EA Chronicles
Newsletter of the UCSD Emeriti Association

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Fuel Cell Technology for Clean and Efficient Energy in the Future

By **Nguyen Minh**
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UCSD Center for Energy Research

The U.S. Energy Information Administration (EIA) projects a nearly 50% increase in global energy consumption between 2020 and 2050. The EIA predicts increased consumption for petroleum and other liquids, natural gas, and renewables (solar, wind). Coal and nuclear are estimated to remain flat. Although renewable energy consumption is projected to more than double through 2050, and to become almost equal to liquids consumption by 2050, fossil fuels will remain the world's largest energy source, supplying about 70% of the energy used worldwide.

Meeting this energy growth while limiting carbon dioxide emissions requires both efficiency improvements and emission reduction in the use of energy sources and generation/transmission/delivery of electricity to the end-use sectors. Fuel cell (FC) technology could play a significant role in this efficiency improvement/emissions reduction strategy because of the following attributes:

- *Clean and efficient energy conversion*: FCs are clean (no combustion, no carbon dioxide emissions with hydrogen fuel and reduced emissions for operation with other fuels) and efficient (direct conversion of chemical to electrical energy).

Nguyen Minh, Ph.D.

- *Reversible operation*: FC operation is reversible, i.e., FCs can operate in power generation mode to generate electricity, but also in reverse mode. In reverse mode, FCs can use electricity, for example, from renewables or nuclear energy to split water to produce hydrogen (a clean fuel by a clean and efficient process).
- *Sustainable technology*: FC technology can be sustainable. FCs can use sustainable biofuels for electricity production and can combine with sustainable energy sources (solar, wind, hydro) in electrolysis mode for hydrogen production from water.
- *Modular and versatile system*: FCs can be used for clean and efficient production of electricity at various power sizes in the end-use sectors: industrial (e.g., megawatts FC power plants), transportation (e.g., kilowatts power for FC vehicles) and buildings (e.g. 100 kilowatts combined heat and power or CHP for residential and commercial buildings) (see the Figure ~~1~~).

Current FC technology has five common types that operate at different temperatures: polymer membrane electrolyte fuel cell or PEMFC (80°C operating temperature), alka-

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Inside

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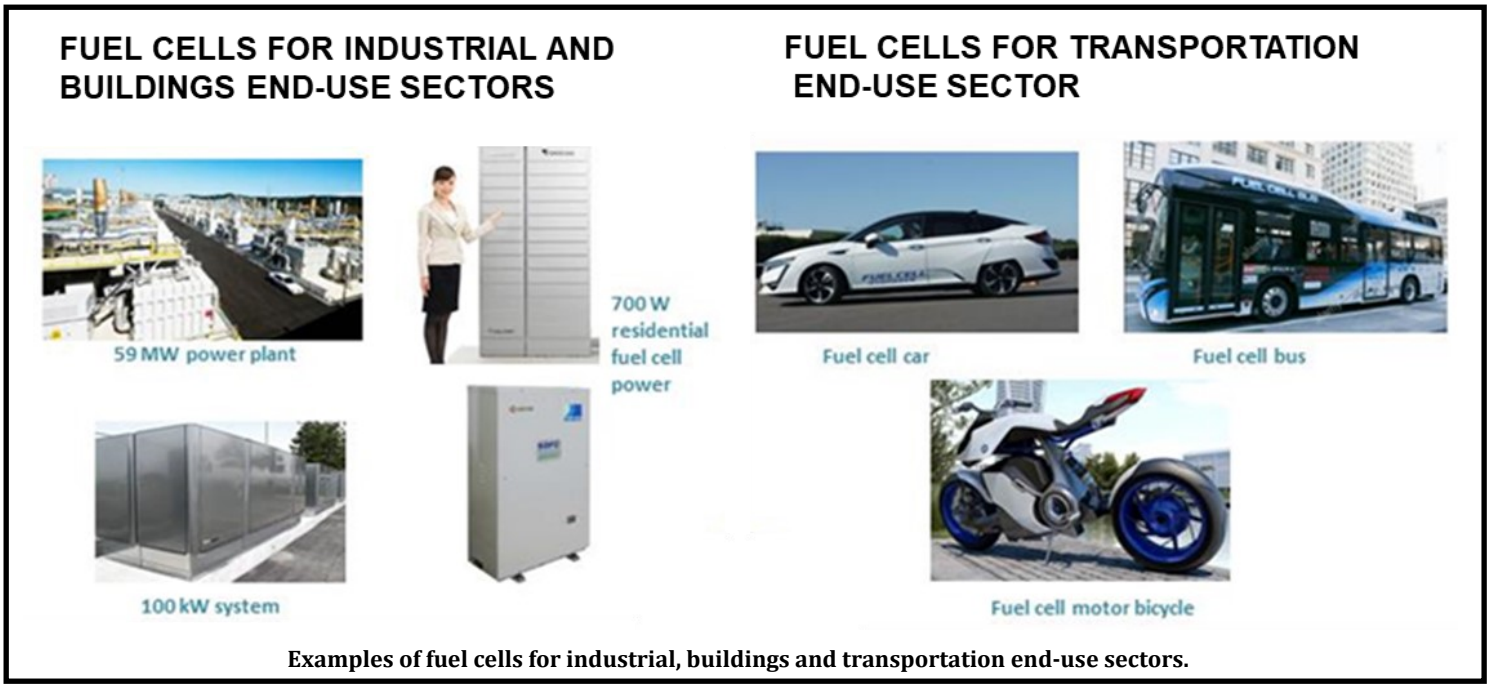

