

Rethinking the University's Role in Scientific R&D

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My concern is with the future of research – and here I will stick to the scientific variety – and with what is taught in the university.

I want to highlight the methodological difficulties in such a discussion, using two analogies.

First, by the nature of university training, we are all specialists of some sort. The university is complex institution. Our plight is that depicted in the Buddhist story of the ten blind men and the elephant, each man convinced from his own particular experience that the animal resembles a pillar or a wall, a rope or a hose.

Second, the complexity we face is, like the human brain, diachronic, evolutionary, and path-dependent. It is difficult to understand how the human brain works if we do not recognize the peculiar history that has haphazardly laid down piscine, reptilian, mammalian, primate, and human layers, which must be dealt with simultaneously. Just so with the university. It is an eight-hundred-year-old institution that is the way it is by virtue of adaptations through historical circumstances. To understand the whys and wherefores of our current problems, we need to grasp how our present predicament came about.

I. The university began in the thirteenth century to train three types of professionals: civil and canon lawyers, physicians, and preachers. The prerequisite for the study of civil law was advanced Latin grammar and rhetoric; for theology, Aristotle's logic and natural philosophy; for medicine, Aristotle's natural philosophy, along with the basics of Ptolemaic geometrical astrology. These preparatory subjects were gathered in an area called the arts.

These origins are important, because despite significant alterations, the university remains for students, fundamentally a training camp for professional careers in the same old professions of law and medicine, along with some newer ones. What the majority of students want to acquire is a steady marketable skill set that leads to economic security. The contemporary research university, centered around the arts and sciences, is a relatively recent development, a graft whose connections with training in the professions needs to be clarified.

The first significant change in what the universities taught and studied arose in the fifteenth-century Italian schools, where Lorenzo Valla succeeded in introducing an improvement in the Latin of the law departments, following the lead of Francesco Petrarca, who had managed to recover a few Latin classics. This introduction of pagan Latin literature was strongly resisted by the theology departments, who correctly foresaw a rise of anti-Christian philosophies of skepticism, epicureanism, and stoicism among civil and canon lawyers, in the movement we know as Italian Humanism. However, since the administrative hierarchy of the Church consisted of doctors of Canon Law, the humanists were politically powerful and could not be eradicated. Thereafter, the universities would continue in a split of two cultures, scholasticism and humanism, in mutual hostility.

II. Since in our experience, the university is the primary home of research, it is difficult to grasp that for most of history, the universities, seeing themselves as pedagogical institutions in the three professions, offering training in an established body of knowledge, fiercely resisted the idea of new knowledge. Curriculum and pedagogical structure were threatened in the sixteenth century at both ends of the Mediterranean. This time, the trouble arose with the medical department. In Iberia, kings demanded training for a new career, that of navigator/cosmographer in the aftermath of Columbus. Since universities were the only loci for teaching Euclidean geometry and astronomy for medical astrology, kings of Spain and Portugal briefly compelled universities to teach navigation and mapmaking geometry for uncharted terrain and the high seas.

This system did not work out.

In Italy, on the other hand, the new artillery revolution created the need for military engineers, who also required training in geometry. Political structures were weaker in Italy than in the Iberian peninsula, and the universities managed to shrug off political pressures to change their curricula. Here, Galileo Galilei's particular problem was in affirming the artilleryman's experience that Aristotle's model of physical movement was unworkable. Since Aristotelian philosophy underwrote both the medical and theological programs of study, Galileo's position was institutionally unacceptable. The universities fought off such disturbances, and destroyed Galileo. The universities continued in the old mold.

The French monarchy, in the face of the military revolution and of university intransigence, took a different route, opening new schools for the military. The system began with the *College du Roi* and would ultimately lead to *l'Ecole Polytechnique*. To prepare boys, they permitted Jesuits to do what the universities would not: teach basic mathematics. Research, hitherto privately undertaken by individuals like William Gilbert or Galileo for the navy or the army, was institutionalized by Louis XIV in employing professional researchers in the *Academie des Sciences*, a move that was later followed by both Frederick the Great of Prussia in Berlin and Peter the Great of Russia in St. Petersburg. Through the eighteenth century, the universities themselves continued with training the professions, ignoring such research.

III. Early in the nineteenth century, facing bankruptcy, the Prussian state could no longer support the researches of the *Berliner Akademie*.

Needing such research, Prussia forced together the *Akademie* and the university. In these new schools at Jena, Halle, Königsburg, and Berlin, beside the usual professional training, the preparatory arts would be expanded into research professions, where arts students would be granted a new research-based degree, a Doctor of Philosophy, and their faculty would combine instruction with research. The purpose of scientific research was,

ultimately, to produce innovations: military, on the one hand, and civilian (to increase the gross national product) on the other. Even humanities research was supported for patriotic purposes, offering students *Bildung*.

The gap between university scientific research and its applications was to be filled by *Techische Hochschulen*.

This was an extremely successful model, as university teaching, research, army and industry came together to produce a second industrial revolution, along with revolutionizing the chemical and physical sciences, and setting standards for historical research, much as the eighteenth-century Paris *Academie* had revolutionized mathematics.

Universities in France and England saw all this as Teutonic absurdity – until the Franco-Prussian war. In France, the defeated and panicked state opened research institutes. In England, a bitterly hostile Oxford and Cambridge had to accept the Clarendon and Cavendish laboratories for experimental physics.

IV. In 1893, a new wave in the US opened three universities on the German model: Chicago, Johns Hopkins, and Stanford. Though most of the Ivy League schools (formed in very loose imitation of Oxbridge) resisted, it was now possible to get a PhD in America. But anti-German hostilities of the two world wars made change difficult. The real influence of German universities came during the Cold War, both because the state stepped in with enormous sums for military-related investigations, as well as through consequent employment of émigré German scientists who led Cold War research.

Yet the historic influences of the Ivy League colleges could not be set aside. The American university thus became itself a peculiar hybrid of an imitation of the German research university combined with an imitation of English athletics-centered residential colleges. This new model, though generally admired, may not be a workable model for the future.

V. With the end of the Cold War, the US government declassified enormous numbers of electronic technologies that had been developed for weapons systems. These technologies are now ubiquitous, as seen in the internet and in communications and GPS satellites. The miniaturized electronics developed for nuclear missile warheads and spy satellites was now available for personal computers and cell phones, digital cameras and flash memory. The high-frequency radar development going back to the Second World War offers us broadband wireless connections.

This technological cornucopia has transformed our ways of functioning, and been of enormous benefit for the American GDP. But for a variety of reasons, this feeding of the civilian economy by military developments is not sustainable. The Cold War is long gone, and so is the State's ability to invest in military technologies, not to mention university research in the US, to any significant extent.

Such technologies are now being designed and packaged as consumer goods. Along with engaging in pharmaceutical research, university administrations without state financial support want to enter such lucrative technology consumer markets to prop up sagging finances. Will this strategy work? If it cannot, without a state at war (which was the source of the original developments), who will pay for research of any kind?

The difficulty with the arts and sciences research university is that it presupposed a polemical state – as displayed by both its German and its American-Cold-War versions. It is not clear that such research is sustainable in peacetime. Our students perhaps sense this problem, increasingly voting with their feet for professional career-oriented studies. But beyond the eight-hundred-year-old careers of law and medicine, and newer careers such as engineering and finance, it is difficult to see how to sustain today's arts-and-sciences research university. Embracing the market through corporations has a fundamental practical difficulty: Innovations and skill sets that sell today do not sell tomorrow, and investing a life's effort in a transient technology does not appear rational to a student. The corporate university, with its short-term demands for innovation, does not seem to be a workable substitute.

