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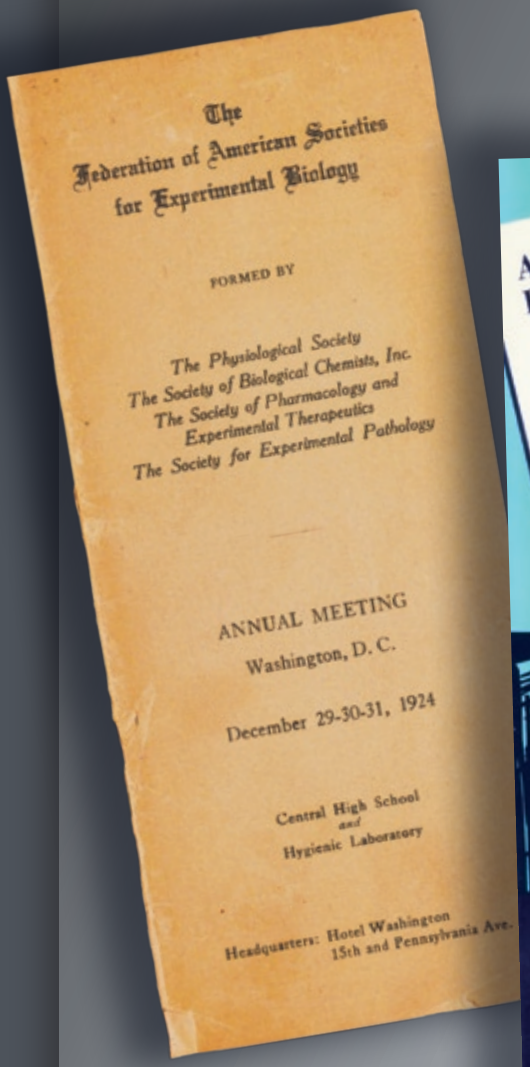
September 2009



A History of the ASBMB Annual Meeting

American Society for Biochemistry and Molecular Biology

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ASBMB
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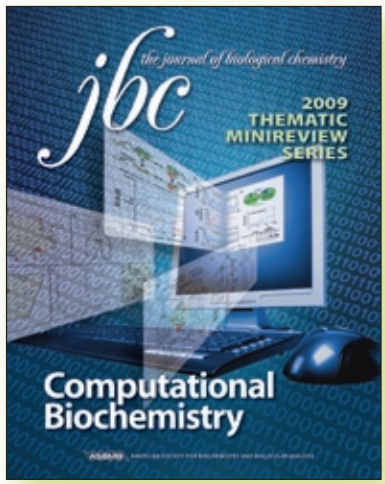

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erratum

The article on the 2009 ASBMB election results in the August issue of *ASBMB Today* mistakenly identified Charles Brenner as professor and head of the Biochemistry Department at Dartmouth Medical School. He is, in fact, head of biochemistry at University of Iowa's Carver College of Medicine.

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2008 APEX AWARDS FOR PUBLICATION EXCELLENCE

president's message

Wimps? What Wimps?*

BY GREG PETSKO

They arrive the last week of August on college campuses all over the U.S. Accompanied by anxious, hovering parents (indeed, the term "helicopter parents" has entered the lexicon), they spill out of rented vans and SUVs, looking bewildered and much younger than their years. They are the freshmen, the entering university students who are about to experience, for the first time in their lives, the thrill of independence.

Or are they? Increasingly, American college students are going through their 4 years of higher education—and often years more beyond that—still firmly attached to the parental umbilical cord. It's an invisible umbilical cord—you probably call it a cell phone—but it's an umbilical cord nonetheless. It's not that unusual for some third- and fourth-year students at university to call or text their parents several times a day. Some of these calls are simply to share the most mundane details of their daily lives, but a large number of them are to ask advice on everything from what courses they should be taking, to what activities they should join, to what they should do about a roommate who snores.

This is completely different from my college experience, and, I suspect, the college experience of practically everyone in my generation. True, we didn't have portable communication devices, but I don't think it would have made any difference if we had. We didn't want to be in constant contact with our parents. We went away to college, in part, so as not to be in constant contact with our parents. What's more—and this is the key point, I think—our parents didn't want to be in constant contact with us. Okay, one time when I hadn't phoned home for more than a week to reassure my folks that I was still alive and spending their hard-earned tuition money, when I finally did call, reversing the charges as usual, my father, on being asked by the operator if he would accept a collect call from his son Greg, replied, "I have no son named Greg. I used to have one, but we haven't heard from him in 30 years," and hung up. But that was an extreme situation. The point is, if I had suddenly started phoning home three or four times a day, my mother would have called the university health service to get them to find out what was wrong with me, and my father would have called the campus police to get them to find out who was impersonating their son. And most of their contemporaries would have reacted the same way.

A few years ago, psychologist Hara Estroff Marano wrote an article in *Psychology Today* called "A Nation of Wimps." (You can find it at www.psychologytoday.com/node/21819 and I urge you to do so; it's worth reading.) In it, he argues that we are in danger of raising a generation of Americans who are unable to think for themselves, who have a distorted view of the world as a dangerous and hypercompetitive place, who are accustomed to gaming the system because their parents have bought or finagled special privileges for them throughout their childhood, and whose self-esteem is consequently nowhere near what it should be. Here are a couple of excerpts:

"Behold the wholly sanitized childhood, without skinned knees or the occasional C in history. Kids need to feel badly sometimes," says child psychologist David Elkind, professor at Tufts University. "We learn through experience, and we learn through bad experiences. Through failure, we learn how to cope." Messing up, however, even in the playground, is wildly out of style. Although error and experimentation are the true mothers of success, parents are taking pains to remove failure from the equation…

"No one doubts that there are significant economic forces pushing parents to invest so heavily in their children's outcome from an early age. But taking all the discomfort, disappointment, and even the play out of development, especially while increasing pressure for success, turns out to be misguided by just about 180 degrees. With few challenges all their own, kids are unable to forge their creative adaptations to the normal vicissitudes of life. That not only makes them risk-averse, it makes them psychologically fragile, riddled with anxiety. In the process they're robbed of identity, meaning, and a sense of accomplishment, to say nothing of a shot at real happiness. Forget, too, about perseverance, not simply a moral virtue but a necessary life skill. These turn out to be the spreading psychic fault lines of 21st century youth. Whether we want to or not, we're on our way to creating a nation of wimps."

"Increasingly, American college students are going through their 4 years of higher education—and often years more beyond that—still firmly attached to the parental umbilical cord."

I've taught college freshmen for almost 30 years, and let me tell you, I think for many of our youth that ship has already sailed. During the past couple of decades, I have seen students on average become less independent and more fearful, indecisive, and risk-averse. Many of them have been so suffocated by their parents and so insulated from even the slightest disappointment by well-meaning, but ineffectual, educators that they are likely to be locked in a state of adolescence for years after they graduate. And because they've never learned how to handle defeat and discouragement, they are also prone to depression and acute anxiety when suddenly confronted by difficulties: in school, in relationships, and in life choices.

Now, I don't want to fall into the trap of making overgeneralizations, something I think Marano is guilty of in that article. Many students today are well-adjusted, capable, and independent young men and women. I meet them all the time. What I'm trying to say is that I have noticed an increase in the number who are not, and that increase seems to be correlated with an increase in what I would call over-parenting. It's also correlated with a sharp rise in the number of students who are documented to have some sort of learning disability, and who, therefore, are entitled to—and always request—special accommodations on tests and quizzes. I'm deeply sympathetic to any student with a legitimate difficulty that they are trying to overcome, but I worry that at least some students have been placed into a category in which they don't belong by their parents and educators as a way of helping them do better, and consequently, they never develop the confidence in their own abilities that they will need when they face a world that won't make any special accommodations for them whatsoever. So, if you allow for the somewhat sensational tone of the article, I think Marano has some important points to make.

"Whether we want to or not, we're on our way to creating a nation of wimps."

Of all the virtues to which I aspire, high on the list would be self-reliance. I take pride in being able to repair computers, fix electrical problems, do basic plumbing, and build some of my own furniture. Until cars became rife with anti-pollution devices and overburdened with complex electrical systems, I did a lot of my own automobile work, as did many people of my, and particularly my father's, generation. I like not having to depend on others any more than is absolutely necessary, and I don't mind making mistakes. But I suspect, if Marano is right, that this is one of many respects in which I am about to become as uncommon as a wooly mammoth.

Yet there is one place where you can still find young people who take risks, think for themselves, and persevere. That place is anywhere you find a junior faculty member in the sciences. We may be about to become a nation of wimps, but the ranks of the instructors and assistant professors constitute a wimp-free zone.

It has become a cliché that, as we get older, we tend to look down on young people as having a much easier time of it than we did. (I've caught myself about to say, to some graduate student complaining about a shortage of pipette-persons, "When I was your age, we didn't have pipettemen; we blew our own glass pipettes, and we made the glass from sand as well!") That attitude couldn't be more inappropriate in the case of scientists just starting their academic careers. Beginning investigators have a much more difficult time than we did, in just about every aspect of academic life. It's so much harder to get funding, for one thing. We went through some troughs in federal support for science when I was starting out, but nothing like the doldrums of the past 7 years. Competition is fiercer for fellowships, young investigator awards, and all the other little things that help make getting one's career going easier. The number of scientists has increased dramatically, but the number of such sources of support has not.

"...we are forcing these young people to publish their papers in journals with astronomically high rejection rates, thereby exposing them to regular pummeling from inexperienced editors and misanthropic reviewers."

Genomics hasn't made things easier. It's the main reason that biology has become a technology-driven science, which means that, to play at a high level, the cost in equipment alone can be very high. So not only does the aspiring genome biologist have to raise money in an era of tight funding, he or she has to raise more than the average senior faculty member in many other fields.

The bar is also much higher in terms of what is expected in order to gain recognition—and, eventually, tenure. "Publish or perish" has become "publish in one of a handful of journals with a high impact factor or perish." I had the luxury, when I was getting established, of publishing my papers in the places I thought they belonged, which often included highly specialized journals. Heaven help the young biologist who does that now.

Then there are the daily discouragements, which are more numerous, I think, than those we suffered at their age. Because it's harder to get grants today, the average young investigator must endure several rounds, and often years, of failure. Tough enough to get turned down when you've at least had the experience of some success. But to be told repeatedly that your proposal hasn't made the grade when you're just setting off on your own would break many a weaker person. And let's not forget, as I just pointed out, that we are forcing these young people to publish their papers in journals with astronomically high rejection rates, thereby exposing them to regular pummeling from inexperienced editors and misanthropic reviewers.

But, you say, at least they have help from of those of us who have already been through the mill. Not necessarily. I know of many institutions where the senior faculty members deliberately take a "hands-off" approach with younger colleague—a sort of "sink-or-swim" philosophy that mandates simply observing whether someone has the right stuff to make it on their own. I believe this distancing is often well-intentioned, because inviting a junior faculty member to collaborate can be the kiss of death: at many schools, if a non-tenured investigator has worked extensively with senior colleagues, when they are brought up for tenure, they are tarred with the brush of not really having accomplished anything themselves.

As if that weren't bad enough, I'm not even sure our junior colleagues get enough sympathy from their elders—at least, not in a form that does them much good. At precisely the time they need encouragement, not just about their own work but about the future of profession they are so eagerly trying to join, what they are most apt to hear from us is a litany of complaints about how difficult things are and how bleak that future looks. It's a miracle more of them don't chuck it all and go into a career with better prospects, like selling land-line telephones.

"It's a miracle more of them don't chuck it all and go into a career with better prospects, like selling land-line telephones."

So let me offer a few suggestions for things we all could do to make their struggles just a bit easier and their burdens a tad lighter. First and foremost, we should abandon, as a matter of policy, the senseless, haughty, and counterproductive belief that they must do everything on their own. Institutions should reward young scientists who collaborate effectively with their senior colleagues for helping to knit departments and programs together, not

penalize them for failing to demonstrate some macho-driven concept of "independence."

Second, we should be wary of what sort of impression our own carping makes on our young associates. Remember, we are who they want to become, and if they see us as dissatisfied, shrill, and constantly frustrated, even the best of them may have second thoughts about getting to where we are. I'm not saying we must give up complaining—at my university that'd be like suggesting that a koala bear give up eucalyptus leaves. But let's do our complaining to each other, and remember that one of the most important things we have to give to our junior faculty (and eventual successors) is a sense that this is a life worth living and a career worth fighting for. We have to help them keep hope alive.

Third, we must, as a community, condemn the practice of trashing research proposals from beginning investigators as "overly ambitious." I've seen this ploy used frequently and it always makes me furious. Being ambitious is what got us where we are. It's what drives much of the great science. It's a virtue, not a vice. I suspect that, when this charge is made, the reviewer actually doesn't have anything negative to say about the substance of the proposal but is merely trying to assert his or her own superiority. It's inexcusable behavior. If you really think the science is exciting but the investigator has proposed far more than they can do in the time allotted on the grant for the money they have requested, fund the damn thing and let them find out by experience how much can be done in 4 years time. To force them to resubmit an otherwise good proposal just to remove some specific aims gives the impression that their senior colleagues are a bunch of nit-picking, supercilious jerks. Which we probably are, but it's nothing to be proud of.

Finally, we should not forget to express to junior faculty everywhere our sympathy and understanding for what they're going through, and our gratitude that they have chosen to endure it. Because without them, our line would be extinct, and the fire of science would die out. Applaud them for their dedication, aspiration, and, above all, their fortitude. Because they are anything but a bunch of wimps.

*Reprinted with permission from *Genome Biology* (2009) **10**, 109.

Former Minority Leader Bob Michel to Receive Schachman Award

BY PETER FARNHAM

Former Illinois representative and House Minority Leader Robert H. "Bob" Michel has been selected as ASBMB's 2010 recipient of the Howard K. Schachman Public Service Award. In a letter to Michel announcing his selection, ASBMB President Greg Petsko said:

"ASBMB offers you this award not only in recognition of your many years of service in the Congress of the United States but also to recognize your efforts over the past decade to increase public and congressional support for the National Institutes of Health. Your work during and after the campaign to double the size of the NIH budget was carried out in the true spirit of public service which the Schachman Award strives to recognize. Your tireless advocacy for NIH, particularly during a time of great stress on the federal budget, was instrumental in the successful completion of the doubling campaign."

Michel was born and raised in Peoria County, Illinois. His public service began at an early age, when he served as a World War II combat infantryman with the 39th Infantry Regiment in France, Belgium, and Germany. He was wounded by machine gun fire during his combat tour and was awarded the Purple Heart and two Bronze Stars.

Upon his discharge from military service in 1946, he received a bachelor's degree from Bradley University, in Peoria, and his public service continued when he served as administrative assistant to the district's congressman, Harold Velde, from 1949 to 1956. Michel was elected as a Republican to the seat held by his former employer in 1957 and served 18 consecutive Congresses—a total of 38 years—finally deciding not to run for reelection at the conclusion of the 103rd Congress in 1994. Michel served as his party's leader in the House of Representatives from the 97th through 103rd Congresses.

However, it was after his service in the Congress that biomedical science became his major focus. He was a key member of the Campaign for Medical Research (CMR), and in the mid- to late-1990s, he, along with his former congressional colleague Paul Rogers, participated in hundreds of meetings on Capitol Hill to try to persuade the Congress to support a doubling of the NIH budget.

Observers who attended those meetings said that no matter how obstinate the member was with whom they were talking, Michel remained true to his genial and gentle

nature. Others who have accompanied Michel on Hill visits note how everyone seems to know him, and when going to a meeting with him, one has to allow extra time to accommodate the many people who want to stop and talk to him in the halls of House office buildings as he passes by.

Bill Brinkley, former chairman of the Public Affairs Advisory Committee, was very active in the CMR in the late 1990s and early 2000s. Brinkley reports that "I went on many, many trips to the hill that CMR arranged in those days, and Bob introduced me to almost every significant member of Congress at the time. He could open doors that no one else could open. Everyone would stop and chat. He would always introduce me and ask if the congressman could talk to me, and often it would happen spontaneously without an appointment. Bob was dedicated to biomedical research, and he played a vital role in the doubling campaign."

"Bob Michel is a giant and will serve as a fine role model for future Schachman awardees. He has done a terrific job for medical sciences," says Robert D. Wells, former ASBMB president, who worked with Michel on the doubling campaign during his presidency.

On January 18, 1989, outgoing President Ronald Reagan conferred upon Michel the Presidential Citizens Medal, the second highest civilian award given, making him the 7th recipient of the honor. On August 8, 1994, he was awarded the Presidential Medal of Freedom, the highest civilian award in the United States, by President Bill Clinton.

While in Congress, Michel was the usual starting pitcher on the Republican side during the annual Democrats *versus* Republicans baseball game.

Michel is memorialized in his district by The Bob Michel Bridge, carrying Route 40 across the Illinois River in Peoria. In addition, his alma mater, Bradley University, named the Student Center after him. Finally, in the Capitol, the second floor suite of offices occupied by the Speaker were designated the Robert H. Michel Rooms by the House in 1995.