Examples of fuel cells for industrial, buildings and transportation end-use sectors.

line fuel cell or AFC (100◦C), phosphoric acid fuel cell or PAFC (200◦C), molten carbonate fuel cell or MCFC (650◦C), and solid oxide fuel cell or SOFC (600◦-1000 ◦C). Each type of fuel cell has its own advantages and disadvantages and selection very much depends on specific applications and requirements. Among these FCs, the PAFC and MCFC are at the commercialization stage (with limited commercial activities at present) for mainly industrial and building end-use sectors and the AFC is an important power source for space flights (power for Space Shuttle during earth orbit). Present FC technology activities mainly relates to PEMFCs and SOFCs. The PEMFC is at the initial commercial/precommercial stage and has been considered as a power source for FC vehicles and residential and commercial buildings. The SOFC is at the precommercial/proto-type demonstration stage and has been developed for a broad spectrum of power generation applications at various power levels (from small watt sizes to large multi megawatt systems). (As a special note regarding the SOFC, this FC in reverse operation— referred to as solid oxide electrolysis cell or SOEC) was deployed by NASA in the Perseverance Rover and demonstrated oxygen production on Mars for the first time in April 2021. NASA plans to use the SOEC and solar energy to convert some of the thin carbon dioxide-rich Mars atmosphere into oxygen which will then be used for propellant and human breathing.)

As the end-use sectors will continue to use diverse energy sources, any future energy systems should have the characteristics of *flexibility* (i.e., fuel flexible, suitable for efficient operation on a variety of practical fuels from fossil to renewable fuels) and *compatibility* (i.e., environmentally compatible, operable on a variety of fuels with reduced carbon dioxide emissions). In addition, other desirable characteristics for such a system include *capability* (i.e., multi-functional), *adaptability* (i.e., appropriate for diverse applications and versatile to local energy needs) and *affordability* (i.e., cost effective and cost competitive). The SOFC has the potential to serve as a technology base for future energy systems as it possesses all the characteristics mentioned above. Its fuel flexibility, adaptability, and capability in particular set the SOFC apart from many energy technologies, especially other fuel cell technologies.

- *Flexibility*: The SOFC is fuel flexible. Like other types of fuel cells, the primary fuel for the SOFC is hydrogen. However, suitable fuels for the SOFC also include natural gas, biogas, coal gas, alcohols, diesel, etc. It should be noted that use of these fuels requires the removal of certain contaminants such as sulfur

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and appropriate ways to prevent carbon deposition.

