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Science and the Urban University

David Adamany

An examination of the topic "Science and the Urban University" is sustained by the size of both academic and applied science in the Detroit metropolitan area. This area houses a remarkable array of institutions of higher learning—six community colleges, a fine technical insti-

never fully restore its economic health. In this environment, where national economic recovery will not provide a minimally acceptable response to economic distress, the potential for science to contribute to economic and civic life is being tested as nowhere else in America. The

Summary. The potential for science to contribute to economic and civic life is of particular importance to urban centers with economic decline. For urban universities, the ability to adapt to changing needs and seize new opportunities has become vital. These universities must take the lead in curricular revision, research emphasizing the application of knowledge, arrangements with private economic enterprises, and public service to improve science and mathematics training in the schools.

tute, and an exceptional center for creative studies, seven 4-year colleges, three regional state universities, a major sectarian university, and, in Wayne State University, one of the nation's principal public research universities—and it is also one of the world's centers of durable goods manufacture, where the scope of the scientific enterprise in private economic institutions is matched by that in only a few places across the nation. But another factor makes this examination compelling: there is no major city in America that has suffered as much in the current economic recession as has Detroit. Unemployment is still more than 15 percent, and it is certain that the gradual rebound in this area's traditional manufacturing enterprise will

role of science is likely to be similarly expanded in other urban centers with structural economic decline, especially the major cities of the Midwest and Northeast.

A Utilitarian Approach to Science

While the advancement of pure science in the expansion of knowledge will certainly continue in Detroit as well as elsewhere, of special interest in Detroit and other industrial cities will be the applications of science to relieve human economic misery and to revitalize social institutions—both public and private—that are essential to mobilize human talent and capital. Such uses of science stir

unease among academic scientists, including those of us in the social sciences. We are more comfortable in laboratories and libraries, pursuing pathways that do not necessarily direct us to well-defined, short-term objectives. In Detroit, however, we cannot indulge ourselves exclusively in scientific endeavors because they have attained prestige in academic disciplines. From necessity, we are today concerned in this urban area and ultimately, I believe, in all industrial centers in the Northeast and Midwest principally with the implications and applications of scientific advances for the benefit of humankind.

This starkly utilitarian approach to science may, in a sense, be only a precursor of the direction of much scientific activity in the world at large. I recently heard Harold Shapiro, president of the University of Michigan, one of this nation's world-class universities, comment on the closing gap between universities and business enterprises. He remarked on the extraordinary shortening of the time between the development of an idea and its useful application. The time between the development of the principles underlying the combustion engine and their application in automobiles was relatively long, and the life of the industry thus spawned has also been relatively long. But the period required for the advancement of electronic computing from an idea into a major industry has been only a few decades. Scientific principles and ideas are now moving to useful applications in only a few years and to product manufacture in only a few years more.

Under these conditions of rapid progress from discovery to application to enterprise, it is inevitable that universi-

David Adamany is the president of Wayne State University, Detroit, Michigan 48202. This article is based on his keynote lecture delivered on 26 May at the Annual Meeting of AAAS in Detroit.

ties—where most of the theoretical and pure scientific work has long been done in America—will be deeply entangled in the applied uses of ideas and then in the production and marketing related to those uses, areas once strange to universities. If for no other reason, this will occur because the scientists and inventors who make important and readily applicable discoveries are likely still to be working on the same or related scientific questions. Such people become extremely valuable in these circumstances, and in a competitive enterprise system they are also likely to want to capitalize on that value. Thus, the utilitarian approach to science that is being forced by necessity on Detroit and other distressed urban centers is only a speeded-up version of the direction of much of the scientific enterprise as it is now unfolding in America.

Urban Universities

For urban universities, these changes are greatly magnified by the character of their instructional activities. The nation's urban universities are not, of course, defined by location, since many traditional institutions are in cities. Rather, the urban universities are characterized by the marriage of two distinct missions. First, they serve a nontraditional student population. The Wayne State University profile is typical of urban universities. More than 95 percent of our students commute. They are older—the average age of undergraduates is 25 years and that of freshmen is 23. They work—75 percent of the students at Wayne are employed—and often they are married or raising families. This pattern of multiple responsibilities for work, family, and study results in much part-time study (at Wayne 45 percent of students attend part-time) and a great emphasis on evening course work (at Wayne 40 percent of course sections are held after 4:30 p.m.). To a greater extent than in traditional residential universities, urban university students are the first in their families to go to college. They are also poorer than most college students, and they are more frequently from minority racial or nationality groups.

