THE UNIVERSITY AND ECONOMIC DEVELOPMENT: OPPORTUNITY AND CONCERN

By McAllister H. Hull, Jr.

I. Introduction

Daniel Bell's forecast of the coming of the post industrial society(1) has been borne out with remarkable accuracy. The only criticism one might offer is on his timing: events have overtaken his prediction. As changes have occurred in the past, his missed timing would rate little comment. But it illustrates a point important to this paper: in our highly interconnected society, changes can take place so rapidly that the rate is difficult to predict – or to be believed if predicted. Further, the majority of sectors of society will need to respond to change rather than cause it, and the response time of those sectors may be so slow that significant dislocations will occur. Steel and automobiles are, perhaps, the most familiar examples, but sections of the computer industry are current victims of this phenomenon as well. The service industries, toward which employment has shifted – and is continuing to shift – are also changing rapidly, and sound economic development must look to that sector as well as to the high technology industries which attract the most attention. Finally, the so-called smokestack industries need to be kept competitive in order not to become the "sunset industries" some observers have labeled them. The global responsibilities of the United States require, it seems to me, that the U.S. maintain a balanced economy capable of supporting not only itself but also of providing leadership around the world. The U.S. cannot, therefore, abandon any significant sector of its economy to other countries. In the complex international system of which the U.S. is such an integral part, to achieve and maintain the appropriate balance is a very difficult project. Similarly, concern for the social impact of economic development increases as changes that we may once have had a few generations to absorb now require a response in a decade or even a few years.

It is my thesis that the university has a role – by no means an exclusive one – in all these aspects of economic development and societal accommodation. The university has always played a role in economic development, and its role in agricul-

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tural development has been institutionalized in the United States by the Morrill Act. Most state supported institutions have a variety of service organizations that contribute directly and indirectly to the state's economic development. Research done in universities is the basis for much technological advance. In addition to these, I am speaking of an extended participation in a range of aspects of economic development in which intercommunication among groups of researchers and university based policy analysts is encouraged and fostered for synergistic benefit. While some of my colleagues may advocate a role for the university in *resisting* technological change, I find no support in history for the effectiveness of such a position, without even raising a question about its validity. So long as the human race survives, it will refrain from applying knowledge (for good or bad) to the functioning of society. Thoughtful persons concerned with the maintenance of human values in the face of the increasing incidence of machines in daily life will play an important role in the societal modifications which must inevitably accompany economic development. Many such persons are in universities.

II. High-Technology Industries: Their Attraction and Support

A principal concern of some 20,000 localities in the United States is to attract the high technology industries which are characteristic of the information society we are developing. These industries are highly desirable members of the community: they are easy on the environment, pay high salaries and grow rapidly. They are relatively independent of the locations of natural resource supplies and do not require large transportation systems, so they are foot loose. They can locate almost anywhere, which is helpful if you are trying to attract them and worrying if you've got a few in your locality already. Typically they employ many more technically educated persons than the average manufacturing industry, spend more for Research and Development, are entrepreneurial and relatively small (75% of these firms have fewer than 500 employees).

These characteristics; i.e., knowledge based, dependent on R & D, high rate of employment of scientists and engineers, indicate the importance of a university for attracting and supporting a high technology industry. A staff paper(2) prepared for the Joint Economic Committee of Congress discusses the location of high technology firms, and details the many con-

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siderations which affect plant siting. Extensive studies included the complexes around Boston and Palo Alto, which, not coincidentally, have two of the major concentrations of universities in the country. My concern, of course, is with the university's role in attracting industry and mediating the social adjustments which may be attendant.