- *Capability*: The SOFC is multifunctional as its operation is reversible. In reverse operating mode, the SOFC is capable of not only splitting water to produce hydrogen but also splitting carbon dioxide to produce oxygen and converting mixtures of water and carbon dioxide into syngas (mixture of hydrogen and carbon monoxide that can be used for electricity production or production of chemicals, e.g., methanol, ammonia and petroleum-based chemicals with added value such as jet fuel and diesel). The SOFC is the only fuel cell to have this capacity in reverse operation.
- *Adaptability*: As indicated earlier, the SOFC has been developed and considered for a wide range of power generation systems, ranging from portable watt-sized devices to multi-megawatt central power plants. An attractive attribute of SOFCs is the possible hybridization of the fuel cell with another piece of power generating equipment, such as a gas turbine, to improve system performance. Integration of SOEC systems with nuclear energy using process steam/process heat/ electricity from the nuclear reactor for hydrogen production has also been envisioned.

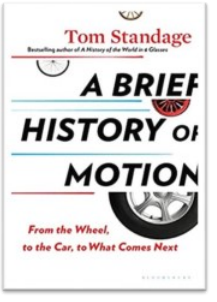
FC research at UCSD has focused on the development of SOFC technology for electricity and hydrogen/chemical production. Key R&D areas include basic and applied engineering and science research on properties, phenomena, design and manufacturing key to SOFC technology and development of innovative concepts.

In summary, use of FC technology if successfully commercialized could play a significant role to address the projected energy growth and the need for energy-related emissions reduction. The impact of fuel cell technology could be significant depending its penetration in the end-use sectors. This clean and efficient technology is presently at the initial commercial/ pre-commercial stage for certain applications. However, significant challenges, especially in the area of cost, must be resolved to move FC technology toward widespread uses in the future.

Emeriti Association Book Club

Until further notice, all Emeriti Association Book Club meetings will be held via Zoom. Please RSVP at least 24 hours prior to the event to receive the Zoom link via email. Event date and time: Fourth Monday of each month, 11:45 AM - 1:15 PM
Be sure to RSVP online to attend.

April 25, "A Brief History of Motion: From the Wheel, to the Car, to What Comes Next " by **Tom Standage**

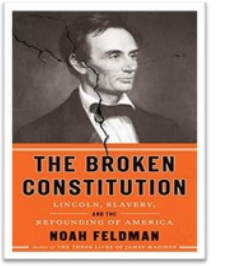


Join other Emeriti book enthusiasts as we discuss A Brief History of Motion: From the Wheel, to the Car, to What Comes Next by Tom Standage.

From the bestselling author of A History of the World in 6 Glasses, an eye-opening road trip through 5,500 years of humans on the go, revealing how transportation inevitably shapes civilization. Standage zips through the eras of horsepower, trains, and bicycles, revealing how each successive mode of transit embedded itself in the world we live in, from the geography of our cities to our experience of time to our notions of gender. Then, delving into the history of the automobile's development, Standage explores the social resistance to cars and the upheaval that their widespread

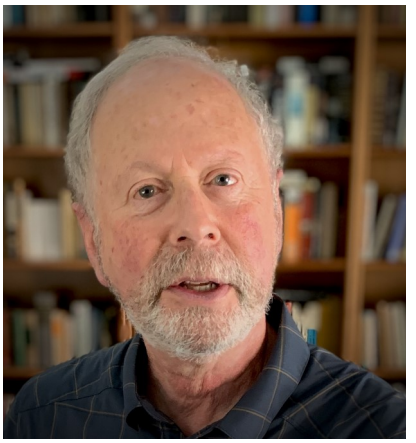
May 23, "The Broken Constitution: Lincoln, Slavery, and the Refounding of America" by **Noah Feldman**

