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BIOLOGY AT BERKELEY: A Case Study of Reorganization and Its Costs and Benefits Spring 1999

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Portions of this paper were originally published as "Leadership and organization: The case of biology at Berkeley," in Rune Premfors, ed., Higher Education Organization, Almqvist and Wiksell International, Stockholm, 1984, pp. 148-178. However, this version reports substantially new materials about the biological sciences at Berkeley during the entire period between the late 1970s and the present with new interpretations. I much appreciate the help of Professor Daniel Koshland in reconstructing the events summarized here, and in reviewing the essay for factual accuracy, though the interpretations are my own. I also appreciate the editorial help of Rogers and Ellen Jane Hollingsworth. This working paper is not to be quoted without the permission of the author. Copyright Martin Trow all rights reserved.

Introduction

This paper is concerned with the reorganization of biology at Berkeley, begun in the late 1970s and early 1980s, and now largely completed and institutionalized. Key to the initiation of change was the appointment of a Chancellor and Vice-chancellor² who were committed to the changes, and the enlistment of outstanding biologists already at Berkeley to design the reform and carry it through. With the benefit of hindsight, I will raise the following questions: what led to the momentous changes in this leading research university; what actually happened as a result of the reform; what the key forces were that made the reform possible, and what if anything are the implications of the reform for other universities, in the United States and in other countries.

I University leadership

Much of my perspective is concerned with "leadership and organization" in higher education. Leadership implies the ability to get something done. But if there is a consensual wisdom on this question, it is that leadership in higher education, especially leadership of universities, is hardly possible, since the nature of the institution and its relation to the larger society make it nearly impossible for presidents or vice-chancellors or rectors or other university leaders to accomplish anything of significance. The weakness of institutional leadership in higher education in all advanced societies, it is argued, arises for at least three reasons, which vary in strength in different countries and under different circumstances. First, institutional leadership is weak because the extreme division of knowledge in academic society locates much of the effective authority and power in the institution at the bottom, in the departments or chairs. In universities, it is the fields of knowledge, the subjects of study, often highly specialized and esoteric, that are "the most important bases of organization." It follows that "a university-type organization is one in which there are many cells of specialization side by side and loosely connected at the operating level, together with only a small number of higher levels of coordination" (Clark, 1983b, p. 17). The centrality of the lower level units which manage teaching and learning, insures a secondary or derivative role for institutional management. In such institutions, "made bottom heavy by the centrality and weight of the disciplines and professional fields, incremental adjustment is the pervasive and characteristic form of change. Since tasks and powers are extremely divided, global change is very difficult to effect... The leading false expectation in academic reform is that large results can be obtained by top-down manipulation. Instead, small results typically follow from efforts at the top, in the middle, or at the bottom, in the form of zig-and-zag adjustments, wrong experiments, and false starts, out of which precipitate some flows of change" (Clark, *ibid.*, p. 114).

Second, so the argument goes, the enormous complexity of colleges and universities, arising both out of the variety of activities that go on within them and the diversity of functions that they play in the larger society, makes those institutions essentially unmanageable. The roles of institutional leaders in those situations are in large part symbolic, to give a veneer of rationality to what is largely a non-rational process of uncoordinated responses to unanticipated events – in the pejorative sense, to rationalize as "decisions" what are the cumulative effects of many actions only a few of which are taken by the institutional leaders themselves. In this view, developed most fully by James March and his colleagues, colleges and universities are prototypical "organizational anarchies" characterized by problematic goals, unclear technology, and fluid participation - in which problems are more often evaded than solved through "garbage can decision processes" (Cohen and March, 1974, p. 2). Without clear purpose or leadership, it follows that "anything that requires a coordinated effort of the organization in order to start is unlikely to be started. Anything that requires a coordinated effort of the organization in order to be stopped, is unlikely to be stopped" (ibid., p. 206).

And if the university cannot be led or moved, then consistently enough in their view "the presidency is an illusion. Important aspects of the role seem to disappear on close examination. In particular, decision making in the university seems to result extensively from a process that decouples problems and choices and makes the president's role more commonly sporadic and symbolic than significant." (ibid., p. 2). Presidents of public universities are, they believe, especially weak: "Public universities make weak budget presidents. The presidents of a public university must simultaneously negotiate the appropriations for his operating budget from the legislature or some intervening body and negotiate the allocation of that budget among his departments. The simultaneity and public character of those two negotiations restrict him seriously and further, "for the most part, however, and particularly in the larger schools, presidents do not appear to have much to say about academic policy." (ibid., p.102-3). Third, the movement in many countries toward greater central direction over educational systems in the name of democratization, broader access, predictability, administrative efficiency and social utility, works against institutional autonomy, without which there is little room for institutional leadership. Indeed, in the discussions by Europeans of decision-making within their own systems of higher education, there is little discussion of the role of institutional leadership, as opposed to management, perhaps for the simple reason that European institutions and those derived from European models do not give institutional leaders much power. Much of this writing addresses the capacity of central governments to make effective changes within institutions, and sees the important dialogue, so to speak, as between central planning agencies and the primary units, the disciplines and the departments, at the bottom. Maurice Kogan's term for the role of central leadership in the British University is "managerialism" and he sees it strengthened by the enormous pressures of budget cuts on the universities from above. But he certainly does not envision a particularly creative role for the university vice-chancellors beyond the orderly management of decline (Kogan, 1984). Similarly, Geoffrey Caston suggests that in British universities "leadership consists of effectively providing support, psychological, social and financial, for those who are teaching, learning and doing research". It is the maintenance of an environment in which these activities can be effectively carried on, and "an essential function of the university leader is therefore to coax and cajole those who command society's resources" (Caston, 1982).