The Schachman Award recognizes an individual who best demonstrates dedication to public service in support of biomedical science, as exemplified by the award's namesake, Howard K. Schachman, who served as chairman of ASBMB's Public Affairs Advisory Committee for more than 10 years. The Award is given annually, and candidates are considered by the Society's Public Affairs Advisory Committee. The award consists of a permanent keepsake, as well as an honorarium and an opportunity to deliver a lecture at a Society function. The Public Affairs Advisory Committee plans to present the Award to Michel on September 21 in Washington, D.C.

On behalf of the Society, *ASBMB Today* offers its congratulations to Michel on his receipt of this award.

Peter Farnham is Director of Public Affairs at ASBMB. He can be reached at pfarnham@asbmb.org.

Third Science Policy Fellow to Start in August

ASBMB's third Science Policy Fellow, Kyle Michael Brown, began his fellowship at Society headquarters in Bethesda on August 17. Although Brown is only beginning his policy career, he brings a strong background in public policy to the job. He double majored in biology and government as an undergraduate at Georgetown University and met with congressional staff during his years in Washington on science policy-related issues. As a Ph.D. student at Harvard University (he earned his doctorate in evolutionary genetics this past May), he provided science advice to a Massachusetts state senator and testified in the Massachusetts State Legislature on safe alternatives to toxic chemicals. He also worked on policy and funding issues with the American Institute of Biological Sciences in 2007 and 2008, receiving an Honorable Mention for one of the AIBS's Emerging Public Policy Leader Awards in 2007. ASBMB is delighted to have Brown join the staff, and readers of *ASBMB Today* will soon be seeing his byline in the magazine.

The ASBMB Science Policy Fellowship was established in 2007 and has proven to be a valuable addition to the Society's public affairs program. The Fellowship is open to new Ph.D.s. The fellow comes to Washington, D.C. and spends 15–18 months working on public policy issues in ASBMB's offices in Bethesda. If you know a student who might be interested in applying for the upcoming fellowship term (which will begin in the late summer or early fall of 2010) please have them contact ASBMB Director of Public Affairs Peter Farnham at pfarnham@asbmb.org.

Quantifying the Benefits of Research

BY ALLEN DODSON

Biomedical research draws broad popular and bipartisan support on the promise of cures for diseases and the improvement of human health. With the economic circumstances of the last year, however, research has taken on a new significance for its more immediate impact. Combined with a strong push for transparency and online access, new tools and methods that have appeared in the last few months have added a major new tool for policy advocacy.

Measuring the "Multiplier" Effect

Research dollars are spent on a multitude of salaries, supplies, and services. The companies that provide equipment and reagents make purchases from their suppliers and pay their own sales and support employees. These salaries are spent as well, on cars and appliances or trips to the local coffee shop. In this very qualitative way, it makes sense to imagine that a dollar spent on research can have more than a dollar's worth of effects on the economy. The question was how to quantify this "multiplier effect."

In June of 2008, the healthcare advocacy group Families USA attempted to put their fingers on the hard numbers, in a report titled "In Your Own Backyard: How NIH Funding Helps Your State's Economy." The report contains details of jobs that are possible because of NIH research and on the business activity multiplier for each of the 50 states.

Reporting the Results

Perhaps equally valuable is a new push by the major funding agencies to make information on awards available online. NIH recently revamped its Research Portfolio website (RePort), and with a few mouse clicks, you can identify research in a specific disease area or work done within a given state or Congressional district.

This newly enhanced database arrived just in time for the passage of the American Recovery and Reinvestment Act (ARRA) and its billions of dollars in research funding. The new NIH database allows for specific searches of recovery act projects, giving research advocates a very concrete way to measure the benefits of the stimulus legislation.

Putting the Numbers to Work for Research

Focus group testing by FASEB has shown that average Americans do not know that NIH is a research funding agency. NIH lacks the pop culture exposure of agencies like the Centers for Disease Control and Prevention and the Food and Drug Administration. Americans who have heard of NIH believe that it is primarily responsible for making public health announcements, or, if they know that the agency conducts research, believe that its activities are focused entirely at the campus in Bethesda, Maryland.

This lack of public knowledge about NIH creates a problem for research advocacy. The Congressional committees that oversee NIH must choose directly between funding for research and other visible public priorities like education and healthcare. Without a greater understanding that funding for NIH supports jobs in research and future cures all around the country, it is difficult for even the most sympathetic Congressmen to make that tradeoff.

Now, more than ever, researchers have access to information that can make the case for research. While it is important to pass that information along to Congress it is equally important for the general public to hear about the benefits of biomedical research. For perhaps the first time, regular researchers have access to the information they need to make that case in newspaper op-ed letters and public discussions. This knowledge is the power to secure increased support for biomedical research in the future.

Allen Dodson is an ASBMB Science Policy Fellow. He can be reached at adodson@asbmb.org.

RESOURCES

The Families USA report:
http://tinyurl.com/7eq7oz

NIH's RePort site:
http://report.nih.gov/

A similar database for the National Science Foundation:
www.nsf.gov/awardsearch

Congress Extends SBIR Program as Details Are Negotiated

BY CARRIE D. WOLINETZ

The House and the Senate both passed bills this summer to reauthorize and improve the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs but were unable to reconcile differences between the bills in conference. Of interest to FASEB members, the Senate bill includes an increase of the SBIR funding set-aside from 2.5 percent to 3.5 percent. The set-aside is taken from the budget of 11 research agencies, those whose budgets exceed $100 million, including NIH, NSF, the United States Department of Agriculture (USDA), and the Department of Energy (DoE). Although the increase will be gradual, it will boost the allocation for the SBIR program by 40 percent, redirecting $1 billion in research funds into the SBIR program.

FASEB has led an effort to support the House version of the bill, which passed in early July, that does not include the set-aside increase. On June 23, FASEB joined nearly 100 groups in sending a letter to both the House and Senate opposing the set-aside increase and urging lawmakers to increase federal investment in all research, rather than increasing funding for one program at the expense of others. FASEB President Mark Lively met with staff aides on the House Small Busixness Committee, and reiterated the research community's concerns about the Senate bill. "FASEB supports the SBIR program and recognizes the benefits of the participation of small businesses in scientific research," Lively stated, and noted that there is no cap on the SBIR program, which means that agencies can fund meritorious SBIR applications above the current set-aside level. "Rather than increasing support for one area of research at the expense of all others, we urge you and your colleagues in Congress to increase funding for all research agencies, thereby increasing the total investment in SBIR and other projects," he continued. FASEB has also contacted the Office of Science and Technology Policy (OSTP) in the Executive Office of the President, including OSTP Director John Holdren and co-chairs of the President's Council of Advisors on Science and Technology (PCAST) Harold Varmus and Eric Lander, as well as activating its grassroots in support of the House version of the bill. FASEB's efforts have been profiled in both *Science* and *The New York Times.*

> **"Rather than increasing support for one area of research at the expense of all others, we urge you and your colleagues in Congress to increase funding for all research agencies, thereby increasing the total investment in SBIR and other projects."**

In addition to the differences in the set-aside increase, the House bill contains a provision that would allow greater participation by venture capital backed companies in the program. Although FASEB does not have a position on this issue, it has proven contentious in trying to reconcile the two versions and undoubtedly played a role in the failure of the conferees to come to agreement. Although the SBIR/STTR programs were due to expire on July 31, Congress passed, and the President signed, S.1513, an extension of the program through September 30, 2009. This temporary extension will allow the SBIR reauthorization pre-conference negotiations between the House and Senate to continue at a staff level through the August recess, with a formal conference sometime in September.

Carrie D. Wolinetz is Director of Scientific Affairs and Public Relations for the Office of Public Affairs at FASEB. She can be reached at cwolinetz@faseb.org.

Retrospective: Ephraim Katchalski Katzir (1916-2009)

BY CYRIL M. KAY AND HOWARD K. SCHACHMAN

Ephraim Katzir, whose creative research in the 1940s had a seminal impact on the development of protein science, died on May 30, 2009 at the age of 93. His pioneering research as a graduate student at The Hebrew University of Jerusalem led to a new field of science—the design, construction, and application of synthetic polypeptides as models of natural proteins. Ephraim also played major roles in the founding of the Weizmann Institute of Science and the establishment of the State of Israel of which he was the fourth President (1973–1978).

The Katchalski family emigrated from Poland to Palestine in 1922 when Ephraim was six, and his older brother, Aharon, was nine. Both brothers had a deep interest in science, graduating from The Hebrew University of Jerusalem. Ephraim's fascination with the flora around Jerusalem led him to study biology, but he switched to the newly opened Department of Theoretical and Macromolecular Chemistry, where he conducted his groundbreaking Ph.D. research with Max Frankel. Their studies on the polycondensation of α-amino acid esters to form polypeptides of glycine and alanine resulted in two papers in 1942 (1, 2). But Ephraim, dissatisfied with the use of amino acid esters, looked for other derivatives to make the desired polymers.

That search led him to the α-*N*-carboxyl amino acid anhydrides synthesized by Leuchs in 1906, launching a new direction for research on proteins. The resulting paper was originally rejected by a *Journal of the American Chemical Society* editor who was not convinced that a polymer was produced. Months elapsed before it was resubmitted with additional evidence and finally published in October of 1947 (3). The editor had difficulty fathoming the reason for this delay, not knowing that Ephraim was deeply involved as an Officer of the Haganah in the War of Independence leading to the establishment of the State of Israel in 1948. During that turmoil, both Katchalski brothers received invitations to join the new Weizmann Institute of Science. Ephraim founded the Department of Biophysics and was its head for many years, while Aharon formed the Department of Polymers, which he headed until his death at the hands of terrorists at Ben Gurion Airport in May of 1972. Largely as the result of the creative research of the Katchalski brothers, the Weizmann Institute of Science became internationally renowned and was the launching pad for many talented students who earned international reputations.

Polypeptides as Models

A flood of papers followed Ephraim's poly-L-lysine article. Better methods for removing blocking groups from side chains were discovered, and a variety of polypeptides such as poly-L-histidine, poly-L-aspartic acid, and poly-L-proline were synthesized along with different copolymers. These macromolecules became the subject of research in physical chemistry laboratories throughout the world. They served as models for optical rotation, circular dichroism, infrared spectroscopy, and x-ray diffraction studies aimed at determining the structure of polypeptide chains in proteins and analyzing conformational changes. Tests of theories of the helix-coil transition were based on experiments with polyamino acids of varying molecular weights and compositions. Experiments on the "melting" of helical polypeptides to form random coils were relevant to ongoing investigations of protein denaturation. The exciting demonstration by Ephraim and his colleagues of the *cis* and *trans* configurations of the peptide bonds in

poly-L-proline played a major role in elucidating the structure of collagen. Their accompanying analysis of the conformations of the polymer in solution demonstrating both right-handed and left-handed helices proved invaluable in much later research on the kinetics of protein folding. The striking discovery that certain amino acids had a propensity to form α-helices, whereas others preferred β-parallel or anti-parallel pleated sheets, had a major impact on research aimed at predicting and determining the structures of proteins. Studies on highly charged polypeptides were crucial in the development and testing of theories of polyelectrolyte behavior. Synthetic polypeptides also were of value in initial investigations of the genetic code, when it was shown that the product of cell-free synthesis using polyuridylate as messenger RNA corresponded to the poly-L-phenylalanine that had been synthesized earlier by chemical means.

An outgrowth of the synthesis of linear polypeptide chains was the construction of multichain polyamino acids and polypeptidyl proteins with polypeptide chains attached covalently to free amino groups. Through these methods, the Katchalski group synthesized polytyrosyl gelatin, and the demonstration of its antigenicity led to an outstanding research program on the formation of synthetic antigens in the laboratory of one of Ephraim's first students, Michael Sela.

Immobilized Enzymes

During the time he was studying synthetic polypeptides, Ephraim started constructing "water insoluble enzymes" that were fully active catalytically. In 1960, he published a paper titled "A Water-insoluble Trypsin Derivative and Its Use as a Trypsin Column" (4) with Atara Bar-Eli. Such columns, they noted, could be "employed repeatedly to induce specific chemical changes in relatively large amounts of substrates." In preparing this column, Katchalski and Bar-Eli used trypsin to initiate the polymerization of *N*-carboxy-L-tyrosine anhydride to form water-soluble, fully active polytyrosyl trypsin. It was then coupled to a diazotized copolymer of *p*-aminophenylalanine and leucine, leading to the insoluble product used as a trypsin column. This imaginative adaptation of the various techniques developed in Ephraim's laboratory was the start of a major international activity leading to industrial processes. For his contributions in the development of immobilized enzymes, Ephraim was awarded the first Japan Prize in 1985.

Education and Training

While deriving a strong sense of aesthetic pleasure from his own research, Ephraim also enjoyed involvement with students and protégés. To pay his debt to teachers who helped shape his aspirations, he developed an extramural scientific program for children on Israeli university campuses. He also co-edited a popular science magazine called *Madah* (Science) aimed at a youthful audience.

Ephraim loved to teach, and it showed; he literally radiated enthusiasm in his lectures. His thoughtful and creative scientific research attracted many trainees, and he delighted in their development as independent investigators. Ephraim always considered these individuals as a second family, and he was particularly proud that three former students became department heads at the Weizmann Institute: Avraham Patchornik (Organic Chemistry), Michael Sela (Chemical Immunology), and Izchak Steinberg (Chemical Physics).

Service to the Nation

Ephraim had a strong sense of national responsibility, which was reflected in the number of positions he assumed in government activities. This included service as Chief Scientist of the Israel Defense Ministry and Chairman of the National Council for Research and Development and the Council for the Advancement of Science Education.

In May 1973, the Israeli Knesset elected Ephraim the fourth President of the State of Israel. It was then that he adopted the Hebrew name Katzir, as his brother Aharon had done earlier. His term in office was a difficult one, since it began some four months prior to the outbreak of the Yom Kippur war and a year after the tragic murder of Aharon, who was the original designee to be President. The presidency of Israel is an honorific and ceremonial position wherein the incumbent symbolizes moral rather than political leadership for the nation. Ephraim fulfilled that role admirably; he was responsive to the needs of the people of Israel, who found in their President a deep resonance with their concerns, their pain, their joys, their achievements, and their dreams.

Post-presidency Research

Following his presidential term of office, Ephraim returned to science at both the Weizmann Institute, as an Institute Professor, and the University of Tel Aviv, where he founded the Department of Biotechnology. In the 1980s, Ephraim

played a major role in the development of biotechnology that catapulted Israel into the forefront internationally.

In his later years at Weizmann, Ephraim investiaged molecular mechanisms of protein interactions between specific proteins and peptides selected from a random peptide library. This approach contributed to a more precise definition of the structural requirements for the binding of a neurotoxin (bungarotoxin) in the nervous system. He also led a group that developed a theoretical protein-protein recognition algorithm (docking) that successfully predicted the structure of the complex between β-lactamase and the protein inhibitor BLIP, before it was experimentally determined. Clearly, the novelty of Ephraim's research continued to the end.

Honors and Legacy

Ephraim received many honors including membership in the Israel Academy of Sciences and Humanities, the Royal Society of London, the U.S. National Academies, and the Académie des Sciences in France. He received the Rothschild and Israel Prizes in Natural Science, the Linderstrøm-Lang Gold Medal, the Engineering Foundation's International Award in Enzyme Engineering, and he was appointed to France's Order of the Legion of Honor.

In addition to his scientific legacy, there are the memories that we will always treasure: the warm humaneness, the unfailing generous spirit, the intellectual honesty and generosity, the insatiable curiosity, the possession of an inner strength rarely encountered, and the unflagging enthusiasm for life. The protein science community has lost an outstanding researcher, a selfless supporter of the scientific enterprise, and an inspirational educator.

His own words provide a beautiful summary of his career:

> "…I have had the opportunity to devote much of my life to science. Few activities can be more rewarding than conducting research that leads to a better understanding of the phenomena of life and nature, and indeed my work in all its aspects—research, teaching, collaboration with colleagues, and promotion of scientific activities—has brought me great personal fulfillment.
>
> "Yet, my participation over the years in activities outside science has taught me that there is life beyond the laboratory. I have come to understand that if we hope to build a better world, we must be guided by the universal human values that emphasize the kinship of the human race—the sanctity of human life and freedom, peace between nations, honesty and truthfulness, regard for the rights of others, and love of one's fellows."

Below, as a tribute to Ephraim we offer thoughts and reflections from several of his friends and colleagues.

I was one of Ephraim's first Ph.D. students. He has been a great teacher and a close friend for the past 59 years. His contribution to science and to the State of Israel has been enormous.

His original development of polyamino acids and water-insoluble enzymes has been among his many important contributions to science worldwide. His optimism in the future of science and its role in the progress of humanity has been paramount, notwithstanding tragedies in his family.

Characteristic of him, were his warm heart, kindness, sense of humor, and desire to help others.

Michael Sela
W. Garfield Weston Professor of Immunology
Weizmann Institute of Science

It was a wonderful period for us to be graduate students with Ephraim in what was then the newly established Biophysics Department at the Weizmann Institute. Ephraim was a true scholar. He showed true respect for other people's opinion and ideas, often expressing his own opinion in Yiddish to clarify his point.

Ephraim's schedule for a work day was interesting and unusual. The day usually started with a meeting with one of the students very early in the morning, studying a subject that often was completely unrelated to the student's research. To an outsider, he probably looked like a checkmate game master who played a simultaneous game against a group of student players.

