The Historical Roles of Pittsburgh's Research Universities in Regional Economic Development

By Annette L. Giovengo

WESTERN Pennsylvania's most critical issues for the rest of the century are its continued diversification away from an economy based on heavy industry and its prospects for future vitality. Carnegie Mellon University and the University of Pittsburgh are playing major roles in that transition, especially by helping to expand advanced technology activity in the economy. Acting as the "engines" for this development, their expertise and resources can help Pittsburgh achieve a leading position in the technological age.

These two universities have long had important functions for Pittsburgh's economic base. Substantially new patterns, however, have emerged locally and nationally in the nature of and expectations for university-driven economic growth. As a result, the history of this process takes on special significance. This history provides a basis for understanding, shedding light not only on where we have been, but where we may be going and how we may arrive there.

What then are these new roles? Traditionally universities have educated the professional workforce and produced new research-based knowledge, while providing cultural advantages and employment opportunities to their region. The past few decades, however, have brought universities across the country into closer contact with a technology-based economy.[1] More and more firms and industries rely

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1 There is a wealth of books and articles that discuss various aspects of university roles in the 1980s. Some of the best books are: Derek Bok, *Beyond the Ivory Tower: Social Responsibilities of the Modern University* (Cambridge, 1982); Business-Higher Education Forum, *America's Competitive Challenge: The Need for a National Response* (Washington, 1983); James S. Coles, ed., *Technological Innovation in the Eighties* (Englewood Cliffs, 1984); General Accounting Office, *The Federal Role in Fostering University-Industry Cooperation* (Washington, 1983); National Commission on Research, *Industry and the Universities: Developing Cooperative Research Relationships in the National Interest* (Washington, 1980); National

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on cutting-edge technological research that resides in universities; new firms "spin off" from university work while existing ones seek close ties with university scientists. Traditional distinctions between "basic" and "applied" research have blurred as time lags between research activity and commercial applications narrow. University-industry research links have reached unprecedented levels and intensities, while state and federal agencies encourage such joint projects. For their part, universities have built new organizational frameworks and programs to allow for a variety of relationships with industry and government.

The most dramatic signs of this process are the "high technology clusters" which have grown up around leading universities in the past twenty years. Although economic theory has long recognized the advantages of agglomerative behavior for traditional industries, these clusters have special features: growth through spin off from universities and existing firms; long-term and extensive ties to the universities for firms within the cluster; a tendency to continually regenerate with new technologies and diverse industries; development of a specialized support structure; and an intangible but powerful entrepreneurial culture.[2]

The two oldest and most successful of these clusters -- the "Silicon Valley" surrounding Stanford University and "Boston-Route 128" surrounding Massachusetts Institute of Technology — are the most important models and standards of comparison in efforts to build new clusters.[3] Both began slowly before World War II and mushroomed

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Science Foundation, *Cooperative Science: A National Study of University and Industry Research* (Washington, 1984); National Science Foundation, *University-Industry Research Relationships: Myths, Realities and Potentials* (Washington, 1982); National Science Foundation, *University-Industry Research Relationships: Selected Studies* (Washington, 1982); Robert M. Rosenzweig and Barbara Turlington, *The Research Universities and Their Patrons* (Berkeley, 1982); John F. A. Taylor, *The Public Commission of the University* (New York, 1981).

2 Good sources on the special characteristics of advanced technology clusters are: Coles; Ray Oakey, *High Technology Small Firms: Regional Development in Britain and the United States* (New York, 1984); U.S. Congress Office of Technology Assessment, *Technology, Innovation and Regional Economic Development* (Washington, 1984); Roger Miller and Marcel Cote, "Growing the Next Silicon Valley," *Harvard Business Review* July/August 1985, 114-23; Raymond Radesovich and Lee Zink, "Efficacy of the High Technology Development Strategy in the Southwest," *Southwestern Review of Management and Economics* 8 (Spring 1983): 19-32.

3 Some of the best works on Boston-Route 128 are: Nancy S. Dorfman, *Massachusetts High Technology Boom in Perspective: An Investigation of Its Dimensions, Causes and the Role of New Firms* (Cambridge, 1982); David L. Birch, *The Job Generation Process* (Cambridge, 1979); Frances E.

dramatically in the post-war years, and to date have continued to grow and to excel in technological leadership. Both universities have shown a strong "ethos of involvement" with their high technology economies, are comfortable with extensive university-industry research relationships, and promote entrepreneurship.

In other areas, smaller and more slowly growing clusters have developed.[4] Some growth has been spontaneous, but planned growth has occurred as well, as local universities recognize their role as "engines" and take part in activities designed to increase economic as well as knowledge bases. Clusters meeting with some success in following Stanford's and M.I.T.'s footsteps include those in Atlanta, Georgia, and Austin, Texas. In other areas, different patterns have emerged where the local universities do not closely follow the model. For ex-

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Wylie, *Massachusetts Institute of Technology in Perspective* (Toronto, 1975); John S. Hekman and John S. Strong, "The Evolution of New England Industry," *Federal Reserve Bank of Boston: New England Economic Review* (Mar./Apr. 1981): 35-46; James M. Howell, "Formula for Growth: The New England Experience," *Business and Economy Review* 31 (Jan. 1985): 17-24.