Join other EA book enthusiasts as we discuss The Broken Constitution: Lincoln, Slavery, and the Refounding of America by Noah Feldman. Abraham Lincoln is justly revered for his brilliance, compassion, humor, and rededication of the US to achieving liberty and justice for all. He led the nation into a bloody civil war to uphold the system of government established by the US Constitution—a system he regarded as the "last best hope of mankind." But how did Lincoln understand the Constitution? The Broken Constitution is the first book to tell the story of how Lincoln broke the Constitution in order to remake it. To do so, it offers a riveting narrative of his constitutional choices and how he made them—and places Lincoln in the rich context of thinking of the time, from African American abolitionists to Lincoln's Republican rivals and Secessionist ideologues. RSVP today!



The Contested History of Brainwashing

By Joel Dimsdale, M.D.
Edward A. Dickson Emeritus Professor and
Distinguished Professor of Psychiatry Emeritus
University of California, San Diego



Joel Dimsdale

I suppose I would never have gotten into this peculiar topic had I not lived near the Heaven's Gate compound in Rancho Santa Fe. Having thirty-six neighbors kill themselves so they could hitchhike to the heavens on the Hale Bopp comet grabs your attention.

In addition, I am a psychiatrist and I have been interested in understanding irrational and destructive behavior. My previous book (Anatomy of Malice: the Enigma of the Nazi War Criminals, Yale University Press, 2016) studied Hitler's cabinet ministers, people who might not have been genocidal "perpetrators" but who were certainly "orchestrators" of World War II. After publishing that book, I started wondering about how large groups of people can be persuaded to follow such leaders. Was a whole population naturally so fanatical, did the big lie of propaganda eventually persuade them, or were people brainwashed?

Where does that flamboyant term come from anyway and can it in any sense be a legitimate focus of study? In 1950, the term "brainwashing" emerged out of the feverish mind of **Edward Hunter**, a former OSS propaganda agent. It originated from a Chinese term *xi nao,* which refers to achieving change by washing or cleansing the heart through retreat from the world and meditation. Now *that* is hardly as catchy as "brainwashing." The philosopher Wittgenstein observed that "a new word is like a fresh seed sown on the ground of the discussion." In Hunter's case his new word flourished like crabgrass. The experts of that time preferred the term "coercive persuasion," but that hardly caught on in popular culture.

Brainwashing is forever associated with musty Cold War conflict and bad science, but in studying coercive persuasion I learned that is only part of the story. It has much deeper roots than the Cold War and can trace its origins to traditions in religious conversion and torture. As to the scientists who studied brainwashing, some were rogues and others were gifted—even Nobel laureates.

Coercive persuasion came of age at the time of the Russian revolution when **Ivan Pavlov** applied the scientific method to persuasion. Pavlov, the methodical experimentalist, could train a dog to respond to the tone of "c" but to ignore "c#." **Lenin** met with Pavlov and asked his assistance in shaping the behavior of the new Soviet people. Pavlov responded, "Do you mean that you would like to standardize the population of Russia? Make them all believe the same way?" "Exactly… that's what I want," Lenin replied. An agreement was made and Pavlov was given an Institute, staffed with 357 assistants—an astonishing level of support given the Soviet Union's precarious economy.

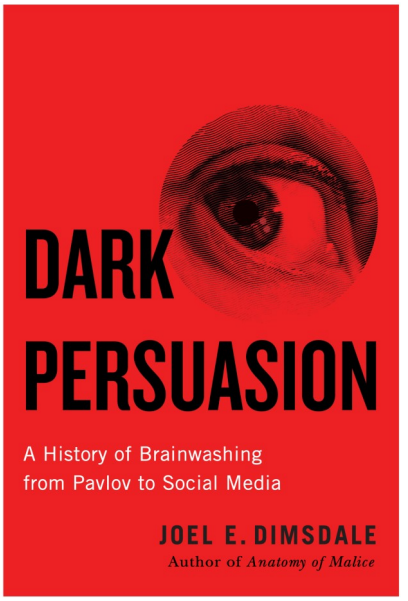
Pavlov wasn't just swayed by lucre. He had learned by accident about the effects of trauma on behavior. The Neva River had flooded St. Petersburg and the waters inundated Pavlov's dog labs in the basement. The dogs were terrified, floating in their cages and barely able to keep their nostrils above the advancing waters, when they were rescued at the last minute. The dogs were never the same. They forgot all that Pavlov had taught them, and their dispositions themselves were altered. From that, Pavlov learned that trauma has a foundational effect on behavior. Meanwhile, he continued his studies on sleep and drugs. There are many who feel that Pavlov's influence was manifest during Stalin's show trials.