It may well be that these generalizations about the nature of academic institutions, and the difficulties of reforming them through purposeful leadership within the institution, are correct in a broad comparative perspective. But there are large and important categories of institutions, particularly in the United States, where they are not true. In one of the few case studies of major academic planning in an American research university – New York University in the early 1960's – Victor Baldrige (1971) observed that: "It is fascinating to note how deliberately and consciously the University began to plan its future. The debate, fact-finding, and committee work ... went on for more than a year. During this time the university's future was being debated on one of those rare occasions when an organization really maps out its destiny. Rather than responding impulsively to the pressure of the moment, the university was attempting to plot rationally its future course after a careful study of its needs. Of course, this is just exactly what one might expect if textbook-style "rational decision-making" were really in control. However, such rationalistic schemes are rarely found in real-life organizations, and NYU's deliberate attempt to chart its future is a remarkable exception to the "muddling-through" policy by which most organizations – and universities in particular – live."

I suggest that such a "deliberate attempt" to chart the future of the university is not quite such a "remarkable exception" in American research universities, that most universities do not live by "muddling through", and that more close studies of actual cases of decision-making in research universities would

uncover more such rational organizational behavior. Here I consider just such a case in which at least in one American university, substantial changes have been made and continue to be made through "a coordinated effort of the organization" which has required institutional leadership at the top, in the office of the university's president – at Berkeley called the "chancellor." The analysis of a deviant case need not have at its intention the overthrow of the truth of the relationship to which it is deviant. But deviant case analysis can help us to specify the conditions under which the main relationship obtains, and the conditions under which it does not (Lipset, Trow and Coleman, 1956). And in so doing, it may enable us to see more clearly the mechanisms which link the elements in the broader relationship.

II Why did Berkeley make major changes in the way it organized teaching and research in the biological sciences?

The case is drawn from recent events covering roughly two decades at the University of California, Berkeley, and has to do with how that particular university responded to rapid changes in the biological sciences, a problem faced by nearly every research university in the world which tries to stay at the forefront of knowledge.

At Berkeley, it was a commonplace in 1983, though one with large consequences, that,

"The science of biology has undergone a revolution in the past twenty years which has transformed the ways in which living things are understood.... Through molecular studies the underlying similarities in the chemistry of all living organisms have been demonstrated, broadening and transforming the sciences of biochemistry into an essential discipline for understanding the functions of all organisms. A second element has been the emergence of molecular genetics, the understanding of the genetic code, and the utilization of genetic engineering to open frontiers in research and industry. Thirdly, cell biology has emerged as a major discipline revealing insights into the similarities and differences of the substructures of all cells. Finally, the development of computers and new mathematical routines has been especially useful in this area, and has critical importance for many aspects of agriculture, as well as for such applied fields as epidemiology and toxicology.

In these ways the study of living things has matured into a quantitative science with a substructure of overlapping component disciplines which no longer have the precise disciplinary lines familiar in the past." (University of California, 1983).

This enormous revolution in the biological sciences, affecting every area and sub-discipline within it, proceeded with accelerating speed, taking special impetus with the emergence of the ability to do genetic engineering – to clone and sequence genes – begun in 1973, and developing a whole variety of ramified and related discoveries since. As byproducts of these discoveries, new opportunities for applied research and development in many fields opened up. In California, new companies have been formed to take advantage of recent discoveries, and large industrial firms in the pharmaceutical, chemical, agricultural and energy areas are beginning to invest heavily in applications of biological technology (*ibid.*)).

Fundamental to the situation of all the sciences in recent decades has been the acceleration in the growth of knowledge, resulting not only from the growth in the number of working scientists but also from the impact of the computer on scientific research. In a recent interview, Professor Daniel Koshland, a prime mover of the events described in this paper, points to the increasing specialization of scientific work and the resulting proliferation of publications and journals, and warns of problems arising from this high level of specialization. One source of this acceleration, he believes, is that "you have computers which make it easier and easier to do calculations and to survey the literature. As a result the pace of modern science increases.... More and more gets published and it isn't because it is more superficial. In fact most modern articles have more data in them than the old articles did. I think this enormous increase in knowledge and the acceleration [of its production] is a problem that we are all going to have to face."³

The great research universities, at least in the United States, have been the locus of this revolution. But the revolution in biology did not just create an enormous ferment of excitement and seemingly endless flow of significant discoveries, each opening up yet another set of research possibilities. It did that, but it also generated a set of problems for mature research universities by the very success and rapidity of development of the science. By "mature" universities I mean those whose broad departmental organizations in biology, as in other fields, were already formed and in place when the revolution in biology began. In addition to the departmental organization of the science, the mature

universities also had in place a large number of research labs, facilities and equipment at the start of the biological revolution. What the rapid changes in biology after 1973 had done was to make the existing biological research facilities, and the departmental organization of biology, in many universities increasingly obsolescent, increasingly a hindrance rather than a help to the advance of the science.

Most mature research universities have experienced difficulties in responding to the rapid advance in biology, both organizationally and with respect to their research facilities. But in 1980 these problems were especially acute at Berkeley. First, the biological community at Berkeley was (and is) large, numbering some 250 ladder-rank biologists of one kind or another, not counting the many full-time researchers, post-doctoral fellows, visitors and the like who are also part of the community. This biological community does not include a medical school; what might have been our medical school was, happily for us, a free-standing campus of the University of California in San Francisco. In 1980 biology at Berkeley was organized in some nineteen or twenty different departments, ten of them in the large College of Letters and Science which encompassed most of the academic disciplines on the campus. These ten included about 120 biologists, with another hundred in the four large departments of the College of Natural Resources, and another 30 or so scattered in various professional schools, including Chemistry, Engineering, Public Health and Optometry.

