attention to the views of severe critics and victims of the neglect of professional obligation. Nonetheless, what is here is valuable, and the American Academy and Professor Freund put us all in their debt with a good beginning to what will have to be a continuing enterprise. Now that biomedical science has come to maturity, its moral obligations may no longer be disregarded.

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A REPORT FROM THE FRONT: MIT IN THE ANTI-SCIENCE WAR

The University and Military Research: Moral Politics at M.I.T., by Dorothy Nelkin (Ithaca: Cornell University Press,1972), xi + 195 pp, £3·60 (cloth back), £0·90 (paperback).

To what extent are scientists responsible for the uses society makes of their research results? Are technologists accountable for the purposes for which the devices or processes they develop are used? If so, to whom are they accountable—their own peers, the whole community to which they belong, the individuals who might be affected by their product? To what degree can technical skills and resources be employed to meet social needs regarded as important? In other words, can intellectual swords be turned into ploughshares? Should universities be mainly responsive to the demands placed on them by other social and political institutions, as sellers to clients or customers, or should they, through their own independent action and example, try to promulgate national policies and goals? Does the sponsorship of university research by industry and government compromise the claim of the university to political neutrality and intellectual "objectivity"? To what degree is the university, as a corporate body, justified in exercising control over the research undertaken by its members, when such research does not violate the law or contravene universally accepted ethical standards? If such control is the responsibility of the university, who within it should exercise it and by what mechanisms? Should it be the teaching staff voting democratically, the administration in informal consultation with teachers and students, or everyone in the university, including clerical and custodial staff, each individual having one vote? Are there circumstances in which official compliance by the university with the requirements or requests of a political authority constitutes a "political act"? For example, does any contractual relation with the military, such as participation in the Reserve Officers Training Corps programme, or the conduct of research for one of the armed services, constitute political endorsement of national military and strategic policies? Does work in the development of "multiply targetable strategic warheads" imply corporate institutional endorsement of the ultimate deployment of such warheads as part of the national strategic arsenal?

These are some of the questions raised by Dr. Nelkin's book, although it must be said that the sub-title is more descriptive of the contents than is the principal title. That is, the book deals mostly with the history of conflict between anti-war political activists and the administration of the Massachusetts Institute of Technology (MIT) over the role of the "special laboratories" which worked on military technology, particularly the Instrumentation Laboratory, directed by the charismatic and combative Dr. Stark Draper.

The book is not to any large extent an exploration of the moral, political, or educational issues involved, but is rather a concrete account of the particular complex of political currents and cross-currents which contributed to the crisis, and of the political tactics of the various actors and their goals and

motives. It is a fair and scrupulously balanced description of what happened and why, but it reads more like an account of the successive moves in a chess game than of a passionate political controversy. In fact, after reading the book, one is left with the impression—which might indeed be correct—that the various factions were not quite serious, particularly the activists, and that they were going through a kind of self-purgative ritual. On all sides, including the teaching, research and administrative staffs, there was a desperate effort to be rational; an enormous proliferation of soon-forgotten memoranda is evidence of this.

All of this contributes to the impression of a self-purgative rite. Perhaps this kind of account was inevitable if the author was to do justice to all the subtleties of the situation and to accept the sincerity of the motivations of all the actors. This is not a book with villains or heroes, and individual motives and public arguments are taken largely at their face value.

Universities are generally accorded the privilege of being "autonomous" institutions, and their autonomy is protected by the concept and practice of "academic freedom". But their autonomy does not extend to the financial resources on which their continued existence depends, and consequently the ideal of autonomy comes into conflict with the necessity for patrons, particularly patrons for research. The system of patronage worked smoothly during the 20 years following the Second World War, in part because there was a very far-reaching consensus on the foreign policy of the United States. It was during this period that universities, particularly the leading research universities, became involved in military research. The universities came in part to be dependent on this support for carrying on many of their important functions.