Some of the best works on Silicon Valley are: Alan Bernstein, et. al., *Silicon Valley: Paradise or Paradox? The Impact of High Technology on Santa Clara County* (Mountain View, 1977); Ernest Braun and Stuart MacDonald, *Revolution in Miniature: The History and Impact of Semiconductor Electronics* (New York, 1982); Thomas Forester, ed., *The Microelectronics Revolution* (Cambridge, 1981); Dirk Hanson, *The New Alchemists: Silicon Valley and the Microelectronics Revolution* (Boston, 1982); Everett M. Rogers and Judith K. Larsen, *Silicon Valley Fever: Growth of High Technology Culture* (New York, 1984); Anna Lee Saxenian, "The Genesis of Silicon Valley," *Built Environment* 9 No. 1 (1983): 11-18; Anna Lee Saxenian, "The Urban Contradictions of Silicon Valley," *International Journal of Urban and Regional Research* 7 (June 1983): 237-61.

4 Sources on the development of other clusters across the country include: Lynn E. Browne, "Can High Tech Save the Great Lakes States?" *Federal Reserve Bank of Boston: New England Economic Review* (Nov./Dec. 1983): 19-33; Susan Goodman and V. L. Arnold, "High Technology in Texas," *Texas Business Review* 57 (Nov./Dec. 1983): 290-95; John M. L. Gruenstein, "Targeting High Technology in the Delaware Valley," *Federal Reserve Bank of Philadelphia: Economic Review* (May/June 1984): 3-14; John S. Hekman and M. E. Miles, "Venture Capital and Economic Growth in the Southeast," *Federal Reserve Bank of Atlanta: Economic Review* 68 (July 1983): 12-21; Donald L. Koch, et. al., "High Technology: The Southeast Reaches Out for Growth Industry," *Federal Reserve Bank of Atlanta: Economic Review* 68 (Sept. 1983): 4-19; Michael J. Merenda, "New Hampshire's High Technology Industry," *New England Journal of Business and Economics* 9 (Spring 1983): 56-66; Theodore A. Minde, *High Technology Development in New Jersey* (Trenton, 1984); Gwendolyn B. Moore et. al., *Local Initiatives for High Technology Economic Development* (Washington, 1984); Larry K. Sawers and William K. Tabb, eds., *Sunbelt-Snowbelt: Urban Development and Regional Restructuring* (New York, 1984); and Radesovich and Zink.

ample, Research Triangle Park in North Carolina is almost as old as Silicon Valley and Boston-Route 128, but its smaller size and slower growth have resulted from reliance more upon attracting expansion divisions of existing high technology firms rather than entrepreneurial university spin-offs. In yet another pattern, Huntsville, Alabama, has experienced high technology growth when large-scale federal space and defense research installation substitute for a university as spin-off base, especially during times of federal budgetary reductions. Smaller pockets of high technology firms are scattered in states such as New Jersey, New York, Virginia, Colorado, Florida, and Texas.

In Pittsburgh, there is very visible evidence that since the early 1980s, Carnegie Mellon and Pitt have begun to accept explicit economic development roles. An advanced technology cluster — with important similarities to Silicon Valley and Boston-Route 128 — is growing around these institutions.[5] Some of the most prominent examples include:

- The partnership of both universities which has created the Western Pennsylvania Advanced Technology Center (1982), the Enterprise Corporation of Pittsburgh (1983), The Nuclear Magnetic Resonance Research and Development Institute of Pittsburgh (1983), the Pittsburgh Cancer Institute (1983), the Pittsburgh Supercomputer Center (1986), and the Pittsburgh Technology Center research park under construction on the former Jones & Laughlin Second Avenue steel mill site.
- Carnegie Mellon's research institutes with direct ties to local advanced technology industries, including the Robotics Institute (1978), the Magnetics Technology Center (1982), the Software Engineering Institute (1985), the Engineering Design Research Center (1986), and the revitalized Mellon Institute.
- University of Pittsburgh research and economic development activities encompassed by the Foundation for Applied Science and Technology (1982) and the University of Pittsburgh Applied Research Center on the former site of Gulf Oil Corporation's Harmarville research laboratory (1986).
- The presence of more than fifty "spin-off" firms founded by university faculty or students in growing Pittsburgh industries such as computer software and services, industrial automation, elec-

5 For more information on Pittsburgh's current development, see Annette L. Giovengo, *Pittsburgh Universities and Regional High Technology Economic Development* (Pittsburgh: Western Pennsylvania Advanced Technology Center, 1986).

tronic components and computer hardware, and biotechnology. Some examples are Tartan Laboratories Inc., Carnegie Group Inc., Bactex Inc., Extrel Corp., Mindbank Inc. and Formative Technologies Inc.

The experiences of each university form an important basis for these and other economic development activities. Studying this history helps to explain the shape current development is taking, as well as answering questions such as why direct university-economic progress links have appeared much later in Pittsburgh than in Boston or Silicon Valley. In short, understanding the institutions' past economic roles reveals lessons and implications for the challenges they now face.

Carnegie Mellon University

The entity now known as "Carnegie Mellon University" has existed only since 1967, after the merger of Carnegie Institute of Technology and the Mellon Institute for Industrial Research. It was the beginning of this century when technology first became an explicit basis for higher education in Pittsburgh, even though the region had been firmly established as a center for heavy industry and its technologies since the mid-1800s. On November 15, 1900, industrialist Andrew Carnegie endowed the Carnegie Technical School as an institution devoted to practical, technical education. The School's original mission was to provide specialized post-high school training and adult evening courses, "with content and methods of teaching to have direct reference to the needs of the great industries in the Pittsburgh district." [6] This curriculum led to diplomas rather than degrees, in schools for science and technology, fine and applied arts, apprentices and journeymen and women.