The departments in which biology was done and taught at Berkeley reflected the history of the science over the past century and a half. The earliest of them centered on the different types and development of organisms as revealed by the theory of evolution. *The Origin of Species* was published eight years before the University was founded in 1868. So Berkeley had departments of Zoology (1870), Botany (1890), Bacteriology (1911). Departments in the College of Agriculture with a more applied orientation such as Entomology and Parasitology (1891), and Plant Pathology (1903), for example, were created at about the same time. The rediscovery of genetics at the turn the century was a unifying influence and left departmental residues (e.g., Genetics, 1913). Somewhat later came Biochemistry and Virology (1948), and Molecular Biology (1964). At Berkeley one saw a kind of geological layering of departments reflecting different historical perspectives on the discipline. Altogether this made for a marvelous, baroque structure that allowed for all sorts of insights and connections that might not otherwise have been made. But another result was that the field was cut departmentally in many ways that resulted in very odd combinations of research interests and activities in any one department. And the disadvantages of these arrangements became increasingly apparent, at least to some biologists, as the rapid advances in molecular genetics cut across existing departmental structures and made them increasingly irrelevant, and indeed, a hindrance to their members. Scientists with similar interests, scattered over many departments and research facilities, had trouble finding and stimulating each other. Moreover, before the reform new areas of research in biology, not formally organized into departments, were simply invisible outside the university. On a broader scale, Berkeley did not have the visibility that its distinguished faculty deserved in immunology, neurobiology, endocrinology, theoretical and applied ecology, plant cell and molecular biology, just to name some of the liveliest and most active areas in the field. As a distinguished committee of outside biologists noted at the time: "The general reputation of the biological sciences at UC Berkeley has declined over the years because of a failure to develop strong faculty groups in newer subject areas. For example, there is a substantial number of neurobiologists on the campus, many with excellent reputations, but the area has not prospered as it might because of difficulties in achieving the proper degree of interaction between faculty members and the fullest development of the graduate program." (External Review, 1981, p. 10).

Berkeley was not lacking in outstanding scientists, both young and old, in these areas, but scattered as they were throughout the different departments, they were not able to work effectively within the University, nor gain proper visibility outside it. Moreover, as this same External Review Committee noted, "Single departments have planned their recruitment of faculty members so that, over the years, each became a microcosm of biology. This has led to duplication and the physical separation of faculty members of like interests. In addition, this mode of recruitment can lead to the appointment of individuals whose interests are not highly relevant to the most urgent needs of the teaching and research programs when viewed as a whole." (External Review, 1981). Nor was there assurance that the departments, which traditionally had governed their own personnel policies, were going to reflect the new advances of biology in their new appointments; some would, and some would not.

The problem for every university, as it was two decades ago when the reforms at Berkeley began, is how to create an organizational structure and environment that supports the rapid growth of biological knowledge, that at once accommodates to the growth of specialization arising out of the growth of knowledge, and also encourages the flow of knowledge and ideas across the boundaries of the emerging specialties. This is in part an organizational problem and in part a financial/architectural problem –

organizational in that the old boundaries of departments rapidly come to be less descriptive of the actual kinds of work that its members are doing, and architectural in that the traditional location of labs and offices of scientists can be a hindrance to their informal communication across both the older and the emerging biological boundaries.

At Berkeley the problem was originally not seen that way. What was seen were the probable consequences of not adapting biology at Berkeley effectively to the new forces unleashed by the revolution in biology following the discovery of the structure of DNA and the ensuing advances both in basic knowledge and in biological engineering. The symptoms, the canary in the mine shaft so to speak, was the decline in the proportion of the ablest young biologists, both faculty and graduate students, receiving offers of appointment or admission to Berkeley but preferring to go to other leading research universities with whom Berkeley was in sharp competition for national rank and status. That failure in the competition for the most talented and promising young scientists, in turn, seemed to be the consequences of Berkeley's archaic programs of research and teaching and of its failure to build new lab facilities in the preceding decade or so.

Adequate laboratory facilities had first become a problem for the University –that is, for its leadership – in 1978 or 1979 when the then Vice Chancellor, later the Chancellor, began to hear complaints from biologists that they were having trouble attracting and retaining some of the ablest young people to whom they were offering appointments. This is indeed a serious symptom of a problem in a scientific or scholarly field, the kind of symptom that makes the patient even sicker. And on opening discussions with leading biologists, the Vice Chancellor, who was then carrying major responsibility for the academic side of the University, first learned that Berkeley's standing and reputation in some areas of biology was declining, and that the very high rankings earned by Berkeley's graduate biology departments in a national assessment in 1970 were no longer descriptive of its reputation in the community at large. There is nothing that so concentrates the mind of a senior academic administrator at Berkeley – and I dare say of their counterparts elsewhere – more than to hear that a department is slipping. And to hear that not one department but several important sub-disciplines within the biological sciences were in grave trouble and slipping fast concentrated the mind of the Vice Chancellor and his colleagues very firmly indeed. The decline was particularly precipitate in the new fields of biology where the most rapid progress had been occurring. For example, in 1970 Berkeley had ranked first in the national ratings of its two oldest biology departments, zoology and botany; by 1982 in a new set of national assessments of graduate departments, Berkeley still ranked second and third in those traditional fields. But biochemistry had fallen in that decade from second to fourth in rank, cellular and molecular biology from second to eighth; and microbiology from second place to somewhere about thirtieth – it had nearly fallen off the scale. The conservatism of success of Berkeley biologists was destroyed by those salutary shocks; they were as useful to reform as losing a war.

Even more pressing, and closely linked to the organizational issue was the character and quality of research space and facilities at Berkeley. The largest single building on the Berkeley campus devoted to biological work had been built over fifty years ago; it was wholly inadequate for modern biological research. The External Review Committee observed in 1981 that,

“UC Berkeley is notable among major institutions in the United States in housing most of its biology programs in substandard buildings. They do not meet safety regulations and it is doubtful that even a complete renovation could bring them to the appropriate standard. “It is impossible to assess the impact that the grossly substandard physical facilities have had on teaching and research programs and on the professional development of the faculty ... The future of biology at UC Berkeley depends upon the provision of proper laboratory facilitiesThe situation has been critical for years, to continue it invites disaster, physically and in terms of the health of the biological sciences as academic disciplines on the campus.” (External Review, 1981, p. 11). Some of the buildings that housed biological laboratories were so dilapidated that they harbored insects and small mammals who were not employed by the University, and who were not part of its research activities.

