EA Chronicles
Newsletter of the UCSD Emeriti Association

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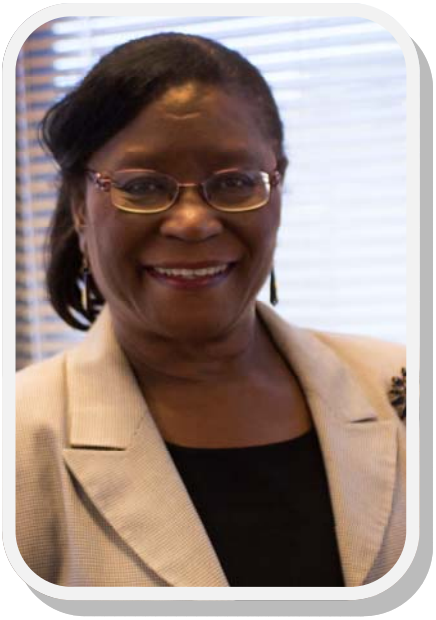
How We Grew to Enroll 31,502 Students

By Mae Brown

Assistant Chancellor for Admissions

UCSD continues to be a popular choice for accomplished students and their families from California, the nation, and the world, largely due to our reputation as an academic powerhouse. Our campus is consistently recognized as an innovative and entrepreneurial, student-centered, research-focused, and service-oriented public university.



TOP RANKINGS

- #1 public university in the U.S. for social mobility, research and service, *Washington Monthly 2014*
- 8th best public university in the U.S., *U.S. News & World Report 2014*
- 18th best university in world, *U.S. News and World Report's* first-ever global ranking
- 14th for best value of California public colleges, *Kiplinger's Personal Finance 2014*
- One of two UC campuses with the top 10 most Highly Cited Researchers in the world, *Thomson Reuters 2014*
- 14th best research university in the world, CWTS *Leiden Ranking 2014*

ENROLLMENT GOALS

UCSD seeks to enroll a student body that demonstrates strong academic achievement and a broad diversity of exceptional personal talents, abilities and experiences. Students from California, across the U.S. and around the world contribute greatly to the intellectual and cultural development of the entire campus community.

California residents have always been and continue to be the top priority. As of the 2013-2014 academic year, 83% of undergraduates at UCSD are from California. Due to severe budget cuts from the state in recent years, the UC system has seen an increase in nonresident enrollment. Each campus sets a target for nonresident students, over and above its California resident enrollment, based on physical and instructional capacity. Nonresident students do not replace California residents; they are helping offset the cost of tuition for California students. International students at UCSD have a major impact on the San Diego economy through the over $143.9 million they and their dependents pay in tuition, educational and living expenses.

Nonresidents are held to higher admissions standards. In addition,

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Inside

the Office of Admissions has a team of international specialists familiar with the educational systems of other countries who evaluate international freshman applications. The vast majority of transfer applications come from California community colleges. The freshman and transfer admission processes and admission data are detailed below.

FRESHMAN ADMISSION

UCSD uses a single-score holistic review process approved by the faculty Committee on Admissions. Applications, including the personal statement, are read by multiple readers. The full record of academic achievement in college preparatory work is reviewed, including grades, strength of high school curriculum, honors, Advanced Placements (AP), International Baccalaureate Higher Level courses (IBHL), transferable college-level courses, strength of the senior-year course load, and test scores. Readers are asked to consider a wide range of academic and non-academic criteria, including the student's interests, passion, special talents, leadership and community service. There are no pre-assigned weights or formulas; applicants are viewed in the context of the opportunities and challenges each has encountered. All applicants are ranked using a holistic review score of 1 to 5. Applicants receiving a score of 1 have a high probability of gaining admission, while applicants scoring a 5 will likely be denied admission.

Nonresident students do not replace California residents; they are helping offset the cost of tuition for California students.

As the charts indicate, we received over 73,000 applications from prospective freshmen and 16,000 from transfer applicants, for a total of 89,582. We admitted 24,552 freshmen applicants, 4,921 of whom accepted. (Our enrollment goal had been 4,900.) We admitted 7,276 transfer students, 2,456 of whom accepted. (Our enrollment goal had been 2,400.) Total undergraduate enrollment is now 24,810. The total UCSD enrollment, including graduate students, the Medical School, and others, is now 31,502. [UCLA enrolls over 43,000, UC Berkeley over 36,000. As a whole, the UC system this year admitted 25,745 out-of-state and international applicants, 3,000 more than in 2013 and 7,000 more than in 2012. Ed.]