There are six attractions a university offers to industry, some of which are crucial to high technology firms. First, a comprehensive university (like a major technical institute) provides a steady supply of highly educated persons in technical and scientific fields. These graduates provide the labor pool from which the ranks of science and engineering employees will be drawn. Secondly, the university is the natural location for the basic research on which technological progress is founded, and the applied research on which development is based. An NSF study showed that between 1960 and 1973, 54% of the basic patents on which "technological breakthroughs" were based had been the results of university research.(3) The current climate of university/industry cooperation encourages staff exchanges and joint research projects – or even industry support for research programs to be carried out in universities. Thirdly, the university is a major source of the information on which the life of the company depends. Through its information resources, including but not limited to its book and journal collections, the university provides access to data bases few corporations could afford to duplicate. As a number of knowledge-intensive industries have learned, it is economical to purchase materials for university libraries in specialized areas, and let the library manage the information for them (and the rest of the university community). Knowledge-intensive industries may frequently have computing and information processing equipment superior to that available in universities, but the university resources may become an important adjunct. In many cases, however, the university's information processing resources form a major support for many small high technology firms. Fourthly, the infrastructure of small entrepreneurial industries that supply specialized research, components and technical services is fostered by the presence of a university. Faculty frequently start these firms or inspire them or contribute directly to their functioning. This activity is an important aspect of technology transfer; i.e., the transition of a discovery from the laboratory to the production of a useful device. University

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faculty may contribute to technology transfer also by assessing the technical feasibility of new ideas and marketability of the product that is proposed to be offered. Fifthly, as an educational institution, the university offers educational opportunity to industry employees, whose promotion opportunities and value to the company will depend on obtaining advanced technical degrees or maintaining technical currency through continuing formal study. As important, the children of the industry employees, who attend postsecondary institutions at a much higher rate than average, have a place close to home in which to enroll. The university will have an increasing role in working with the primary and secondary schools in its area, as the demand for computer and scientific literacy, analytical reasoning and sound communication skills are recognized and strategies for responding are developed. And sixth, the university is a cultural center, offering and attracting cultural activities which are especially important to the employees of these industries.

It is, of course, the university as a research center, that is most attractive to knowledge-intensive industry. No such industry can survive, much less develop, without access to current research. A Brookings Institute study(4) showed that 50% of the national economic growth between 1948 and 1969 was attributable to R & D, and the figure is higher for the last 15 years. In the United States, 70% of the country's research is done in universities. A dramatic recent example of the importance high technology industry attaches to the presence of a strong research university is the siting of the Microelectronics and Computer Technology Corporation at Austin, Texas.(5) The ability of the University of Texas to commit itself to *growth* in the appropriate areas (electrical engineering and computer science) was the key to the final choice of Austin over other contenders.

III. Research Corridors and Research Parks

To make the university/industry interface more convenient and productive, the university-associated research park has been developed. Stanford led the way with the Stanford Research Institute, and currently there are research parks associated with Purdue, Princeton, Utah, Georgia Institute of Technology and Cornell. Among other functions, these parks provide small companies with facilities to set up research projects that they could not afford to house independently. Research space is

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expensive to build and equip with special requirements for vibrative isolation, environmental control, standarized measuring instruments, and precisely controlled power. Obviously the opportunity to associate with other research personnel and to engage the services of graduate students and faculty consultants are important factors in the success of the small firm engaged in technical innovation. For first-time entrepreneurs, the university's assistance in developing a marketing plan and business management plan may be essential. Even the larger firms do not cover in house all the varieties of R & D they must undertake to keep abreast of competition. Research parks are, therefore, of value to them as well, and the presence of one on a university campus is a strong attraction to locating nearby.

The importance to the economic development of the country of forming new small companies has received considerable attention. Shapiro reports(6) that young electronics firms have 20 to 40 times the job growth of older firms, and the growth rates of still younger firms (up to ten years old) are 50 to 100 times the rates of older firms. Obviously their base is small, but the point is that economic self renewal requires such new blood to be strong. Older and larger companies have recognized this need by starting independent new firms with capital from the parent organization. Innovation and risk-taking, essential to economic health, are characteristics of new small businesses rather than older well-established industries. As demonstrated universities can play a strong role in facilitating the circumstances which favor industries.

The ability of the University to assist effectively in the economic development of a state, region or the country is dependent on available resources, which are supplied in many cases by governments at every level. The Federal role in research support has been significant since the Second World War. The states have been slow to become involved in that area (although there has been some support for development and applied research with a short payoff potential), but have increasingly been active in a number of ways more recently. The Research Triangle in North Carolina is a pioneer example of a cooperative arrangement between the state and university (three of them in this case) to support economic development in the high technology arena. Realizing that with such businesses more was needed than land availability, a work force, and a favorable tax climate (although these are essential, too), the state built a

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research facility and funded the universities to allow faculty to work alongside a permanent staff on appropriate research projects. High technology industry was invited in to contract for applied research or to support basic research in selected fields.