Scientific writing was done at night, often in a small group, with the involved partners in the famous Ephraim's style, which involved checking and rechecking every word until Ephraim was satisfied, regardless of the tired eyes of the participants. (He never seemed to get tired himself.)

It was certainly a privilege to be associated with Ephraim. His death is a sad loss to all of us.

Izchak Steinberg
Professor Emeritus of Neurobiology
Weizmann Institute of Science

I knew Ephriam as a friend and a scientific collaborator. I first met him at a Proteins Gordon Conference in the 1950s, where I heard his brilliantly delivered and exciting

lecture on polyamino acids. Later, in December 1959, on a return trip from a summer lecture course in Melbourne, Australia, I stopped at the Weizmann Institute to visit Ephraim and deliver a lecture in his biophysics department. In 1963, Ephraim graciously accepted me in his laboratory during my sabbatical leave from Cornell, and I have been a steady visitor to the Weizmann Institute almost every year since then, including another sabbatical leave there in 1970.

During all these years, I had very close scientific contact with Ephraim, with much give and take on scientific issues, on Israeli politics, and other topics, either in his office or in his home on the campus. We had many overlapping scientific interests and challenged each other with problems at the frontier of our field. This relationship continued even in his home in Jerusalem when he became President of the State of Israel. As President, Ephraim convened many scholarly discussion groups, to which he invited me. It was there that I met many of university intellectuals and Israeli government officials and benefited from wide-ranging discussions there.

Ephraim was the father of the field of polyamino acids, including his studies of the synthesis and physical and biological properties of these biopolymers. He had a vivid imagination that enabled the field to make leaps of progress at many stages of its development. His international stature as a scientist brought honor and fame to the Weizmann Institute and to the State of Israel. I am very pleased to have known him and am saddened only in never again being able to drop into his home on the campus for coffee and exciting discussions.

Harold A. Scheraga
George W. and Grace L. Todd Professor of Chemistry, emeritus, Cornell University

Looking back at my career, it is clear to me that I have been extremely fortunate in having had Aharon and Ephraim as mentors and friends. Both brothers were gifted and broad-minded scientists, original thinkers who made seminal contributions, each in his respective area, Aharon in polymer science, Ephraim in protein research. They were mesmerizing speakers and inspiring teachers with friendly and warm personalities. I first came to know them in 1948, during the Israel War of Independence, when I served under their command in the Scientific Corps of the Israel Defense Forces, of which they were also among the founders. Subsequently I did my Ph.D. research on the interaction of monosaccharides with amino acids under Aharon at his Department of Polymers of the Weizmann Institute. Soon after, in 1954, Ephraim took me into his fledgling Department of Biophysics. Although he and his colleagues were then fully occupied in their ground breaking studies of synthetic polyamino acids as protein models, he still gave me the freedom to move to work on carbohydrates and lectins, for which I have been ever grateful to him.

Ephraim would often tell us that doing basic research in Israel is a special privilege and that it is justified only if it is of the highest level. He also used to say that scientists in Israel must take an active part in contributing to the solution of national problems, for example in education, technology, or industry. He not only preached but also acted; his pinnacle was his service as Israel's President.

Nathan Sharon
Weizmann Institute of Science

Ephraim taught a course in biophysics in 1962 that included laboratory experiments. The course was given at The Hebrew University of Jerusalem, where I completed my M.Sc. thesis, and the laboratory experiments were conducted at The Hebrew University of Jerusalem and the Weizmann Institute. The course opened my eyes to macromolecules, mainly polyamino acids. It was a fascinating time in macromolecular biochemistry because polyamino acids were the only pure molecules that mimicked proteins and whose properties could be studied in a precise manner. I therefore came to the conclusion that one could utilize polyamino acids also as models for enzymes, so I moved to the Weizmann Institute where the action was. I wanted to generate a model enzyme, so I, together with Israel Pecht, generated a complex between Cu(II) and polyhistidine and proved that this complex indeed behaved as an oxidative enzyme. Ephraim was immensely impressed with this finding because it was a proof that polyamino acids can mimic enzymes. He therefore hooked me up with Arieh Berger, a great enzymologist at the Department of Biophysics, with whom I finished my Ph.D.

Alexander Levitzki
Wolfson Family Professor of Biochemistry
The Hebrew University of Jerusalem

Ephraim was my postdoctoral mentor from 1971 to 1972. He gave me the greatest time of my life, scientifically speaking, as his office was always open to me, and his mind was always receptive to discussing scientific ideas. I think Ephraim's great success as a scientist was embodied in the four enduring lessons I learned from him: 1) words matter; 2) use synthetic chemistry to study biological problems; 3) know and love your system; and 4) build a team. Ephraim lived these lessons and imparted them to his colleagues and students. His legacy will endure in the lives of those he touched and in the greater context of science in Israel.

Jeffrey M. Becker
Professor and Head, Microbiology Department
University of Tennessee, Knoxville

Ephraim was my postdoctoral mentor. I remember him as a passionate advocate for basic research who taught his students a love of science and a tremendous respect for careful systematic investigation. He always urged us to see the big picture and to pursue important problems. In that respect, he added greatly to the biochemical sciences in peptide synthesis, enzymology, protein chemistry, biotechnology, and immunology. He was my teacher, my supporter, and ultimately, a dear friend. I and his other students will miss him terribly.

Ephraim emulated the importance of hard work to scientists. He led a large group of scientists and was also involved in many aspects of Israeli society. These included advocacy for applications of scientific research in the industrial sector, and science policy vis-à-vis the security of Israel and its impact on the economy. Given his enormous responsibilities, he needed to find a way to provide access to the young scientists that he trained into his late 1980s. One way he did this was working literally around the clock. I remember writing papers with him through the night, from 1 am to 6 am. How did he do this? He took brief naps to regenerate his strength and then plowed ahead. He was truly a force to behold.

Fred Naider
Distinguished Professor of Chemistry and Biochemistry, College of Staten Island
The City University of New York

During my last meeting with Ephraim, he was really very tired, but he took my hand, looked in my eyes, and asked me how will we, at the Weizmann Institute and in Israel at large, succeed in recruiting excellent, top candidates for faculty positions. "Getting bright people is so important for our future," he added. That was two hours before his death.

Benny Geiger
Dean, Faculty of Biology
Department of Molecular Cell Biology
Weizmann Institute of Science

Ephraim was an excellent scientist, teacher, and human being. His door was always open. Whenever I had a problem or results I did not fully understand, I went to him. During our discussions, everything became clear. He was also a great lecturer. Three days before he passed away, I visited him, and he told me that the most important thing is to take care of young scientists.

Meir Wilchek
Professor of Biological Chemistry
Weizmann Institute of Science

Ephraim achieved the almost unbelievable; while remaining for his entire adult life totally immersed in science, breathing it 24-7, he managed also to leave an unforgettable signal imprint on the Israeli society at large. He did this not only by training scores of students and postdocs, many of whom are the backbone of Israeli science, but also by serving in key positions on the national scene. These included the chief scientist of the Ministry of Defense, head of various government committees, and, ultimately, the President of the State of Israel. I will particularly remember him for being a very wise, highly influential, and broad-minded mentor with a terrific sense of penetrating humor.

Yadin Dudai, Professor
Weizmann Institute of Science

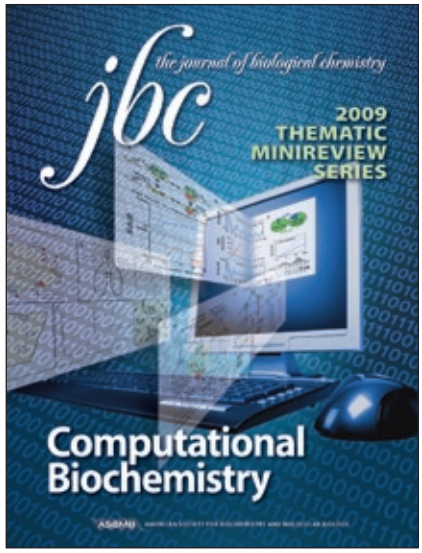
Cyril M. Kay is an emeritus professor of Biochemistry at the University of Alberta, and Howard K. Schachman is a professor of Molecular and Cell Biology at the University of California, Berkeley.

REFERENCES

1. Frankel, M., and Katchalski, E. (1942) Poly-condensation of α-Amino Acid Esters. I. Poly-condensation of Glycine Esters. *J. Am. Chem. Soc.* **64**, 2264–2268.
2. Frankel, M., and Katchalski, E. (1942) Poly-condensation of α-Amino Acid Esters. II. Poly-condensation of Alanine Ethyl Ester. *J. Am. Chem. Soc.* **64**, 2268–2271.
3. Katchalski, E., Grossfeld, I., and Frankel, M. (1947) Poly-Lysine. *J. Am. Chem. Soc.* **69**, 2564–2565.
4. Bar-Eli, A., and Katchalski-Katzir, E. (1960) A Water-insoluble Trypsin Derivative and Its Use as a Trypsin Column. *Nature* **188**, 856–857.

JBC Highlights Computational Biochemistry

BY NICK ZAGORSKI



Understanding how complex biological systems operate requires a thorough description of their underlying biochemical mechanisms. Until recently, most approaches toward describing these biochemical mechanisms have been experimental. Although this has added to our understanding of the biochemical basis of biological processes, it has also brought a vast and somewhat disjointed "parts list." As this list continues to grow and become increasingly connected, scientific reasoning coupled with experimental observation becomes insufficient in providing a detailed understanding of how these systems function. This has led to the recent resurgence of computation as a major tool in studying systems biology.

To bring attention to this emerging discipline, the *Journal of Biological Chemistry* brought together a series of six minireviews this past February that describe some diverse research areas where computational approaches have provided mechanistic insight into the regulation and function of complex systems. Organized by Ravi Iyengar and *JBC* Editor Herbert Tabor, the "Computational Biochemistry" thematic series, which emphasizes the systems level knowledge that computation provides rather than focusing on computational methods, should open the eyes of many *JBC* authors and readers to the possibilities of using computational approaches in their own research. This series will also serve as a great primer for anyone attending the upcoming ASBMB-sponsored small meeting, "Systems Biology for Biochemists," which will be held on October 22—25 in Granlibakken, Lake Tahoe (http://tinyurl.com/l6e5la, see also the article in the April 2009 *ASBMB Today*).

In the first minireview, Jennifer Linderman describes how modeling G protein-coupled signaling pathways has been valuable not only in understanding basic mechanisms of signal transduction such as collision coupling but also in drug discovery and modeling disease. Thomas Pollard and Julien Berro's review provides a feel for the full range of ways in which mathematical modeling helps us understand actin cytoskeleton-dependent cell movement from the three-dimensional structure of actin monomers to the organization of actin filaments to how filament structure drives movement at the leading edge of the cell. Jeffrey Kearns and Alexander Hoffman describe studies of NF-κB that have been useful in developing the concept of cell-state-dependent rate limiting steps and the role that different isoforms of the same protein play in contributing to complex behavior.

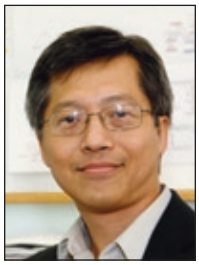
In the fourth minireview, Iyengar and Susana Neves discuss how computational analyses of spatially restricted biochemical reactions, such as membrane-bound receptor binding, have helped identify spatial information as a distinct entity that is transmitted through cell signaling networks. Avi Ma'ayan introduces the utility of graph theory in dealing with and inferring mechanisms from large data sets; graphs have been successfully applied to model complex systems in numerous disciplines, and, similarly, graph-based network analysis has been extremely useful in understanding global regulatory features of large biochemical systems. Finally, Jan Schellenberger and Bernhard Palsson describe emerging methods for dynamic studies of metabolic networks based on whole genomes. Although models of metabolic networks are themselves not new, this review discusses new approaches that help convert static network maps into dynamic systems, providing a glimpse of how the future of computational biochemistry may look.

The series is available at www.jbc.org/thematics.

Nick Zagorski is a science writer for ASBMB. He can be reached at nzagorski@asbmb.org.

asbmb member spotlight

Liao Garners Marvin J. Johnson Award



James C. Liao, Chancellor's Professor of Chemical & Biomolecular Engineering at the University of California, Los Angeles, has been selected to receive the Marvin J. Johnson Award in Microbial & Biochemical Technology from the Biochemical Technology Division of the American Chemical Society. The award, sponsored by Pfizer, was given to Liao for his work in metabolic engineering and systems biology.

Liao's research encompasses many areas. He uses metabolic engineering and systems biology principles to produce next-generation biofuels, and he also develops novel gene-metabolic circuits for use in bioenergy research. Liao is also involved in investigating fat metabolism in hepatocytes and nitric oxide signaling in humans and bacteria, as well as intracellular regulation and metabolism.

Walsh Awarded Inaugural Scott Medal

Christopher T. Walsh, Hamilton Kuhn Professor of Biological Chemistry & Molecular Pharmacology at Harvard Medical School, has been awarded the inaugural A. Ian Scott Medal from the American Chemical Society Texas A&M Section and Texas A&M University's Department of Chemistry. The medal recognizes excellence in biological chemistry research.

Walsh received the A. Ian Scott Medal for his contributions to the area of bioorganic chemistry related to natural products. His research focuses on biological catalysis and enzymatic reaction mechanisms and uses a variety of approaches centered on protein biochemistry to decipher the molecular logic of enzymes. Walsh and his colleagues study the enzymatic synthesis of dedicated monomers for the enzymatic assembly lines, the organization and function of the assembly line machinery, and enzymes involved in maturation and tailoring steps after release of nascent products from the assembly lines. Ongoing projects include investigating the enzymatic pathway for biosynthesis of the vancomycin family of glycopeptide antibiotics; examining the enzymatic assembly lines that make enterobactin, the *Escherichia coli* siderophore, pyochelin from *Pseudomonas aeruginosa*, vibriobactin from *Vibrio cholerae*, and yersiniabactin from *Yersinia pestis*; and studying the biogenesis of epothilone (antitumor agent), rifamycin (antitubercular drug), and yersiniabactin to decipher the rules for switching between polyketide synthase and nonribosomal peptide synthetase assembly lines in the synthesis of these proteins.

Silverman Awarded Perkin Medal

In recognition of his outstanding work in applied chemistry, the Society of Chemical Industry 2009 Perkin Medal has been awarded to Richard B. Silverman, the John Evans Professor of Chemistry at Northwestern University.

The Perkin Medal, established in 1906, is given annually to a scientist residing in America for an "innovation in applied chemistry resulting in outstanding commercial development." It is considered the highest honor given in the U.S. industrial chemical industry.

The medal commemorates the discovery of the first synthetic dye by Sir William Henry Perkin in 1856. The medalist is chosen by a jury of officers from the Society of Chemical Industry, the American Chemical Society, the American Institute of Chemical Engineers, and the Chemical Heritage Foundation.

Silverman's research focuses primarily on medicinal chemistry: studying the molecular basis of drug action, reaction mechanisms of enzymes, and design and synthesis of pharmaceutical agents. He has worked to deepen the understanding of several diseases, including epilepsy, cancer, Parkinson disease, and cerebral palsy. One of Silverman's many scientific accomplishments is his synthesis and subsequent investigation of the medicinal properties of pregabalin, a γ-aminobutyric acid analog that is the active substance in Lyrica, a pain and epilepsy medication commercialized by Pfizer.

Petsko to Become IUBMB President

Gregory Petsko, Gyula and Katica Tauber Professor of Biochemistry & Chemistry at Brandeis University, has been elected to the office of President Elect of the International Union of Biochemistry and Molecular Biology. Petsko, who is currently the president of ASBMB, will assume the position of IUBMB president in 3 years at the IUBMB Congress in Seville, Spain.

The IUBMB unites biochemists and molecular biologists in 77 countries through their academies of science, research councils, or biochemical societies which belong to the IUBMB as either Adhering Bodies or Associate Adhering Bodies. Its mission is to foster and support the growth and advancement of biochemistry and molecular biology as the foundation from which the biomolecular sciences derive their basic ideas and techniques in the service of mankind.

Current IUBMB President Angelo Azzi commented, "I 'wanted' Greg to become president for two reasons: I wanted a high caliber scientist and not a retired teacher at the head of the Union and I wanted one from the country where more high quality science is produced."

Sourkes Honored with Lifetime Contribution Award

Theodore L. Sourkes, professor emeritus in the Departments of Psychiatry, Biochemistry, and Pharmacology at McGill University in Montreal, has been honored with the 2009 Lifetime Contribution Award from the International Society for the History of the Neurosciences (ISHN). Sourkes received the award this past June at the annual meeting of the ISHN in Charleston, SC.

Sourkes is one of the pioneers of Parkinson disease research in Canada. He demonstrated as early as 1960 that Parkinson disease involved a deficiency in dopamine. This finding led directly to a clinical trial in which the specific neuropharmacological action of L-DOPA (which gives rise to dopamine) in Parkinson disease was demonstrated. Together with Louis J. Poirier, Sourkes then identified the pathophysiological mechanism operating in Parkinson disease, which resulted in the redirection of this research in many laboratories and clinics and in disease treatment in general.