TRANSFER ADMISSION

California Community College transfer students receive priority in the admission review process. Transfer applicants must attain a competitive grade point average, complete a minimum of 60 UC transferable semester (90 quarter) units and the seven-course pattern by the spring prior to the start of the fall term. Major preparation is strongly encouraged. Several majors in the Jacobs School of Engineering (JSOE) are impacted and major preparation is required. Beginning in Fall 2015, all JSOE majors for transfer students will be impacted.

The Office of Admissions and Relations with Schools offers a full range of activities and programs designed to attract, admit and enroll California community college transfer students. One such effort is the faculty-approved UniversityLink program. The program is open to student veterans, active duty service members and current/former foster youth enrolled or planning to enroll at a University-Link Local Partner Community Col

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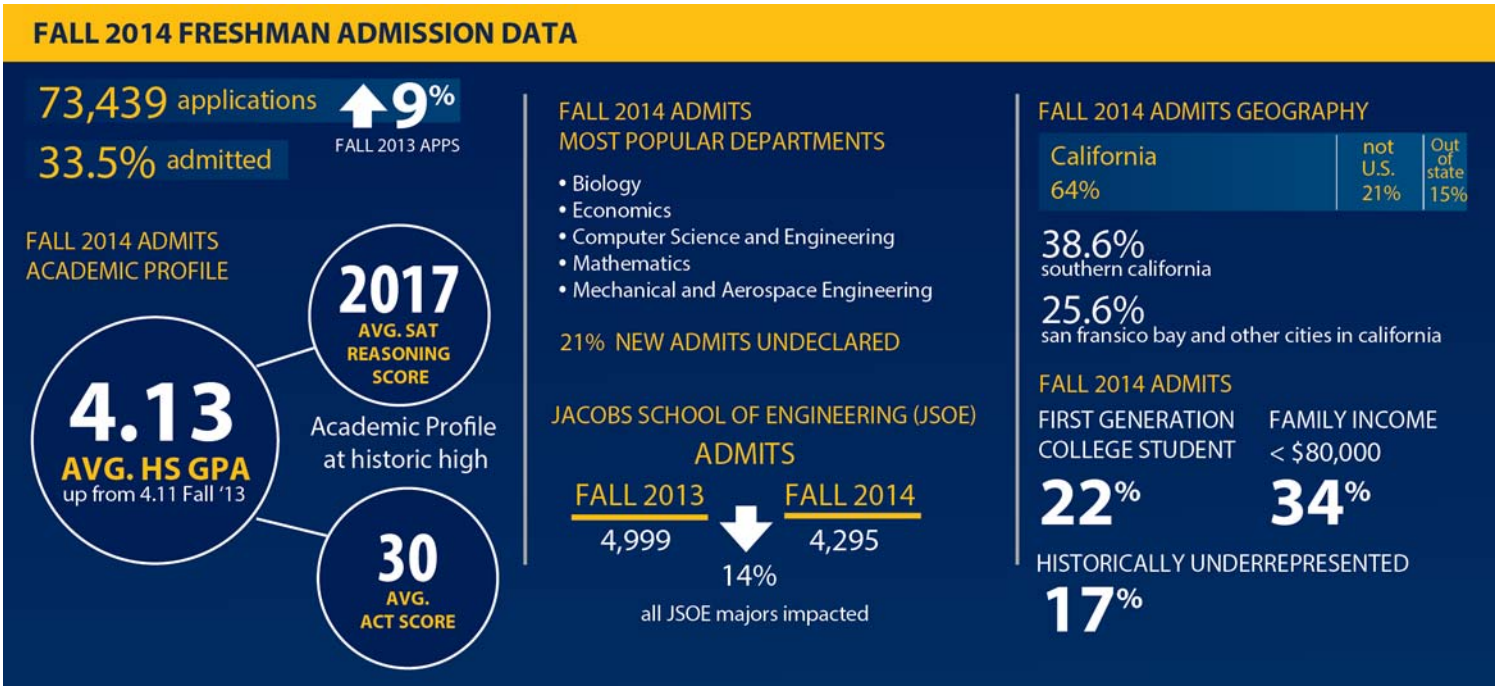
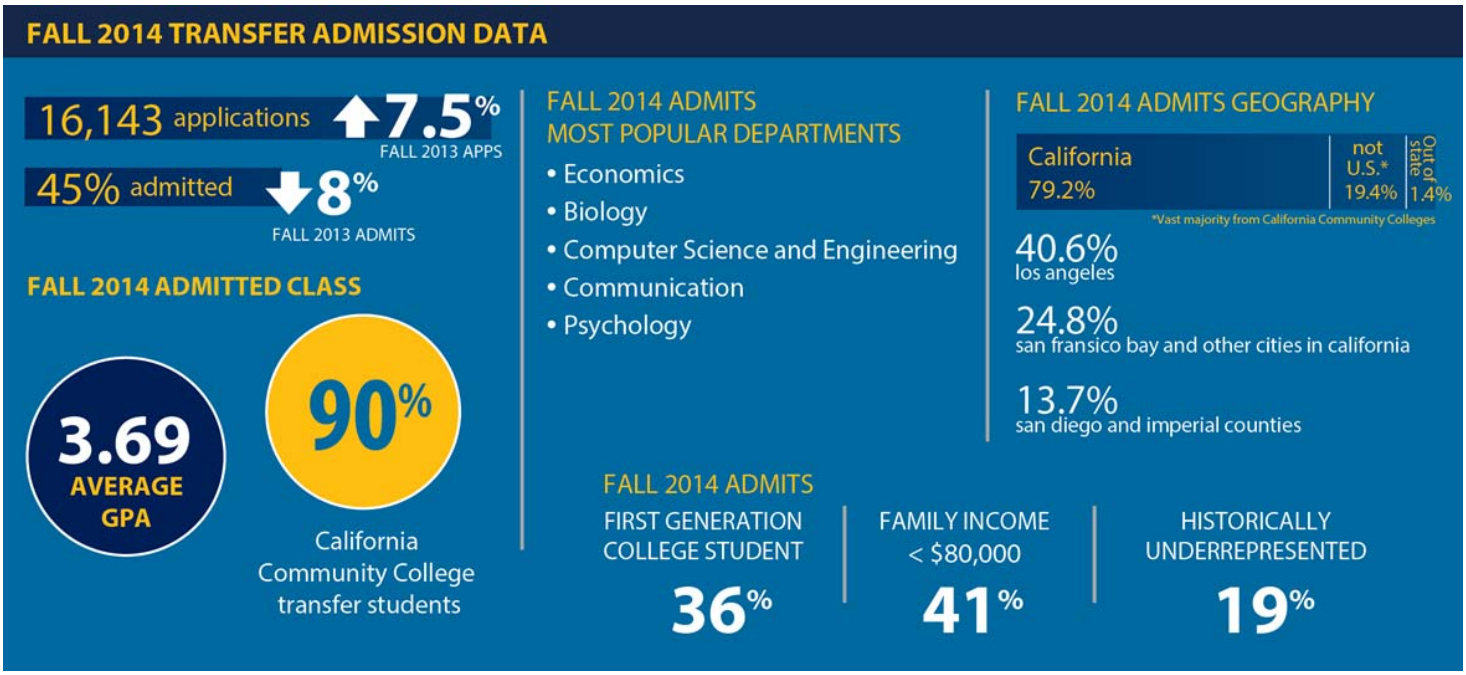


Mae Brown, *How We Grew to Enroll 31,502 students.* **cont. from page 2**

lege*. The program is also open to high school seniors planning to enroll, or first-year community college students enrolled, at a ***University-Link Local Partner Community College*** with family income of no more than $40,000 per year. The Transfer Student Services office provides individual advising, application workshops, invitations to special events at UC San Diego and campus tours.

UniversityLink Local Partner Community Colleges: Cuyamaca, Grossmont, Imperial Valley, Mira-Costa, Palomar, San Diego City, San Diego Mesa, San Diego Miramar and Southwestern.