It soon became apparent that Pittsburgh industries critically needed employees with technical and scientific training at the higher college level.[7] In 1912, the school became Carnegie Institute of Technology, with its ideals and functions patterned along the model of Massachusetts Institute of Technology. At the time, technical university education was already 50 years old at M.I.T. In the next decade, academic divisions were reorganized at Carnegie Tech and programs for graduate and professional education were established. As was true for M.I.T. and other institutions in the early 1900s, connections to local

6 Dean Arthur Wilson Tarbell, *The Story of Carnegie Tech: 1900-1935* (Pittsburgh, 1937), 27.

7 Tarbell, 49-56.

industry rapidly became an integral part of Carnegie Tech's functions and philosophies. From the spirit of its founding by steel magnate Carnegie, linkages soon developed, including information and personnel exchanges among industry and university scientists, specialized centers and contract mechanisms to perform basic research for industry, and abundant local employment of graduates.[8] These interactions took place primarily in the metals and engineering disciplines, although the "Division of Applied Psychology" (established in 1916) performed much research on "human engineering" topics relevant to the needs of new bureaucratic corporate organizations.[9] The night school program for those who worked industry by day also represented a substantial tie to Pittsburgh's economic structure.

Involvement with the civic needs of Pittsburgh was another important trend established during Carnegie Tech's early years. Progressive Era ideals common to many universities resulted in direct involvement of university leaders in the unsuccessful 1912 and 1917 smoke control movements in Pittsburgh.[10] Although these results were not encouraging, the attitudes surrounding the effort formed an important ideological basis for Carnegie Tech's later involvement in Pittsburgh's Renaissance.

Carnegie Tech's first research ties to the federal government came during World War I, as the government mobilized academic resources for national defense across the nation. Research conducted by the Division of Applied Psychology contributed to the personnel system of the armed forces, while other divisions of the school concentrated on "war course" training for soldiers.[11] The connection to "war training" remained throughout the inter-war years, as at many other engineering schools, with a military science and tactics department set up to operate the Reserve Officer Training Corps.

Governmental research continued in the inter-war period, aided by construction of the U.S. Bureau of Mines building next to the campus. The bureau also brought close ties with local metallurgical and mining industries, in industry-sponsored Carnegie Tech/Bureau of Mines research projects and student fellowships.[12] U.S. Steel's National Tube

8 Tarbell, 55ff, for descriptions of these interactions.

9 Tarbell, 60-65.

10 Glen U. Cleeton, *The Doherty Administration: 1936-1950* (Pittsburgh, 1965), 296; Roy Lubove, *Twentieth-Century Pittsburgh: Government, Business, and Environmental Change* (New York, 1969), 48; and other accounts of Pittsburgh's smoke control efforts.

11 Tarbell for discussion.

12 Tarbell, 72-73, 100-7; Engineers' Society of Western Pennsylvania, *Pittsburgh* (Pittsburgh, 1930), 391-93.

Company research laboratory was built next to the campus in 1927 to further exploit this university-government bond. Carnegie Tech attracted metals and mining scientists from across the country and hosted numerous international conferences on bituminous coal during the 1920s and 1930s.

Carnegie Tech also tried to further exploit connection to local industries in areas other than mining and metals.[13] Although born from the same ideals as M.I.T., Carnegie Tech's later founding had slowed its ability to reach the same levels and varieties of research and industrial links shown by M.I.T. and other older technical schools. This time lag became visible in the 1920s and 1930s, leading some historians to observe — much later — that Pittsburgh was not supplied with the scientific and technical resources needed by its industries during this era.[14]

Efforts during these decades did pay off somewhat, as increased interaction was noted.[15] Research was stressed through the establishment of research laboratories within the university, again patterned after M.I.T.'s administrative models. These labs included the fields of metals, coal, chemistry, physics, and civil, electrical, and mechanical engineering. Industry-sponsored research projects were accepted regularly, and graduate education improved along with the increase in research.[16]

One striking aspect of the research and graduate emphasis during these inter-war years was the overwhelming focus on long-established basic Pittsburgh industries. In 1940, Carnegie Tech President Robert Doherty declared that for Pittsburgh to be a leading technological center, university research would need to "strengthen the scientific and technical foundations upon which the future development of the essential industries of the Pittsburgh district may rest." [17]

It is not surprising that research would dwell on industries that had built Pittsburgh and Carnegie Institute of Technology itself. Even as Doherty made his prediction, however, fundamental research in the electronic fields that would power post-war technologies was occurring at M.I.T. and Stanford — a dramatic illustration of the historical time lag.

This difference would prove to be one of the most important factors

13 Tarbell, 96.
14 Stefan Lorant, *Pittsburgh: The Story of An American City*, 2nd edition (Lenox: Author's Edition, 1975), 361.
15 Tarbell, 96-100, 108-16.
16 Cleeton, 66-67; Engineers' Society, 395.
17 Cleeton, 75.

in each university's economic development roles after World War II. While Carnegie Tech focused on industries that would soon begin to decline, M.I.T. and Stanford linked up with growing new industries. Thus, the expertise needed for a high-technology "cluster" was already in place in Silicon Valley and Boston before the war even began. Thus, Carnegie Tech was unable to provide a springboard setting for a jump to new industries after the war.

