Q&A: Phillip Sharp on Biomedical Convergence

Upgrading therapeutics calls for tighter links across scientific and engineering disciplines

We're living, declares Phillip A. Sharp, PhD, in biomedicine's third revolution.

The first revolution started 6 decades ago in the dawn of molecular biology, says Sharp, who won a Nobel Prize in 1993 for his discovery of RNA splicing. Genomics, which brought the second revolution, kicked off about 3 decades ago. Now we're entering the age of convergence, in which biologists work ever more closely with physical scientists, engineers, and information specialists to accelerate progress in treating disease.

An Institute Professor at Massachusetts Institute of Technology, Sharp helped lead the formation of MIT's David H. Koch Institute for Integrative Cancer Research, whose new headquarters formally opened in March. He talked with *Cancer Discovery*'s Eric Bender about the promises and practicalities of this deeply cross-disciplinary work.

How do close collaborations of scientists and engineers help to drive cancer research today?

Here's just one example. We now know that small RNAs can be used to target the silencing of specific genes. And we also know a lot of other chemical agents that could inhibit specific targets, if we could deliver them into the interior of the cell.

This is what I would consider modern pharmacology. We've been doing pharmacology with small molecules for just about a century and with proteins that interact with the surface of cells for about 50 years. Now we'll be doing pharmacology with agents that do not pass to the interior of the cell unless they are facilitated with a delivery process.

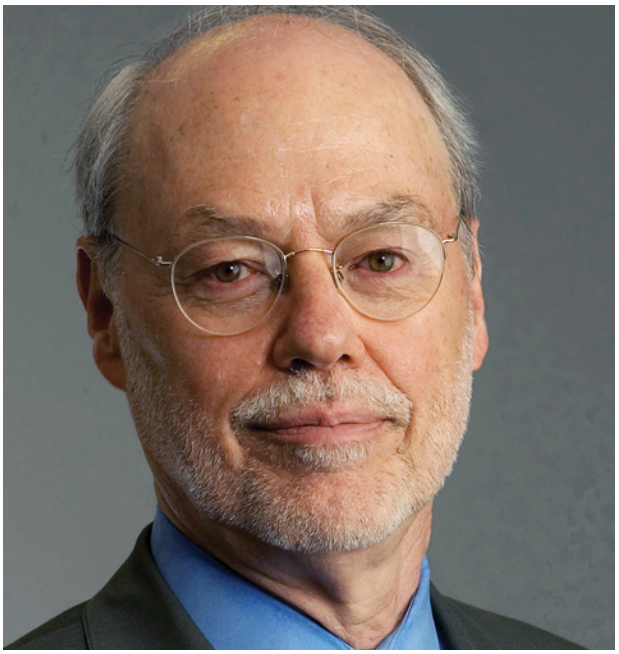
Work at the Koch and elsewhere is exploring nanoparticles in this delivery role. We now know how to fabricate nanoparticles, to target nanoparticles, and even to use cells to direct nanoparticles. These kinds of abilities come from the interface of cancer biology, engineering, and physical science.

How does the Koch encourage tight collaborations?

The Koch was designed for the full integration of engineering with cancer biology, not only intellectually but physically in our building. We've got 3 or 4 engineering labs on every floor with 3 or 4 biology labs. They are grouped by interest. One is, for example, immunology—at MIT there are more immunologists in engineering than in the biology department.

Are the collaborations developing as hoped?

The first months in this new building have been wildly successful. We see these interest groups interacting, holding joint seminars, and collaborating on science. People in the different research groups are becoming friends. The engineers are learning the language of cancer biology and the cancer biologists are learning the language of engineering. To fully gain the benefit of what the Koch offers, blending the cultures and opening up new opportunities, will take years. But I'm very encouraged.



Massachusetts Institute of Technology

"If you look down the road a decade or two, and you ask yourself how this country will achieve increased quality of medical care, continuing to integrate scientific and engineering innovation is the only hope we have," says Phillip Sharp.

Do you see similar trends at other institutions?

There are a number of research institutes across the country, such as the Clark Institute at Stanford and the Wyss Institute at Harvard, that also are organized to take advantage of opportunities in convergence.

Are the National Institutes of Health and other funding agencies backing such efforts?

Both NIH and the National Cancer Institute are supportive of convergence, although I wouldn't say they put it at the top of their lists. But I think that these opportunities will be seen as increasingly important, and as successes appear, there will be more and more support.

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What advice do you give graduate students?

First, we're living in the Twitter society and in some ways our students are overloaded with information. There's so much information available that they may select, from that vast pool, only things that they already know to learn more about. But not only do they need to master their specific interests, they need to continue to broaden themselves by moving outside their comfort zones. They need to sit in seminars where they may not understand more than 20% of the presentation—to just absorb the language and the concepts, talk to people, and work through the most important general concepts.

Second, this is a *really* exciting time to be a student! An individual who becomes educated in the current technical and biomedical world will have just a multitude of opportunities to use their education and their talents. ■

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