The Inverse Theory of Backus and Gilbert

In Memoriam Freeman Gilbert

By Robert Parker
Professor Emeritus of Geophysics

I first met **Freeman Gilbert** when he and **George Backus** were on sabbatical leave at the Department of Geodesy and Geophysics, Cambridge. This must have been in 1966, when they were working on their famous approach to inverse theory (Backus & Gilbert, 1967, 1968,1970), and I was a graduate student studying electromagnetic induction in the Earth's core and in the oceans. I went to lectures given by Freeman, some on the new theory, some on seismology. I was fascinated by the abstract mathematical machinery, the idea of a " functional;'' I even went out and bought-***Functional Analysis*** by **Riesz** and **Nagy**, hardly a book to be found on the shelves of many geophysics students! Freeman and I often talked over morning coffee and afternoon tea; he was very helpful with a problem I was having computing lines of magnetic force in a rotating sphere.

Before he returned to California he invited me to become a postdoc at IGPP. I accepted and that is how my career at UCSD began. I would like to describe the impact of those three early papers and provide some background. In geophysics we are faced with the difficulty of describing inaccessible regions, sometimes thousands of miles beneath the surface, based on energy that has traveled through those places or on fields, like gravity or magnetic fields generated within them. The task of revealing the interior property using the surface measurements is called solving the "inverse problem," in contrast to the "forward problem," in which one calculates the observed values from a known structure. By the the 1960s the problem of converting the information obtained at the surface into a picture of the interior was the province of applied mathematicians, who studied highly idealized models and proved difficult theorems.

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Robert Parker, *The Inverse Theory of Backus* and Gilbert

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One of the principal concerns was that of uniqueness, answering the question "When does the given signal correspond to a single model structure?" The answer is usually presented in the form of conditions that the underground system must obey, conditions that would sometimes be unrealistic for a geologic system; but that was no shortcoming to the mathematician. An implicit precondition for any uniqueness proof was the availability of a perfectly accurate and complete set of observations.

The poster child of the prevailing paradigm in geophysics was the **Herglotz-Wiechert** solution for the seismic wave velocities inside a spherically symmetric Earth. In the idealized model an earthquake sends a sharp pulse to a distant station on curved path inside the earth. The inverse problem in this case is to determine the velocity as a function of radius from the times taken to reach stations at various distances from the source. This information was presented as a travel-time curve, a graph of time against distance.

Travel-time curves had been available since the early days of the 20th century and the mathematics was in equally good shape. If the velocity increases with depth (a plausible assumption), there is only one corresponding velocity profile for any travel-time function and there is a definite, arduous procedure for finding it associated with Herglotz and (1907) and Wiechert (1910). The simplified (spherically symmetric) model of the interior was adequate for the first half of the 20th century and the Herglotz-Wiechert method was used to construct a picture of the Earth's interior. Any notion of uncertainty in the model could be ascribed to inaccuracy of the travel-time curves.

By the 1960s, another kind of seismic information was just becoming available: after a great earthquake, the Earth continues to vibrate like a bell after it has been struck. And like a bell the earth does not oscillate at a single frequency, but at a distinct set of characteristic frequencies, governed by the density and elastic properties, and associated with the shape of the oscillation pattern. Those vibrations (called free oscillations) are quite slow (one has a period of about forty-five minutes). The motion can continue for many days after the earthquake but the signals were difficult to detect at the time. (Freeman played a central role in the development of arrays of more sensitive instruments around the globe to observe the free oscillations in the latter half of the century, but that is a different story from mine.) The frequencies of the various modes of oscillation were expected to contain information not found in the simple travel-times of pulses; in particular the material density could not be extracted from the travel-time data, but it was conjectured that the oscillation frequencies could yield that property, a conjecture confirmed by the three papers and much subsequent work.

It was the construction of an Earth model based on the free-oscillation frequencies that was the focus of the three Backus-Gilbert papers. A problem confronting the two authors was the incompleteness of the data set: There can never be a complete catalog of the infinitely many oscillation frequencies, just a finite list. This fact implied there could not be a uniqueness theorem, since the description of the mechanical model of two elastic parameters and density as functions of position, demands in principle infinitely many numbers. The Herglotz-Wiechert problem maps one curve (the travel-time curve) into another (the velocity-radius curve); both comprise functions with infinitely many values. Absent

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a uniqueness theorem, there could be more than one solution in agreement with the frequency estimates. Describing this ambiguity was one of the great achievements of the trilogy.