Most of the ensuing developments in coercive persuasion were bankrolled by governments. During World War II government agents on all sides urgently tried to develop drugs that might facilitate interrogation. These truth drugs emerged from peculiar places—obstetrics and psychiatry—and were repurposed to extract information. In the 1940s and 1950s academics worked with government agencies to study the effects of the drugs on truth telling in laboratory based studies and in field studies of questionable ethical design.

When the Cold War worsened in the 1950s and early 1960s, the US government entered into hidden partnerships with universities in what has been called "The Manhattan Project of the Mind." The research portfolio included studies on the effects of sleep

deprivation and sensory deprivation on suggestibility. A huge portfolio studied effects of psychedelic drugs, amphetamines, and marihuana on unsuspecting "volunteers" who were surreptitiously dosed and observed. The **Jason Bourne** books and movies allude to the government having obliterated his memory and taught him to become the consummate assassin. Curiously, the government did fund at least one researcher who specialized in obliterating memories and then teaching people new memories while they were sleeping and drugged with LSD. The whole edifice came crashing down when such experiments were discovered.

It is a mistake to think that coercive persuasion was advanced only by governments. Cults and criminal groups have also adopted its premises, often with lethal consequences. It would be harrowing to review them all, but analyses of groups like Jonestown and Heaven's Gate typically reveal the familiar hallmarks of coercive persuasion—trauma immersion, sleep deprivation, surreptitious drugging, isolation from opposing views. Coercive persuasion has also been observed in the numerous instances of paradoxical behavior evoked in hostages who refuse to flee from their captors or abusers and even side with them—battered women, Stockholm syndrome, Patricia Hearst, the list goes on and on.



People dismiss brainwashing for several reasons. They criticize its luridness. They criticize it because historically the term brainwashing has been employed by conservatives as a weapon to dismiss new beliefs or movements ("Don't take them seriously. They have been brainwashed."). They also criticize the term because it seems to blame the victim even though some victims have been very gifted individuals. It may be an outlandish term, but it continues to be a focus in our culture (and others).

I used Google's Ngram Viewer to examine how frequently the term *brainwashing* appeared in English language books published in the twentieth century (see figure). It appears in 1950 and shot into prominence rapidly. Critics might argue, "Well, you would probably see something similar if you searched for other things that don't exist like unicorns." Just because a word is used doesn't mean people are taking it seriously. I then turned to PubMed, the National Library of Medicine's compilation of medical journals. From 1950, there has been a progressive increase in brainwashing research citations (see figure).

So, yes, I agree that "brainwashing" is a terrible term, but we are stuck with it. "Coercive persuasion" is a much better term. Advances in neuroscience research and in social media suggest that future coercion effects can be even mor extensive. We need to reflect upon how brainwashing developed in the twentieth century in order to prepare ourselves for this century. And we need to listen to **H.G. Wells** , who warned that "human history becomes more and more a race tween education and catastrophe." We are in such a race now. It is up to us to control how dark persuasion shapes our future.

UCSD Chancellor's Scholars Poster Session

Friday, May 6, 2022, 1 - 3 PM— Conference Rooms 1-2-3, UCSD Faculty Club

All Emeriti Association members are invited to attend the Chancellor's Scholars Poster Session. First-year scholars will interact with attendees, practicing their academic poster presentation skills. Come view the posters which deal with a wide array of health topics. Ask the scholars questions to help them on their academic journey as they perfect their poster presentation and networking skills. Your contribution of time and effort will be appreciated.