The inadequacy of the biological space at Berkeley was visible in the early 1960s when other universities were building or upgrading their lab facilities. But the effort then to get substantial improvement in facilities at Berkeley fell through, largely because the University at large was at that time placing higher priority on getting the newer campuses of the University built up. Moreover, a review of campus space had been made in 1956 which had established standards for the size of labs and offices, and by those standards Berkeley did not look bad in the early 1960s. Those standards themselves had come under sharp criticism in the biological community as having been short-sighted and inadequate even when drawn up. Certainly the 1956 formulas did not reflect the deterioration of the biological labs at

Berkeley which had already occurred, and the accelerated decline in their adequacy that resulted from the explosion in the biological sciences after the mid-1970s.

In a way, the poor condition of Berkeley's labs was something of an advantage in the efforts at reform and revitalization. Berkeley's lab facilities, were, with some exceptions, so clearly inadequate that their replacement or upgrading gained quick consensus from all parties – in the Systemwide Administration, where capital requests from all campuses are given priority, as well as in the state government, where part at least of the new space must be funded. And indeed, it was this concern about space that was the driving force of the developing program for the revitalization of biological research and teaching in Berkeley.

III How was the reorganization of biology at Berkeley accomplished? Initiation of Reform

Here are Professor Daniel Koshland's recollections of how the reform was initiated:⁴

Q: I'd like to ask you about the reorganization of biological sciences on the Berkeley campus. What was the origin of this massive reshuffling?

A: I think it was in 1973. Rod Park, who was dean of the College of Letters and Science at the time, was having cocktails with me and my wife at the Faculty Club. He rather casually asked, "What's the state of the biological sciences today?" I think he was expecting a routine answer. I replied: "We're in trouble." He said: "What do you mean? You've got all those good ratings." And I said: "The senior professors are staying here, but we've having a hard time attracting the young assistant professors." Our problems were twofold: we didn't have the facilities—the Life Sciences Building was getting very old and degraded. Secondly, some of our programs were anachronistic. We hadn't been on top of the newest developments—in molecular biology, for instance.⁵

In the discussions with the local biological community on campus that ensued, it became increasingly clear that an effort had to be made to provide new lab facilities if very able young faculty members were to be attracted and held. Emergency measures could be and were taken to provide special funds for upgrading lab facilities offered to new appointees, though these ad hoc arrangements made no sense in terms of the broader problems of the antiquated buildings themselves, and were enormously expensive. As part of the serious effort to get a new building, Berkeley had first to learn what its biologists were actually doing, what projects and research interests were actually being pursued by the faculty on the campus, and that information had to be linked to the adequacy of existing space. The Provost of the large College of Letters and Science – himself a former professor of botany – persuaded his counterpart in charge of the professional schools, where most of the rest of the biologists held their appointment, to jointly undertake a campus-wide inventory of the biologists on campus, organized not by their departmental affiliation, but by their areas of research interest. The results of the inventory told the University administrators for the first time what the biologists on campus were actually doing, and incidentally, identified research areas and sub-disciplines where Berkeley was weak as well as where it was strong. The inventory provided clear evidence for the need to reconsider a departmental organization of biology on campus, as well as providing the basis for the next step in what was already seen as a long-range planning process.

This inventory of faculty research interests began the planning process for biology at Berkeley. It had two qualities which characterize other planning documents in this program. First, the inventory generated new information and ideas for use in making decisions internally; but it also served to justify the next step in the planning process, a broad assessment and evaluation of the state of the biological sciences at Berkeley. Second, while it was focused on the scientific and organizational questions of how faculty research interests were distributed, and the extent to which they did or did not coincide with departmental affiliations, the same information was already seen to have relevance for the nature and design of the laboratory facilities in the proposed new biology building. So the very first planning document linked knowledge and justification, as well as the organization of biology to research facilities. Those two linkages were to mark all the succeeding planning documents.

To return to the interview with Professor Koshland,

Q: What happened next?

A: In the early 1980s, when [Professor, then Dean] Rod [Park] became Vice-Chancellor of the campus, he remembered our conversation and set up the so-called Gang of Four to examine the

biological sciences at Berkeley. It became clear that we needed two things: We needed to reorganize the intellectual program and we needed new facilities.

And this was done when Jerry Brown was governor... the state had run through its surplus and there was a deficit. We came in to [then] Chancellor Heyman and gave him three plans. The ideal plan was to tear down everything and start with new buildings; the intermediate plan – which was the one that was eventually adopted – was to renovate the LSB [Life Science Building], not completely gut it; the minimal plan was to just patch things up within existing buildings. With the minimal plan, we said, you're not only not going to recruit new young people, you're going to lose your good senior people as well.

Heyman got behind the intermediate plan. The Legislature also supported the plan, except that they demanded that Berkeley raise one-third of the money, some \$50 million. This was a tremendous hurdle; UC had never raised that kind of money on its own before. But Chancellor Heyman committed himself to raise it, and launched the Keeping the Promise campaign. It was clear that the reorganization had to have those funds and the new facilities to succeed. And it got them. (*ibid.*)

The Gang of Four were actually the chairmen of four separate committees set up by the Vice-chancellor to look into various aspects of the situation in the biological sciences. The four chairmen took to meeting together, and together decided that Berkeley needed a major reorganization in biology, and not the usual modest ad hoc reforms. Their radical recommendations led to their becoming known as the Gang of Four. They were also the driving force in the Chancellor's Advisory Council when it was established. The broader lesson here is the importance of a very small number of actors taking the initial step of defining the problem as the need for a major reform rather than minor reforms. It is important that these initiators be people of distinction in their fields so as to command respectful attention to their proposals.