The naive expectation is that it should be possible at each point of the model to set a range of permissible values, a kind of error bar at each point. This turns out to be incorrect in general, because a large-amplitude deviation on a small enough base would be undetectable. Backus and Gilbert showed that only averages of properties
could be reliably inferred, not values at a particular point.

Furthermore, they showed that there is an intrinsic scale for the averaging, called the resolution, and detail on a scale smaller than the resolution, would be inaccessible from the given set of data. The brilliant analogy was made with astronomical observations: measurement incompleteness leads to a fuzziness in our picture of the inside of the earth like the blurriness in a telescopic image due to imperfect optics and the finite wavelength of light. The concept of the resolution of a given data set has become central pillar of geophysical data interpretation ever since.

Despite their concentration on the problem of free-oscillation data, the Backus-Gilbert inverse theory was perfectly general. Data inadequacy is a general property of all practical inverse problems, that is, those involving actual measurements. (The apparent perfection of the travel-time curves in the Herglotz-Wiechert scheme was an artifact—the finite catalog of arrival times was made into a smooth curve by connecting the measured points graphically). The fundamental asymmetry between the measurements (infinite in number) and the unknown (a function of position, requiring infinitely many values) meant that Backus and Gilbert had to employ advanced an unfamiliar mathematics for their work; functionals on Hilbert space were not part of the geophysicists' toolbox in those days.

Their first paper was rejected by the premier American geophysical journal, the Journal of Geophysical Research, as too abstract and not practical (a short-sighted opinion, given the widespread subsequent application of the ideas in all areas of geophysics including in industry); **Orson Anderson** once told me that turning down that paper was his biggest mistake as editor of JGR. The complexity of the equations for calculating the free-oscillation frequencies (the solution of the forward problem) virtually guaranteed there would never be an ingenious formula for constructing solutions as there is in the Herglotz-Wiechert problem. Backus and Gilbert therefore provided a general purpose systematic numerical solution method, firmly based in Hilbert space, for building solutions, something widely adopted by geophysicists afterward. Computers at the time were fairly primitive and programs for solving complex systems were not generally available; this is an area where Freeman was a master and we can be confident the calculations and codes for the three papers were his responsibility.

We learned that our ignorance can and should be evaluated quantitatively, and that it can be expressed as a lack of detail in our models. They (Backus and Gilbert) introduced the variational approach to finding solutions, an idea that has universally been adopted.

The three Backus-Gilbert papers changed the way geophysicists looked at one of the crucial aspects of our science, how to learn about the interior from observations made at the surface. In particular we learned that our ignorance can and should be evaluated quantitatively, and that it can be expressed as a lack of detail in our models. They introduced the variational approach to finding solutions, an idea that has universally been adopted. These papers essentially created the subject of geophysical inverse theory, which until then, had been treated on a problem-by-problem basis without a coherent approach or unifying methodology. Even at the time they were published it was clear these were papers of enormous importance, the work of giants. Sadly one of those giants is no more, and geophysicists everywhere mourn his passing.

REFERENCES

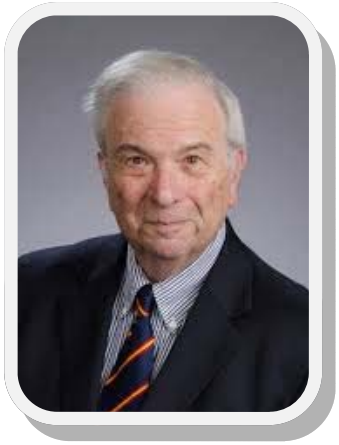
- Backus, G. E. and J. F. Gilbert, Numerical applications of a formalism, Geophys. J. Roy. Astron. Soc., 13, 247-276, 1967.
- Backus, G. and F. Gilbert, The resolving power of gross Earth data, Geophys.
- J. Roy. Astron. Soc., 16, 169-205, 1968.
- Backus, G. E. and J. F. Gilbert, Uniqueness in the inversion of inaccurate gross Earth data, Phil. Trans. Roy. Soc., A 266, 187-269, 1970.
- Herglotz, G., Uber das Benndorf'sche Problem der Fortpflanzungeschwindigkeit der Erdbeben strahlen. Phys. Zweitschr., Bd 8., 145-7, 1907.
- Wiechert, E. Bestimmung des Weges von Erdbebenwellen. I. Theoretisches, Phys. Z., 11, 294-304, 1910.