World War II brought more federal and industry funding to Carnegie Tech, in much the same way as to other technical universi-

"While Carnegie Tech focused on industries that would soon begin to decline, M.I.T. and Stanford linked up with growing new industries."

ties. The cooperative structure for federal-industrial research solidified in those years and continues today. Specific war-time contributions were made in nuclear physics, metals and chemicals[18]; again, this reflected some traditional strengths of Pittsburgh industry. The only example of direct links to local post-war economic growth existed with nuclear divisions of Westinghouse Corporation.

Direct involvement by university leaders in the civic efforts of Pittsburgh also increased, following the trend begun decades earlier. Doherty played a leading role in the 1943 founding of the Allegheny Conference on Community Development, and the resulting establishment of an effective public-private policy infrastructure for Pittsburgh.[19]

Dramatic expansion occurred in the 1950s and 1960s in science and engineering research and graduate education. Departmental and individual faculty research funded by government and industry reached new levels throughout Carnegie Tech, and new research centers included the Nuclear Research Center and Petroleum Research Laboratory.[20]

As contributions to Pittsburgh's new economy, these decades mainly brought increased prominence in academic advanced technology to the university. Three factors now appear significant:

18 Cleeton, 74.
19 Cleeton, 296-99.
20 Austin Wright, *The Warner Administration at Carnegie Institute of Technology: 1950-1965* (Pittsburgh, 1973), 116ff.

First, Carnegie Tech's comparatively small size and flexible departmental boundaries made possible a unique interdisciplinary quality for many scientific efforts.[21] This is not true at many larger schools whose size results in more rigidly separate and often competing departments.

Second, the previous emphasis on traditional technologies finally shifted in the late 1950s. Major scientific breakthroughs occurred in the fields of electronics, semiconductors, and magnetics.[22]

Third, the new discipline of computer science emerged and Carnegie Tech emerged as a computer science leader. In particular, research in programming languages, systems, and early artificial intelligence provided Carnegie Tech with an important area of high technology expertise in which it did not lag behind the other technological universities.[23] Carnegie Tech led in establishing extensive relationships with the Department of Defense for computing research projects, and in interdisciplinary problem-solving for computer science.[24]

The mere existence of breakthroughs rivaling those of M.I.T. and Stanford did not lead to the growth of an advanced technology cluster in Pittsburgh, however. When scientific findings left the laboratory, the economic benefits simply did not accrue to Pittsburgh, Carnegie Tech or its faculty members.

In retrospect, several characteristics played a part. Pittsburgh's economic strength during the 1950s and 1960s still resided in traditional basic industries, organized in large corporations. This type of economic structure did not expose obvious niches for entrepreneurship, unlike Silicon Valley's orchard-based, under-developed economy or Boston's depressed textile economy. In the collective conscience, Pittsburgh equated "industry" with "corporation." Further, traditional industries were by and large still profitable, and were not driven to integrate new technologies into their operations. Finally, few Carnegie Tech administrators or faculty members encouraged students and professors to start new firms to exploit the commercial fruits of their academic labors, unlike M.I.T. and Stanford.[25]

The 1960s and 1970s continued these earlier patterns: academic re-

21 Wright, 121.

22 Wright, 123-24.

23 Wright, 142-46.

24 Wright, 146-47.

25 Exceptions, of course, can always be found. A few faculty members — particularly ones who had once taught at M.I.T.—did emphasize entrepreneurship during these years, but they were not able to lead the university as a whole in that direction.

search advanced but did not yield local economic benefits that could allow a high technology cluster to develop. In 1967, Carnegie Tech merged with Mellon Institute for Industrial Research to form Carnegie Mellon University. The 1970s can be viewed primarily as a transitional period.

The Richard Cyert administration — dating from 1971 — achieved dramatic, aggressive academic and financial improvement, so that by 1980, Carnegie Mellon was in a position to exploit its own strengths for the local economy. Its computer science and engineering school now ranks with M.I.T. and Stanford. The strength in computer science, especially, has in some senses made up for earlier years, when Carnegie Mellon's later founding and long focus on traditional Pittsburgh industries prevented it from competing on the same level with M.I.T.'s and Stanford's early electronics technology breakthroughs.

This comparative ranking with M.I.T. and Stanford is in some ways at the heart of the question of Carnegie Mellon's involvement with Pittsburgh's high technology economic development. After reaching par with the leading technological universities in the country in academic and research excellence, the primary achievement with which Carnegie Mellon cannot compare is the growth of the high technology clusters around those institutions.

The challenge of creating such a cluster is not a simple one. Carnegie Mellon has not yet reached M.I.T.'s and Stanford's levels of dollar value of research performed, and its university endowment is smaller, especially in comparison to Stanford's. Until recently, Carnegie Mellon's industry links were with basic metals technologies and corporate organizations, rather than electronics technologies and entrepreneurship. The types of connections — with new high-technology firms and entire industries growing out of university research — that M.I.T. and Stanford forged in the 1940s, 1950s, and 1960s have only appeared in the 1980s for Carnegie Mellon. If Carnegie Mellon is to serve as one of the engines for a Pittsburgh high-technology cluster, its own recent achievements must prove to be solid and strong enough to compensate for its lesser wealth and shorter time of close involvement with high-tech industries.

Carnegie Mellon's challenge is even more complex than simply replicating the M.I.T. and Stanford models of twenty years ago, however. Its activities must occur in an economic and social climate very different from that of the post-World War II era. High technology economic development itself is now a more articulated, planned activity than was true twenty years ago.