Francis Crick: A Nobel Vignette

By **Mel Green** Edward A. Dickson Emeritus Professor Emeritus of Cell and Developmental Biology

The best known names in modern Biology are undoubtedly **Watson and Crick**. They go together so often that many of my students even thought they belonged to one person, Dr. Watson Crick. In addition to their discovery in 1953 of the structure of DNA, the double helix, both have led very productive scientific careers, albeit quite distinct ones. **James D. Watson** soon became Director of the Cold Spring Harbor Laboratory and transformed it from classical genetics into one of the most prominent molecular biology centers in the world. **Francis Crick** meanwhile continued conducting theoretical biological research, primarily in the area of Neurobiology at the Salk Institute in La Jolla, California.

The common view of a brilliant theoretician is that of a shy introvert buried in his work night and day. Nothing could be further from that description of Sir Francis. He loved being with people of all ages, and he was always the center of attention. His boisterous laugh resounded throughout the room, especially when he was the one telling the funny story. But he was also a workaholic until his dying day in 2004. In addition to numerous research publications, Crick authored two books that summarized his major

Mel Green

thoughts and discoveries: "What Mad Pursuit: A Personal View of Scientific Discovery" in 1990 and "The Astonishing Hypothesis: The Scientific Search for the Soul" in 1994. His strong emphasis on theory is also evident from his often quoted statement, "Never allow a good theory to be discarded because of a poor experiment." Crick was strictly a theoretician.

My first interaction with Dr. Crick occurred at the Salk Institute in 1976 while he was on a sabbatical leave from Cambridge University in England. He had been a nonresident fellow of the institute since 1960. Emboldened by my recent discovery of viral chromatin, I made an appointment to visit Dr. Crick at his office overlooking the Pacific Ocean. Prior to my discovery, it was generally believed that the transcription of cellular DNA, i.e., the copying of DNA into RNA by the enzyme RNA polymerase, took place on "naked" DNA. Chromatin is DNA which is covered with proteins called histones. Since all of the viral DNA in the infected cells was present in the form of chromatin, it was clear that chromatin must be the structure used for transcription. As seen by electron microscopy, the histones attached to the DNA in the form of large balls called "nucleosomes," which were at least as large as the enzyme, RNA polymerase. Because James Watson had used an electron micrographic photo of viral chromatin for the cover of his textbook, I felt certain that Crick was well aware of my discovery.

As I approached the office of Sir Francis Crick, just a few minutes down the street from my own, I suddenly felt very nervous. I wanted to ask him how he imagined a big enzyme like RNA polymerase could get past the equally large nucleosomes that were bound to the DNA in order to copy the DNA into RNA. But the answer might be so obvious that this genius would make me feel like an idiot. Too late. His secretary saw me approaching and offered me a seat before I could escape. A moment later, Crick beckoned me into his office with a cordial smile, his eyes sparkling like the proverbial mad scientist. "What's on your mind, young man?" No small talk, no nonsense, just right down to business.

Yes, he was well aware of my discovery of viral chromatin, but he had never thought of the question that was both-

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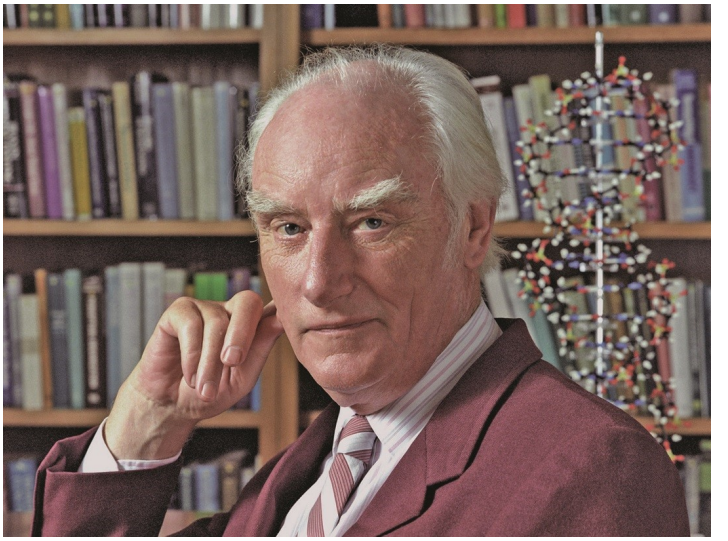
ering me. Without wasting a moment, Crick went to the blackboard and began to lecture in a formal tone of voice. I was certain that I would feel stupid in a very short time. To the best of my recollection, the lecture went like this:

"As you know, DNA has two strands wound together in a double helix." He stopped and peered at his drawing of DNA for several minutes, then continued with "That's a good question. I have no idea how RNA polymerase can get past those big nucleosomes." That was it. Class dismissed. I felt relieved. At least it wasn't a dumb question.

Always gracious, Francis Crick never turned down my invitations to lecture to my introductory biology classes. He had a clear and entertaining way of speaking that enthralled even the non-majors in biology, and believe me, they were a tough audience. After becoming Director of Academic Enrichment Programs, I invited Crick to speak to a general audience at UCSD about his research on consciousness and the soul, with an opportunity to sign copies of his recently published book, "The Astonishing Hypothesis." The entire ballroom was filled with over a thousand students in attendance for the opportunity to hear this famous scientist.

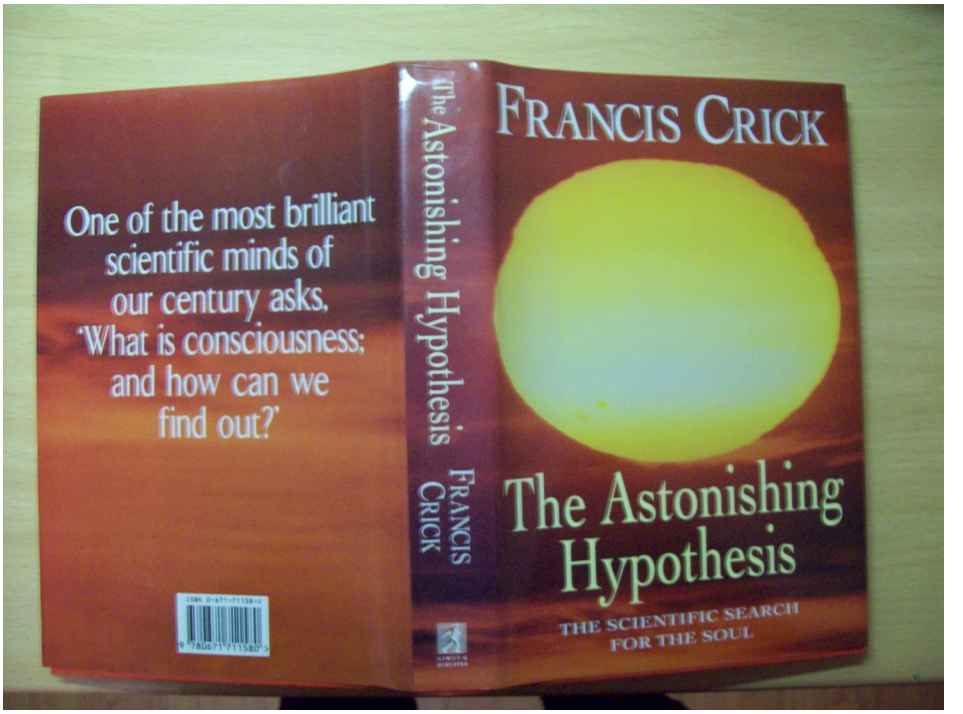
After lecturing for an hour, Crick happily fielded numerous questions from the audience about his research. It seemed he could go on all night with this, but he had agreed to go to dinner with me and several of my students, so I finally decided



Dr. Francis H. C. Crick

that, as his host, I had the right to put an end to the research oriented questions with a question of my own. I wanted the audience to get some idea about Francis Crick the man.