Anecdotage

By Sandy Lakoff

The First Thursday Club at 34, Going on 35

The First Thursday Club is a monthly dinner and discussion group that brings together some two dozen invited UCSD faculty and confreres from neighboring institutions. Over the years it has had some especially distinguished members, including **Roger Revelle**, **Herb York, Marvin** (**"Murph") Goldberger**, all the chancellors post-**McElroy**, and hardly least, the Nobel Laureate **Francis Crick**. Last December, at the annual event for members and spouses hosted by **Walter** and **Mary Munk** and **Dick** and **Rita Atkinson,** the club marked its 34th anniversary. This month the Munks' very special dining room will again be the venue. As one of its founders, I was asked to offer some remarks on its history. Since I was urged to be brief, I began by retelling a story I heard at a conference dinner at Cambridge University. It seems an American visitor from Yale had been invited as a courtesy to give regards from his home campus. Instead he took the opportunity to present an excruciatingly long disquisition. "Y" he began, stood for Youth, upon which he expatiated for 20 minutes; "A" for Ambition (another 20 minutes), "L" for Learning (20 more), "E" for Enlightenment (still another 20). When he finally sat down, his host, ever the polite Englishman, rose and said, "We must –must-- sincerely thank our American visitor for explaining to us the meaning of the name of his college," and then added a kicker: ".and-- and -- and we must be even more grateful that he did not come from the



Massachusetts Institute of Technology."

When the laughter died down, I proceeded to recall that the club had been founded by the biochemist **Charles A. Thomas, Jr.,** who came to the Scripps Research Foundation from the Harvard Medical School, after a dustup over his lab's adherence to federal guidelines on recombinant DNA research. (He was later exonerated by the NIH.) The local biochemist **Elie Shneour** had seen a letter to the editor in Science magazine in which Charlie defended himself and got in touch with him to suggest they meet for lunch at La Valencia. There, Charlie mentioned that he had belonged to a club in Boston loosely modeled after the Royal Society of London. He and Elie agreed that one like it should be opened here. One of the Boston club's members had been **Don K. Price, Jr.,** Dean of the School of Public Administration (now the Kennedy School) who knew me from my Harvard days and suggested Charlie get in touch with me. He did and I offered enthusiastic encouragement.

In 1979 UCSD had 10,000 students; today it has over 30,000. Our once sleepy Navy and tourist town is now a dynamic center for science and technology.

It took shape quickly and has flourished ever since, though not without controversy and a parting of the ways with Charlie. What happened was that he invited a guest to one of our meetings who put forth a claim –by then altogether discredited -- -- that AIDS was not transmitted by a virus. That was too much for our biologists. Their acid reaction, so to speak, made Charlie so uncomfortable that, to our regret, he rarely came to the meetings after that.

Looking back on the three decades since its founding, I noted that in at least one respect nothing had changed. **Jerry Brown** was governor then and he is now. But in other ways there have been big changes. In 1979 UCSD had 10,000 students; today it has over 30,000. Our once sleepy Navy and tourist town is now a dynamic center for science and technology. The campus boasts a greatly expanded Medical School, formidable engineering facilities, a Graduate School of International Relations under club member and dean **Peter Cowhey**, the Institute of the Americas, the Rady School of Business, and the futuristic Calit2 headed by the computer scientist and member **Larry Smarr**. In the vicinity stand Qualcomm, the behemoth of the telecommunications industry, the Sanford Consortium for Regenerative Medicine, headed by our member **Larry Goldstein**, the new Venter Institute, and all the biotechs and startups on Torrey Pines mesa and in Sorrento Valley.

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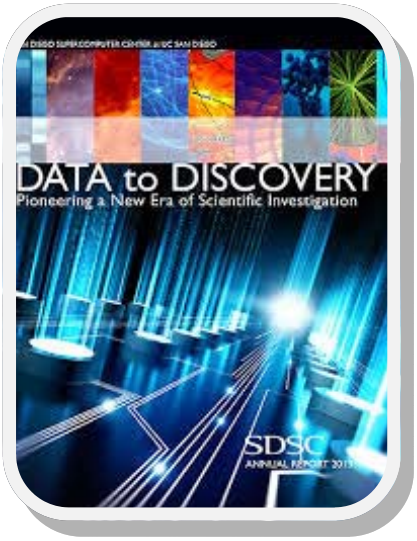
As I noted, much of the credit for this spectacular growth is due to the vision and persistence of Revelle, UCSD's founding father and one of the club's first members. He also deserves credit, I added, for reviving, in a prescient paper in 1957, the warning that the world would experience potentially dangerous warming because of anthropogenic emissions of greenhouse gases.