Side-by-side with this nontraditional instructional program, leading urban universities have generally attempted to build traditional programs of research, scholarship, and creative activity. A number have succeeded, as evidenced by their designation by the Carnegie Commission as class I research universities. The University of Pittsburgh and

the University of Cincinnati, as well as Wayne State University, are good examples.

When the new vocationalism of all college students is added to the special economic vulnerability of urban university students, most of whose families enjoy little financial security, the pressures on vocationally related scientific and technical curricula are obvious. For both science and the urban university this poses difficult choices. On the one hand, times of economic turmoil do compel acknowledgment that students who do not have economic security should be able to pursue studies that will help them to obtain or continue productive work. On the other hand, it would certainly betray both the students and the interests of society for urban university students to be narrowly trained, because their long-term personal prospects and their economic and civic contributions to society require a firm grounding in concepts, theories, and methods. The difficulty is that traditional academic science gives almost exclusive weight to the long-term benefits of education at the expense of the short-term needs of students and of the local economy. Some rethinking of that approach will be necessary. In Detroit, for example, unless the area's economy is secured in the short run, its people have no economic prospects in the longer perspective.

Curricular Revision to Meet

Current Needs

In the urban environment, other curricular issues also confront science in the university. Some of them can be resolved with relative ease. It is not new for universities to offer courses of study needed or requested by specific companies or public sector institutions. But we have arrived at a time when whole degree programs—especially at the specialist or master's level—will be needed by companies. Funded by the companies, these programs will be offered both at the university and at the company site. The curriculum will represent a joint deliberation between university faculty and the company. Such curricular co-sponsorship would, only a few years ago, have been regarded as a compromise of academic prerogatives and standards. Today, following extraordinary joint research arrangements between companies and universities, it scarcely excites comment.

Because of their accessibility to adult students, urban universities will certainly be in the forefront of new, certifiable academic programs that offer people

with university degrees new fields of study or advanced specialization. These tracks will resemble second majors at the undergraduate level and the course work of a master's program at the graduate level. Demand for these programs is most likely to occur in scientific and technical fields for persons whose original study was in the social sciences, and in the social sciences for persons whose original training was technical. For all scientific fields, the preparation of adult students whose training and work life has been in another discipline will be difficult.

Finally, it seems inevitable that the different purposes underlying community college curricula and university curricula will bring these institutions into conflict. The vocational and technical programs in community colleges are one of the great successes of contemporary America. They fit students with skills and knowledge needed for productive economic work in the short run. The need for this training is evidenced by the mercurial growth in community college enrollments, the high levels of student satisfaction with community college training, and the easy and effective collaboration between private enterprise and community colleges.

But the community colleges also create a work force that will need advanced training, both in scientific and technical fields and in general education. The former will be important in providing the conceptual framework necessary for long-term success in applied fields. The latter will be important for persons seeking promotion from technical work to supervision and management. The question that will face urban universities is whether these students are eligible for special degree programs, either in technical and scientific fields or in liberal studies curricula.

It will not be surprising if academic science—with its rigorous requirements and well-developed paradigms—proves to be among the strongest centers of resistance to these changes. Yet I have no doubt that these needs for specialized training and for liberal studies will be met. If urban universities cannot adapt, community colleges will provide education to the baccalaureate level. This, I believe, would be a mistake, for the diverse, large-scale university presents a special environment to which students initially trained in other institutions should be exposed. Devices for providing special degree programs for community college students are already available. Our colleagues at the University of Michigan in Dearborn now offer a bachelor's degree—specially designated as a

bachelor of general studies—to community college students who follow a prescribed liberal arts curriculum for 2 years beyond the vocational or technical degree program.

I emphasize the scope of curricular revision that faces urban universities because it occurs at the same time that the national research enterprise is undergoing such dramatic change. And I believe that the changes in the research enterprise, like those in curriculum, will be magnified in urban universities.

Yet universities have traditionally been conservative institutions, and they are poorly organized to make rapid changes. Faculties will, I believe, now find themselves pressed continuously not only by their urban communities and government, but also by their institutional administrators and governing boards, to modify their processes in order to adapt to a climate of accelerating change. Traditional faculty governance beyond the department level has already reached crisis levels, not only because it is slow and cumbersome, but because it has increasingly represented a congregation of special interests rather than deliberation from an institutional and societal perspective.