Although highly successful during wartime conditions, an alliance of the university, business and government to promote economic development in peacetime is relatively recent(7) but is receiving considerable attention.(8) The different value systems of these three elements of society require an accommodation that has not always been viewed as comfortable.(9) The current concern for the relative decline of the United States in technical innovation has inspired the effort to bring these elements together, and the results have, perhaps, pleasantly surprised all parties. The possibility of the support program getting caught in the crossfires of politics is perhaps the least comfortable feature of the association.

One important result of the alliance has been the formation of research corridors, where the universities and businesses already inhabiting a region associate for mutual assistance and to provide the attractions for new industry along the corridor. State government support, principally to allow the universities to increase their strength (in research and educational programs at the graduate level) in selected areas, is the basis for the corridor formation. New Mexico's Rio Grande Research Corridor, which includes four major government laboratories, a number of branch plants of high technology industries, several institutions offering postsecondary technical training, is a new venture which has already attracted some attention. Tennessee is planning a Technology Corridor to include another national laboratory (Oak Ridge).(10)

When one is building on a small base in competition with others, one values such advantages. Information networking, to make available the public data bases of all institutions participating in corridor activities, is one such advantage. A fiber optic network to span the Rio Grande Research Corridor is being developed in New Mexico by Mountain Bell, with each participating institution developing its own local area network to be connected to the trunk. When completed, each work station will be able to access all the others. This will prove a tremendous advantage to a new company coming into the corridor and being able to access the extensive information

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available on the network. Eventual hookups to national networks will increase the range of information available. Electronic mail, conferences, the sharing of seminars and delivery of education will also be accommodated by the network. Thus, for example, special courses can be delivered on site to an industry from any one of the universities, or from more than one if expert background is distributed. A private not-for-profit corporation (Technet) has been formed to facilitate the university/laboratory/industry cooperative use of the network.

A further advantage which a state or region can gain in economic development is by involving university experts in planning the effort. The range of items considered by industry in relocating(12) requires comprehensive response. Studies of the state's laws, regulatory policies, natural and human resources carried out with the aid of university faculty and graduate students can provide a major portion of an effective response. Such a study, conducted, for example, by a commission including private sector industrial representatives as well as government and university persons can also recommend changes in tax and regulatory policies. These policies are frequently formulated to realize a specific purpose, without regard to their impact on other sectors of society.(11) A comprehensive study can attempt to balance the needs of various societal sectors and optimize the benefits to all of them. This requires the kind of careful and objective analysis and development of alternatives that can be considerably aided by university faculty accustomed to working in this mode.

An aggressive development policy should seek to find corporations that can be persuaded to locate in a given state. This effort can be supported by a careful and broad based study of the corporate characteristics to find a match with the local advantages provided especially by the programs of the university — and the strengths of these programs should be carefully compared to the needs of possible target corporations. When a match is found, the target is identified and the campaign can be focussed with the greatest likelihood of success. The university will clearly have a major role in this type of study, and given the probability that senior officials of the target high technology companies will be technically trained, appropriate university personnel should be included in the development team assigned to approach the target industry.

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IV. Strategic Planning

Strategic economic planning can occur at several levels: a national government can coordinate the planning and development for all the industries of the country, a comprehensive plan for a sector of industry (steel, electronics) can be made, or an individual corporation or division of a major corporation may develop a plan for its development. The primary characteristics of strategic planning are the comprehensiveness of its information base, the identification (with, of course, some uncertainty) of trends that will persist into the future, the selection of long range goals, and the design of flexible methods of moving towards those goals. The criticism that American management has fallen collectively (with significant exceptions) into a mode of very short range planning(12) perhaps makes this fairly obvious description relevant.

At least two of our allies, Japan and France, have developed strategic plans at the national level.(13) For Japan, focus is on microelectronics, computers, new materials, robotics, telecommunications, aerospace and biotechnology,(14) but it has not neglected its basic steel and automobile industries in its planning.(15) The United States has traditionally put its faith in the private sector rather than in national planning, and there is no likelihood that this will, or should, change. Attempts at national planning for an industry sector, such as synthetic fuels, provide examples of the failure of this approach in the U.S. This does not mean that the national government has no role in the development of advanced technology in the U.S., and in fact there is considerable need for a comprehensive data on national and international laws, regulatory policies and practices that affect technological development.(12) I believe that the supply of comprehensive data on such subjects could lead to a strategic plan for the development of each sector of our industrial complex. This could be presented in terms of options and projections while recognizing that the primary action will remain in the private sector — most likely within individual corporations — to select its future voluntarily from among the options.

