsibility towards all humankind. The developed world and the third world are but one family.”

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**Revolutionary Dreams**

This address was written before the Egyptian revolution on Jan. 25 of this year. The revolution gave birth to a dream that materialized on this historic day, and I had the privilege of witnessing the event unfolding in real time with millions of Egyptians peacefully uprising for democracy. Living through such a dream is the experience of a lifetime; in this case, not only for me, but also for 85 million Egyptian citizens. Those who died in the struggle were seeking a better future. I hope we can honor their sacrifice by fostering education and science to help forge the future they fought for.

“A wise man [woman] will make more opportunities than he [she] finds.”

—Francis Bacon

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**SHUTTLE DIPLOMACY**

During the Egyptian revolution last month, I (back row, center) met in Cairo with the leaders of young demonstrators, activists, and organizers with the purpose of carrying their views to Egypt’s top brass.
EVEN BY AHMED H. ZEWAIL’S standards, the intensity of the past month or so has been off the charts.

Zewail, the Linus Pauling Professor of Chemistry and professor of physics at California Institute of Technology, is no stranger to keeping a relentless and high-profile work and meeting schedule. What with the demands of leading a busy research group, traveling the globe to lecture about science and education, and meeting over the years with presidents, prime ministers, kings, queens, and even the pope, Zewail—who won the 1999 Nobel Prize in Chemistry and now serves in President Barack Obama’s Administration as the Middle East science envoy—has seen plenty of headline-making action.

Nonetheless, this year’s Priestley Medalist, who is known internationally for his pioneering femtosecond spectroscopy work and for ultrafast electron microscopy imaging, says the history he personally participated in and witnessed unfolding before him last month in his native Egypt “is by any measure, the most momentous event in my life.”

Even before millions of demonstrators took to the streets of Cairo, Alexandria, and other Egyptian cities in late January and early February, calling for longtime Egyptian president Hosni Mubarak to step aside, Zewail had been planning to return to Egypt to continue promoting scientific and educational collaborations designed to foster friendlier relations.

Straddling the U.S. and Middle East, PRIESTLEY MEDALIST AHMED H. ZEWAIL thrives at the interface of science, culture, and international affairs

MITCH JACOBY, C&EN CHICAGO

MITCH JACOBY/C&EN

SCIENTIST-DIPLOMAT EXTRAORDINAIRE
in support of U.S. diplomacy in that region.

But when the popular uprising began to take hold in Egypt, Zewail sprang into action—not as a U.S. government representative, but rather as a concerned citizen. “I made it very clear that I was coming to Egypt as an Egyptian citizen to help my mother country,” says Zewail, who holds dual citizenship.

Before leaving for Egypt, he quickly prepared statements that were broadcast on Al Jazeera, Al Arabiya, and Egyptian television, and he wrote opinion pieces that were published in the New York Times and the Times of London declaring that superficial and cosmetic changes to Egypt’s power structure simply wouldn’t cut it. Fundamental change is what’s needed, Zewail said via those media outlets, and he respectfully but directly urged Mr. Mubarak to step down immediately.

UPON ARRIVING IN Cairo, Zewail kept a fast-paced schedule as he continued to deliver that message in public forums. “I was mainly trying to give moral support, especially to Egypt’s energized youth, who simply thirst for democracy and a new Egypt,” he says. He did so by holding interviews with numerous news organizations, including BBC and CNN, and appearing on CBS News’s “Face the Nation” and “PBS NewsHour.” In addition, he served as an unofficial mediator, spending long hours meeting with various youth leaders, protest organizers, activists, and young academicians and presenting their views to high-ranking ministers and to Omar Suleiman, who briefly held the post of Egypt’s vice president last month.

As the events of early February played out in Cairo, and especially as news of Mubarak’s resignation on Feb. 11 sparked major celebrations, the media was abuzz with speculation about who might become Egypt’s next president.

Journalists, bloggers, and even science enthusiasts who were closely following the story, drew up short lists of likely candidates that often included Zewail’s name.

After a meeting that Zewail held with young Egyptian researchers, Nature Middle East posted a blog entry announcing that Zewail had reconsidered his oft-stated intention to remain in science and stay away from high office—and was now thinking about running for the presidency.

But in a recent interview with C&EN, Zewail emphasized that he does not really want to become president of Egypt. “I have always said I can serve both Egypt and the world more effectively as a scientist, and that is my preference,” he asserted. Yet out of a sense of duty and respect for his fellow Egyptians, Zewail is cautious not to reject too hastily the barrage of requests he says he has received by phone, e-mail, and in person, urging him to consider becoming Egypt’s president.