In the spring of 1980, the Vice Chancellor appointed a special Internal Biological Sciences Review Committee with the charge, simply, "of evaluating the programs in the biological sciences on the Berkeley campus and analyzing the space needs of these sciences" (Internal Biology, 1981, p. 1). This committee was organized into four sub-committees, each chaired by a very distinguished Berkeley biologist, and each having six other highly respected and active research biologists on it.

The four sub-committees reflected four broad areas of biology which had emerged as a kind of natural division of scientific labor in the field – groupings, incidentally confirmed by the inventory of faculty research interests. These groupings did not correspond to existing departmental lines, but were related to characteristics of the organisms that biologists study, and thus to the kinds of laboratories and facilities that they need in their research. One sub-committee addressed itself to problems and developments in biochemistry and molecular biology; a second, to cellular biology; a third, to organismal biology, that is, to the study of whole insects, plants and animals; a fourth, to ecology and evolution, that is, to the study of populations rather than of single organisms. This division of intellectual labor thus linked the organization of the science to the provision of new research labs and facilities in the current plan.

After this internal review committee was appointed, but before it started its work in July 1980, there was a major change in the administrative leadership of the Berkeley campus. The Chancellor who had served the previous eight years retired, and was replaced by the man who had served for some six years as his vice-chancellor. The new Chancellor had been a Professor of Law and City Planning in Berkeley, but also by virtue of his long service on the Berkeley campus and as second in command during the previous administration, knew the Berkeley campus very well, and had, with his colleagues, started the planning process in biology. The new Chancellor immediately appointed as his vice-chancellor the biologist who had been serving under him as Dean of the College of Letters and Science. It was important that the new vice-chancellor knew and understood the nature of the revolution in biology, and was sympathetic with it. And indeed, as a botanist himself he was interested in the cellular structure and processes of the growth of plants, and was, in the words of a colleague, "a molecular kind of guy." This referred not to his own research but to his sympathy for the impact of the advances in molecular biology on all branches of the discipline. For a knowledgeable biologist to be the second senior administrative officer on campus, and the only administrator besides the Chancellor himself who had general authority across the whole campus, was of the greatest importance throughout these events. But of equal importance (though I do not want to minimize the significance of a genuine biologist so close to the chief campus officer), both he and the Chancellor were active administrators who tended to initiate events and

programs rather than wait for them to happen; they showed that familiar drive towards achievement that we see in leading scholars and scientists and in some administrators, rather than the equally familiar tendency to lay low and try to avoid trouble.⁶

The report of the internal Biology Review Committee, completed in August 1981, provided the major scientific underpinning for the subsequent efforts to strengthen the discipline at Berkeley. The report fulfilled certain functions:

1. First, it set forth in non-technical language an overview of the changes underway in biology at large with a statement of their implications for teaching and research, and for research facilities.
2. It reviewed the current status of the biological sciences on the Berkeley campus in detail, both organizationally and with respect to space.
3. It proposed the creation of a Chancellor's Advisory Council on Biology, a small group of outstanding Berkeley biologists, as the major instrument for reshaping and upgrading biology at Berkeley.
4. It proposed plans for the improvement of instruction in biology on campus.
5. It discussed and recommended specific areas of biology which should be given greater emphasis at Berkeley.
6. Finally, it developed a detailed assessment and recommendation of space needs across the whole range of the biological sciences, including an assessment of the adequacy and utilization of the existing laboratory space.

The Report supplied the needed "campus plan for biology" that would explain and justify to the Systemwide Administration and to the state government why Berkeley needed new buildings for biology. But it did much more.

First, the report reviewed the problems arising out of the existing departmental organization of biology at Berkeley, and considered and rejected the proposal to bring all the biological departments on campus into one College of Biology, with internal divisions and departmental membership rationalized to bring them into line with the actual inventory of research interests and activities. Instead, it recommended the creation of the Advisory Council on the Biological Sciences as the key instrument in reshaping and restrengthening biology at Berkeley. Essentially, this Council, of some seven (later nine) members, each a very distinguished biologist drawn from different sub-fields, was to exercise an authority which rested on the collective scientific standing and reputation of its members, as well as on the power it derives from the Chancellor.

The internal Biology Review Committee, besides recommending the creation of the Council, made another important recommendation which linked the organizational changes in biology at Berkeley to proposed space additions. Responding to the marked discrepancy between the formal departmental affiliations of biologists and what they actually did in their research, the committee recommended that the new buildings it was proposing should include different kinds of laboratories and research space keyed to the different kinds of organisms studied by biologists: molecules and genes, cells, whole organisms and populations. These different kinds of study require different kinds of laboratory facilities, conditions of cleanliness and environmental control, different instruments and so forth.

In the new buildings biologists would be encouraged to locate their own laboratories in the spaces appropriate to what they actually did rather than according to their departmental affiliation, and in so doing, would create what the report called "affinity groups" – temporary groups of scientists of whatever department, working on similar problems and needing similar kinds of laboratory facilities. While linked by common space needs, such "affinity groups" would also bring together people with similar or related interests, and thus respond to the criticism that research at the frontiers of biology was fragmented and invisible when done within the existing departmental organization at Berkeley.

These "affinity groups", since they would represent research interests, could be less permanent than department affiliations, and could change as the interests of individual scientists changed, or as the science itself left some sub-disciplines behind, its problem solved. Whether the existing departments should be abolished was therefore left to time to determine; the Internal Review Committee thought that a more rational administrative structure might be needed in five or ten years, or that it might appear then to be preferable to respond organizationally to rapid scientific change through these fluid and changing "affinity groups" centered around the labs.

The decision by the Internal Review Committee not to undertake a general reorganization of the departmental structure of the biological sciences at Berkeley thus has to be seen as a positive and purposeful one, rather than an evasion or oversight. The case was made that the Advisory Council, by making the present departmental boundaries irrelevant to the development of the field, would give the

campus time to allow a more appropriate organizational form to emerge out of experience; and certainly the postponement of that decision greatly reduced the political problems that would have faced the Chancellor and his colleagues if a major departmental reorganization had been attempted at the beginning of the process rather than at its end.