The issue of a national industrial policy continues to be hotly debated.(16) It has already been pointed out that other countries *are* developing national policies and any study of the developing economic scene(17) extends these remarks. The

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United States has not developed policies with a similar intent because of its tradition of individualism and private enterprise. It sees its strength in the response of many persons to opportunities they discover and can pursue without central control. But I wish to distinguish between the establishment of government-directed policies and the provision of research and accumulation of data useful to help the private entrepreneur to make their own informed decisions. I believe that task groups of industry, government, and university experts can usefully address the current status, future prospects and the means to reach a chosen future from the existing present for each sector of industry. In fact, this is already under way, at least in part,(18) and hence may only need extending. The question of how the goals are to be achieved then arises. In our society, participation by industry must be voluntary, but a well researched set of coordinated goals will attract the attention of the most forward looking managers as a matter of enlightened self-interest. There are examples of industry-wide efforts to support research for the common good (EPRI, the Steel Institute, and, most recently, the Microelectronics and Computer Technology Corporation), and these should be encouraged. University faculties have a role in this process as consultants, researchers and teachers.(19)

Of particular concern is strategic planning in high technology industries. The rapid changes in technology have made many companies the "victims of technology rather than its masters."(20) International competition makes such a situation especially problematic for American industry.(12) Richard Foster(21) has pointed out that technologies follow a rising "S" curve as they develop. This is an example of the "logistic" or "biological growth" curve familiar to workers in a number of academic fields. Simply stated, as a new technology developes, it is rapidly adopted, producing exponentially increasing sales or production. As the market becomes saturated, however, the demand will level and may eventually drop. Anticipating this stage, the planner should have selected the next rising technology and should prepare to make the shift to it. This requires that the research necessary to facilitate strategic planning should be in hand: one needs to have sufficient information to select the new technology and to decide when to jump. There will be a *drop* in corporate sales at the discontinuity, because the new technology will be in the early stages of its rise. Hence

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the long range is emphasized at the expense of short range returns. If this is not done, "competitive leadership in a market generally changes hands."(20) Foster notes that none of the top ten vacuum tube manufacturers successfully made the transition to semiconductors. But in Japan, between 1950 and 1982, electronic industry emphasis changed from radios to black and white TVs to color TVs to high quality audio equipment to Video Tape Recorders – with each new product phased in so that the total production of declining and rising items resulted in net rising sales.(15) No better example of the value of strategic planning need be offered.

Should a state decide to facilitate strategic planning in a particular sector, university faculty can join representatives of government and private industry in researching data. New Mexico has decided to plan in the energy sector, and has created the New Mexico Energy Research and Development Institute to assist the Energy Mineral and Economic Development and Tourism departments of state government in both planning and implementation in the energy area. Research, development, pilot demonstration, market analysis and distribution studies can all be supported with state funds. The availability of small amounts of state funding to assist industry in various ways to get started or to grow is an obvious incentive – which works not only with the small firms for which the support may be vital, but also is attractive to large corporations as they assess the societal climate in a region. A strategic plan, revised each year to respond to experience and changes in opportunities, guides the support of entrepreneurs. Technical advisors are drawn from the universities and private sector.

V. Automation and Integration of Control

Strategic planning must be applied to the methods of manufacture of a given product or line of products as well as to the development of new products. The application of technology in manufacturing is an important area of concern. The key jargon includes Computer Aided Design/Computer Aided Manufacturing (CAD/CAM), Computer Integrated Manufacturing (CIM) and Flexible Manufacturing Systems (FMS, sometimes called FFS for Flexible Fabricating Systems), which may be the outcome of CIM involving CAD/CAM!