Urban Adaptations of Industry-University Relations

The conservatism of universities in curricular development is leavened by small initiatives to adapt the research enterprise to modern economic arrangements. The lessons of Silicon Valley, Route 128, and the North Carolina research triangle have become symbols of higher education, at least as seen by journalists and commentators. Yet those examples have had effects on university research nationwide. University incubator centers, joint ventures between researchers and business enterprises, and university policies that provide financial rewards to faculty whose work has market value are now widespread. The focus of these arrangements has been heavily on new products, new processes, and new services. All of this has been subsumed under the rubric of high technology, whether it is highly technological or not. Urban universities are moving in the same directions, although there is not yet an in-city center of industry-university collaboration that has become highly visible.

Nevertheless, the urban universities are likely to produce significant adaptations of the industry-university relations developed elsewhere. Partly this reflects the character of business and industry in

the urban centers, especially of the Northeast and Midwest. There will be economic development in the nonmanufacturing sectors in these cities, and the universities will take leading roles in that. But for the foreseeable future, heavy manufacture will still be the economic staple in the cities of the Midwest and Northeast. Hence, much applied university research will be in areas important in traditional heavy manufacturing, whether in production processes or product quality or work force productivity.

Urban adaptations of university involvement in the economy will also reflect the underdevelopment of urban universities. Their research base has been only two or three decades in the making, compared to a century of activity in our leading private universities, principal state universities, and land-grant institutions. Moreover, they have not had the special subsidies for research and its applications that have been available to agricultural institutions since the Morrill Act was enacted more than a century ago. Consequently, I believe that urban universities will relate their efforts to business in ways that will be dramatically different from the formulations employed by other public institutions.

For instance, I believe that much of the research activity of urban universities will take place directly on the premises of major business enterprises located near them. These enterprises have the capacity to invest in modern laboratories and equipment, which are difficult for urban universities to afford. And they will have an incentive to make such investments if there is a good prospect for product or productivity improvement and if they are able to displace some of their costs for R & D personnel by having university scientists undertake these activities. Even more striking, I believe, will be the tendency for graduate and specialized undergraduate instruction to follow faculty activity onto private premises.

New Arrangements for Students and Faculty

Business and industry will increasingly need to employ large numbers of highly skilled students in science and technology. To ensure the highest quality of preparation, they will want students who have been educated in environments having the most modern equipment and laboratories. Universities, too, will need to provide environments for state-of-the-art education, although this is well beyond their financial means. The mutual-

ity of interest in industrial site education is clear.

In this way, students will not only obtain experience with modern equipment and laboratories, they will also develop first-hand knowledge of the relation between science and economic enterprise. The best of them will become prime candidates for employment in companies where their universities have provided educational sites. And their own research, especially at the graduate level, will tend to be on projects funded through their professors by business and industry, thus providing benefits to students, faculty, universities, and business.

These arrangements will be controversial. To what extent can publicly funded university research by faculty and students be directed to the benefit of private concerns? To what extent do faculty members face conflicts of interest, both economic and intellectual, when their professional lives involve attachments not only to their universities but to private industries as well? To respond to some of these concerns universities will become intermediaries between government officials representing the public interest and faculty members involved with private industry. New schemes for mixed employment, joint ownership of scientific results, patents and licensing, and disclosure and publication of scientific findings will be developed. I believe it is likely that the practice plan model for professional activity, already used in medical schools, will become widespread in other disciplines and professions, especially in the social sciences, to ensure that some of the economic benefits gained by university faculty will be reinvested in the educational and research enterprises of their public universities.

In this revolution of relations, urban universities will have special advantages and will make special contributions. I have already mentioned their proximity to industrial locations. The special character of their student bodies is also important. These older, working students rarely seek traditional collegiate lifestyles. Study at off-campus research sites, even in industrial settings, will generally be acceptable to them. In addition, as our society is changing so that virtually all faculty families consist of two employed, professional spouses, faculty appointments in urban universities, where a nonfaculty spouse has greater employment opportunities, will become increasingly desirable. In many cases, the close collaboration between universities and major business enterprises will help educational institutions

to assist in those employment arrangements.

The revolution in university research arrangements is, in my view, likely to be Janus-faced. Not only will university activities move to business sites, but business and to some extent government will become involved with universities in more elaborate ways than our traditional research contract arrangements. Where universities are located side-by-side with major business enterprises, it will not be surprising for businesses to become virtually the sponsors of academic specialties. In these arrangements, businesses are very likely to provide not only research contacts, but also equipment, student learning opportunities, and industrial scientists to serve as adjunct members of both the teaching and research faculties. It is only slightly hyperbolic to suggest that these new arrangements will resemble the patron system that allowed the arts to flourish during the Renaissance. A lesson of that period is that there can be enormous creativity and innovation even when persons or institutions sponsor artistic or intellectual effort to attain specific results. At the same time, a corporate patronage system for public universities flies in the face of this nation's democratic impulse to make its public institutions genuinely independent of private persons and entities. The weakening of this impulse is as much a product of governmental penury in funding higher education as of the economic advantages that can be derived from such collaboration.

