Can the Chasms Be Bridged?

Arthur T. Johnson

Appeared in the 23 August 2006 issue of the AIMBE News

Earlier this summer the Biomedical Engineering Society (BMES--an AIMBE member) received a letter from the National Council of Examiners for Engineering and Surveying (NCEES) about interest in a meeting to discuss beginning a Professional Engineers examination common to all bio-based engineers. The American Society of Agricultural and Biological Engineers (ASABE--an AIMBE member) had initiated this inquiry. Also involved was the Society for Biological Engineering (AIChE-SBE--an AIMBE member). Invited to the meeting, in addition, were the American Society of Mechanical Engineers (ASME--an AIMBE member), the Engineering in Medicine and Biology Society (IEEE-EMBS--an AIMBE member), National Institute of Ceramic Engineers, and the American Academy of Environmental Engineers. Not invited was the Institute for Biological Engineers (IBE--an AIMBE member), and other AIMBE member societies that may or may not be interested in a licensure exam).

The responses to the invitation that I have heard go something like this: it is probably a good idea to have professional registration for biological and biomedical engineers whose work relates to public health and safety, but. . .

BUT, how can we expect biomedical engineers to know about ventilation requirements of stored fruits and vegetables, how to operate a compost pile, or how to optimize a bioreactor? How can we possibly expect biomedical engineers to know about environmental toxins, biochemical extractions and enzyme kinetics?

But, how can we expect biological engineers to know about medical practice? about imaging? about bioinformatics? How can we possibly expect biological engineers to know about Markov chains, surgical techniques, and automatic cardiac defibrillators?

Well, excuse me, but aren't these the wrong questions to ask? Isn't this like asking how mechanical engineers can know all about engine design, refrigeration, and electronic controls? Isn't it true that electrical engineers can deal with energy grids, electrical motors, nanofabrication of computer chips, and communications systems? Isn't there just one PE exam for all mechanical engineers and another for all electrical engineers? Why is there no one from each of these groups questioning how everyone from their respective field could possibly take the same PE exam?

The answer, of course, is that mechanical engineers, electrical engineers, and all of the others, focus on common knowledge: that which all members are expected to know. There may be some applications-specific questions that make their way on the PE exam, but the exam is structured in such a way that anyone in that field should be able to pass as long as they have had the expected common education.

One thing is clear from sessions at the American Society for Engineering Education, from Rob Linsenmaier's Delphi studies of required BME courses, from the Whitaker Foundation educational summits, and from intersociety discussions related to biological engineering and biomedical engineering. That is that there is no fundamental agreement about core knowledge for bio-based engineering fields. Each academic program approaches education of its students in a different way. Some, especially those located close to associated medical schools with teaching hospitals, mandate that their students should spend a lot of time learning medical technology. Others require several

laboratories on bioreactors and bioseparations. It occurs to me that both of these are preparing their students for particular types of careers, and only for those careers.

Perhaps the problem is that faculty members who designed and administer these programs were themselves not educated as bio-based engineers. The great advances in biology over the last few decades came during a time when their formal educations had ended. They had only enough time to learn the one small portion of biology relevant to their research area, and that constituted their view of what a bio-based engineer should know. And, then again, perhaps the problem is this and a host of other factors.

I believe that any bio-based engineer who doesn't appreciate how any living being (or system) interacts with, reacts to, and is affected by its total chemical, physical, and biological environment is not well prepared. I believe that almost any engineer can work with living things, and, most likely, produce credible products and processes involving those living things. Perhaps right away, or perhaps eventually. That doesn't make that engineer a biomedical engineer or biological engineer, or whatever.

What distinguishes a true bio-based engineer from the others, I believe, is the essential study of biology forming an intrinsic part of the foundational knowledge base of that engineer. This bio-based engineer has a biological-science based understanding at least equal to the understanding of engineering sciences. This bio-based engineer is equipped to deal with the vagaries of living things. This bio-based engineer is versatile and valuable and able to look ahead to a long career filled with adjustments of technology and capability. But, maybe that's just my expectations.

Apparently, the people considering the common PE exam didn't see it that way. They were apparently looking at the application more importantly than the science. They saw the divisions, but didn't see the commonality.

As long as those perceptions pervade, there will be a divide that cannot be bridged. There will be at least one group on one side of the crevass and at least one group on the other. Each group will, in turn, believe it is superior, and that the other group has no validity. The chasm will prevent common communication, and misunderstanding will prevail. It will not be apparent to either group why they want exchange with the other.

That is, until we have a bridge. We need to build a bridge.