



Reshaping Scientific Boundaries

Will Multidisciplinary Collaboration Drive Tomorrow's Scientific Breakthroughs?

By Thomas Ricci



Today, more and more research in analytical chemistry is occurring at the interfaces between biological, physical, and the materials sciences. The need to rapidly develop new analytical procedures or, more broadly, multidisciplinary strategies has given birth to innovative scientific solutions facilitated by collaborative multidisciplinary research.

The convergence of the sciences is beginning to reshape, or even dissolve, the traditional boundaries between the scientific disciplines, while significantly changing the role of the analytical chemist. It has also given rise to the importance of multidisciplinary collaborations between experts in their respective fields, while raising questions as to how best prepare future scientists to engage in these collaborations.

Pittcon Technical Program Reflects the Changing Landscape

Evidence of the rapidly changing analytical chemistry landscape can be found at the Pittsburgh Conference and Exposition, which annually hosts more than 2,000 technical papers in the form of symposia, workshops, contributed oral presentations and poster sessions. Pittcon, which was traditionally considered an analytical chemistry meeting, presents a broad Technical Program covering just about every scientific discipline imaginable. In the past several years, research in proteomics, genomics, and other non-traditional bioscience and pharmaceutical areas have become more prominent. At Pittcon 2007, for instance, nearly 50% of the presentations and posters in the Technical Program addressed research in the life sciences, clinical chemistry, and the pharmaceutical sciences.



**John Varine Pittcon 2008
President**

The trend will continue at Pittcon 2008, most notably with contributions from distinguished geneticist, Dr. Leroy Hood, President, Institute for Systems Biology, who will deliver the plenary lecture, and a number of other leading life scientists who will present their current research findings.

What is driving this trend? Dr. Jane Chan, Pittcon 2008 Technical Program Chairwoman, believes "the cross-discipline expansion of the traditional role of the analytical chemist is a natural evolution driven, in some part, by rapid advances in scientific instrumentation and techniques across all fields."

John Varine, Pittcon 2008 President, added "Organizations like the 'Bridging the Sciences Coalition,' whom we hosted at Pittcon 2006, are proactively seeking funding to support programs that facilitate the interface between the physical/computational and the biological sciences. The results of these efforts are clearly recognizable at Pittcon."

The late Dr. Charles Garber¹, former CEO of Structure Probe, Inc., offered his perspective after attending Dr. Charles Lieber's Pittcon 2007 plenary session on Nano wire Nanoelectronic Devices for Detection of an Interfacing to Biological Systems.

"... what struck me as being the most amazing is how so many of the traditional barriers that define materials science, biological science, chemistry, physics, and perhaps a few other disciplines have so quickly disappeared. This also suggests that those scientists having the greatest potential for profound discoveries in the future will be those who know as much about materials science as they do about life science and vice versa," noted Garber in a Blog entry after Pittcon 2007.

The Chemistry Enterprise in 2015



William F. Carroll, Jr.
Chemical Corp. and ACS
President 2005

In January 2006, the American Chemical Society published a report entitled *The Chemistry Enterprise in 2015*, which was the result of a year-long research project led by William F. Carroll, Jr. Occidental Chemical Corp. and ACS President 2005, and Douglas J. Raber of GreenPoint Science. The project encompassed interviews with a number of experts from academia, industry and government and symposia participants from the ACS national meetings. One of the objectives of the research was to project a vision of the chemistry landscape in the year 2015. Among the many interesting observations presented in the report was the role that multidisciplinary chemistry would play in the future: "Multidisciplinary research—collaboration by scientists in different disciplines who bring a depth of expertise and an interest in the periphery—will be increasingly common. Ultimately, it may be difficult to identify a project's disciplinary origin, and the question will seem irrelevant. Strength in core chemistry will remain the essential platform for advances in all of molecular science."

The report also addressed the overlap between chemistry and biology and the dissolution of the boundaries of chemistry and materials science completely. "The inherent multidisciplinary aspects of these areas, together with new technologies such as high-throughput screening, are generating advances at an accelerating pace, and the needed expertise often requires multifield collaborative work."

However, effective multidisciplinary collaborations will not occur without challenges.

"We are finding truly challenging problems at the interfaces of some of the traditional sciences and solving them requires multidisciplinary work across the interface. But in my opinion, the best work is done when scientists with depth and expertise in complementary fields collaborate. It's not a matter of being a mile wide and an inch deep; breadth is important, but depth and the ability to apply it while working with other experts or groups matters more," noted Bill Carroll. "Moving forward," he added, "multidisciplinary resources will become more important: there will be new journals dedicated to hybrid fields; meetings will highlight the synergies; professional organizations will serve the niches but also see the need to be broad in coverage so as to prepare their members for the 'next big thing.'"

The Role of the Analytical Chemist across Multiple Disciplines

The American Chemical Society's Division of Analytical Chemistry will dedicate a symposium on Interdisciplinary Analytical Chemistry at Pittcon 2008. Organized by Isiah M. Warner, Vice Chancellor for Strategic Initiatives Boyd Professor and Philip W. West Professor of Analytical and Environmental Chemistry and Howard Hughes Medical Institute Professor of Louisiana State University, the symposium will highlight the many disciplines inside and outside of chemistry which are impacted by analytical chemistry. Experts in various fields, including biology, organic chemistry, clinical chemistry, and nuclear chemistry, will discuss how analytical chemistry is being applied in their areas of focus.

Interdisciplinary Chemistry Education—What's the Optimum Curriculum?

In recent years, interdisciplinary chemistry curriculum has expanded in colleges and universities. Some are considering changes in the way traditional chemistry departments are organized. But is it too early to decide how best to prepare the scientists of the future to successfully facilitate multi-disciplinary collaborations? The rapidly changing landscape has created debate as to the most effective approach to education and training. For example, should students become expert in one field with only a cursory knowledge of other disciplines, or will they need to be trained thoroughly in several disciplines?

Bill Carroll believes there is still a need for students to be expert in a specific field. "The time-to-degree cannot expand indefinitely to accommodate learning everything about everything. Individual courses in the curriculum or mid-career symposia on the state of a particular art can help broaden a person's horizons. The most important skill a student will acquire beyond mastery of a field is the interest in and the ability to learn about a new field and adapt his or her expertise to that new area," he said.

Dr. Garber offered a different perspective: "Perhaps the way of the future will not be along the lines of classical chemistry, physics, biology, etc. departments but structured more along the lines of multidisciplinary departments. If I am right about this, then this surely does suggest that any life science researcher, to stay ahead of their peers, will need to become an expert in materials science as well."

Bill Carroll agreed that if there were to be a wholesale reengineering of undergraduate or graduate education, it might well

be reorganized under multidisciplinary lines, but he doubts that such a wholesale reengineering would occur.

“If you ‘bolt on’ courses to an undergraduate major you could simply be increasing the time to degree; if you remove courses in a traditional discipline and substitute others you have a major built on two half-majors and risk microspecializing too early. As a grad student, you will take courses to support your major but also your research. Since research in universities is bridging the interfaces you will almost necessarily be learning the depth of your field and some breadth to support your research. Most importantly, you need to teach yourself how to learn and reinvent your self—that will be a useful skill throughout your career,” he concluded.

Either way, multidisciplinary collaboration is sure to offer unique opportunities and create new challenges for analytical chemists in the future, and what better place to get a multidisciplinary education than Pittcon.

Footnote

1. Dr. Charles Garber passed away on September 19, 2007 during the writing of this article. His comments are included posthumously in recognition of his contributions.

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