This was nowhere more true than at the Massachusetts Institute of Technology, which is the world's leading technological university. It is little wonder that the breakdown of the consensus about foreign policy which accompanied the involvement of the United States in Vietnam had severe repercussions within the Institute. Institutional commitments of long standing could not be broken overnight, nor could the technical resources built up over many years be easily re-assigned to perform other tasks which were now regarded as more urgent, regardless of how much those tasks were recommended in principle by the administration of the Institute. Circumstances made it virtually inevitable that the role of the administration of the Institute would be seen by many activists as diametrically contradictory to the administration's own public statement of its views regarding the part the Institute should play in working on the newly defined tasks of American society. Given the constellation of patrons on which the Institute depended for continued financial support, and the obligations the administration felt to its long-term employees, it could not have been otherwise. The $50 million Instrumentation Laboratory, with more than 1,000 employees, was after all a part of the community to which the administration was accountable. The constraints of the real world—the administration's sense of obligation to its donors and its staff—enforced an inevitable collision between groups whose publicly asserted ideals and goals differed very little.

How can one explain this paradox? The answer is that few if any situations are characterised by single goals. Even when there is a fairly widely shared consensus on particular goals, the different actors will have different hierarchies of other goals, and will therefore attribute different degrees of importance to the particular goal. Thus, as the discussion moves from the mere affirmation of widely agreed-upon ends to their realisation through various means, the consequences of those means for the various secondary goals and preferences

of the actors becomes increasingly important. The actors differ widely in the price, in terms of other goals, that each is willing to pay in order to achieve the widely agreed-upon, and ostensibly primary, goal. Hence the consensus on primary goals disintegrates into arguments over secondary consequences, both as to their likelihood, and as to the values to be attributed to them. These arguments are embittered by the feelings of those who see any defection from the absolute priority of the first goal as evidence of duplicity and base tactical manœuvring.

Thus the administration of the Massachusetts Institute of Technology, and a large part of the teaching and research staff which supported it, saw the redirection of the Institute's resources into civilian-oriented technology as a matter of high urgency on its agenda—but only a small minority were prepared to accept the costs which would have had to be borne by other parts of the Institute and its programme. The latter became more and more evident as the practical details of the proposed reorientation were discussed and explored. The financial cost to the Institute's educational programmes, the disavowal of obligations to long-term employees, the appearance of one group in the Institute legislating morality for another group at very little cost to its own members, the disowning of a man, "Doc" Draper, in whose world-renowned technical virtuosity the Institute took great pride, and the potential alienation of many of the external supporters of the Institute were some of the considerations which the administration of the Institute bore in mind.

The basic point which emerges from Dr. Nelkin's book is that there was no way, within the real constraints of the situation, by which the objectives of the "March 4 movement" could be achieved without incurring unacceptable costs. Ironically, with time, many of these costs might have to be paid anyway as the federal government gives less importance to "high technology", particularly military and space technology. But the change is occurring more gradually, and is more impersonal and politically less costly to the administration when it is imposed by the federal government.

The story is in many ways a microcosm of the problem of institutional and social change in modern technological-bureaucratic societies, in which diverse goals and interests are linked in complex ways. Political radicals view this resistance to change as evidence of a deliberate conspiracy among elites to retain their power over society and to hold onto their wealth or privileges. The story told by Dr. Nelkin shows that life is much more complicated than that, that the same resistance to change can occur in a situation where everyone's purposes are honourable and where there is widespread agreement on the direction in which the Institute ought to be moving. The friction is inherent in the organisation of any institution or any society, not just a product of the recalcitrance of a few individuals holding obstinately onto the reins of power. The problem, in fact, is not that some persons have too much power, but that no one small group or individual has control over a sufficient number of the available resources to effect a major institutional change on its own. Diffusion of responsibility also implies dispersion of accountability.