The partnership situation in Pittsburgh with another university of differing orientation and structure represents further complexity — neither M.I.T. nor Stanford were involved in a partnership with other local institutions when their high-technology clusters were established. Before moving on to the University of Pittsburgh, however, the look at Carnegie Mellon's past economic development roles must be completed by examining the history of Mellon Instiute.

Mellon Institute

Mellon Institute was one of the first private research institutions in the country, established explicitly to serve as an interface between academia and industry. In fact, the Institute served as a model for other independent research centers founded in the early twentieth century.

Robert Kennedy Duncan is credited with the idea of an independent laboratory to provide an academic-type setting for state-of-the-art research paid for by industry — allowing the application of science to commercial activity.[26] Duncan, a professor of industrial chemistry at the University of Kansas, wrote of his ideas in *The Chemistry of Commerce,* published in 1907. Pittsburgh financier and industrialist Andrew W. Mellon read Duncan's book, and brought him to Pittsburgh to establish his laboratory. An experimental department of industrial research with Duncan as its head was founded in 1910 at the University of Pittsburgh, Mellon's alma mater.

In 1913 — after the experiment had proved successful — Mellon Institute of Industrial Research was removed from the university and independently endowed by the Mellon family, with a mandate to function as "an engine to serve as a prime mover for industrial progress." [27] The Institute provided facilities, staff, and administration for industry-funded research through two mechanisms: "industrial

26 For accounts of Dr. Duncan's work and relationship with the Mellons: Dr. Robert Bowman, "Mellon Institute — History and Operation" (Sept. 1985); *The Crucible: Mellon Institute Number* (Pittsburgh, May 1937), 95-96ff; F. R. Denton, *The Mellons of Pittsburgh* (Pittsburgh, 1948), 19-20; Philip H. Love, *A. W. Mellon: The Man and His Work* (Baltimore, 1929), 31-33; William Larimor Mellon and Boyden Sparks, *Judge Mellon's Sons* (Pittsburgh, 1948); *Mellon Institute News: Robert Kennedy Duncan Supplement,* Nov. 1, 1968; *Science and Human Progress: Addresses at the Celebration of the Fiftieth Anniversary of Mellon Institute* (Pittsburgh, 1963), 19-25; *Trip Through Mellon Institute* (Pittsburgh, 1937); and Dr. Edward R. Weidlein, *Historical Sketch of Mellon Institute* (Pittsburgh, 1963).

27 Mellon and Sparks, 351; Bowman; *Crucible;* and *Science and Human Progress.*

fellowships" that were open-ended, long-term agreements for wide-ranging applied research, and individual, applied projects with more short-term, specific, limited goals.

The training function of the Institute was also important. The chance for scientists to work on applied projects in such an academic-like atmosphere yielded experience not available elsewhere at the time. Many of these scientists would later move on to careers in both academia and industry.

Although independent from the University of Pittsburgh, informal ties to Pitt remained over the years, mainly through the involvement of Pitt faculty in some Mellon Institute projects. Carnegie Tech also participated in research projects.[28] Further, a number of scientists employed at Mellon Institute earned advanced degrees from both universities, through cooperative education programs.

Mellon Institute's research was concentrated in the physical sciences — chemistry was the most prominent, followed by biology and physics — and resulted in numerous improvements in a variety of commercial products.[29] A number of studies, funded more philanthropically, focused on public health areas, especially in conjunction with the University of Pittsburgh's health sciences schools. Mellon Institute contributed to both World War I and World War II research projects as well, forging significant links with the federal government.

Mellon Institute's leaders were active in civic improvement movements, often through informal partnerships with both Carnegie Tech and Pitt. Research results from the Institute's work in the public health area were used in various campaigns for smoke control over the years, and its members served on numerous boards created to deal with this problem.[30] Mellon Institute's President Edward Weidlein took an active role in the founding of the Allegheny Conference on Community Development in 1943, along with Carnegie Tech's President Doherty.

The 1930s through the 1950s represented Mellon Institute's heyday in commercial linkages with new divisions of existing firms, new firms, and new industries. The majority of the 650 new processes and products created at the Institute by 1980 were developed during these decades, and focused primarily on chemical applications to consumer

28 *Science and Human Progress*, 28-31; Weidlein.

29 *Crucible;* Arnold Thackray, "University-Industry Connections and Chemical Research: An Historical Perspective," National Science Foundation, *University-Industry Research Relationships: Selected Studies* (Washington, 1982), 214-15.

30 *Crucible;* Lorant, 374.

needs. Some familiar firms involved included Dow Corning, Union Carbide, Lubrizol, Continental Can, Visking, Bakelite, Calgon, H. H. Robertson, and Gulf Oil (whose extensive Research and Development Laboratory at Harmarville began in Mellon Institute).[31] Mellon Institute was clearly able to provide scientific and research resources that few corporations could afford or manage on their own.

Entrepreneurial activities, however, stemmed from outside industrial sponsors rather than from scientists within Mellon Institute. Further, not all — or even a majority — of the economic benefits of this "spin-off" commercial activity occurred in Pittsburgh, as Mellon Institute's national reputation allowed it to draw industrial support from across the country. Finally, very little research in the fields that would become the bases for contemporary advanced technology industries was done at Mellon Institute during these decades.