Since his retirement in 1991, Sourkes has devoted himself to research on historical topics in biochemistry and neuroscience.

Taniguchi Receives HUPO Distinguished Service Award

Naoyuki Taniguchi has been selected to receive the HUPO Distinguished Service Award, which will be presented during a special lecture at the HUPO 8th Annual World Congress in Toronto, Canada in September.

Taniguchi graduated from the Hokkaido University School of Medicine in 1967 and completed his doctorate at the Hokkaido University School of Medicine in 1972. He was then appointed assistant professor at the Hokkaido University School of Medicine in 1975. In 1986, he joined the faculty of Osaka University Medical School as Professor and Chairman of the Department of Biochemistry, where he remains today. His laboratory focuses on glycomics and proteome research.

Taniguchi served as the chair of HUPO's Glycomics in Disease Scientific Initiative. In 2005, he was honored by the Japanese Government for his contributions to scientific research with the Purple Ribbon Medal. Taniguchi is an honorary member of the American Society for Biochemistry and Molecular Biology and has served on the editorial board of the *Journal of Biological Chemistry*.

Eight Members Named ACS Fellows

Eight ASBMB members were recognized in a ceremony this past August to honor the first class of 162 American Chemical Society (ACS) Fellows.

The ACS Fellows Program was created by the Board of Directors in December 2008 "to recognize members of the American Chemical Society for outstanding achievements in and contributions to Science, the Profession, and the Society." Unlike ACS national awards, the honor of a Fellows designation goes to those who have distinguished themselves in multiple areas, including promoting the science, the profession, and service to the American Chemical Society. Ultimately, the body of Fellows is intended to reach approximately 1–2 percent of ACS membership.

The 162 members "share a common set of accomplishments, namely true excellence in their contributions to the chemical enterprise coupled with distinctive service to ACS or to the broader world of chemistry," said ACS Immediate Past-president Bruce E. Bursten, who championed creation of the program and shepherded it through board approval last year.

The fellows come from the entire breadth of ACS's membership, including high school teaching, entrepreneurship, government service, and all sectors of industry and academia. Academic chemists make up 72 percent of the new class of fellows, 15 percent are from industry, 7 percent retired nonacademic, 5 percent government, and 1 percent consultants.

The following ASBMB members were named ACS fellows:

JAMES A. COWAN, Professor in the Department of Chemistry at Ohio State University

MICHAEL P. DOYLE, Professor and Chair of the Department of Chemistry and Biochemistry at the University of Maryland

CATHERINE FENSELAU, Professor in the Department of Chemistry and Biochemistry at the University of Maryland

F. PETER GUENGERICH, Harry Pearson Broquist Professor of Biochemistry and Director of the Center in Molecular Toxicology at Vanderbilt University

BRUCE E. MARYANOFF, Distinguished Research Fellow and Team Leader of the Vascular Research Team at Johnson & Johnson Pharmaceutical R&D

C. DALE POULTER, John A. Widtsoe Distinguished Professor and Chair of Bioorganic Chemistry at the University of Utah

HAROLD A. SCHERAGA, George W. and Grace L. Todd Professor of Chemistry, emeritus in the Baker Laboratory of Chemistry and Chemical Biology at Cornell University

ELIZABETH K. WEISBURGER, Former Assistant Director for Chemical Carcinogenesis in the Division of Cancer Etiology at the National Cancer Institute

Lifting the Veil on Biological Research

BY NICK ZAGORSKI

This article is the first in a series in which we look at the intersection of science and popular culture.

If you're curious to learn more about medicine, anthropology, or forensic science, you can turn to television and film for an abundance of viewing options—both in the fiction and reality genres—that can serve to educate, inform, or at least entertain you. Biological research, on the other hand, is woefully neglected; the inner workings of academic, medical, or industrial labs where tireless researchers labor away at the fundamental discoveries that someday will lead to the next medical breakthrough remain veiled in mystery to many in the general population.

It's a situation that Richard Rifkind knew all too well; while working as a professor and laboratory head at Columbia University and later as Chairman of the Sloan-Kettering Institute, Rifkind was often asked about his work, and he could never describe laboratory life in a way that would satisfy both him and the questioner. So, after he retired from active research in 2004, he and his wife Carole, an author and architectural historian, decided to remedy this situation. As both were budding filmmakers who were just wrapping up their first project (a documentary about the changing social and demographic landscape of Venice), the pair decided to lift the veil on scientific research through film.

Now, over 4 years, hundreds of hours of video footage, five different editors, and about 20 different rough cuts later, the Rifkinds have completed their labor of love: *Naturally Obsessed: The Making of a Scientist.*

The documentary chronicles the lives of three graduate students working in the laboratory of Lawrence Shapiro, a biochemist and structural biologist at Columbia University (who Richard Rifkind actually tried to recruit, unsuccessfully, to Sloan-Kettering when he was chairman). Scientifically, the MacGuffin driving *Naturally Obsessed* is the lab's quest to solve the crystal structure of AMP-activated protein kinase (AMPK), a critical mediator of cellular energy balance. However, the film is really more concerned with the path taken; during the course of an hour, the viewer follows the students and mentor over 3 years—both inside and out of the lab—as they experience the camaraderie and competition of science, the joys and frustrations of bench work, and the endless tug-of-war between career and family—issues most anyone involved in a Ph.D. program can empathize with.

"The original title of our film was actually *The Lab*," notes Carole, "but we decided to change it because we realized during the production that this film was really driven by the people and had a great deal of emotional intensity. *The Lab* would have been just too bland."

Indeed, through its combination of action footage in the lab and sit-down interviews with the lab members, *Naturally Obsessed* does a wonderful job capturing the

Richard and Carole Rifkind chronicle the lives of three graduate students working in an x-ray crystallography lab in the film, *Naturally Obsessed: the Making of a Scientist.*
PHOTO BY AMY ROY.

mood and mindset of being a graduate student (and young, untenured professor) in the structural biology field, including the struggles. As the film points out, structural biology remains even today a difficult line of research where success can depend as much on luck and black magic as knowledge and technical skill (a case highlighted in a very memorable scene in which Shapiro discusses tongue-in-cheek how playing the Flaming Lips song "Yoshimi Battles the Pink Robots" while mounting crystals increases the probability of diffraction).

This degree of scientific uncertainty was one of the Rifkinds' biggest concerns when they began shooting their film. "We worried whether we would have to change the direction of our story in a year or so depending on the results, or even if we would have a story to tell," Richard says. "In many ways, our documentary, or any creative endeavor for that matter, is very similar to a scientific experiment, and that's how we decided to view this project going in. Fortunately, for both us and the lab, the experiment turned out well."

A similar concern arose once the film was complete; Richard worried that the frustrations and failures portrayed in the film might deter some viewers from considering a career in science, because in addition to providing more transparency about academic research, the film could serve as a motivational tool for young people. And though some people expressed concerns over the grueling hours and risks of failure, Richard says that in the various screenings he and Carole have attended, the reception has been extremely positive. "Students would come up to us after screenings and tell us they loved the film's realism and are thankful that they now knew what to expect when they go to graduate school," he says. And though *Naturally Obsessed* was meant primarily for the general public, the Rifkinds were also pleasantly surprised by the stamp of approval scientists have been giving the film in regards to its depiction of laboratory life.

Since the film's debut this past March at the Environmental Film Festival in Washington, D.C., the Rifkinds have been keeping busy showing their documentary across the country, a process they enjoy a great deal. "It's so much fun interacting with all kinds of individuals and building a dialogue with the audience," she says. Carole adds that she and Richard are also preparing the DVD of the film, which will include bonus tracks such as extended interview segments—"they were really fascinating but did hinder the flow of the movie somewhat," Carole says—and highlights from some of the audience screenings.

"We live in a society that values science, as well as a society that depends on science," Carole says. "But at the same time, it's a society that doesn't always appreciate or understand the scientists behind the work. And I hope that our film can help provide some of that appreciation, and maybe even inspire some other scientist filmmakers. After all, I think we've shown that laboratory research can be tense, dramatic, and even have a happy ending—all the stuff of Hollywood."

Interested in seeing Naturally Obsessed*? Visit ASBMB.org on September 15 at 2:00 pm, when we will present an online screening of this acclaimed film. Also, check out our podcast interview with Lawrence Shapiro at www.asbmb.org/Interactive.aspx.*

Nick Zagorski is a science writer at ASBMB. He can be reached at nzagorski@asbmb.org.

Meeting Award Lectures

ASBMB will be screening our 2009 annual meeting award lectures in addition to *Naturally Obsessed*; if you missed the meeting or a particular talk, you can come back and check it out. The full ASBMB screening schedule is as follows*:

OCTOBER 15:
David R. Davies, "Fifty Years of Protein Structure: From Myoglobin to the Innate Immune System." (Herbert Tabor/ *Journal of Biological Chemistry* Lectureship)

NOVEMBER 11:
Sandra L. Schmid, "Clathrin-mediated Endocytosis: Dynamics and Dynamin." (William C. Rose Award)

DECEMBER 15:
Sarah Spiegel, "The Outs and the Ins of the Pleiotropic Lipid Mediator Sphingosine-1-phosphate." (Avanti Award in Lipids)

JANUARY 15:
Phillip D. Zamore, "What Fruit Flies Teach Us About RNA Silencing." (Schering-Plough Research Institute Award)

FEBRUARY 15:
Susan L. Lindquist, "Prion Proteins: One Surprise After Another." (FASEB Excellence in Science Award)

MARCH 15:
Rochelle D. Schwartz-Bloom, "Science Education: A Basic Scientist's View of Translational Medicine." (ASBMB Award for Exemplary Contributions to Education)

**The current lineup is tentative and may be subject to change; please check back at ASBMB.org to find updates on days and times.*

Mildred Cohn: Isotopic and Spectroscopic Trailblazer

BY NICK ZAGORSKI

Mildred Cohn in her lab at the University of Pennsylvania, shortly after her arrival.

Mildred Cohn's scientific career could perhaps be described as a series of silver linings. She displayed tremendous intellectual talent in her early years, completing her undergraduate degree in chemistry at Hunter College before the age of 18, designing a model of a combustion engine by 21, and obtaining a Ph.D. under legendary chemist and Nobel laureate Harold Urey by 24. These achievements would make her the pick of the scientific litter today. However, back in Cohn's day, even her own Ph.D. advisor could not help her find a suitable job, for in the era before equal opportunity employment, Cohn had two strikes going against her that no amount of talent could seem to overcome: being a woman and being Jewish.

And so Cohn's career advancement was met with one obstacle after another, whether it was being unable to enroll in Columbia University's male-only graduate program in chemical engineering or the fact that it took her 21 years after earning her Ph.D. to receive her first tenure-track faculty appointment. Yet despite many of these setbacks, Cohn received opportunities; her foray into Urey's lab that followed her denied entry into chemical engineering sent her down a path where she could combine her loves of physics and chemistry and placed her in the forefront of the emerging field of biochemistry, while her long period as a research associate educated her in diverse areas of biochemistry and eventually allowed her the freedom to pursue challenging projects without worrying about publishing results.

Together, those silver linings have made Cohn one of the leaders in applying physical chemistry to tackle biological questions. She pioneered the use of stable isotope tracers to study enzymatic reactions and metabolic processes, particularly related to organic phosphates and

ATP. Later, she addressed the same topics with electron spin and nuclear magnetic resonance, becoming one of the first researchers to use these technologies in biochemistry as well. "I was definitely a rare bird back then," she says jokingly. Of course, no mention of Mildred Cohn and the word "first" would be complete without recognizing that she was the first woman appointed to the *Journal of Biological Chemistry* Editorial Board and the first female president of ASBMB.

Ready for Takeoff

While the distinction of being a Jewish woman would prove a thorn during Cohn's scientific career, growing up as the daughter of a pair of Russian Jewish immigrants in New York City during the 1920s was initially a benefit; both of her parents had strong rabbinical backgrounds and thus valued scholarly pursuit. In fact, Cohn's father indoctrinated in her that she could achieve great success if she put her mind to it—an uncommon attitude of fathers towards daughters at that time. That led her to excel in chemistry and math, though surprisingly, she didn't particularly care for biology. "Of course, when I went to high school, biology was primarily a descriptive field; all we did in biology class was dissect frogs," Cohn says, noting that she grew to appreciate the beauty of biology as it began to intertwine with the progression of her career.

"...no mention of Mildred Cohn and the word 'first' would be complete without recognizing that she was the first woman appointed to the *Journal of Biological Chemistry* Editorial Board and the first female president of ASBMB."

Her first significant setback occurred at Hunter College, which she started attending at the age of 14, when she realized she could not pursue a major in physics; "it wasn't offered as a major, probably because it was assumed that girls shouldn't or didn't want to be physicists," Cohn says (Hunter was an all-girls college back then). She notes that, in fact, many of her science teachers were uninspiring (an engrossing senior-year course in physical chemistry was a notable exception), and she progressed primarily through her own persistence and desire to learn.

After completing college in 1931, Cohn attended Columbia for 1 year, paying her way with savings from previous summer jobs and babysitting; she obtained a Master's in chemistry but then had to leave and try to find a job. This was no small feat, considering the U.S. was still reeling in the Depression, but soon Cohn found a position at the National Advisory Committee for Aeronautics (NACA, which eventually became NASA) laboratory in Langley Field. There, as one woman amongst 70 men, Cohn worked on a project trying to develop improved fuel-injection airplane engines, an initially rewarding experience that taught Cohn the value of applied science but one that ultimately fizzled; within 2 years, she had reached a dead-end in her position. However, she had saved enough money to return to Columbia and partially finance her graduate studies.

Tracing a Path to Independence

For financial reasons, Cohn's first plan was to continue some of her NACA work and study fuel vaporization for her Ph.D. thesis, combining course work at Columbia with experimental work at the NACA. The chairman of the chemical engineering department quickly quashed that idea. So Cohn fell on a backup plan and asked Urey, who had taught some of her Master's courses, about joining his group. Initially hesitant, Urey soon agreed, and Cohn was quickly introduced to the world of stable isotopes and their many applications. After failing in her first project of trying to separate carbons 12 and 13, she focused her efforts in a more productive area of studying the rates of exchange of oxygen 18-containing water and organic compounds.

By the end of the 1937 academic year, Cohn was ready to graduate, though her future remained uncertain; jobs were still scarce, and the few openings available at the major chemical companies were effectively restricted to white males. Fortunately Vincent du Vigneaud, then a researcher at George Washington University, was interested in introducing stable isotope tracers into his metabolic studies of sulfur amino acids, and so David Rittenberg and Rudolf Schoenheimer, close colleagues of Urey, convinced du Vigneaud that Cohn would be an ideal person to join his lab as a postdoc. And in another sign of

> **"...every member in the chemistry faculty personally congratulated me when I got the position with du Vigneaud, because obtaining an academic position, even a lowly postdoc, was such a rare achievement, particularly for a woman."**

Mildred Cohn at her 96th birthday party.

the times, Cohn notes that "every member in the chemistry faculty personally congratulated me when I got the position with du Vigneaud, because obtaining an academic position, even as a lowly postdoc, was such a rare achievement, particularly for a woman."

Over the next several years, Cohn worked on a variety of questions involving methionine and cysteine metabolism; with deuterium labels, she helped establish that methionine was the source of the methyl groups in both choline and creatine and she also elucidated the mechanism behind the conversion of methionine to cysteine in rats. The work was very exciting, but eventually Cohn tired of the apprenticeship role as male postdocs in the group came and went on to higher positions. "I didn't even care about advancing in rank," says Cohn. "I just wanted the freedom to pursue my own interests and goals, but even after 9 years, that freedom was limited in du Vigneaud's lab."

In 1946, though, an opportunity arrived when Cohn's husband, theoretical physicist Henry Primakoff, received a job offer from Washington University in St. Louis; Washington was one of the few schools that had only partial nepotism rules, and it enabled Cohn to obtain a research associate position with Carl Cori in the biochemistry department.

A Resonating Career

A short while after Cohn had arrived at Washington University, she received a most interesting piece of mail; it was a letter from the Johns Hopkins University offering her a job. She particularly enjoyed the closing part of the offer, which stated, "we understand your husband is a physicist; maybe we could find him a job too."

After spending so many years trying to escape the classification of being a second-class citizen due to her gender and religion, this letter was priceless. "I remember showing the letter to Gerty [Cori], and she said, 'Mildred, frame it; I never got a letter like that.'" However, even though her husband was extremely supportive and offered to move to Baltimore, Cohn turned the offer down for two reasons: the position was a service job, and she sensed that Cori's lab would be a special place.

Her intuition proved correct, and it wasn't just because the Coris won the Nobel Prize for Medicine in 1947 (incidentally becoming the third straight Nobel laureate Cohn would train with—du Vigneaud would win for Chemistry in 1955). At Washington University, Cohn had found a second mentor and shining example of female success in science in Gerty Cori—"she sort of adopted me as soon as I got to the lab," Cohn says. Cohn notes that she initially published two collaborative papers, one with each Cori, but then conducted her own research the rest of the way, long before she finally received a long-overdue professorship in 1958.