On the broad issue of research facilities, the Internal Review Committee came up with a set of alternative plans for the program of building and renovation for biology on the campus. The first of these plans, which was strongly recommended by the committee, involved two new buildings and a substantial renovation to the existing Life Sciences Building. Each of the two new buildings would cost about \$45 million. They would be designed for modern biological research, including what is called "high-tech" biology. In addition, there would be a substantial renovation of the existing sub-standard biology buildings for use by those branches of biology not requiring high-tech lab facilities – libraries, museums, computer facilities and the like. This renovation would cost perhaps an additional \$40 million for the biology part alone. The total package would run somewhere between \$120 and \$150 million.

The recommendations of the Internal Review Committee, both for a powerful Advisory Council to give guidance and direction to biology throughout the University, and for new and renovated space, were immediately and fully accepted by the Chancellor. That, from a comparative perspective, was perhaps the most astonishing event in the whole story. The Advisory Council to implement the plan was appointed even before the Internal Review Committee could finish its work, and immediately began to sketch search committees for new faculty members in specific sub-disciplines. A firm of architectural consultants had been appointed in parallel with the internal Review Committee and had begun to develop more detailed plans for the needed new space. Between the review committee and the architectural consultants, the plans for a new biology building had become a much larger plan for two new buildings and the major renovation of a third, over a decade. And the Chancellor took on the commitment to raise the money for that whole enterprise.⁷

It is worth stressing that the Chancellor, and only the Chancellor, had the authority to accept these recommendations in the confidence that he could implement them. He had been careful to get the informal approval of the President of the University for the building program (he did not need it for the organizational changes on campus), and he had won the support of the Vice President for Financial and Business Management (Systemwide) who had basic responsibility for presenting the capital request of the University to state government, and without whose support and advice Berkeley's efforts to get the approval of the Legislature and the Governor for the first phase of the building program would surely not be successful. But apart from the President and his staff, the Chancellor did not need the formal approval of anyone else to begin serious work on the "revitalization" of biology at Berkeley. In a formal sense (and the formal structure of authority is important here as elsewhere) he did not need the consent of the Academic Senate, nor of any group of provosts or deans or department chairmen, nor of any student organization, nor initially of any state official. In fact he did consult informally with the leadership of the Academic Senate, and formally with its Committee on Academic Planning, on such matters as the membership of the External Berkeley Review Committee, on the membership of the Advisory Council, and on other issues. Consultation with the biologists and their intellectual and administrative leaders on campus was broad and constant, and, earned him the support of most of Berkeley's biological community, its scientific leadership as represented on the powerful Advisory Council, and the relevant deans of the biological sciences.

IV The Chancellor's Advisory Council for Biology

The Council was essentially the chief mechanism of the reform for overriding departmental authority on crucial issues, especially of staffing. Before the reform the deans of biology in the two large colleges, Letters and Science and Natural Resources, which included most of the biological departments, already had that authority, but had difficulty in exercising it in a large way against the scientific authority of each department. Moreover, the authority of each dean was restricted to the departments within his own college. The Advisory Council had two special virtues: first, it could look at the problems of biology – both organizational and material – across the University as a whole. In addition, it could put the great weight of its own scientific authority behind the "advice" it gave to the deans, helping them to counter the normally decisive expertise and scientific wisdom lodged in the department. It thus could provide needed credibility and "faculty approval" for the actions of the deans in implementing their plans and recommendations. It must be stressed that those plans and recommendations emerged in the course of ongoing consultations with the deans, who continued to have an input to them.

The Council exercised its "advisory" powers in a number of ways. First, it decided where and in what fields of biology Berkeley needed new strength. Then it explored with deans (who in turn discussed with departments) where new appointments in these areas would be located. A specific department might choose not to accept an appointment in a given sub-discipline, but in that event it might have to wait for new places in biology to open up before it would get a new appointment, and even then it might have to accept the appointment in a sub-discipline chosen by the Council. Finally, the Council would recommend – essentially name – the membership of the search committees for new appointments, thus insuring that the quality of new appointments in biology would be both high, and in the newly designated areas of emphasis. Needless to say, these search committees were not drawn at random from the roster of biologists on the faculty, but from a much narrower list, perhaps a third of the total number, who are of course the biologists whom the Council members "knew" to be active and successful researchers and who were therefore likely to make the "right" choice of junior colleagues. The Council did not itself make the appointment – that would indeed be an overload on a group of very active scientists – but it did not hesitate to comment on and question when an appointment was made by a department that did not look quite right to it, either in the quality of the person, or in the nature of his sub-field.⁸

Formally, as I have noted, the Council was "advisory" to the deans and provosts, and to the Chancellor and Vice Chancellor, and met regularly with the deans of the two colleges in which most of the biological departments are located. But its "recommendations" were and are as good as decisions, and these are firmly in the service of its members' views of where the cutting edges of the biological sciences are.

On the organizational side, the Chancellor, on the recommendation of the University's leading biologists, put all the biology departments at Berkeley into a kind of receivership under the authority of the Advisory Council – a condition in which the departments no longer have the ordinary degree of control over their own recruitment of academic staff or graduate students, their course offerings, or their assignment of laboratory space and facilities to their own members. Putting all the biology departments, strong and weak alike, under the "guidance" of the Advisory Council greatly reduced the difficulties that would arise from any explicit invidious distinctions among them, while allowing the Council complete freedom in the way it exercised its "advisory" functions (i.e. authority) in relation to the various departments.

But if the departments no longer had complete or nearly complete autonomy over their own faculty and graduate student recruitment, teaching and research resources, then departmental membership became increasingly nominal.⁹ That was not accidental, but was the key to the proposed linkage of organizational structure to the nature and allocation of new research space.