The success of Mellon Institute in the early and mid-twentieth century led one historian to characterize it as embodying crucial features of the larger pattern of industrial-academic connections during those years:

> It relied on the vision of an academic entrepreneur familiar with industrial problems; it profited from the philanthropy of a family whose fortune came [partly] from these [industrial] endeavors; it had loose but real connections with an academic institution; and its members saw no great barriers between academic knowledge and manufacturing concerns, or between careers in industry and activity in learned societies.[32]

Mellon Institute's peak volume of research occurred early in the 1950s, with seventy-seven different industrial fellowships and eight non-proprietary fellowships in operation. From 1955 onward, the Institute began to decline, a victim of many of the same pressures experienced by academic research as a whole during this time. Mellon Institute's emphasis began to gradually shift to greater amounts of non-proprietary, fundamental research as industrial support decreased; many corporations across the country flirted with in-house basic research laboratories. Further, the federal funds upon which the Institute had begun to rely heavily ceased to increase during these years. The gradual patterns of decline of the metals industry in Pittsburgh would take a toll as well on a number of important, long-standing metals-oriented research fellowships, even though the long-term effects would not be fully evident until the 1980s.

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31 Bowman, *Science and Human Progress.*

32 Thackray, 215; *A Brief Anthology of Fundamental Scientific Research* (Pittsburgh, 1963); *Crucible.*

Largely as a result of financial pressure, Mellon Institute merged with Carnegie Tech in 1967.[33] Under terms of the merger, Mellon Institute retained its identity as a division within Carnegie Mellon, and continued its focus on applied research. As would be expected, involvement between Institute scientists and university faculty and graduate students increased, but full-time Institute scientists did not automatically become faculty members. Interactions with University of Pittsburgh faculty and students continued as well on an informal, case-by-case basis, much as they did during the Institute's years of independence.

Mellon Institute's financial and scientific decline was serious at the time of the merger, and it was not until the mid-1970s that any improvement was noted. Although new centers for research in high technology areas were established in the later 1970s, little effort was made by Carnegie Mellon to bring new business into the Institute until the early 1980s. Carnegie Mellon's President Cyert said in 1981, "The previous administration at Carnegie Mellon University set it [the Institute] up to let it die." [34] In fact, Mellon Institute showed a net loss in income in 1980-81, due to insufficient business combined with the long-term cost of the new equipment.

Since then, the university has made substantial financial and administrative commitments to modernize the facility and to increase its industry-sponsored research. By 1986, the mix of funding for research programs was approximately 80 percent industry, 20 percent government. In addition to the remaining free-standing industrial fellowships, increasing efforts were concentrated on seven new technical research centers established within the last decade that encompass both industrial fellowships and short-term project work. Some of these important areas for research include computer and process engineering and advanced metals and materials. A number of Mellon Institute programs in the 1980s have been funded through limited tax partnerships for research and development, under provisions of federal tax reforms designed to encourage technical innovation.[35] Revenues have climbed steadily since 1984.

Mellon Institute is now poised to achieve new vitality through Carnegie Mellon's ties to Pittsburgh's high technology sector. It is

33 Ken Eskey, "CMU . . . The Name is Changed, A University is Created," *Pittsburgh Press* (July 2, 1967): 12-14; Jennifer Lin, "Mellon Institute Trying to Shed Mysterious Ways," *Pittsburgh Post-Gazette*, Oct. 7, 1981.

34 Lin, "Mellon Institute Trying to Shed Mysterious Ways."

35 Bowman; John R. McCarty, "Mellon Institute Welcomes Research Partners," *Pittsburgh Press*, Sept. 12, 1982.

clear that Mellon Institute carries not only a strong tradition of industry-interaction but also many years of experience with proprietary research. The heavy emphasis currently being placed upon cooperation between academia and industry holds great potential for an Institute with historical and functional experience in that exact interface. To realize this potential, Mellon Institute's traditions and experience — grounded in the traditional Pittsburgh economy — must be brought into line with the needs of Pittsburgh's new economy.

University of Pittsburgh

The University of Pittsburgh is the oldest institution of higher learning in the region.[36] Its history and traditions of involvement with the surrounding economic structure are unique, differing widely from the M.I.T./Stanford technical university model.

Its origins date back to the Pittsburgh Academy, chartered by the Pennsylvania Legislature in 1787.[37] The Pittsburgh Academy was similar to other early American institutions of higher learning, with a curriculum heavily oriented toward theology and classical study. In 1819, the Academy was chartered as the Western University of Pennsylvania.[38] For most of the nineteenth century, the university continued its early theological and moral tradition. At the time when the earliest technical schools were being formed, this university's reaction to that trend focused more on "science" than "technology." A "Scientific Association" was formed in 1848,[39] most likely a result of German university reform of this era, as there was a high concentration of German immigrants in the Pittsburgh region and specifically in Old Allegheny, where the university was located.

As the nineteenth century drew to a close, the classical educational emphasis shifted. Professional schools oriented to the manpower needs of human services were established: medicine (1886), law (1895), pharmacy (1896), and dentistry (1896).[40] Some engineering schools oriented to the manpower needs of local industry were also

36 Robert C. Alberts, *Pitt: The Story of the University of Pittsburgh, 1878-1987* (Pittsburgh, 1986).

37 Leland D. Baldwin, *Pittsburgh: The Story of a City, 1950-1865* (Pittsburgh, 1981), 111-12; Robert I. Vexler, *Pittsburgh: A Chronological & Documentary History* (Dobbs Ferry, 1977), 9; Lorant, 52, 539; Engineer's Society, 79-81.

38 Baldwin, 215, 163-64; Lorant, 400, 542; Vexler, 17.

39 Vexler, 29-35.

40 Vexler, 44, 47-48.

founded — such as mines and mining engineering (1895) — but these remained secondary to the human service schools. The university's overall orientation focused on research and graduate education in the health and social service professions, rather than in technical fields.