I listed a few of the many honors won by several colleagues. Revelle, Munk, York, and **Marye Ann Fox** have been awarded the National Medal of Science; **Pat Churchland** holds a MacArthur grant. Kudos too went to two chancellors: **Bob Dynes** for his role in getting us one of the nation's four supercomputer centers; Atkinson, ignoring critics who



"Chancellor Bob Dynes was instrumental in getting UCSD one of the nation's four supercomputer centers."

called Thornton Hospital a white elephant, laid the groundwork for the transformation of UCSD's health care facilities into a comprehensive world-class center for research and therapy.

On a lighter note, I recalled that when Atkinson's term as chancellor was up for renewal, President **David Gardiner** had come to campus to sound out faculty on his performance. As one of those he interviewed, I gave Dick high marks. But then Gardiner threw a curve that nearly struck me out. "Does the faculty agree with his philosophy of education?" he asked. I paused, unsure how to answer, and finally blurted out: "I think if he had one, we'd lynch him." Gardiner was not displeased by this response – perhaps because he had no such philosophy himself.

Mindful of **Abigail Adams**' admonition that her husband "remember the ladies," I praised the spouses who had done so much to raise the community's cultural standards, including **Helen Raitt** for organizing social activities at SIO (before our club's formation), **Ellen Revelle**, for her support of Oceanids, the International Center, historic preservation of La Jolla landmarks, and the La Jolla Music Society; **Judy Munk** for raising architectural standards; and my own late wife **Evelyn** for editing Bear Facts and leading the Early Music Society to a permanent place on our musical calendar.

Then I memorialized Francis Crick by quoting from his book *What Mad Pursuit* the passage where he describes the first announcement he and **Jim Watson** made of their epochal discovery:

The first Nature *paper was both brief and restrained. Apart from the double helix itself, the only feature of the paper that has excited comment was the short sentence: "It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible mechanism for the genetic material."*

"We were not being coy," Francis explained. He wanted the paper to discuss the genetic implications but Watson was afraid the structure might be wrong and he would have "made an ass of himself." So they compromised on the wording lest readers suppose they had been too blind to see the importance of their discovery!

For a long time, before we were joined by the late economist **Hal White** and recently by **Dan Yankelovich**, one of the nation's leading analysts of public opinion, the cognitive scientist **Jeff Elman**, and the political scientists Cowhey and **David Victor**, (and more recently by historian and science policy analyst **Bill Lanouette**) I had been the only social scientist in the house. Crick liked to tease me by challenging me to admit that political science wasn't a real science. In one such exchange I replied that while it was true we couldn't make as much use of mathematics as natural scientists or conduct controlled experiments, still we had made solid contributions to the understanding of social values and to the comparative study of governments and voting behavior. "And maybe," I added with a touch of malice aforethought, "by the time you natural scientists can tell us when and where the next earthquake will hit, and exactly what its magnitude will be, we political scientists will be able to predict the next revolution." To which riposte he was kind enough to say "Touché."

"Chancellor Atkinson ... laid the groundwork for the transformation of UCSD's healthcare facilities into a comprehensive world-class center for research and therapy. "

We ended the event by toasting the future of the club, the university, and all who will contribute to the advance of learning in our community. It was, as the saying goes, a night to remember.

Chronicles

Newsletter of the UCSD Emeriti Association

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Mark your calendar for 2015 events!

Professor Susan M. Narucki, *Grammy Award winning soprano*

Topic: "Transformations and journeys: the beauty and power of classical singing and opera in the 21st century :

Wednesday, January 14, 2015, 3:30 - 5:00 PM

Please note meeting venue: Prebys Music Center

Sara Johnson, *Associate Professor, Literature*

Topic: "The Multilingual Americas in the Age of Revolution: A Visual Cartography."

Wednesday, February 11, 2015, 3:30 - 5 PM

Ida & Cecil Green Faculty Club