Aerospace has led the way,(23) but other industries are in the process of automating with the aid of computers.(24)

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Wherever the work is dangerous, physically demanding and/or repetitive, there is an obvious place for a robot (the anthropomorphic science fiction robots are misleading). In a CIM system, automated segments of the process, including inventory control, parts delivery at the right time and place, movement of the unfinished product to the next stage of manufacture, and inspection of the result for quality assurance are all controlled by special purpose computers. General purpose computers are part of the system in the CAD stage, and, finally, the business functions of the corporation are both automated and integrated into the whole system. Automated processing has been the heart of the petrochemical industry for years, and the lessons learned and taught by chemical engineers are available for application to CIM. The Japanese, with typical aggressive foresight, are concentrating significantly on robotics.

It is especially important that the so-called "low tech" or "smokestack" industries develop CIM systems. Machine tool, automobile and steel manufacture are among the basic industries which, in my view, must not be abandoned to other countries and treated as "sunset" industiries, but should instead be automated in order to remain or again become competitive. Not only are these basic industries so large a part (much larger than high technology industries now are) of the economic mix that to replace them by imports staggers the imagination,(25) the role of the United States in world affairs requires a balance in its productive sectors. These industries should depend on the government for relief from international dumping, but on automation rather than protectionism for maintenance of market. A recent NSF study has developed the alternatives available to steel.(26)

The complexity of CIM requires research for its optimum design and implementation. For example, the best arrangement of computers to control the system presents a topological problem of long standing – which we now have a handle on.(27) The research role of the university should provide an important support for the effort. As in the case of strategic planning, research and instruction in CIM will be broadly multidisciplinary – and will require an integrative approach not always comfortable to members of academia. The striking accomplishments of the Princeton group under Hazony(28) in this field show what can be done. Industry and other universities will need to take a hard look at this work.

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VI. The Social Consequences

Technological unemployment would seem to be one consequence of the wide-spread use of CIM. Indeed, the increased productivity required in the basic steel industry to remain competitive is obtained by replacing people by machines. In Japan, the system takes care of this: people are retrained, reassigned – and retained. There is little labor opposition to automation.(15) In the Aerospace industry in the U.S. the same attitude seems to prevail.(23) Retraining and reassignment have been the keys, and workers formally accustomed to a single task enjoy a better quality of work life when they are part of a manufacturing team with multiple responsibilities. The use of emerging educational technologies, developed with the aid of university research, can reduce the economic burden of retraining.

But these positive responses cannot be used to dismiss the problem. The paternalistic Japanese system is unlikely to be widely adopted here. In some industries, significant reduction in force may occur. At minimum, displacement, both technological and geographic, is likely to be an important consequence of automation. It is a function of society to deal with this problem. We cannot afford massive unemployment for any reason. The problem is not new – technological unemployment, or displacement has occurred before. But we cannot learn much from earlier experience because of the rate at which change may take place now – much more rapidly than before. So long as the economy is strong, the end result is clear: people change jobs, finding employment in other industries – service industries, for example. But there are a number of subsidiary problems which require considerable study. Here I believe the university again has a role – along with government and industry. Current unemployment in Michigan, for example (which is economic, not technological) has produced displacements that are difficult to deal with, and not yet satisfactorily handled. With a greater societal complexity and potentially a larger displaced population, it is not clear that, without help, the absorption of dust bowl victims which occurred in the 1930s, for example, can occur again. But I believe the consequences can at least be ameliorated if research and planning take place. Industries like steel should take the lead with labor in defining the problem, to be joined by the universities and government in finding and implementing solutions. An intriguing possibility

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for a manufacturing industry employing the products of the information industry to increase production is to plan and launch small firms which can absorb retrained personnel and provide employment growth. Diversification is not only sound economically in this mode, but socially positive as well.

But this is not the only or even the biggest problem with our evolving society. Whether basic industry will only decline in its share of the economy while growing in absolute terms, as I believe it should, or fade into the "sunset" as some high technology enthusiasts propose, there is no question that the proportion of people in service industries and in information processing will increase. This is what Bell meant by the post-industrial society: not that traditional industries would disappear (agricultural production is, of course, much greater than it was when over half the population engaged in it), but that the service sector would dominate employment.

Service sector jobs, as they are now constituted, are relatively low paying. In some cases they are part time, or their holders move from job to job without establishing a work place identity.(29) There is a developing polarization of job opportunities between those requiring high levels of education and those requiring only basic skills – and the latter are an increasing fraction of the whole.(30) Japan is already experiencing the problems of a two-tiered society.(31)

I have no new solution to offer, but I believe the problem is susceptible to analysis and that solutions can be found. It is not too early for the universities to begin doing their part in that analysis.