The early twentieth century saw the final name change — to the University of Pittsburgh in 1907 — and the continued growth of the dedication to public service.[41] Private industrial philanthropy began to make an important contribution to Pitt's growth, often in the form of financial endowments and land from wealthy Pittsburghers — such as the Mellon family — who had graduated from the university in the nineteenth century. University civic involvement was substantial, especially in early unsuccessful fights for smoke control in 1912 and again in 1917.[42] During World War I, government mobilization led the university to train students for war-related industrial work.[43]

Relatively few ties to industry were established in the early twentieth century, with the most direct links occurring through Mellon Institute. Industry needs that did receive attention in these years were connected to Pittsburgh's basic industries; chemical research dominated, in keeping with Mellon Institute's emphasis.[44]

Pitt was clearly a "university" rather than a "technical institute." Its rapid growth in size and number of diverse schools also contributed to this identity. The health and social service schools responded to local needs, but these were fundamentally different than linkages displayed by schools in the technical model. Rather than producing research and graduates needed by corporate organizations, these schools at Pitt were producing research and graduates in human service fields that were not viewed as "industry." Even when it was a private university, the school demonstrated a strong sense of public mission.

World War II research at Pitt increased ties to the federal government, as was true for academia as a whole. The decades after World War II brought a new, strengthened focus on academic growth and improvement, particularly in medical and related health sciences. The years of the 1940s and 1950s saw a number of capital commitments made to the health schools, including the 1948 establishment of the new School of Public Health. Many of these expansions were funded through industrial and private philanthropy, with a great amount stemming from the trusts and foundations created by the Mellon

41 Lorant, 272, 234-35, 291, 400, 554.
42 Lubove, 48.
43 Alberts, 70.
44 Engineers' Society, 395.

family.[45] Expansions in the health schools also received support from the City of Pittsburgh's Urban Redevelopment Authority in the 1950s, as part of the Renaissance I effort.[46]

Schools in social and business fields also achieved notable growth during these years, and the quality of students and research rose throughout the university. Pitt, as a whole, came to resemble the "multiversity" model with a wide diversity of departments.

The 1960s were important for the university and produced events that hold the most significant historical precedents and insights for current economic development activities.

First, calls for responses to social and urban needs being experienced by universities across the country were felt especially strongly at Pitt. Acting on its long-established tradition of public service, it took part in a number of federally funded urban and social research partnerships with the City of Pittsburgh.[47]

Second, a 1962 event serves as an example of missed opportunities for economic growth surrounding Pitt's medical research. Although a number of important biotechnology advances were made at the university during the 1950s and 1960s, further applied research and commercial benefits did not take place in Pittsburgh. The most visible example of this occurred as Jonas Salk, developer of the Salk polio vaccine, left the university in 1962 to build an independent, applied research institute at LaJolla, California. Originally planned as an affiliate of Pitt, an agreement over management and administration of this institute could not be reached.[48] A third critical event also occurred in 1962, as Chancellor Edward H. Litchfield tried to strengthen university links with the federal space program. He highlighted Pittsburgh's pre-eminance in metals and nuclear energy, its research laboratories, and its need for an "institution that would channel the 'spin-off' of space technology into industrial and commercial use." [49]

Fourth, the "spin-off" idea became a central component in a grandiose 1963 plan to develop Panther Hollow Ravine into office and laboratory space shared by both universities.[50] The Ravine would contain ". . . a research complex which will serve as a focal point of a great cultural-educational-scientific center, and by so doing lift Pitts-

45 Alberts; Lorant, 364; Vexler, 60-62.
46 Lubove, 129.
47 Garry D. Brewer, *Politicians, Bureaucrats, and the Consultants: A Critique of Urban Problem Solving* (New York, 1973); Peter Szanton, *Not Well Advised* (New York, 1981).
48 Alberts, 219.
49 Alberts, 286.
50 Lubove, 135-36.

burgh into first rank among world cities." [51] Some surviving planning documents contain specific references to Litchfield's commitment to programs for deliberately managed commercial spin-off activities from university laboratories and the eventual development of new industries and a new economic base. The Panther Hollow research park, whose roof would have reached ground level and tied together the Pitt and Carnegie Tech campuses, was projected to cost $250 million. The initiative never went beyond the early planning stages, however, as only lukewarm support was forthcoming from city officials, including powerful Pittsburgh Mayor David L. Lawrence and prospective tenants such as Alcoa and IBM.[52]

The Panther Hollow Plan was the first attempt at formal cooperation between Carnegie Tech and Pitt. The "MPC Corporation" is the name of the organization that manages joint projects today; it is the renamed and revitailzed "Oakland Corporation" established in 1963 to handle the Panther Hollow Plan. Prior to this attempt at partnership, the relationship between Carnegie Tech and Pitt had often been one of neighborhood rivalry.

This failed attempt at economic development roles for the universities is not the only example of Pitt's acknowledgment of university support roles similar to those played by M.I.T. and Stanford. The fifth critical event for Pitt in the 1960s lies in the more quiet but longer lasting support of university spin-off companies. A small number of spin-offs did emerge from Pitt during the early years of that decade, and the experiences of their entrepreneurs indicate that Chancellor Litchfield not only strongly believed that the university was an appropriate spin-off base, but was willing to assist his faculty-entrepreneurs when possible. (An example is Extrel Corporation, set up in 1964.) This encouragement of the entrepreneurial spirit did not seem to go beyond the Chancellor's office in the administration, however, and failed to filter down throughout the university before Litchfield's resignation in 1965, leading some observers in the 1980s to characterize him as a man twenty years ahead of his time in some respects.