The full story taking place over many years involved many different people and specific administrative/scientific actions and decisions. But one of them will illustrate especially well the pattern of implementation of the reform. The Chancellor's Advisory Council for Biology was a fundamentally different kind of organization than the then existing Biology Council, which had previously brought together the chairpersons of each of the twenty or so biology departments. Koshland was a member of that Council at the beginning of the reorganization by virtue of being chairman of the Department of Biochemistry. But in that role, as he observed, he "did not want to preside over the decline of biochemistry,"¹⁰ that is to say, he came with the normal expectations of his departmental colleagues that he would defend the turf and interests of that department in the competition for scarce resources – for additional staff appointments, labs or whatever. And the other members of that Council came with similar commitment to their own departments. That familiar pattern in academic life lies at the heart of the university's deep intellectual and organizational conservatism.

The Chancellor's Advisory Council, created at Koshland's suggestion precisely to avoid these built-in norms and constraints, specifically excluded departmental chairpersons, but was composed of nationally and internationally recognized scientists in their several specialties at Berkeley, to give the highest scientific legitimacy to their actions. At its outset, Koshland told them that they were included for their scientific expertise to act for the good of the University and not to defend their departments. This appeal to a higher and larger loyalty had powerful effects; as Koshland says in retrospect: "After hearing that, they were not the same people." Just the way they were recruited shaped their behavior. If the members had been appointed as representatives of their departments, they were morally obliged to defend their departmental interests. But the members of the Chancellor's Advisory Council had different hats (and roles) given to them on appointment which prescribed that they act in light of the larger interest of biology and of the University. Many of them, freed from the constraints of their departmental roles, wanted to behave that way, knowing that a stronger and more flexible organizational structure would redound to the benefit of all. These scientists experienced the familiar tension between short and long

term benefits – and the substitution of a Council appointed by the Chancellor, who represented the University interest, for one designed to represent more parochial departmental interests allowed the primacy of long-term and broader interests to prevail in their decisions and actions.

The strongest opposition from within the biological community at Berkeley to the new arrangements came from evolutionary biologists and ecologists, who feared that the clear molecular bias of the new seven-person Council would hinder proper development of areas of biology concerned with populations rather than biochemical processes at the level of molecule, gene and cell. Their protests were strong enough to lead the Chancellor to add two members to the Council during its first year of operation, one an evolutionary biologist, the other an ecologist. While there were still a significant number of biologists who were critical of some aspect or other of the proposed reform, there appeared to be broad satisfaction among biologists on campus with what was done, and a general sense that the overall movement was in the right direction.

V. Continuing the Momentum of Reform

It is difficult to describe very briefly the subtle and complex processes of "shared governance" in American research universities. It is true that American colleges and universities place large powers in the hands of their presidents and chancellors. But the leading research universities also have strong departments, and also often have strong academic senates. These govern with the president and his staff through a process of continuous consultation among academic and administrative leaders who see themselves in cooperative rather than adversarial roles. (Like other leading American research universities, Berkeley does not have an academic trade union to sustain an adversarial relationship.) The relative importance of the several actors differs on different issues and in different circumstances, and it would require a careful analysis of many such issues to see the interplay of tradition, policy, and personal authority as these give rise to the myriad decisions that shape the life and fabric of the great institutions.

At Berkeley, the Academic Senate includes all the 1500 regular academic members of the University. It does its work through a network of committees – on admissions, courses, academic policy and planning, research, graduate education, academic personnel, and academic freedom, among others. In some areas, for example, setting requirements for earning the several degrees, and the character and content of courses, the departments and senate committees together are almost wholly determining. In others, for example the appointment and promotion of academic staff, the initiative lies with the departments and academic committees, but senior academic administrators have clear and defined if marginal influence. In the allocation of academic positions, and budget allocations more generally, the administration is preponderant, though again, depending on circumstances, it ordinarily consults with affected departments and relevant Senate committees.

In the case of the reform of biology at Berkeley, the Senate committees played a relatively small part in the course of events. The Senate's major concern was the defense of Berkeley's high academic standards against other pressures and priorities, whether they came from the faculty or from administrators. But with respect to biology at Berkeley, the fears and motives of the leading administrators coincided almost exactly with those of the Academic Senate committees, and the two most relevant Senate committees – the Committee on Courses, and the powerful Budget (i.e., academic personnel) Committee, were glad to approve the recommendations of the equally tough Advisory Council and its related Committee on Instruction in Biology.

The Academic Senate at Berkeley, as noted above, includes the whole of the regular teaching staff, from Instructor through full Professor, and is undoubtedly the most powerful such academic senate in American higher education, with powers granted to it by the University's governing board over the curriculum, appointments, admissions and much else. And several of its committees clearly had jurisdiction over various changes being introduced by the reorganization, including the abolition of some departments, and changes in the departmental affiliation of many biological scientists. At the outset of the reorganization its leaders referred several of its proposals to the Senate committees for their rulings and approval. But they discovered, or perhaps were reminded, of how slow the Senate procedures are, and how reluctant it is to approve sweeping changes at variance with past practice. And the leadership knew that the reorganization had to maintain its momentum, could not be seen to be flagging, or even reversed at crucial points by adverse decisions of Senate committees. So they simply stopped asking the Senate for permissions, and instead adopted the practice of informing the Senate of changes already under way.

The Senate leadership, in turn, turned a blind eye on these apparent transgressions of the role of the Senate in university governance. They did so partly, I suspect, because to have objected would have put them in sharp conflict with the Chancellor and Vice-chancellor, who had given evidence of their own

strong commitment to the changes in biology. The Senate also did not interfere because it was increasingly apparent that the changes in question had the support of most of the biological community, and involved technical and scientific issues outside the competence of the Senate committees, which ordinarily include members from all over the University, with biologists a small minority.¹¹

Professor Koshland has remarked that he would have known that the senior administrators had withdrawn their support if Vice- chancellor Park had ever said to him, "We better run this by the Senate for approval." That would have been a clear signal that such a move would have spelled the end of the reorganization. But that never happened.