Cohn's hope was to expand isotope studies—not simply to use them as metabolic pathway tracers, but as tools

to gain insight into the mechanisms of enzyme activity, such as using oxygen-18 to determine bond cleavage in phosphate reactions. She revealed many details about the nature of enzymes with organic phosphate substrates, including discovering that oxidative phosphorylation was mechanistically different than glycolytic phosphorylation. Further efforts to deduce the detailed phosphate-water exchange reactions behind the formation of ATP in oxidative phosphorylation proved intractable though (this was before Peter Mitchell developed his chemiosmotic hypothesis), so Cohn decided to move into another area.

That area would be analyzing the reactions that used ATP as a substrate and particularly their requirements for divalent metal ions. She took up new technologies, first electron paramagnetic resonance (EPR) of manganese complexes and later nuclear magnetic resonance (NMR) and produced one of her most memorable experiments, a seminal study demonstrating the effects of metal ions on the 31P spectrum of ATP—particularly memorable for her because the paper was initially rejected by the *Journal of the American Chemical Society* but has since become a *Current Contents* Citation Classic and a *JBC* Classic following its publication in 1962.

A Chapter Finished, a New One Begun

In 1960, Cohn followed her husband after he received a position at the University of Pennsylvania, and though this move was not of her choosing, it ended up being a tremendous boon. Taking a position at the Johnson Foundation, Cohn was now in the same department as Britton Chance, who was also interested in the EPR and NMR techniques that Cohn had initiated at Washington University. Much like a kid in a candy store, Cohn and her lab had access to some of the finest instruments and expertise in magnetic resonance, and over the next two decades, she used them to look at numerous enzyme-substrate complexes like creatine kinase, pyruvate kinase, and adenylate cyclase.

Though Cohn closed down her laboratory about 10 years ago, she still maintains an office at the university where she occasionally advises graduate students or postdocs and remains active in a number of organizations, including the Chemical Heritage Foundation and the American Philosophical Society. And, while reflecting back on her unusual career is nothing new to her—she's written several reflections for journals and has recently completed a 500-page memoir that she will present to her family—she's not finished looking ahead either. This October, Cohn will be formally inducted into the National Women's Hall of Fame in Seneca Falls, New York. Accolades are not foreign to Cohn, who has received both the American Chemical Society's Garvan Medal and the National Medal of Science, among other honors, but the Women's Hall of Fame is the first organization not specifically involved in science to recognize her achievements, which she embraces with some fondness.

"And when I saw that Hilary Clinton and Oprah Winfrey were also members," Cohn adds, "I decided this could be a good place for me."

If you are interested in learning more about Mildred Cohn's research, read her JBC *Reflection comparing research life in the 1930s and 1940s to that of today (http://tinyurl.com/ksf2yy) or watch her* JBC *Centennial video on the ASBMB web site (www.asbmb.org/video.aspx).*

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REFERENCES

du Vigneaud, V., Cohn, M., Chandler, J. P., Schenck, J. R., and Simmonds, S. (1941) The Utilization of the Methyl Group of Methionine in the Biological Synthesis of Choline and Creatine. *J. Biol. Chem.* **140**, 625–641.

du Vigneaud, V., Kilmer, G. W., Rachele, J. R., and Cohn, M. (1944) On the Mechanism of the Conversion *In Vivo* of Methionine to Cystine. *J. Biol. Chem.* **155**, 645–651.

Cohn, M. (1953) A Study of Oxidative Phosphorylation with O^{18}-labeled Inorganic Phosphate. *J. Biol. Chem.* **201**, 735–750.

Cohn, M., and Hughes, T. R. (1962) Nuclear Magnetic Resonance Spectra of Adenosine Di- and Triphosphate II. Effect of Complexing with Divalent Metal Ions. *J. Biol. Chem.* **237**, 176–81.

Cohn, M., and Hu, A. (1978) Isotopic (^{18}O) Shift in ^{31}P Nuclear Magnetic Resonance Applied to a Study of Enzyme-catalyzed Phosphate-Phosphate Exchange and Phosphate (oxygen)-Water Exchange Reactions. *Proc. Natl. Acad. Sci. U.S.A.* **75**, 200–3.

Commander-in-Chief

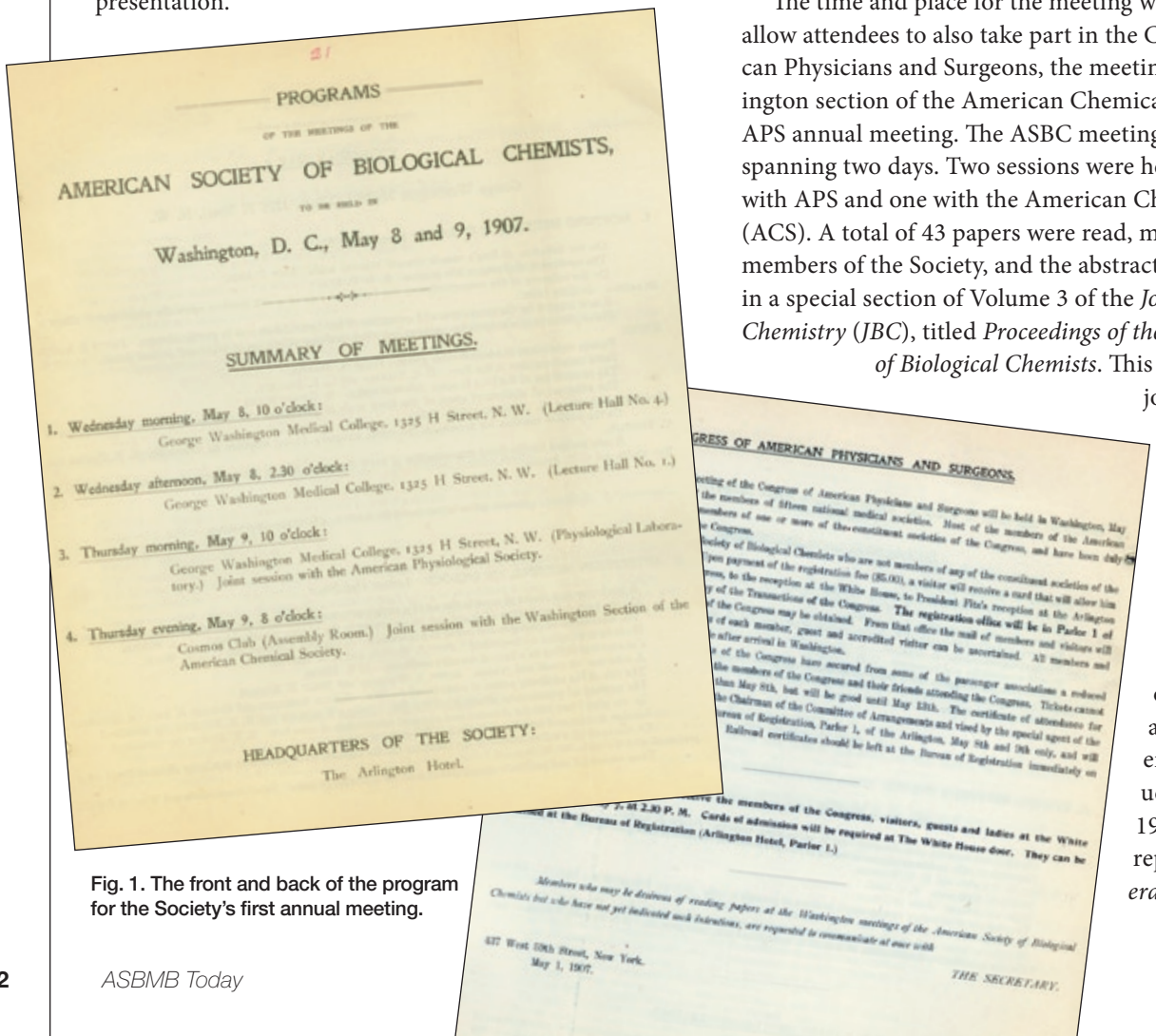
Considering her own long uphill battle in advancing her scientific career, one might think Mildred Cohn would have found a great platform to advance women's issues when she became the first female ASBMB president in 1978. However, she decided to take a gender-neutral approach to the presidency and not carry any specific agenda, although she still managed to distinguish herself from her male predecessors in an unusual fashion. "One of the duties of president was to preside over a business meeting at each year's conference, and I remember after mine, one of my colleagues came up to me and complimented my efficiency," she says. "He told me that the members were so used to presidents rambling on and on that they often wandered in late, but today, he wandered in, and the meeting was already over; apparently, the meeting I presided over was the shortest on record."

The ASBMB Annual Meeting*

BY RALPH A. BRADSHAW, *SOCIETY HISTORIAN*

The recent ASBMB annual meeting in New Orleans was an important milestone for the Society because it was the 100th in the series of annual meetings that have been occurring since 1907. (The 3-year gap between this centennial celebration and that of the Society was caused by a period during World War II (1943–1945) when no meetings were held.)

The annual meeting has always been an integral part of the Society's activities. Indeed, one of the main reasons for forming a separate society in 1906 had been the perceived problems of accommodating the growing number of biochemical research papers in the American Physiological Society's (APS) annual meeting, which, prior to the formation of the American Society of Biological Chemists (now ASBMB), had been the principal forum for their presentation.



PROGRAMS

OF THE MEETINGS OF THE

AMERICAN SOCIETY OF BIOLOGICAL CHEMISTS,

TO BE HELD IN

Washington, D. C., May 8 and 9, 1907.

SUMMARY OF MEETINGS.

1. Wednesday morning, May 8, 10 o'clock:
George Washington Medical College, 1325 H Street, N. W. (Lecture Hall No. 4.)

2. Wednesday afternoon, May 8, 2.30 o'clock:
George Washington Medical College, 1325 H Street, N. W. (Lecture Hall No. 1.)

3. Thursday morning, May 9, 10 o'clock:
George Washington Medical College, 1325 H Street, N. W. (Physiological Laboratory.) Joint session with the American Physiological Society.

4. Thursday evening, May 9, 8 o'clock:
Cosmos Club (Assembly Room.) Joint session with the Washington Section of the American Chemical Society.

HEADQUARTERS OF THE SOCIETY:
The Arlington Hotel.

GRESS OF AMERICAN PHYSICIANS AND SURGEONS

Cards of admission will be required at The White House door. They can be

THE SECRETARY.

Fig. 1. The front and back of the program for the Society's first annual meeting.

The First Meeting

The society's first meeting was held in Washington, D.C., at the downtown campus of George Washington University on May 8 and 9, 1907 (Fig. 1), just over 4 months after the Society was formed. The meeting was attended by 26 of the 81 charter members.

The decision to hold the first meeting so soon after the formation of the Society resulted from a mail ballot to the members of the Society's council. In it, William J. Gies, the Society's first secretary, argued that it would provide an opportunity to consider the new constitution and "enable… a prompt beginning of the scientific career of the society." (As it turned out, the new constitution was not considered until the second annual meeting, held in December 1907/January 1908.)

The time and place for the meeting were selected to allow attendees to also take part in the Congress of American Physicians and Surgeons, the meeting of the Washington section of the American Chemical Society, and the APS annual meeting. The ASBC meeting had four sessions spanning two days. Two sessions were held jointly, one with APS and one with the American Chemical Society (ACS). A total of 43 papers were read, mostly by charter members of the Society, and the abstracts were published in a special section of Volume 3 of the *Journal of Biological Chemistry* (*JBC*), titled *Proceedings of the American Society of Biological Chemists*. This addendum to the journal, which supplied meeting abstracts and information of general interest to Society members, including recommendations on various aspects of nomenclature and Council deliberations, continued into the early 1940's when it was replaced by the *Federation Proceedings*.

It is interesting to note that on the back of the program (Fig. 1) there is an invitation to a reception at the White House for the attendees and guests of the meeting. This reflects a more open access to high U.S. government officials in those days, in particular those of the Theodore Roosevelt administration.

Holding an annual meeting in conjunction with those of other scientific societies would become a hallmark of ASBC/ASBMB. In the earliest days, meetings were held with various sections of the American Association for the Advancement of Science (AAAS) and the Society of American Bacteriologists (now the American Society for Microbiology) in addition to the APS and the ACS. This policy not only reflects the broad interests that were (and still are) commonly held by many ASBMB members, but it also underscores the central role that biochemistry plays in all biological sciences. After the Federation of American Societies for Experimental Biology (FASEB) was founded in December 1912, the Society met regularly as part of this group for the next 60 years. However, in the period from 1971 to 2005, only some of the Society's meetings were held with FASEB; other joint meetings were held with societies not affiliated with FASEB. In 2005, after a thirty-year hiatus, the ASBMB began meeting with FASEB again on a regular basis and continues to do so today (Fig. 2.).

Fig 2. The 2009 ASBMB Annual Meeting Guide.

Fig. 3. Howard Hiatt, Jerard Hurwitz, and Herbert Tabor at an Atlantic City meeting.

Meeting Places

The Society's meetings prior to WWII were relatively small and generally took place in the eastern United States (and Canada) at academic institutions. In 1946, at the first meeting to be held after a 3-year wartime hiatus, attendance was large enough to warrant using a convention center. This meeting was held in Atlantic City, NJ and began a 30-year period during which this was the favored venue. Between 1946 and 1975, the Society met in Atlantic City 18 times, all as part of the larger FASEB meeting. (Chicago was the next most popular site, and the Federation met there six times during the same period.) Thus, for several generations of biochemists, Atlantic City, which was also the location of the Society's 50th Anniversary Golden Jubilee in 1956, was synonymous with ASBMB (and FASEB) meetings, and many still fondly recall important discussions and exchanges on the boardwalk (Fig. 3).

It took nearly 50 years for the Society to move the annual meeting beyond sites in the East and Midwest. The first meeting west of the Mississippi (discounting St. Louis) was in 1955 when the ASBC met in San Francisco for the first time. This was the 46th annual meeting. The eastern dominance of annual meetings would continue

Fig. 4. Exhibit booths as the 1966 (*top*) and 2006 (*bottom*) FASEB meetings.

until the early 1980s, when the annual meetings began to take place in alternating West Coast, Midwest, and East Coast cities.

It is important to note that the Society's annual meeting, particularly in the first 75 years, had a similar atmosphere to a reunion, as it was a meeting place of old friends who otherwise saw each other infrequently. It was also a place for young people to make new friends and acquaintances, known in today's parlance as "networking." It should be remembered that cross-country travel prior to jet transportation was slow and infrequent. As a result, there were fewer competing meetings. Add to this the absence of facile electronic communication such as fax, email, and teleconferencing, and it is easy to see why the social content of the meeting was vital. The informal science discussions held outside the formal presentations made attendance of paramount importance. Not only were the latest research findings shared, but the "dealings" of the biological research community were accomplished as well. The Federation meeting was so significant to all the member societies that everyone, from upper level graduate students to the most senior investigators, attended faithfully. This would continue to be true well into the 1970s.

A Break from FASEB

An occurrence not related to science eventually altered the pattern of the Society holding its meeting with the Federation. In reaction to the antiwar demonstrations during the 1968 Democratic convention in Chicago and the city's responses to them, the Council received letters and petitions signed by over 400 members objecting to the FASEB meeting scheduled for Chicago in 1971. The situation was exacerbated by the fact that the Council was already unhappy with the Society's relationship with FASEB. A poll of the membership was conducted, and although no clear majority opinion on the question was obtained, the Council subsequently decided to meet separately from FASEB in San Francisco in June 1971 for the first time since 1912. In 1972, the Society met with FASEB again, but a pattern of meeting separately from FASEB on occasion was established and continued for another 3 decades.

The Winds of Change

Although the primary purpose of the annual meeting is scientific communication, exhibitions by vendors of services and commodities important to researchers have always been a major part of the event (Fig. 4). Not only did this longstanding arrangement provide opportunities for meeting attendees and companies to exchange information about the availability of new reagents and equipment, it also helped underwrite the cost of the meeting and provided income to support other Society activities.

However, by the mid-1980s, the Society began to look at the net meeting income resulting from the cyclical separate meeting format (two "stand-alone" meetings out of every three) and realized that significant changes were occurring. First and foremost, there was a decline in attendance. While this was likely due to a number of factors, the predominant one was competition. The Society was, to a degree, a victim of its own success. As biochemistry rapidly expanded into what is commonly called "molecular biology," there was a concomitant rapid expansion of all of the biological sciences in general. New societies formed in areas that were traditionally part of biochemistry, and there was a proliferation of meetings, both large and small, some associated with new societies and some with other non-profit organizations. (FASEB itself started a series of very successful smaller meetings around this time.) The resulting effect on the Society's annual meeting was dramatic; by the 1990s, it had decreased considerably in size from the first stand-alone meeting in 1971.

> **"...the Society's annual meeting, particularly in the first 75 years, had a similar atmosphere to a reunion."**

Exhibitors were, of course, looking at the number of attendees at a particular meeting compared with the costs of booth rental, shipment of equipment and materials, and the salaries of employees necessary to staff the booths. Although attending both the FASEB meeting and the ASBC/ASBMB meeting had been an annoyance to the exhibitors, they realized that the ASBC/ASBMB meetings were the best way to reach biochemists and molecular biologists. But, by the early 1990s, with the decrease in attendance and the fact that many of the exhibitors were having financial problems due to a downturn in the general economy and several mergers within the biomedical equipment industry, the ASBMB annual meeting became less attractive. This, in turn, affected the number of booths they rented and hence the bottom line of meeting revenue.