Finally, the University of Pittsburgh maintained the status of a private university until 1966, when it became a member of the Commonwealth of Pennsylvania university system. This shift largely resulted from financial pressures and served to reinforce the long-

51 Alberts, 308.

52 Alberts, 312.

standing mandate of public service, overlying it with direct public accountability concerning university actions. State status also brought growth and diversity so that in 1987, Pitt counts fifteen schools, four campuses and 2,500 faculty.

Pitt's public status makes comparisons with M.I.T. and Stanford both problematic and intriguing when considering its role in high-technology development. The public orientation seems to hold both positive and negative implications. Pitt has since 1982 become more active in these efforts than ever before, as well as more receptive to

"Pitt has less latitude to concentrate its resources in specific technological areas...than a private school...."

the role as spin-off base. University administrators attribute this new attitude in large part to the combination of Pitt's older public-service tradition and its institutionally mandated responsibility of responding to the needs of the Pittsburgh region. Pitt has another important ideological tradition to draw on in this area: the grand scheme, never realized, of Chancellor Litchfield in the 1960s.

On the negative side, however, this same public responsibility that spurs Pitt's involvement also means complexities not faced by a private university. Pitt has less latitude to concentrate its resources in specific technological areas, through research with industrial applications or large-scale agreements with industry, than a private school with no publicly mandated responsibilities or accountabilities. Also, a greater portion of Pitt's research has human service applications in the health industry, often viewed in a far different light than other commercial endeavors. Pitt's size and corresponding diversity in attitudes and activities make consensus on high-tech development that cuts across departmental lines extremely difficult.

By virtue of its organizational form and orientation toward public service, Pitt presents a very loose fit with the previous models for a successful center of a high-tech cluster. It does, however, have key expertise through which valuable economic contributions to the advanced technology sector are being made. The ways in which the potential contributions of a public university such as Pitt can be most effectively realized are not yet clearly evident from the experiences of other existing high-technology cluster developments. Thus, whatever success Pitt — and the Pittsburgh cluster as a whole — achieves

cannot help but add a new dimension to the model of university roles in such an enterprise.

It is clear that the experiences of Pittsburgh's research universities hold important implications for city-wide contemporary efforts to build a viable high-tech industry base in the area.

Carnegie Mellon represents Pittsburgh's best fit with the M.I.T.-Stanford model, but its smaller size, endowment, and dollar value of its research suggest that it must rely heavily on outside support for continued growth, and that its recent advances must prove solid enough for it to raise Pittsburgh's economic status as it continues building its own. The prospects seem bright. Even without considering specific comparative advantages in pivotal industries, Carnegie Mellon's history has left many important legacies.

Of particular advantage is the university's rapid rise to national prominence under financial pressure in the last three decades. In an atmosphere of pressure from the Pittsburgh region's changing economy and the need to compete with other parts of the country bent on building their own high-tech cores, Carnegie Mellon's recent experiences may prove quite valuable.

As for the University of Pittsburgh, from its early days as a theological and classical institution and even through its formation of engineering schools, research and manpower needs of industry took a back seat to those of human services. This public-service ethos, entrenched long before it became a public university, is a strong positive factor when considering the current challenge. The concept of serving regional needs for economic improvement is ideologically compatible with the concept of health and social improvement.

The most crucial evidence to consider on this issue is only beginning to appear, however. Will the universities be able to work together over the long term? The failure of the Panther Hollow project in the 1960s meant that the first real test of the Pitt-Carnegie Mellon partnership in technical research and economic development was put off until the 1980s. This lack of an earlier working relationship is both positive and negative: positive in the sense that the current rapport started with a virtually "clean slate," and negative in that neither university had previous experience in this sort of endeavor.

The overall historical lessons for each institution appear to be positive and the present indications are that their cooperation is working. Since 1980, a significant and rapid increase has occurred in both

the size and sophistication of Pittsburgh's cluster. Contrasts with previous decades underscore how far Pittsburgh and its research universities have come. An abandoned steel mill is being turned into a fitting symbol of this progress at the Pittsburgh Technology Park. This contrast serves as a reminder that the simple existence of technological expertise in Pittsburgh was not sufficient to create an advanced technology hub; philosophies and mechanisms that provide opportunities for university-industry transfer of technology and for entrepreneurship had to be established.

The transition is underway, as both universities gain experience and more firmly reinforce their roles in high technology activity. They can better shape the region's future by keeping in mind the lessons of their past. ■

WOMEN REMEMBERED

Seeking to ensure the comfort of his posterity, Allegheny County resident Ephraim Hughey, in a will dated July 31, 1812, bequeathed:

> the kitchen furniture, beds and bedding, her living and accommodations of the farm I possess, as also a sufficient quantity of wool and flax to make her clothing yearly—that is to say as long as she remains my widow, but in case she marry, my executors shall be exempted from finding her in anything from that period.
>
> I leave my daughter Jane Hays the property I have already given her—that is to say one horse, saddle, and bridle, one bedstead and furniture and one bureau, two cows, one breakfast table, four sheep, four chairs, one wash pot, one cook pot, one bake oven, middling size, six knives and forks, six spoons, one tea kettle and tea furniture, three delph dishes and six plates. These I lent you when married, and now I bequeath them to you as your portion of my property.