Public Service by University Scientists

Finally, I believe that the joint interests of industry and universities will have a revolutionary implication for public service by university scientists. It is well known that science and mathematics education in our public schools is in disarray and that, without better secondary education in science and mathematics, our economy cannot be competitive.

The federal government is correct in regarding this as a national problem requiring federal action. But we must not fail to recognize the role of the private market in the decline of scientific and mathematics education in the public schools. The speed of change in science and technology has so altered the market for persons with competence in science, technology, and mathematics that they are unlikely to remain in the public schools. Federal education policy will be correct when it emphasizes merit and market compensation factors in teachers' salaries. But even new funding for

those purposes will be thwarted as long as the seniority provisions of union contracts require that teachers from all disciplines be treated as having fungible skills, knowledge, and training. And even if new funding is provided and disciplinary specialization recognized in teacher employment arrangements, it is not clear that teaching will become attractive enough, either economically or in work environment, to compete with the private sector for the most capable students trained in science and mathematics.

Hence, it is uncertain whether long-term solutions lie in funding policy and in improved opportunities for the retraining of teachers. But however that uncertainty is resolved, there must be intervention, first in the short term to provide students presently in schools with more science and mathematics training, and then in the long term to ensure that teachers have periodic relief from the high-burnout environments of our schools, especially our urban public schools.

These needs can, I believe, be joined to the needs of business and industry and of universities to produce mutual benefits. A relatively modest program of fellowships for advanced undergraduates and graduate students in areas of science, mathematics, and technology, where the nation is now undersupplied, would be wise national policy in any case. Undergraduate fellowship holders should assume modest teaching responsibilities in junior and senior high schools during the course of their university studies. Graduate fellowship holders should not only teach students but also conduct classes for teachers who need retraining. Such a program would retrain teachers, add large numbers of well-trained, temporary science and mathematics teaching personnel in urban schools, and build up the cadre of university-trained scientists, engineers, mathematicians, and computer science specialists who, upon graduation, would mainly be available to business and industry.

The nation's economy would benefit at two levels. Science and mathematics training in our schools, increasingly essential for persons entering the workforce whose training ends with high school or community college, would be strengthened. And the number of university-trained specialists would also increase. Fellowships carrying mixed obligations—for modest public school teaching in some semesters, and for research in others—would also build up the lagging science enterprise in our universities, especially our urban universities.

The Challenge in Urban Universities and Academic Guilds

It will be said, I believe, that these pathways of science and technology in our urban universities are too risky, too revolutionary, too divergent from our traditional ways, and too fragile in the face of resistance from teachers' unions and state education agencies. I agree that they are risky, revolutionary, divergent from our traditional ways, and politically controversial. But just as the time period from the occurrence of an idea to its manifestation in marketable products has become much shorter than in the past, so the ability to adapt to changing needs and to seize new opportunities has already become vital for our urban universities. In new curricular formats, in new patterns of research that emphasize the application of knowledge, in new, vastly complex, and high-risk involvement with private economic enterprises, and in special service to reverse the decline of science and mathematics knowledge in the schools—and thus in the citizenry and the work force—urban universities must either take the lead or become obsolete.

The most significant resistance to change is likely to be due not to perceived risk or political opposition, but rather to the inertia of our professional associations and academic disciplines. Much of what we do will depend directly on the extent to which academic professions and professional organizations, including the AAAS, will take part in adapting professional norms to these new ways. The challenge for the urban universities is thus also a challenge for the academic guilds.

Professional and academic associations have, in general, been noted for lack of sympathy toward diverse professional career tracks. And science itself tends to be conservative in character, which is a benefit in the search for knowledge but may be a disadvantage in adapting knowledge to specific, economic uses. The challenge to reexamine professional norms and expectations is at least as difficult as the challenge to urban universities to revise their curricula, their relation to the private economy, their research enterprises, and their visions of service. Neither should fail, for the future of science and of this nation's economic health are inextricably linked, and both are linked to the national interest. Those of us who have the responsibility for heading urban universities anxiously await a signal of recognition from the science establishment in this nation that new ways will be accepted and supported.