In the end, the book does not answer any of the questions which it raises, and which were listed at the beginning of this review. Perhaps they are unanswerable in any definitive way. Clearly scientists do bear some responsibility for the foreseeable consequences of their work, but to what extent do scientists have a right to impose their political views on society through concerted withholding of their skills from the execution of those policies with which they are in political disagreement? It seems to me that there is no absolute answer to such a question. At the same time, there is a question as to what consequences of research, especially basic or exploratory research, can

really be regarded as foreseeable. Even technology produces only alternatives. It is society which chooses among them; and science generates many more alternatives than are ever chosen. Many different choices, entailing different social values, may be derived from the same research results. Some argue that the obligation of the scientist does not extend beyond explaining what the alternatives are, and then only to the degree to which his special knowledge and experience are required to illuminate the alternatives, leaving the actual choices to society. Others argue that in fact it is relatively easy to foresee which alternatives society in its present state will choose, and that therefore scientists must exercise much more active influence on the choices which are to be made. But the logical end-point of such a view would be a technocratic society in which political goals were implicitly set by experts through their monopoly of the generation of the alternatives and the choices among them which society can make. This is exactly the sort of undemocratic control by experts which the advocates of social responsibility of scientists deplore, and which they feel we already have to an excessive degree. Thus, implicit in the arguments of the critics is not really concern with social responsibility, but disagreement with the allegedly conservative political bias of the currently influential experts.

The redirection of technological resources raises other problems and questions. Part of the very effectiveness of the scientific-technological system arises from its capacity to adapt itself to new opportunities—from the fact that it is biased towards attacking soluble problems, in the expectation that the "seamless web" of scientific knowledge thereby generated will contribute to the solution of socially important problems, more effectively than a frontal assault on the problems themselves. Again, the final answer is bound to be an uneasy compromise, about which it is impossible to generalise. "Science for the people" is a will-o'-the-wisp, likely to end in futility, but "pure technology", the pursuit of "technological goals" for their own sake, just because they are intellectually challenging, does not automatically produce social benefits. The socially beneficial "spin-off" from high technological research, undertaken simply because it is intellectually challenging, is certainly present, but is almost certainly not commensurate with the costs. Laboratories organised around highly specific technologies, and dependent on skills and experience, accumulated over a whole professional lifetime, are not easily turned to radically new tasks, even though some of the intellectual skills might in principle be applicable to a new range of problems. In fact, the story of the Instrumentation Laboratory is interesting just because it illustrates in most striking form the importance of continuity in technical theme, and organisational personality, in the generation of major technological innovations.

The dependence of university scholarship on external sponsorship might compromise its objectivity to some degree, but lack of resources may involve an even more serious handicap. Sponsored research is a bargain between the scholar and society in which each renounces a little of its own values. To some extent, objectivity is preserved by the pluralism of the sources of support, but this too is not wholly satisfactory because the pluralism itself is uneven. In the end, I believe pluralism of patronage combined with relative affluence is less compromising to the objectivity and influence of an academic institution than is institutional poverty. In the case of the Massachusetts Institute of Technology, however, the situation was complicated by the fact that the controversial Instrumentation Laboratory was a "womb to tomb" operation involving not only exploratory research, but development and planning of specific weapons-systems which were in themselves objects of intense controversy. In this case it was argued that students and professors

could gain direct experience of realistic engineering which was possible in no other way.

Thus, support of the Laboratory as part of the Institute could plausibly be justified in part by educational objectives; and it could be argued that only in the military-space field was it possible to obtain the quantity of resources and the continuity of sponsorship necessary to conduct an operation having this degree of engineering realism. Hence the pluralist argument was invoked in this case, much as in the case of the more common situation of militarily sponsored basic research. Defenders of the arrangement could also rightly point out that it was the professors and administrators of the Institute who assumed leadership in publicly opposing the actual use of some of the very weapons-systems which were being developed at the Instrumentation Laboratory, and in educating the public about the implications of these systems for the arms race. It would be more difficult to prove, perhaps, that the presence of large defence contracts did not subtly cause some individuals to "pull their punches" in public more than they might otherwise have done, but it was also the Institute's deep first-hand involvement in weapons work which helped these individuals to speak out publicly and authoritatively and to be believed. As eminent citizens having little first-hand contact with military-technological development, it is unlikely that their views would have received much attention.