The resultant decline in registration income, combined with a reduction in booth rentals by exhibitors, led to decreased net income from the annual meetings. Because meeting locations had to be contracted several years in advance, the Council was increasingly forced to make hard decisions on which societies to meet with and where to meet. Complicating this situation was the fact that cities began demanding minimum attendance numbers at the meeting (evaluated by the numbers of hotel rooms rented by attendees) before they would rent the convention centers that were vital for exhibit and meeting space. An example was San Francisco, which was one of the most popular venues for meetings. The city demanded guarantees of 1,800 hotel rooms sold before the convention center could be rented. As the size of the national meeting shrank, this guarantee became impossible to fill. Thus, by the mid-1990s, the Society was forced to reevaluate its meeting philosophy and to begin making decisions on when and where to meet on a year-to-year basis.

It should be noted that FASEB's meeting strategy was also changed in 1993. Because the number of FASEB societies had been rapidly increasing since 1990 and many of the newer member societies met separately, the "FASEB Meeting" was now a misnomer. A new meeting called "Experimental Biology" was created to replace the old one, and societies were free to meet as much or as little within the Experimental Biology umbrella as served their own needs. Because plans for the Experimental Biology meeting had to be made about 4 years before the actual meeting, the ASBMB Council had to forecast participation well ahead of time. Finally, in 2002, a decision was made to meet with Experimental Biology every year beginning in 2005. This strategy provided a more or less steady revenue stream that did not depend on the vagaries of attendance and exhibit booth rental. In addition, the logistics of the meeting were left to the meeting management specialists of FASEB, so that the Society would only have to worry about scientific content.

Thus, in 2009, at the 100th anniversary of the annual meeting, the ASBMB has returned to meeting with other FASEB societies, including some of its original 1912 partners. Although this has proven to be a very workable arrangement for the past several years, it is, of course, not known whether this will remain the case. As yet unforeseen changes in science may force new formats and arrangements in the annual meeting and bring about new changes.

Ralph A. Bradshaw is a professor of chemistry and pharmaceutical chemistry and deputy director of the NCRR Mass Spectrometry Facility at the University of California, San Francisco. He is also the ASBMB Society Historian and can be reached at rab@cgl.ucsf.edu.

This article is part of a series based on the book, "The ASBMB Centennial History: 100 Years of the Chemistry of Life." by R.A. Bradshaw, C. C. Hancock, and N. Kresge. To learn more about ASBMB's history or to order the book, go to www.asbmb.org/history.

The Chemistry of Life

BY PETER J. TONGE AND ADRIAN WHITTY

TONGE

WHITTY

Chemical biology involves the use of chemical perspectives and techniques to explore biological processes, whereas drug discovery constitutes the direct application of designed, discovered, or engineered molecules to achieve specific perturbations in human biology. The Annual Meeting theme "Chemical Biology and Drug Discovery" thus encompasses a very broad range of science. Rather than attempting to cover this vast area evenly—and therefore, by necessity, superficially—we instead identified as session topics four specific subjects that represent areas of rapid progress that we believe will be of interest to a broad cross-section of the field. These topics are "Mechanisms of Drug Action," "Dissecting Cellular Processes," "Drug Resistance," and "Evolution, Engineering, and Design." Although two of the sessions are nominally designated as "Drug Discovery," and the other two are called "Chemical Biology," they are to a significant extent complementary and, in all cases, give a molecular and mechanistic perspective on the problems discussed.

"Rather than attempting to cover this vast area evenly... we instead identified as session topics four specific subjects that represent areas of rapid progress that we believe will be of interest to a broad cross-section of the field."

Our speakers include representatives from both industry and academia, due to their common interest in the theme, which allows us to include problems and examples from the most fundamental to the directly applied. After each talk, we aim to actively foster open and substantive discussion of the issues raised by each presentation, with the goal that participants will leave with an enriched understanding of the current challenges and opportunities in the field. Details of the sessions, speakers, and topics are as follows.

Session 1, titled "Mechanisms of Drug Action," focuses on methods to determine the molecular basis for drug action and how this information is exploited to develop and optimize lead compounds. Lizbeth Hedstrom (Brandeis University) is targeting inosine monophosphate dehydrogenase (IMPDH) from the protozoan parasite *Cryptosporidium parvum* and is using mechanistic differences between the protozoan and human enzymes to develop specific inhibitors. Jessie M. English (Merck & Co., Inc.) will discuss the growing importance of polypharmacology in drug discovery and highlight both the benefits and drawbacks of compounds that inhibit multiple kinases. Peter J. Tonge (Stony Brook University) is developing compounds that target fatty acid and menaquinone biosynthesis in pathogens such as *Mycobacterium tuberculosis*, *Francisella tularensis*, and *Staphylococcus aureus* and will the discuss the importance of designing slow-onset enzyme inhibitors that have long residence times on the target.

Session 2, "Dissecting Cellular Processes," includes three distinct perspectives on the development of chemical and biochemical tools for probing cellular processes. Tom Wandless (Stanford University) will illustrate his group's work on engineering conditional protein stability and using it to interrogate biological function in cultured cells as well as organisms ranging from yeast and Apicomplexan parasites to mice. Joanna S. Fowler (Brookhaven National Laboratory) will describe the development and application of radiotracers labeled with short-lived positron emitters and their application to problems in neuroscience including drug addiction. Adrian Whitty (Metcalf Center for Science and Engineering) will discuss the activation mechanism of the RET tyrosine kinase receptor and how the

molecular interactions involved correlate with functional outcomes at the cellular level.

Session 3, "Drug Resistance," addresses this important problem using examples from antibacterial, antiviral, and anticancer drugs, encompassing both the molecular mechanisms responsible for drug resistance as well as the current thinking on approaches to avoid or circumvent drug resistance. John Blanchard (Albert Einstein College of Medicine of Yeshiva University) will explain the mechanisms of drug resistance in tuberculosis chemotherapy. Celia Schiffer (University of Massachusetts-Amherst) will describe the "substrate envelope hypothesis" and its use in designing inhibitors of HIV protease that avoid resistance mutations. Joseph Wu (Pfizer, Inc.) will present recent work on mechanisms of drug resistance involving mutations in cKit in gastrointestinal cancer patients.

The final session, "Evolution, Engineering, and Design," aims to explore recent progress and current thinking on how directed evolution of proteins and organisms can be exploited to achieve desired functional outcomes, the engineering principles that relate protein structure to protein function, and how these principles are being applied to engineer proteins for therapeutic use in humans. Donald Hilvert (Swiss Federal Institute of Technology) will discuss engineering of enzymes and what it reveals about the complex interplay between structure, stability, and function in these delicately balanced and highly optimized molecules. Frances H. Arnold (California Institute of Technology) will depict how directed evolution can be used to generate highly efficient new biocatalysts and what those studies have taught us about natural protein evolution and the complex interplay between protein sequence, structure, and function. Alexey Lugovskoy (Biogen Idec, Inc.) will describe the application of protein engineering to developing protein drugs with improved properties, which will be illustrated with specific examples of drugs that are currently in development.

In addition to the presentations by the invited speakers, 12 short talks will be chosen from the submitted abstracts to allow for the presentation of new and exciting results.

Peter J. Tonge is a professor in the Department of Chemistry at Stony Brook University and can be contacted at peter.tonge@sunysb.edu. Adrian Whitty is an associate professor in the Department of Chemistry of Boston University at Metcalf Center for Science and Engineering and can be contacted at whitty@bu.edu.

Chemical Biology and Drug Discovery

SYMPOSIUM: MECHANISMS OF DRUG ACTION

Kinase Inhibitor Specificity and Targeting Human Disease, *Jessie M. English, Merck & Co, Inc.*

Targeting a Prokaryotic Enzyme in a Eukaryotic Pathogen, *Lizbeth Hedstrom, Brandeis University*

Slow-onset Enzyme Inhibition, Residence Time, and in Vivo Drug Activity, *Peter J. Tonge, Stony Brook University*

SYMPOSIUM: CHEMICAL BIOLOGY: DISSECTING CELLULAR PROCESSES

Imaging Brain Chemistry in Diseases of Addiction, *Joanna S. Fowler, Brookhaven National Laboratory*

General Methods to Conditionally Regulate Protein Function, *Tom Wandless, Stanford University*

Towards an Integrated View of Receptor Signaling, *Adrian Whitty, Metcalf Center for Science and Engineering*

SYMPOSIUM: DRUG RESISTANCE

Drug Resistance Mechanisms in Mycobacterium tuberculosis, *John Blanchard, Albert Einstein College of Medicine of Yeshiva University*

Combating Drug Resistance: The Balance Between Inhibition and Substrate Recognition, *Celia Schiffer, University of Massachusetts-Amherst*

Molecular Mechanisms of Resistance to Imatinib or Sunitinib in KIT Mutants from Patients with Gastrointestinal Stromal Tumors, *Joseph Wu, Pfizer, Inc.*

SYMPOSIUM: CHEMICAL BIOLOGY: EVOLUTION, ENGINEERING, AND DESIGN

How Proteins Adapt: Lessons from Directed Evolution, *Frances H. Arnold, California Institute of Technology*

Teaching Old Enzymes New Tricks, *Donald Hilvert, Swiss Federal Institute of Technology*

Engineering of Monovalent, Multivalent, and Bispecific Antibodies for New Therapeutic Applications, *Alexey Lugovskoy, Biogen Idec, Inc.*

New Frontiers in Genomics and Proteomics

BY DAVID N. ARNOSTI AND MICHAEL WASHBURN

ARNOSTI

WASHBURN

Modern biochemistry and molecular biology commonly call on many tools to generate novel biological insights and new hypotheses. Genomics and proteomics technologies have often been thought of as discovery driven and high throughput approaches. Over the past several years, however, this has changed. Genomics and proteomics tools are being increasingly used by a wider variety of biological researchers. These applications will be the subject of the 2010 ASBMB meeting theme, "New Frontiers in Genomics and Quantitative Proteomics."

The first proteomics symposium, "Quantitative Proteomic Analysis of Protein Complexes," is designed to highlight how protein mass spectrometry can be used in a quantitative fashion to provide new insights into multi-protein complexes. Up until recently, there have been few tools available to study these dynamic molecular machines in a systematic and quantitative way. Lan Huang (University of California, Irvine) will describe her studies on the dynamics of the proteasome. This critical molecular machine is involved in the regulation of a variety of processes, the most widely studied being the degradation of ubiquitinylated proteins. Major questions remain regarding how the proteasome itself is regulated and how it changes with cellular states and stimuli. Lan Huang and her colleagues are taking an innovative approach to begin to address these questions. Michael Washburn (Stowers Institute for Medical Research) has been developing straightforward quantitative proteomics tools for quantitative analysis of multiprotein complexes and protein interaction networks. He will talk about how his group uses these tools to analyze transcriptional regulatory complexes and characterize new interactions of well known complexes like RNA Polymerase II. Carol V. Robinson (University of Cambridge) will explain a new area of mass spectrometry that analyzes whole protein complexes. Robinson has published ground breaking mass spectrometry-based structural studies on the COP9 signalsome and the translation factor eiF3.

The second proteomics symposium, "Quantitative Analysis of Post Translational Modifications," is designed to highlight the exciting applications of new protein mass spectrometry techniques for the analysis of post-translational modifications. These modifications play important roles in the regulation of proteins, protein complexes, and cellular systems. Post-translational modifications of histones, for example, are critical regulatory modifications that define the transcription state of chromatin and DNA. All the presenters in this symposium are developing and applying exciting new proteomics tools for the analysis of post-translational modifications. Forrest M. White (Massachusetts Institute of Technology) and his group focus on the quantitative analysis of protein phosphorylation events in signal transduction cascades. They have analyzed the epidermal growth factor reception signaling networks and T cell signaling using advanced proteomics tools. Yingming Zhao (University of Chicago) and his group have characterized novel histone modifications like lysine propionlyation and butylation. They have also used proteomics approaches to characterize the widespread nature of lysine acetylation in cells, revealing that this modification is more common than previously thought. Joshua J. Coon (University of Wisconsin, Madison) has been a leader in the development of a novel protein mass spectrometry system named "electron transfer dissociation" that has excellent capabilities for the analysis of long portions of proteins. This technology has particular application in the analysis of histone tails and phosphorylation patterns.

The first genomics symposium, "Model Organisms and New Frontiers I," will feature speakers who have contributed significant insights on mechanisms of gene expression in vertebrates, the role of microbial communities in human health, and the diversity of microbial microbiomes that are resistant to conventional methods of characterization. Nearly three decades ago, transcriptional enhancers were characterized as small viral regulatory segments that drove gene expression in a distance- and orientation-independent fashion. Over the years, the roles of these transcriptional control elements in development and disease have been intensively explored, but fundamental questions remain. Using comparative genomics and molecular genetics, Edward M. Rubin (U.S. Department of Energy Joint Genome Institute) has tackled some of the most enigmatic of these elements—ultraconserved sequences

that show little variation throughout the entire vertebrate lineage. His group has shown how discrete changes in other developmental enhancers drive species-specific changes important for facets of human gene expression.

Many specialized microbial communities populate niches that support human health or lead to disease. Metagenomic analysis of these communities, based on large-scale sequencing of DNA extracted from complex mixtures of genomes, has provided quantitative representation of elusive microbes, many of which have yet to be cultured independently. Claire M. Fraser-Liggett (University of Maryland School of Medicine) has pioneered the application of metagenomics to diverse areas relating to human health. Phillip Hugenholtz (U.S. Department of Energy Joint Genome Institute) has extended these approaches to the most diverse, and least understood environments, including the termite gut, sludges, and prehistoric deposits, whose microbes may be the key to understanding climate change as well as paths to a new energy future.

In the second genomics session, "Model Organisms and New Frontiers II," we look at how the genomics of model systems paves the way to understanding the complex transcriptional workings of metazoans. Expert comparative genomicist Andrew G. Clark (Cornell University) has provided insights on the evolution of the *Drosophila* genome based on the extensive sequencing and analysis of diverse species, including the origin of the Y chromosome, the evolution of the immune system, and overall mutation rates that underlie these processes. Bing Ren (University of California, San Diego) is a leader in the application of genome-wide analysis of chromatin features to identify transcriptional regulatory elements; his studies have provided a complementary method to identify functional DNA elements that drive gene expression in eukaryotes. To interpret the quantitative output of such regulatory elements, one needs a sophisticated understanding of the cis-regulatory "grammar" that dictates how particular sets of binding sites generate precise outputs. David N. Arnosti (Michigan State University) studies this language of transcriptional control using quantitative measurements of gene expression and fractional occupancy modeling, a method adapted from statistical physics.

In addition to these invited presentations, 12 short talks will be chosen from the submitted abstracts.

David N. Arnosti is a professor of biochemistry and molecular biology at Michigan State University and can be contacted at arnosti@msu.edu. Michael Washburn is the director of the Proteomics Center at the Stowers Institute for Medical Research and can be contacted at mpw@stowers.org.

New Frontiers in Genomics and Quantitative Proteomics

SYMPOSIUM: QUANTITATIVE PROTEOMIC ANALYSIS OF PROTEIN COMPLEXES

Exploring the Dynamics of the Proteasome Interaction Network by Quantitative Proteomics, *Lan Huang, University of California, Irvine*

MS Analysis of Protein Complexes, *Carol V. Robinson, University of Cambridge*

Dynamics of Protein Complexes, *Michael Washburn, Stowers Institute for Medical Research*

SYMPOSIUM: QUANTITATIVE ANALYSIS OF POST-TRANSLATIONAL MODIFICATIONS

New Technologies for the Large-scale Analysis of Proteins and Their Post-translational Modifications, *Joshua J. Coon, University of Wisconsin, Madison*

Biological Insights from Quantitative Analysis of Tyrosine Kinase Signaling Networks, *Forest M. White, Massachusetts Institute of Technology*

Identification and Initial Characterization of Histone Lysine Propionylation and Lysine Butyrylation Pathways, *Yingming Zhao, University of Chicago*

SYMPOSIUM: MODEL ORGANISMS AND NEW FRONTIERS I

The Role of Microbial Communities in Health and Disease, *Claire M. Fraser-Liggett, University of Maryland School of Medicine*

Sludges, Termite Hindguts, and Lake Vostok Accretion Ice: What Metagenomics Can Tell Us About Microbial Communities, *Phillip Hugenholtz, U.S. Department of Energy Joint Genome Institute*

Genome Regulation from a Distance, *Edward M. Rubin, U.S. Department of Energy Joint Genome Institute*

SYMPOSIUM: MODEL ORGANISMS AND NEW FRONTIERS II

Genomic Predictions of Regulatory Information: Modeling and Measurements, *David N. Arnosti, Michigan State University*

Genomic Insights on Population Genetics, *Andrew G. Clark, Cornell University*

Decoding the Human Epigenome, *Bing Ren, University of California, San Diego*

Hypertension: Molecular Mechanisms, Treatment, and Disparities

BY CRAIG E. CAMERON AND ROBERT HOOVER

CAMERON

HOOVER

Approximately 1 billion people around the world suffer from hypertension. According to a study by the World Health Organization, hypertension was the risk factor that contributed the most to worldwide mortality, with more than seven million deaths per year. Investigating the diagnosis, treatment, variability in patient populations, and underlying molecular mechanisms of hypertension will likely be the key to controlling this disease.