VII. New Responsibilities and the Maintenance of Traditional Values in the University

The economic development of this, or any other, country in the information age demands an educated populace. Skills beyond the minimum in reading with understanding, writing with clarity and reasoning from data are essential. Several reports in the last few years have pointed to the failure of our educational systems to ensure that those essential skills are possessed by all our people.(32) Mathematical, scientific and computer literacy are needed at all levels, from general acquaintance to expert knowledge. Universities that educate the teachers have a responsibility to provide updating for in-service, as well as new curricula for pre-service teachers. The develop-

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ment of educational technologies that will be an important (but not only) element in remedying the deficiencies in the schools is a shared responsibility of the universities, the schools, the government and a variety of industries.(33) Universities will be called upon also to use those technologies not only for programs delivered in house, but to reach industrial audiences on site. Research opportunities in the development of expert educational software will be presented, and the universities must be ready to assemble the groups that can respond.

The management of information has become so important that administrative initiatives must be taken to ensure that the university optimally serves its students and faculty as well as constituents in industry and the professions outside the institution. A study done for the U.S. Department of Energy estimates that $13 billion annually is saved by the proper management of information in the energy field alone.

Educational program opportunities in information management must be provided students and in other developing fields indicated above where information control is a hallmark.

The need for increased foreign trade if U.S. industries are to remain healthy has been pointed out in a number of studies — one of recent date was carried out by the National Academy of Engineering.(35) The university has an important role in educating persons to serve in the international trade divisions of American industry. Successful penetration of foreign markets requires that the economic climate, political structure, cultural background and legal complexity of the target country be well understood. Communication and transportation make world markets accessible to any industry of any state, but the market is not of one piece. Understanding the needs and potential of other countries calls for a complex body of knowledge which universities can supply. Programs in international management, integrated with appropriate language, cultural and legal studies need to be developed and offered by universities in considerably greater numbers than in the past if the U.S. is to readress its current imbalance in international trade.

The research capabilities of universities are being called upon to provide direct assistance to industry. In New Mexico, the legislature has funded five centers of excellence at three institutions to extend university research capacity in areas attractive to industry and in support of the Rio Grande Research Corridor already mentioned. Government laboratories and local industry

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are offering joint appointments between themselves and the universities for technical personnel. With these welcome opportunities come natural concerns for the maintenance of traditional values of the university. In particular, corporate and government laboratory partnerships raise questions about intellectual property and openness of communication of research results for university participants. Bremer(36) has remarked that universities must not be considered merely "a readily available and convenient source of brain power...a mere extension of the development arm of industry...." But, as he also says, "If a university/industry research arrangement is to succeed, the parties must first recognize that their respective roles are different and that, therefore, the peculiar needs of each must be respected" – a point I have made before.(37)

The question of intellectual property in government partnerships has been resolved (the university retains the patents) for research supported by Federal funds, and the universities acquire the responsibility then for technology transfer. But intellectual property rights lead quickly to withholding research from publication – at least until patents are issued. While this is at least questionable by traditional university standards concern may be even stronger that the traditional university emphasis on basic research may be compromized by efforts to undertake potentially marketable projects. The spring 1985 issue of *Science, Technology and Human Values* is concerned with this question, and is recommended to those with this concern.

More troublesome would be questions of research that might be in a classified area – or, as has happened recently – might become classified after the fact. Some of the research in support of the Strategic Defense Initiative will be done in universities, but so much of it will be basic and benefit to the non-military economy,(38) that classified projects need not be undertaken. Nevertheless, caution must be exercized to see that the principle of openness in university science not be violated – or that there is clear and compelling justification for doing so.

VIII Conclusion

I have outlined an ambitious and far reaching role for the university in economic development. It is a role that calls for more speculative analysis than scholars are accustomed to. It calls for an extension of the partnership with government and

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industry (of which labor is an important part) that has served us well in war and is being revived in current stressful times. While we aid the advance of technology, we must at the same time maintain the traditional human values essential to the quality of life. While embracing a new role, the universities must maintain the essential elements of intellectual balance and independence which have made them a constant force in the world for 800 years. We must learn to cope with changes of such rapidity that new social and personal survival techniques have to be devized. I have no doubt that we have the capacity, but am not sure we have the will.