The question of corporate control by the entire university community over the research and development undertaken by its members under the auspices of the university is, if anything, even more complex, and less subject to generally stated principles. Clearly every institution does place limitations on the freedom of research, even assuming the availability of facilities and financial support. There are, for example, limitations on experiments involving human subjects which violate generally accepted, and often legally specified, norms. But these limitations pertain primarily, if not wholly, to the methods used in research, not to its ultimate objectives—or to those of its sponsors, to the substance of the scientific questions asked, or to the nature of the end-product sought—if it is not illegal.

More importantly, the university exercises corporate responsibility over its future programmes through the appointment of its faculty members, and through the priorities it sets when it seeks private resources for buildings and facilities. The theory behind this process is that once an individual has been selected for a permanent position on the basis of his past scholarly accomplishments and future promise, he should be free to determine the directions of his own creative work, and to seek the necessary financial support for it, although the selection process itself obviously involves the discussion of the institution's own future priorities. However, it is also true that the commitments involved in appointments of faculty members may be much longer than the duration of any particular national policy, or the university community's own consensus about which programmes should have priority.

Proponents of a *laissez-faire* policy of university research draw a sharp distinction between the responsibility of the individual scholar, and the collective responsibility of the institution as a corporate body or community. The community, it is said, has a right to criticise the choices of its members but not to constrain them. The social responsibility of the scholar is individual, not collective or institutional. The concept of corporate responsibility brings greater potential dangers for society than those it avoids. Political beliefs and campaigns are transitory, and often change in the perspective of history. Deliberative bodies, such as university faculties, are notoriously subject to

"bandwagon politics" in times of stress, especially when presented with the opportunity to pass satisfying moral judgements at little personal cost.

One of the claims of universities to intellectual autonomy rests on their need and ability to nurture and protect scholarship and opinions which are currently unpopular or unfashionable, but which may be of significant importance for the future. The obligation to protect freedom includes not only freedom from outside interference, but freedom from internal interference as well.

Those who argue on the other side, point to the fact that the university does exercise collective responsibility for its teaching through the setting of curricular and degree requirements; it is only in research that the tradition of *laissez-faire* has been gradually extended from individual scholarship to the large research empires which have been permitted to grow in a period of generous federal support.

Where, then, can one draw the line between individual scholarship, protected by academic freedom, and large research projects with elaborate hierarchical organisations? The involvement of university scholars in technological development from "womb to tomb", or in the analysis of controversial areas of public policy, extends the issues beyond those normally considered under the rubric of academic freedom. Yet there is no well-defined boundary at which academic scholarship becomes a "research business", subject to different controls or norms.

In the end, the solution of the Massachusetts Institute of Technology crisis was satisfactory to no one. It alleviated the symptoms rather than the substance of the conflicts which wracked the Institute. It was agreed to cut off the offensive appendage, but in such a way as to minimise the pain on all sides. The deluge of paper served as an anaesthetic, which purged political passions and paved the way for a delicate amputation, but which left the question of national priorities unaddressed and unaffected, since the Instrumentation Laboratory remained in business under a new name, with no constraints on its freedom of action other than those set by federal policy—over which the strenuous churning of the "March 4 movement" and its aftermath had no visible influence. It was just a "microseism" in the long process of the Institute's adjustment to a changed social and political situation in the country at large.

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PHYSICS THROUGH ROSE-COLOURED SPECTACLES

Physics Survey Committee, *Physics in Perspective*, Vol. I (Washington, D.C.: National Academy of Sciences, 1972), 1064 pp., $25.

THIS enormous volume is the report of a committee created in 1969 by the Committee on Science and Public Policy of the National Academy of Science. It surveys physics in the United States from a variety of angles. With several hundred cooks stirring the broth it could scarcely be considered a culinary masterpiece, but there are a few good lumps of meat. The chapters on "Information", and on "Manpower", are carefully argued, and full of unusual and instructive evidence: for these alone, the book is worth consulting. The descriptions of the "Institutions of Physics", and of the machinery of financial support are useful, if rather indigestible. The caustic chapter on