The Origins of My Interest in the Economic Impact of R&D

presented by

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My interest in the impact of research predates the launch of the *Science Citation Index*® in 1964. Many people believe the *SCI* was created to study research impact for tenure evaluation or to forecast Nobel Prizes. However, the *SCI*® was invented primarily to improve information retrieval. The unique multi-disciplinary and hyperlinked structure of the *SCI* opened the field we variously called scientometrics, bibliometrics, or informetrics -- measuring the impacts of papers, researchers, journals, institutions, and countries using publication and citation outputs. So, when in the seventies, I encountered the work of Julius Comroe and Robert Dripps at the University of Pennsylvania, I could see potential value in using the *Science Citation Index* in tracing the impact of basic research on the practice of medicine as they had done in their now classic 1976 article in *Science*.[1] In 1979, I published an essay which asked "How Can We Prove the Value of Basic Research?"[2] In it, I also cited the work of Hugh H. Fudenberg who had studied the dollar benefits of research.[3] I discussed at some length the book he edited on *Biomedical Scientists and Public Policy*[4] as well as the Comroe and Dripps work.

Fudenberg provides many interesting examples. He pointed out that basic research in the 1950s on feedback control of antibody synthesis led to the near eradication in the early 1960s of Rh hemolytic disease in newborns. He estimated that its eradication saved $60 million in the U.S. and 10 times that amount throughout the world. Another example was the basic research on antigens which led to methods for screening blood donors for serum hepatitis with estimated yearly savings of $100 million. I am sure that Dr. Silverstein can up-date these estimates.

Time doesn't permit me to repeat all the details but you can access these essays and others on my website at www.eugenegarfield.org.

Other examples of basic research spin-offs include prevention of birth defects in fetuses whose mothers have contracted measles saving $180 million a year, as well as the work of Nobelist author John F. Enders whose work on virus propagation led to the development of a polio vaccine, with an estimated savings of $2 billion yearly. And in more general terms, Fudenberg estimated that the $33 million spent on basic research at the National Institute of Allergy and Infectious Diseases (NIAID) alone resulted in saving

$3 billion a year. Based on these estimates, he recommended in 1973 that a National Foundation for Biomedical Research be established that would collect and disseminate information on the costs and benefits of biomedical research. He also estimated that there is probably a worldwide cost benefit payoff from NIAID research alone of 200 to 1.[5]

Subsequent to my encounters with Dripps and Fudenberg, I met Professor Edward Mansfield at the University of Pennsylvania. He demonstrated the high rate of return to society on its investment in research and development.[6] These encounters culminated in a major review that I published in *Current Contents* in 1981 on "The Economic Impact of Research and Development."[7]

In that 1981 essay, I provided other examples including many that are directly involved with industry. These included such diverse industrial problems as a vaccine for Marek's Disease in chickens, the control of Herpes infections, rat poison based on anti-coagulants derived from basic research, sweet clover disease in cattle, and home permanent kits for waving hair. The latter came out of basic research on the structure of carotene, the protein in mammalian hair. [Sales of hair care products in the U.S. in 2005 are estimated to be $7.5 billion.].

Mansfield's analysis of 20 manufacturing industries used a model employed by many economists to measure the relationship between R&D and productivity.[8]

Finally, the then Canadian Minister of State for Science and Technology, U.R.K. Chand, used a less complex method to analyze the overall performance of 18 Canadian industries and the amount they invested in R&D.[9] He found that research intensive Canadian industry outperformed low intensive industries in a variety of forms such as 50% growth in employment, 23% higher growth in output, and so forth.

It would be of considerable interest to follow-up each of the studies that I referred to 24 years ago by a search of the *Science Citation Index* to see what others may have done with these data. Dr. Hanney perhaps can tell us about recent follow ups on Dripps-Comroe by Jonathan Grant, Rand Corporation of Europe at Cambridge. They tried to replicate their results but their methodology was not entirely clear.[10]

Later this morning, Mary Woolley will be discussing the idea of a *Research!Europe* initiative similar to that of *Research!America*,[11] of which she is President. The brief historical background I have provided explains how ISI and *The Scientist* came to join *Research!America* over a decade ago. In 2000, I joined its Board of Directors. And four years ago I established the Eugene Garfield Award for studies on the Economic Impact of Medical and Health Research (http://garfield.library.upenn.edu/researchamerica/award.html).[12] There have been three winners so far and the fourth will be announced later this year at the October 2005 Board Meeting. The awards committee includes several distinguished economists. We believe that these awards will not only stimulate further research but also provide ammunition to members of Congress and others for expanded funding of basic research.

This talk is essentially a restatement of the remarks made on the occasion of the first *Research!America* Economic Impact on Medical and Health Research Award. (http://garfield.library.upenn.edu/researchamerica/dmeltzer.html).

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