Despite the longtime existence of multiple therapeutic agents for hypertension, the treatment of this complex disease continues to evolve. In the latter part of the previous century, this evolution centered on developing important new classes of anti-hypertensive reagents. Now, changes in treatment have begun to focus on defining the blood pressure at which treatment should be initiated, using the most efficacious combinations of therapeutic agents and determining the differences between diverse patient populations. The recognition that different patient populations may have different optimal therapeutic regimens and rates of adverse outcomes is an important factor toward improving the treatment of this disease.

> **"The recognition that different patient populations may have different optimal therapeutic regimens and rates of adverse outcomes is an important factor in improving the treatment of this disease."**

Much of the drug development from the latter half of the previous century was driven by a greater understanding of the molecular mechanisms underlying the regulation of blood pressure. All of the monogenic hypertension disorders that have been identified have involved disruption of sodium chloride handling in the kidney. Understanding the regulation of these salt reabsorptive pathways at the molecular level will be important to developing future therapeutic interventions. The ASBMB Minority Affairs Committee has organized a hypertension theme for the Annual Meeting that will consist of three symposia discussing these key subjects of "Molecular Mechanisms, Treatment, and Disparities of Hypertension."

In the "Molecular Mechanisms of Hypertension" session, the seminars will focus on mechanisms of regulation of salt reabsorption in the kidney. The epithelial sodium channel (ENaC) and the sodium chloride cotransporter (NCC) are key ion transport proteins that mediate salt reabsorption in the kidney. Hyperactivity disorders involving either of these proteins result in hypertension in humans and animal models. Conversely, disorders involving decreased activity result in hypotension. Thomas R. Kleyman (University of Pittsburgh School of Medicine) will discuss how alterations in ENaC activity affect blood pressure as well as the impact of proteolytic cleaving on activity of the channel. David Pearce (University of California, San Francisco) will discuss how kinases and regulators of kinases impact the activity of the channel. Robert Hoover (University of Chicago) will examine the role of hormonal regulation of NCC in the development of hypertension.

In the "Diagnosis and Treatment of Hypertension" session, John M. Flack (Wayne State University) will provide an overview of the present paradigms for developing individual treatment regimens for hypertensive patients. Kenneth A. Jamerson (University of Michigan Health System) will discuss recent clinical studies focusing on the efficacy and importance of combination therapies in the treatment of hypertension. Treatment of what was previ-

ously described as "mild" hypertension results in improved morbidity and mortality. Shawna D. Nesbitt (University of Texas Southwestern Medical Center) will discuss studies indicating that even earlier treatment of "pre-hypertension" is beneficial.

In the "Disparities in Hypertension Treatment and Sequelae" symposium, Lawrence Agodoa (National Institutes of Health) will address differences in the diagnosis and treatment of hypertension based on gender and age. Many clinicians have developed biases concerning the use of ACE inhibitors and angiotensin receptor blockers in African American patients. Jackson T. Wright, Jr. (Case Western Reserve University) will examine the evidence concerning the use of these key therapeutic agents in this patient population. In addition to disparities in treatment of hypertension, there are also large differences in the rate and severity of complications of hypertension between different patient populations. Janice P. Lea (Emory University School of Medicine) will discuss these differences in cardiovascular and renal outcomes and the potential reasons for these differences.

Hypertension: Treatment, Disparities, and Molecular Mechanisms

Sponsored by the ASBMB Minority Affairs Committee

SYMPOSIUM: MOLECULAR MECHANISMS OF HYPERTENSION

Hormonal Regulation of the Sodium Chloride Co-transporter, *Robert Hoover, University of Chicago*

Epithelial Sodium Channels and Hypertension, *Thomas R. Kleyman, University of Pittsburgh School of Medicine*

Regulation of ENaC Trafficking, *David Pearce, University of California, San Francisco*

SYMPOSIUM: DIAGNOSIS AND TREATMENT OF HYPERTENSION

The Importance of Combination Therapy in the Treatment of HTN, *Kenneth A. Jamerson, University of Michigan Health System*

Paradigms for the Diagnosis and Treatment of HTN, *John M. Flack, Wayne State University*

Pre-hypertension: Diagnosis and Treatment, *Shawna D. Nesbitt, University of Texas Southwestern Medical Center*

SYMPOSIUM: DISPARITIES IN HYPERTENSION TREATMENT AND SEQUELAE

Gender and Age Disparities in Hypertension, *Lawrence Agodoa, National Institutes of Health*

Disparities in Cardiovascular and Renal Complications of Hypertension, *Janice P. Lea, Emory University School of Medicine*

RAAS Inhibitor Containing Antihypertensive Regimens in African Americans: A Look at the Evidence, *Jackson T. Wright, Jr., Case Western Reserve University*

MAC-sponsored Session on Mentoring

Traditionally, the Minority Affairs Committee organizes an issues-based session to contribute to the professional development of the ASBMB membership. This year's theme is mentoring. Topics will include: mentoring students (Sydella Blatch, National Institutes of Health), mentoring at a distance (David Porush, MentorNet), mentoring women (Marilee Benore, University of Michigan), and mentoring non-traditional students (Phillip Ortiz, Empire State College).

Craig E. Cameron is the Paul Berg professor of biochemistry and molecular biology at Pennsylvania State University and can be contacted at cec9@psu.edu. Robert Hoover is an assistant professor of medicine at the University of Chicago and can be reached at rhoover@medicine.bsd.uchicago.edu.

Mentoring

Mentoring Students from Undergrads until Tenure, *Sydella Blatch, National Institutes of Health*

Neither Teacher, Parent, Friend, nor Boss: MentorNet and Mentoring at a Distance, *David Porush, MentorNet*

Mentoring Women- Strategies and Success Stories, *Marilee Benore, University of Michigan*

Reaching out to Nontraditional Students, *Phillip Ortiz, Empire State College*

Patching the Pipeline

BY REGINA STEVENS-TRUSS

In 1992, an issue of *Science* featured a series of articles called "Minorities in Science: The Pipeline Problem" (1). The introductory report began with the following excerpt:

"For 20 years, science has been wrestling with the pipeline problem: how to keep minorities from turning off the obstacle-strewn path to careers in science, mathematics, and engineering. Thousands of programs have been started since the late 1960s to bring diversity to the scientific workforce."

Fourteen years later, *The Scientist* published a supplement devoted to diversity. In it, there was an article by Kirsten Weir (2), who wrote, "It's clear that many factors conspire to push underrepresented groups out of the pipeline…There's been a lot of noise [about increasing diversity] for years, but there has been no systematic change."

As a black Latina woman (or, as I like to think of myself, a triple-cripple or a Trifecta), I often think about why and how I remained in the game despite my odds. I am an immigrant from Central America and have lived in the United States for 35 years. My father strongly believed in education and its power and constantly emphasized its importance. Despite his preaching, there were many societal influences that pulled me and divided my attention; my peers, the media, and many adults in my life. So how did I end up in science? The answer is two-fold: 1) my genuine love of science and 2) the right role models at the right time. My eighth grade math and art teachers had me convinced that I could do anything I wanted to. I already believed in the power of education; they just convinced me that I could excel at science and math.

Why am I telling my story? Because it shows the incredible role that mentoring plays in shaping young lives. What if all along the educational pipeline, minority students encountered mentors that served as "monitors" and helped them along? What if they were convinced at a young age that they "could do it?" All studies point to the fact that by the time minority students get to high school, they have already been turned off science. In fact, as pointed out by Weir, "Kids from underrepresented groups often give up before they've even entered the pipeline…" So, we as educators MUST play a bigger role in mentoring and either move the pipeline entry to an earlier point in education or be more mindful of the leaky points. As college educators, we expend tremendous amounts of energy on the few minorities that remain in the pipeline and are already in college. But it is my belief that we can become patches in the pipeline much sooner.

It is astounding that 17 years after the *Science* article was published this is still a conversation we are having. Nonetheless, we must continue to make the issue known and the problem heard and truly commit to being the plugs in the pipeline. Albert Einstein defined insanity as "doing the same thing over and over again and expecting different results." The conventional wisdom of initiating programs that target students solely at the college level has not been successful. As noted by Weir, "Failure to question conventional wisdom contributes to persistent leaks in the scientific pipeline." As science educators, we need to revisit current practices and devise new ways of attacking this continuing problem.

As a chemistry/biochemistry professor, I have made an effort to patch the pipeline. By devising outreach/mentor programs that make me and my college students visible to the K-12 community, I believe that we are imparting to children a sense of belonging, a sense of seeing themselves in the picture. We can and MUST commit to devising ways in our communities to help patch the pipeline. From serving as mentors and encouraging our protogées to be mentors, to speaking out at every opportunity, we must not become complacent and comfortable in our "successes" and allow this conversation about diversity to continue to fester.

Let's patch that leaky pipeline now; there may not be a better time than the present. XXXX

Regina Stevens-Truss is an associate professor of chemistry at Kalamazoo College and a member of the ASBMB Minority Affairs Committee. She can be reached at rtruss@kzoo.edu.

REFERENCES

1. Culotta, E., and Gibbons, A., eds. (1992) Minorities in Science: The Pipeline Problem 1st Annual Report. *Science* **258**, 1175–1237.
2. Gallagher, R., ed. (2006) Diversity 2007: Measuring Effectiveness. *The Scientist* Supplement (November 2006).

Lipid Research in Australia

BY STUART PITSON

Australian biomedical science has long been known for its seminal contributions to immunology, apoptosis, and protein biochemistry. The summary below, written by Stuart Pitson, illustrates that there are underappreciated centers of excellence in lipid biochemistry and biology as well.

With a population one-fifteenth the size of the U.S. (21 million), the current lipid research in Australia represents a mere microcosm of the larger international effort. In particular, Australian research has played a significant and longtime role in understanding the function and regulation of lipids such as cholesterol in cardiovascular disease (for example at the Heart Research Institute and University of New South Wales (UNSW) and the Baker IDI Heart and Diabetes Research Institute in Melbourne). Much of the strength in this area has been in response to increasing obesity rates that place Australia not far behind the U.S. and has stemmed from support provided by the National Health Priority Area framework of the National Health and Medical Research Council (the Australian equivalent of the U.S. National Institutes of Health).

Australia has also had longstanding strength in vesicular trafficking research at centers such as the Institute for Molecular Bioscience (IMB) in Brisbane and the Garvan Institute in Sydney. While much of this research has traditionally focused on protein regulators, considerable work is now being carried out on the important role lipids play in these processes. Considerable expertise in membrane biology (for example at the IMB and UNSW) and, more recently, membrane microdomains as platforms for signaling and mediators of diverse cellular functions has existed for some time in Australia.

With the exception of phosphoinositides, the notion of cellular signaling by other lipids was slow to be widely accepted in Australia, especially compared with the U.S. This was probably due to the depth of Australian research in deciphering the role of protein phosphorylation cascades in cellular regulation as well as the local strength and long history in proteomics in this country (the term "proteomics" was first coined in Australia), which naturally predisposed local researchers toward a protein-centric view of signal transduction. The concept of lipid signaling is now commonplace, however, with considerable Australian research efforts now being devoted to cellular regulation by sphingolipids, lysophospholipids, phosphatidic acid, and other lipids across a number of institutions, including the Centre for Cancer Biology in Adelaide, the Garvan Institute, and the Centenary Institute in Sydney. Quality work also continues on the regulation and biological roles of the phosphoinositides at centers such as Monash University in Melbourne, the University of Queensland, and the Garvan Institute. A few isolated pockets of resistance remain, however, such as acceptance in some parts to the role of ceramide and sphingosine in apoptosis. Again, this is almost certainly due to the pivotal initial and continuing work from Australian researchers in discovering and deciphering the role of Bcl-2 family proteins in apoptosis instilling a natural bias toward this regulatory model. With such strength in this area (most notably at the Walter and Eliza Hall Institute in Melbourne), the current lack of widespread collaborative efforts in Australia to better understand the interplay that exists between the Bcl-2 family and sphingolipid components of apoptotic regulation remains somewhat of a lost opportunity.

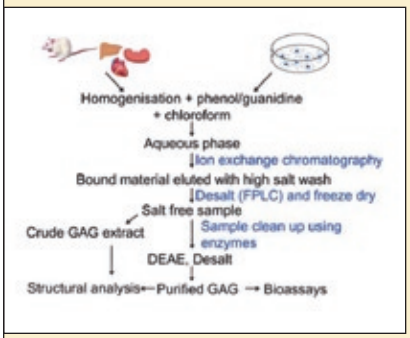
Lipid research in Australia has certainly diversified in the last decade, and, similar to the situation in the U.S., is set to hold center stage like never before. Lipids have long been a focus in cardiovascular disease-related conferences, but lipid-centric themes are now included in most Australian conferences, including ComBio (the annual conference of the Australian Society for Biochemistry and Molecular Biology—the other ASBMB), the Hunter Valley Cell Biology meetings, the Barossa Valley and Garvan Cell Signaling meetings, and the Lorne Cancer meetings. Notably, Australia will also host two other significant lipid meetings in the next year: the 28th World Congress and Exhibition of the International Society for Fat Research (September 2009) and the 19th International Symposium on Plant Lipids (July 2010).

The current strong interest in lipid research in Australia and the recent development of a number of lipidomics facilities as well as the ever-increasing expertise in various lipid analyses bodes well for the future of the field in this country.

Stuart Pitson is a senior research fellow at the Centre for Cancer Biology in Adelaide. He can be reached at stuart.pitson@health.sa.gov.au.

Simple Heparan Sulfate Purification

Glycosaminoglycan heparan sulfate (HS) is a component of cell surface proteoglycans that is critical in many biological and disease processes. However, the current methods of purifying HS are laborious, time consuming, and can sometimes result in alteration of native structure. This study, however, puts forth a simple and rapid extraction and purification protocol employing phenol/guanidine/chloroform reagents known as RIP (rapid isolation of proteoglycans). The authors demonstrated that using a BODIPY fluorescent label in conjunction with RIP purification allowed for structural analysis of HS at up to 100-fold higher sensitivity than previous fluorescence detection methods and 1000-fold higher sensitivity than standard UV detection. With this new technique in hand, the authors managed to observe novel insights into HS structural changes in Sulf1 (glucosamine endosulfatase) knock-out mice *in vivo*, which had been previously unattainable. RIP should emerge as a significant contributor in the field of glycomics and will enable better understanding of the structure-function relationships of HS and other glycosaminoglycans in complex biological systems.



RIP strategy for the rapid isolation of heparan sulfate from tissues and cells.

Rapid Purification and High Sensitivity Analysis of Heparan Sulfate from Cells and Tissues: Toward Glycomics Profiling

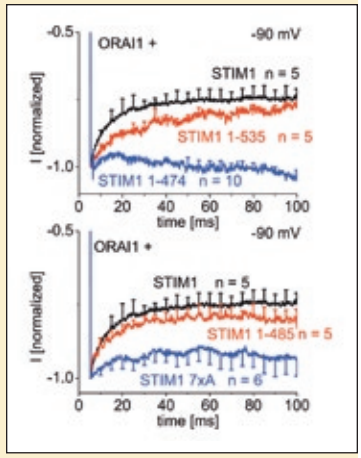
Scott E. Guimond, Tania M. Puvirajesinghe, Mark A. Skidmore, Ina Kalus, Thomas Dierks, Edwin A. Yates, and Jeremy E. Turnbull

J. Biol. Chem., published online July 13, 2009

jbc

A CRAC Reporter

The Ca^{2+} release-activated Ca^{2+} channel (CRAC) is a well-known example of a store-operated channel system in which intracellular depletion of an essential ion indirectly triggers channel activity. A key intermediary in the CRAC cascade is stromal interaction molecule 1 (STIM1), which senses ER calcium depletion and then binds to ORAI1, the pore-forming subunit of CRAC. A cluster of seven negatively charged residues in the cytosolic part of STIM1 act to modulate ORAI1 binding and activity, and, in this study, the researchers used patch-clamp analysis to examine this CRAC modulatory domain (CMD). Deletion of CMD or substitution of the seven negative residues with alanines severely reduced or even abolished channel inactivation, whether in cells expressing exogenous ORAI1 or endogenous CRAC. Interestingly, this reduction was not as pronounced for endogenous CRAC or the homologous ORAI3, suggesting these two systems have additional factors that contribute to their inactivation processes. The researchers also found that decreasing intracellular Ca^{2+} chelators could promote ORAI1 inactivation, while substituting Ba^{2+} for extracellular Ca^{2+} completely abrogated activation, indicating this STIM1 feedback signal works in a calcium-dependent manner.



Removing the CMD of STIM1, either through deletion (*top panel, blue*) or alanine substitution (*bottom panel, blue*) inhibits the fast inactivation of ORAI1 currents.