As the Arab world’s only science Nobel Laureate, Zewail is accorded rock-star status in the Middle East. Students and young people pack auditoriums to hear him speak. For example, last July, more than 5,000 people gathered at the Alexandria Library to hear Zewail speak, according to newspaper and blog accounts of the event. One of his televised addresses, delivered last year from Cairo and broadcast across the Arab world, drew some 30 million viewers,

Margaret Warner of “PBS NewsHour” recently likened interviewing Zewail in downtown Cairo to “sitting in public with Bono and Einstein combined,” referring to the lead singer of Irish superband U2.

The world of Islam holds intellectual achievement in very high regard, Zewail says, explaining the likely source of his popularity. Underscoring that point, he quotes a lofty Arabic expression, al-‘ilm nur, meaning “knowledge (or science) is light,” and another one comparing ‘ilm, knowledge or science, to water and air, the essentials of life. So in a culture with a tradition of praising academic excellence so highly, especially one that in recent memory has witnessed so few of its members rise to international prominence for scholarship, Zewail stands out.

BUT WITH that popularity comes responsibility—and Zewail feels it strongly. That’s why he cannot bring himself to summarily and carelessly brush off throngs of Egyptians calling for him to become president, even though he has no desire to hold that office. “In this historic moment, when people have died for such an important cause and Egyptians are asking me to help...
by becoming president, it’s my duty, at the very least, to think about it,” he says. But until now, that’s as far as it has gone. That same sense of duty and a desire to help people better themselves are what drive Zewail to continue globe-trotting, especially to Muslim-majority countries, where he promotes education reform and investment in science. He knows he has given “the man and woman on the street” hope that those improvements will come, he says, because they tell him of their newfound optimism and shared desire to strengthen their countries’ educational systems. Their governments, however, have thus far been less responsive to Zewail’s encouragement and have remained reluctant to substantially increase allocations for education and science.

Even before becoming a U.S. science envoy, Zewail was busy trying to raise awareness of the importance of obtaining a rigorous education and establishing solid science and technology bases in developing countries. In lectures and in written opinion pieces, for example, he called upon developed nations not only to provide financial aid for these causes, but to become partners with the recipients and provide them with expertise, educational guidance, and implementation plans (Nature, DOI: 10.1038/35071136). He also helped bring prestige to highly committed young people by setting aside part of his Nobel Prize winnings to establish three prizes. Two are awarded annually by the American University in Cairo for outstanding academic performance in science and service to society. A third one is presented at the Cairo Opera House each year for achievements and creativity in the arts.

LONG BEFORE any of those efforts in education took shape, Zewail was shaping his own education. Had this year’s Priestley Medalist been honored for “developing revolutionary methods for the study of ultrafast processes in chemistry, biology, and materials science” in any year other than this one—a year in which a key chapter in the history of his native Egypt and the Middle East is being rewritten—this biographical sketch might well have started with the little sign posted by the medalist’s parents on the door of young Zewail’s bedroom naming the serious schoolboy who slept and studied there “Dr. Ahmed.” For even when Zewail was a little kid, his parents recognized and encouraged their son’s inquisitiveness and passion for learning. “If I got a 98 out of 100 on a test,” Zewail recalls fondly, “my father would scold me playfully, ‘Ya-bmi, my son, what about the other two points?’”

Eager to pursue a career in academia, Zewail completed his master’s study at the University of Alexandria and applied to U.S. schools to do Ph.D. work. He was accepted to the University of Pennsylvania, and after clearing countless hoops and hurdles imposed by Egyptian bureaucracy, he finally set off for the U.S. in 1969. He had little cash in hand and equally little command of the English language, and he soon found that he was in for one giant culture shock.

And so it was that Zewail’s drive to earn top scores in school continued throughout his younger years in his hometown, Disuq, and in nearby Alexandria, where he went on to attend university. There, as a science student majoring in chemistry, Zewail’s academic performance distinguished him as the highest-ranked student in his class and qualified him to serve thereafter as a mu’id, or demonstrator, equivalent to a teaching or research assistant. That position, which just seven chemistry students in a class of roughly 500 managed to attain, was a big deal because if a mu’id earned a Ph.D., the university would offer him or her a position as a professor. Although he had passed all of his courses with flying colors, Zewail’s science education in Egypt was very traditional and didn’t cover much quantum mechanics, group theory, or other topics in modern chemistry and physics needed for the foray into spectroscopy on which he was embarking. Likewise, he had had little experience with lasers and advanced instrumentation up to that time. But learning science was his forte, and in no time he came up to speed. Acclimating to American culture was an entirely different story.