FOOTNOTES

(1) Bell, Daniel, *The Coming of the Post Industrial Society* Basic Books, N.Y., 1973.

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(3) Peng, Charles, *Harvard Business Review*, September/October 1981.

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(6) Shapiro, Albert, "Developing a High Tech Complex Through Small Company Formations," *Business Review*, University of Tenneessee, Summer 1982.

(7) Hull, M.H., "A Leadership Troika in Technological Progress: The Role of the University in Partnership with Government and Industry," address to the NASA Symposium, Albuquerque, March 15, 1979; *Albuquerque Journal*, "UNM Provost Urges Teamwork on Research," May 26, 1980; "Prospects for Growth of High Technology Industry in New Mexico," testimony prepared for Senator Harrison Schmitt, Senate Subcommittee on Science and Technology, February 9, 1981; "Moving Technology Into the Market Place: A University View," address for the Showcase for Technology, Albuquerque Convention Center, October 30, 1981.

(8) WICHE Reports, Vol. 26, #3, Autumn 1981: Industry, Government and Higher Education: Partners in Economic Development, is one of may discussions of the matter.

(9) Report of the University-Industry Relations project, University of California, 1982; Hull, M.H., "Moving Technology Into the Market Place: A University View," op. cit.

(10) Alexander, L., Parish, J., and Haslam J., "The Technology Corridor," *Survey of Business*, University of Tennessee, Summer 1982.

(11) Jordan, Jerry L., "The Problem of Productivity in Restoring Prosperity," 1983 Frank M. Engle Lecture of the American College, Bryn Mawr, Pennsylvania, discusses, for example, the impact of environmental protection and worker safety policies on productivity measures. He does not argue for the elimination of these policies but on the appropriate method of paying for them. In a major policy paper, the Panel on Advanced Technology Competition lists a wide range of national and international policies which affect economic development in Advanced Technology (National Academy Press, 1983).

(12) National Research Council, "International Competition in Advanced Technology Decisions for America," National Academy Press, Washington, D.C., 1983, cited in footnote 11, is one of many analyses making this point.

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(13) National Research Council, op. cit. Japan shares its plans quite freely: Abeggelen, J.C. and Etori, A., "Japanese Technology Today," Advertisement in *Scientific American,* November 1983, p. 54 ff.; and Long Term Credit Bank of Japan "Japan's High Technology Industries," May 1983.

(14) Long Term Credit Bank of Japan, op. cit.

(15) Abeggelen and Ttori, loc. cit.

(16) Modic, S.J., *Industry Week,* November 14, 1983, p. 38 reports one example of the debate.

(17) Rubin, M.C. *Information Economics and Policy in the U.S.,* Libraries Unlimited, Inc., Littleton, Colorado 1983, p. 319.

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BOOK REVIEWS

MODERN CHINA: The Mirage of Modernity
I.W. Mabbett
St. Martin's Press, New York, 1985

Most writing on modern China dwells on those aspects which are new to China since the Communist takeover, stressing above all politics, Marxism, economic and agricultural development. This book argues that all this writing creates a false impression of what present-day China is really like.

Modern China: The Mirage of Modernity contends that much of traditional China remains, particularly at the grass-roots level, and that Buddhism and the Buddhist tradition continue to exert an influence. Politics in communist China is best understood in the context of this tradition. Throughout arguments are supported by revealing how tradition continues in the economy, in society and the family; by examining in detail the Buddhist tradition; and by using the case study of education to show the interplay between modern and customary forces.

Thus the author points out:

> What happened to Chinese society was only partly that the weak rose up and overturned the throne of the strong. It was partly that an attempt was made to freeze village politics at a particular point, to draw a line around those parties considered potential friends of the regime and another around those considered potentially hostile, and to make a regular aristocracy out of the first, regular outcastes of the second...

The officials of Communist China, although drawn from a new elite comprised primarily of persons recruited from the original lower classes, are faced with much the same problems as confronted the highly educated mandarins of the *ancien régime:*

> Like mandarins expected to keep order in turbulent cities, the officials have found themselves constrained to make their weight felt by recruiting allies. Mandarins could

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