"Why did you leave Cambridge University and come to La Jolla, California?" I asked. Without hesitation, never at a loss for words, Crick went on and on about how wonderful it was at Cambridge, with its brilliant professors and students, delicious banquets every Friday night, etc., etc. Just as I started thinking he had completely forgotten my question, Crick stopped talking, peered out at the throng of admirers, and announced, "But the girls are much prettier in La Jolla." The audience went into hysterics as this 80-something year old man stepped down from the podium.



Proposed Slate for 2022 - 2023

Emeriti Association Executive Committee

Officers

J. Allen McCutchan	**President**, School of Medicine
Peter Gourevitch	**Vice President**, Campus, GPS
Gail Lew	**Secretary/Treasurer**, Pharmacy
Steven Adler	**Past President**, Theatre & Dance

At-Large and Ex-Officio members

Members at Large: Irving (Jake) Jacoby (School of Medicine); **Joe Watson** (VC Student Affaires, Chemistry); **Jean Bernard Minster** (SIO); **Mark Paddock** (Physics); **C. Richard (Rick) Boland** (School of Medicine); **Duncan Agnew** (SIO);

Ex Officio members: Howard Kushner, Historian; **Mae Brown,** Liaison to the UCSD Retirement Association and Chair, Emeriti Mentor Program; **Sandy Lakoff**, Editor, Chronicles, **Suzan Cioffi,** Managing Editor, Chronicles, and Director, UCSD Retirement Resource Center; **Kim Signoret-Paar**, Liaison to Oceanids; **Henry Powell**, Chair, CUCEA, and **Phyllis Mirsky**, Secretary, CUCEA.

The election of the proposed slate is taking place now via Survey Monkey. If you do not have access to the internet, you are welcome to mail in your approval of the proposed slate, or your proposal of an alternate officer or Member at large to: Suzan Cioffi, Director, UCSD Retirement Resource Center, UCSD, 9500 Gilman Dr., #0020, La Jolla, CA 92093-0020. The deadline for mail ballots is April 29th.

Chronicles

Newsletter of the UCSD Emeriti Association

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Jack C. Fisher	**Co-Editor**
Suzan Cioffi	**Managing Editor**

Officers

Steven Adler	President
Allen McCutchan	Vice President
Kim Signoret-Paar	Secretary/Treasurer
Irving (Jake) Jacoby	Past President

Executive Committee

Members at Large: John Goodkind, Richard Madsen, Roger Spragg, Gail Lew, Jean-Bernard Minster, Joe Watson, Ex-Officio members: Sandy Lakoff, Editor, Chronicles; **Ann Craig**, Chair, Emeriti Mentor Program; **Jack Fisher**, Historian; **Suzan Cioffi**, Director, UCSD Retirement Resource Center; **Gail Lew**, Liaison, UCSD Retirement Association; **Kim Signoret-Paar**, Liaison, OCEANIDS; **Henry Powell,** Chair, CUCEA; **Phyllis Mirsky**, Secretary, CUCEA

Forward queries, changes in mailing/email address to: Suzan Cioffi, Director, UCSD Retirement Resource Center, UCSD, 9500 Gilman Drive, #0020, La Jolla, CA 92093-0020.

Mark your calendar for Spring 2022 events!

Spring Emeriti Association Meetings

RSVP here to receive the Zoom event link

Wednesday, April 27, 2022
3:30 PM—5:00 PM, *via Zoom*

"How Civil Wars Start And How to Stop Them"
presented by Barbara Walter, Professor of Political Science and Rohr Chair in Pacific International Relations at the School of Global Policy & Strategy

Wednesday, May 11, 2022
12:00 PM - 2:00 PM, *via Zoom*

Emeriti Association Annual Meeting
With a talk presented by Peter F. Cowhey, Dean and Qualcomm Chair Emeritus of the School of Global Policy and Strategy,
"Cybersecurity and the Ukraine War"