Picture a 20-something, well-groomed, conservative Arab man in a starched white shirt, pressed dress pants, and coat and tie walking around the campus of a U.S. university in the free-spirited days of 1969. Surrounded by fellow grad students sporting colorful T-shirts and jeans with holes, Zewail wasn’t quite sure what to make of the curious dress habits of the young people in his strange new world.

“Ahmed’s work has changed not only what we know about chemical reactions, but what we believe is possible to know.”
The refined mu'id from the banks of the mighty Nile River was even less sure what to make of their social habits. He smiles now when he recalls how a young man and woman, students in the first lab course he taught, decided right in the middle of running a titration that the time was ideal to start making out. “These two students began kissing, right in front of me, right in front of the whole lab, with passion,” Zewail emphasizes laughingly. “In Egypt, this scene would have been impossible.”

THE SCIENTIFIC and cultural education Zewail acquired at Penn and later at the University of California, Berkeley, where he conducted postdoctoral research, served him well. Although it would be quite a while before he tried on a pair of jeans—and even then only ones without holes—and a while more before he would come to understand why a man came running past his Berkeley lab one night wearing a mask and nothing else ("streaking" doesn’t translate easily into Arabic), Zewail’s easy manner and charm soon brought many close and long-lasting friendships among people of many nationalities and cultures. And his gift for devising insightful and probing experiments, and for explaining their meaning in simple, straightforward language, soon earned him a reputation as a topnotch scientist.

Within a few years of taking a faculty position at Caltech in 1976, Zewail and his new research group were thoroughly immersed in pushing the limits of molecular dynamics. The team soon developed femtosecond laser methods for exciting sample molecules with a “pump” beam and then quickly probing them with a second light pulse. By carefully tuning the interval between the two pulses, the researchers recorded series of snapshots that captured reactants evolving to products by way of transition states that existed for mere quadrillionths of a second.

That body of work, for which Zewail was honored with the Nobel Prize, “has made it possible for us to observe and understand some of the most intimate details of the processes by which substances are transformed,” says Zewail’s Caltech colleague David A. Tirrell. “Ahmed’s work has changed not only what we know about chemical reactions, but what we believe is possible to know,” Tirrell adds.

Years after those pioneering experiments were conducted, Harvard University’s George M. Whitesides still finds it “truly remarkable” that Zewail’s team devised ways to observe dynamics of molecular bonds on a timescale several orders of magnitude shorter than the time required for a bond to vibrate.

Thinking back to the days when some of those key experiments were being carried out, Zewail recalls the period as being “filled with thrilling moments,” adding that the excitement meant he wasn’t sleeping much at that time. Neither were his students.

Jennifer Herek, who joined the Zewail group in 1990 as a graduate student, says the experience was “intense.” Now a physics professor at the University of Twente, in the Netherlands, Herek says Zewail “always was so enthusiastic, and motivated us to work hard and long hours.” She recalls the way Zewail engendered a “collective spirit” that inspired the group to get things done. “He often told us we would look back on this time as the best days of our lives.” At the time she wasn’t so sure. “But he was absolutely right,” she acknowledges.

Working in the Zewail group at around the same time as Herek did, Dongping Zhong, now a physics professor at Ohio State University, says that one of the most important lessons he learned from Zewail is that “in order to succeed in science, you have to be passionate about your work.” But that was easy, he adds, because Zewail’s passion for science was “highly contagious.”

WINNING A NOBEL PRIZE in 1999 didn’t temper Zewail’s drive to push the frontiers of science. It was around that time that his group was developing ultrafast electron diffraction techniques, which led to the more recent development of four-dimensional electron microscopy. That technique enables the temporal and spatial behavior of matter to be studied directly and simultaneously as events unfold in real time. These latest efforts are spawning new imaging methods that experts say may revolutionize biological and materials sciences because they can provide 3-D views of nanometer-scale objects evolving on the femtosecond timescale (C&EN, June 28, 2010, page 11).

And just as the fame and never-ending list of obligations that come with international scientific recognition didn’t dampen Zewail’s drive to advance science, they also didn’t diminish his care and concern for the welfare of the people in his group. Students and postdocs whose era in Zewail’s group spans from more than 20 years ago to as recently as last year, unanimously agree that their adviser truly cares about them.

For a man like Zewail, who has shown himself to be a concerned citizen of the world, that characterization hardly comes as a surprise. “Ahmed is among the most decent of people,” says Harvard’s Whitesides. He adds, “He’s a warm and dignified man.”