A CRAC Modulatory Domain (CMD) within STIM1 Mediates Fast Ca^{2+}-dependent Inactivation of ORAI1 Channels

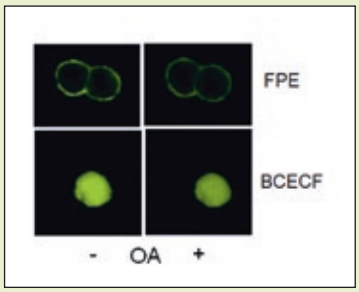
Isabella Derler, Marc Fahrner, Martin Muik, Barbara Lackner, Rainer Schindl, Klaus Groschner, and Christoph Romanin

J. Biol. Chem., published online July 21, 2009

jbc

Caveolins Gather Up the Fat

Caveolins are small integral membrane proteins that are responsible for forming surface invaginations known as caveolae in a variety of cell types. They are also involved in lipid storage and movement, as evidenced by ectopic expression of caveolin-1 enhancing fatty acid (FA) sequestration in membranes. In this study, the researchers further characterized the effect of caveolin-1 and -3 expression on transmembrane FA movement and distribution by labeling the outer membrane leaflet of HEK293 cells with a fluorescent marker (FPE) whose emission is quenched by the presence of FA anions. Their real-time measurements indicate that caveolins-1 and -3 promote localization of FA anions on the inner leaflet membrane through interactions with basic amino acid residues on their C termini. This localization resulted in enhanced cellular triglyceride accumulation and increased protection against FA-induced toxicity. Together with data from caveolin-deficient animal models, these findings suggest an important role for caveolins in modulating FA flux and storage, likely due to the ability of caveolin to facilitate the formation of lipid rafts to buffer high FA levels.



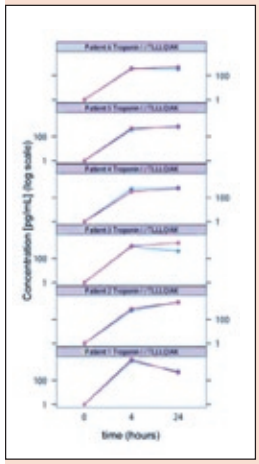
Imaging HEK293 cells labeled with FPE or BCECF shows that treatment with 20 μM oleate decreases fluorescence intensity due to fatty acid binding (FPE) and transmembrane diffusion (BCECF).

Caveolins Sequester Fatty Acids on the Cytoplasmic Leaflet of the Plasma Membrane, Augment Triglyceride Formation, and Protect Cells from Lipotoxicity

Jeffrey R. Simard, Tova Meshulam, Biju K. Pillai, Michael T. Kirber, Kellen Brunaldi, Su Xu, Paul F. Pilch, and James A. Hamilton

J. Lipid Res., published online July 15, 2009

Alternative Approach to Biomarker Verification



MRM quantification of the low abundance protein cardiac troponin I in six patients 0–24 hours post-injury.

While unbiased searches for disease-associated proteins can uncover hundreds (or more) differentially expressed proteins, comprehensive validation studies are required to weed out the false positives that constitute most of these discoveries. Immunoassays are a standard verification approach, but because reagents for clinical grade immunoassays often exist for only a handful of potential candidates, alternative methods that are able to screen large protein sets are required. In this study, the researchers used multiple reaction monitoring (MRM) coupled with stable isotope dilution mass spectrometry (SID-MS), to develop a quantitative, multiplex assay that could detect low abundance plasma proteins without the need for antibody enrichment. Next, they used their technique to assay six proteins of clinical relevance to cardiac injury (CRP, MRP14, MPO, cTnI, cTnT, and NT-proBNP, which vary 3–4 levels of magnitude in their abundance) in six patients undergoing alcohol septal ablation for hypertrophic obstructive cardiomyopathy. The researchers found that the assays had a high degree of precision, reproducibility, and sensitivity in both inter- and intra-assay analysis, indicating that SID-MRM-MS technology can be valuable in verifying novel or uncharacterized candidate protein biomarkers.

Quantification of Cardiovascular Biomarkers in Patient Plasma by Targeted Mass Spectrometry and Stable Isotope Dilution

Hasmik Keshishian, Terri Addona, Michael Burgess, D. R. Mani, Xu Shi, Eric Kuhn, Marc S. Sabatine, Robert E. Gerszten, and Steven A. Carr

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From Lab Work and Genetics to Toxic Chemicals and Public Policy

BY HOLLY DAVIES

I don't know whether my career path has been a logical extension of my varied interests or random happenstance. Five years ago, I never would have expected to be where I am today, working on chemical policy for the Washington State Department of Ecology. Instead, I thought I would be doing academic research in genetics.

I went to Cornell University and got an undergraduate degree in biology with a concentration in genetics and development. I also worked in several genetics labs while I was in college. After college, I entered a Ph.D. program in the Department of Genetics at the University of Washington (UW). I rotated through several labs and chose to work on RNA and translational control during mouse spermatogenesis. For my postdoc, I went to the National Institutes of Health to work on transcription and mouse oogenesis.

I left NIH earlier than I expected and went back to Washington when my husband was offered a job managing salmon populations for a group of tribes. His job is in Olympia, the state capital. There is no genetics research in Olympia.

Shortly after moving to Washington, I saw an ad for the perfect job teaching genetics and molecular biology at a private university in Tacoma, about 30 miles away. I got the job, and it was great, but it was only a 1-year visiting assistant professor position. After that was up, I started saying "yes" to every job that came my way. I heard about an opening to teach cell biology at a community college as an adjunct, but when I spoke to the dean, he asked me to teach nutrition. That led to teaching nutrition at another community college, and then the dean at that school asked me to teach environmental science at the last minute for one quarter. I wouldn't have applied to my current position at the Department of Ecology if I hadn't been teaching environmental science.

My Current Job

My current job is at the intersection of what we know about chemicals and what we should do to protect human health and the environment. I mainly work on persistent, bioaccumulative, and toxic chemicals (PBTs). These chemicals last in the environment for a long time, build up in organisms and ecosystems, and are toxic. It has been really interesting to learn about PBTs, where they come from, and what we can do to get rid of them. My first project was on lead, which can be found everywhere. I now know more than I ever thought I would about lead in consumer products and in the environment. I tagged along on a compliance visit to a local organ factory, as organ pipes are made of lead. I was afforded the opportunity to tour a prison to see its shooting range and what it does with lead ammunition. I learned more than you can imagine about balancing car tires with lead wheel weights.

My agency is full of knowledgeable and helpful people, and I love learning new things all of the time. I work with a lot of people doing different things within my agency and in other state agencies. I also interact with the state legislature, industry, environmental groups, and others. During the last legislative session, I amended part of a bill that was passed and signed by the governor. It's satisfying to see my words in law. We have also been working with other states on reforming chemical policy, especially for harmful

Davies

Holly Davies received a B.S. in Biology with a concentration in genetics and development from Cornell University in Ithaca, NY in 1993 and a Ph.D. in genetics from the University of Washington in Seattle in 2000. She worked as a postdoc at the National Institutes of Health from 2000 to 2004. In 2004, she moved to Washington State and taught biology at different schools before joining the Washington Department of Ecology in 2007. At Ecology, she is working on reducing PBTs.

chemicals in children's products. Do you realize how little you know about what is in your household products? In the U.S., chemicals are presumed safe until proven harmful. We often talk about chemicals that cause cancer, but it's also important to look at developmental toxicity and endocrine disruption. I find my training in development and reproductive biology is useful for that.

While nobody asks me about genetics anymore, and I haven't run a gel or looked through a microscope in almost 5 years, I still use my training. As the senior scientist in my section, I read a lot of scientific papers and look at a lot of data. I also use the logic and way of thinking that I learned in graduate school and my postdoc. I use my public speaking and writing skills all the time, but it is different when I am not talking to a group of Ph.D.s. It has also been challenging to learn how a state agency works and interacts with the rest of state government. Even after 2 years, I still ask my boss all the time about what group does what and what the acronyms mean. After I had been at Ecology for a year, I saw an ad for a similar visiting assistant professor position at the university where I had taught previously, and I couldn't believe such a position had ever looked good to me.

Ideas That Did Not Work Out

I did not take a direct path to my current job. I meandered a bit and started down paths that did not work out. At some point, I realized that I didn't feel strongly enough about my research to move my family to anywhere I could get a faculty position. I've always been interested in law, so I looked into patent law. If we hadn't moved across the country, I might have applied for a job as a patent agent at the U.S. Patent and Trademark Office in Virginia. I spoke to some lawyers and patent agents in Seattle and Portland, but the jobs are scarce, and both Portland and Seattle are far from Olympia. I applied for a human genetics policy fellowship in Washington, D.C. Looking back, I see it would have been crazy to leave my husband and two young children for a year, especially during the year our oldest child started elementary school. I applied for a job in management consulting. In hindsight, I am glad that I did not get a job that requires so much travel. Somehow, I ended up in the perfect place.

Changing Course: How Faculty Can Better Engage Students

BY SHAWN R. DREW

"I hear, and I forget; I see, and I remember; I do, and I understand."
Chinese Proverb

There is a paradigm shift in the traditional role of a professor, from that of the "sage on the stage" providing instruction in didactic lecture format to that of the facilitator or the "guide on the side." The transformation away from the teacher-centered approach to the student-centered approach is due, in large part, to advances in communication technology (*e.g.* the Internet) (1). However, many faculty members today have limited experience in modern pedagogical skills that confer an engaged learning environment since they, as students themselves, were taught in the traditional form of didactic instruction. Below are various strategies that science faculty can use to engage their students.

Strategies for Engaging Students

There are many strategies that faculty from any academic discipline can use to promote student engagement for high academic achievement. One approach is providing students with challenging work. This enables students to think critically about new concepts, explain their reasoning, defend their conclusions, and explore alternative strategies and solutions. Student engagement and achievement are promoted when instruction is rigorous (and yet still achievable) to allow students to develop and maintain their intellectual ability. Intuitively, students become disengaged when the work seems unchallenging and boring.

Another method for student engagement is peer collaborative assignments, where students work in groups for shared interactions instead of working in isolation. Research shows that peer collaborations provide better learning experiences (2). For instance, in the late 1970s, Uri Treisman, a graduate student at the University of California, Berkeley, wanted to understand why African American students were not doing as well in calculus as their Asian American counterparts. Through extensive observations and careful data analysis, Treisman concluded that the major difference was that African American students typically worked in isolation, while Asian American students worked together and learned from each other. Treisman then emphasized group learning and a sense of community in his teaching, and the results were dramatic—the African American participants outperformed not only other underrepresented minority students, but their Caucasian and Asian American classmates as well. The Treisman model of peer collaboration is widely used today and exists in many closely related forms on some 200-plus college campuses.

"Because of the nature of discovery-based disciplines, science faculty members have two additional tools to engage students: i) active learning and ii) the research classroom."

Providing challenging work and fostering peer collaboration are useful strategies that engender an academic atmosphere in which students thrive. However, they should be considered with some degree of caution, as faculty members recognize that there are subtle caveats. For example, challenging curricula may lead to disengagement and students feeling overwhelmed if it is not tempered with an appropriate level of support where the learning goals are clear and achievable. Likewise, if peer collaboration is inappropriately conducted, it may undermine engagement if it threatens students' self-efficacy and/or trust in peers. The student who is known as the "teacher's pet" may not be well received among his or her classmates for a collaborative project; therefore, faculty must be mindful of the interpersonal relationships between students and dispel favoritism.

Active Learning and Laboratory Research

Because of the nature of discovery-based disciplines, science faculty members have two additional tools to

engage students: i) active learning and ii) the research classroom. Active learning comes in various forms, including problem-based learning (PBL) (3). Here, students are presented with a problem and are asked to define an approach for addressing the problem that is based on their current knowledge of the subject. Students then learn the content of the subject matter and later participate in exercises designed to determine how much they learned. A key to the success of PBL is that the problem must be open-ended and not strictly defined. As such, this creates situations similar to those that real world scientists face which yield unexpected results that can be a source of new hypotheses and major theoretical insights (4).

"...to achieve dynamic learning environments, faculty must go beyond the status quo of the conventional didactic delivery approach and incorporate various strategies that purposefully engage students in the learning process."

Although many proven methods for incorporating active learning into postsecondary courses are available (5), they are far from the norm as faculty struggle to implement them. The barriers to incorporation include inflexible curricula, insufficient time to prepare lessons, concern about the potential for not accomplishing specified learning goals, and fear of the unknown. Researchers at Cornell University (6) have shown that when educators are able to address these concerns and become increasingly comfortable with this approach, a range of benefits ensue; *e.g.* increased student motivation and interest in science and a greater degree of critical thinking leading to deeper understanding.

Many science faculty members recognize that a good way to supplement pedagogy is for students to conduct extracurricular laboratory research. However, due to limitations in human and fiscal resources, most institutions can only offer this type of training to a small subset of students, typically those in an externally funded science program.

There are well documented and strongly supported benefits of research exposure, in particular for undergraduate students (7-9). For example, the United States Air Force Academy developed a classroom-based research program in their biology department. Students were presented with a range of potential research projects, followed by discussions and the opportunity to work collaboratively with one or two other students with similar interests (employing the peer collaboration engagement strategy). Faculty carefully designed each project to be completed in a single semester, accommodating sufficient time for students to prepare an adequate literature review (3–5 weeks), collect and analyze data (6 weeks), and perform written and oral assessments (4–6 weeks). To accomplish the tasks in the time allowed, projects were narrow in scope and employed proven laboratory methodologies (for example, some of the student research projects were "subcloning a gene encoding a bacterial lipase" and "cloning a gene encoding a novel thermostable esterase"). The students' projects were not designed as a techniques course for conducting laboratory experiments, but rather activities in which students took ownership of their learning. Grades were not based on specific research findings at the end of the semester, but on the level of effort and application that students bestowed through the scientific process. The result was nearly a three-fold increase in independent research enrollment and the exposure of 80 percent of biology graduates to research (10).

Another institution (with a grant from National Science Foundation's Course Curriculum and Laboratory Improvement) which assessed outcomes from its research classroom courses found that science majors had a deeper appreciation and understanding of science that guided their career trajectory post-undergraduate training (11). This is an important concept, as many science undergraduates, in particular those majoring in biology, often view graduate school as a last resort if they do not get accepted into medical school. As a consequence, such students enter graduate programs undermotivated, under-prepared, and uninformed about the nature of academia. Providing research training through the research classroom strategy during the undergraduate years better prepares science students for the rigors of graduate school.

In summary, to achieve dynamic learning environments,

faculty must go beyond the status quo of the conventional didactic delivery approach and incorporate various strategies that purposefully engage students in the learning process. Science faculty members who have used the various engagement strategies presented in this paper have witnessed increased student motivation, interest in science, and a deeper understanding of the subject matter. Such students are motivated to learn as they pursue higher order learning; they also experience other benefits, such as improved communication and problem-solving skills, heightened critical thinking and inquiry, and increased confidence. The benefits outweigh any implementation challenges faculty faced incorporating these modern pedagogical modalities. Through implementation of these engagement strategies, students may provide a modern take on the Chinese proverb: "Because I hear, see, and do, I am engaged, and I understand."

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REFERENCES

1. Garrison, D. R., and Vaughan, N. (2008). *Blended Learning in Higher Education: Framework, Principles, and Guidelines*. Jossey-Bass, San Francisco, CA.
2. Goodsell, A., Maher, M., Tinto, V., Smith, B. L., and MacGregor, J. (1992). What Is Collaborative Learning? *Collaborative Learning: A Sourcebook for Higher Education*, National Center on Postsecondary Teaching, Learning, and Assessment; Pennsylvania State University.
3. Allen, D. E. (1996). Bringing Problem-based Learning to the Introductory Biology Classroom in *Student-Active Science: Models of Innovation in College Science Teaching*, ed. A. P. McNeal and C. D'Avanzo. Phil.: Sauders College Publishing, 259–278.
4. Dunbar, K. (2000) How Scientists Think in the Real World: Implications for Science Education. *Journal of Applied Development Psychology* **21**, 49–58.
5. Handlesman, J., Ebert-May, D., Beichner, R., Bruns, P., Chang, A., DeHann, R., Gentile, J., Lauffer, A., Stewart, J., Tilghman, S. S., and Wood, W. B. (2004) Scientific Teaching. *Science* **304**, 521-522.
6. Trautmann, N., MaKinster, J., and Avery, L. (2004) What Makes Inquiry so Hard? (And Why Is It Worth it?) *Proceedings of the NARST 2004 Annual Meeting*, Vancouver, BC, Canada.
7. Halaby, R. (2001). Promoting Undergraduate Research in Science. *Scientist* **15**, 35.
8. National Research Council (1996). *From Analysis to Action: Undergraduate Education in Science, Mathematics, Engineering, and Technology*. Washington, D.C.; National Academy Press. Also available online at www.nap.edu/catalog/9128.html.
9. National Research Council (2003). BIO2010: *Transforming Undergraduate Education for Future research Biologists*. National Academy Press, Washington, D.C.
10. Snellman, E., Krueger, J. A., and Unangst, E. T. (2005) Moving Research into the Classroom: Successful Adaptations at a Service Academy. *Journal of College Science Teaching*, March/April, 24–28.
11. Kight, S. Gaynor, J. J., and Adams, S. D. (2006) Undergraduate Research Communities: A Powerful Approach to Research Training. *Journal of College Science Teaching*, July/August, 34-39.

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