Having taken the scientific direction of biology at Berkeley in hand and given it immediately back to a group of elite scientists, all that remained for the Chancellor was to raise the money for the building program. This required:

- a. The approval and material support of the President of the University.
- b. Intensive work in Sacramento and throughout the state of California, marshaling support on key legislative committees, and among powerful alumni, to insure favorable action in state government for funding the first new building.¹²
- c. The strengthening of the campus Development Office, that is, the University's organization for raising funds from private sources, looking toward a broad capital fund campaign to build the second building and renovate the third.
- d.. Discussions with federal agencies and Congressional committees, looking for federal help with the second and third buildings.

All this points to the importance for university leadership of the availability of new resources from both public and private sources, and the central role of a chief campus officer in an American university in raising new money.

The dynamic between the statement of a goal and its achievement as illustrated here is revealing. The Chancellor surely could not guarantee to the biological community or to any other actors that all of the funds needed for the building program could in fact be raised. But he believed that by committing himself to a broader conception of the needs of the campus and the larger sum that would be required to achieve it, he would make it more likely that the first stage could be achieved, and that in turn would increase the likelihood of achieving successive steps in the plan. There was, at least it was hoped, an element of a "self-fulfilling prophecy" in the large statement of plans and accompanying financial goals. The plan itself, its breadth and ambition, was a statement by the University of its determination to remain a leader in the country and the world in this area of science. It told potential sources of funds – state government, federal agencies, private foundations, wealthy alumni, private corporations, and the rest – that their contributions would in fact be part of a bold and ambitious enterprise, one that would have large and visible effects on the University, on science, and on the economy of the state. Indeed, the large capital needs of the biological sciences might be part of an even larger program for the renewal of physical plants across the whole campus. In the setting of these goals, and in his judgment of the right balance between audacity and foolhardiness, the Chancellor indeed exercised significant leadership. No one but the Chancellor could set these symbolic goals, thereby reminding the University community of its own quality and distinction, and educating its funding sources about the levels of support required to maintain that distinction. But it was not enough for the Chancellor to set these symbolic, institution defining goals; the Chancellor himself had to lead the fund-raising effort by direct and personal appeals to important sources of funds, both public and private. That link between fund- raising (however backed by a strong and professional development office) and the statement of target goals was itself a way to discipline what otherwise might be empty rhetorical gestures. Where a university president (or chancellor) is strong, symbolic leadership is tied very closely to practical administrative activity, and the two necessarily discipline and reinforce one another in the person of the chancellor.

But while the chancellor of a campus of the University of California is very strong and has many powers, still with respect to the important dimension of capital growth, the campus depended on the support of the President of the University of California system. In California, it is the President and his Office that has responsibility for managing the relations between the University, its nine campuses, and the government of the State. In this case, by the rule and custom of the University, Berkeley's Chancellor could not deal directly with the Governor and Legislature in Sacramento, but required the help and intervention of the President. David Gardner, newly appointed to the Presidency of the University in 1983, was in the process of negotiating substantial increases in the annual support by the State for capital investment in the University. On hearing of Berkeley's plans, which originally were to try to raise the whole

of the needed sum for new buildings by its own efforts from the private sector, President Gardner persuaded the Chancellor that it was important that the State shoulder its portion of the burden; otherwise the State might learn, inappropriately, that the University could fund all its capital needs from private sources. The President then placed Berkeley's needs for new biology buildings at the top of the University's priority list for capital investment annually presented to state government. These and other actions by the President and his senior officers resulted in the State accepting its responsibility for funding two-thirds of the capital requirement, raised through a bond issue passed by the electorate at the next election.

In addition to raising money the Chancellor oversaw a complex planning process requiring the development of numerous and lengthy reports. Public life in California is characterized by highly professional bureaucracies; this is true both of the University's own large Systemwide administration and the various agencies of state government. And both University and state government agencies require very detailed professional planning documents that show where a campus wants to go and how it means to get there. The inventory of biological research at Berkeley began that process; the internal and external reviews extended it, and it continued, in such documents as:

1. Facilities Planning for the Biosciences (1981);
2. The Berkeley Campus Space Plan (1981);
3. Site Studies: Life Sciences Addition (1982);
4. The University of California Capital Improvement Program (1982).

These planning documents, needless to say, were costly to prepare. The earliest studies cost about \$300,000 and were funded by the University itself from its own discretionary funds. But in 1982 the state committed a half million dollars for further study, thereby also committing itself, at least implicitly, to larger expenditures down the line. The next step was to gain another \$1 million of state funds for preliminary architectural plans and sketches. As I have said, the direction and management of this planning process was squarely in the hands of the Chancellor and his staff, and it was he who provided the links between fund-raising and physical planning on the one hand, and the continued involvement of the biological community and their research needs, on the other.

VI What Happened to Biology at Berkeley

Profound and fundamental reforms in the organization of the biological and related sciences at Berkeley continued and were consolidated in the score of years following. Looking back, observers would judge that reform on the whole a success, as judged by these criteria:

1. The reform has gained broad acceptance among the hundreds of academic biologists on the Berkeley campus.
2. It has achieved marked improvement in the rankings and international reputations of many of the biology departments at Berkeley that had formerly slipped.
3. Berkeley's biology departments have shown marked success in attracting the best young scientists to whom they offer appointment, and in retaining the most distinguished biologists against the competitive offers of other leading research universities such as Harvard.
4. The reorganization of biology at Berkeley has evoked widespread interest in other leading research universities, and triggered efforts by many of them to copy Berkeley's reform, among them the Universities of Illinois, Wisconsin and Texas, and the California Institute of Technology.

Beyond the broad pattern of success, details of the reorganization of the structure of the biology departments are worth summarizing. The roughly 20 distinct departments in the biological sciences in place before the reorganization have been combined into four large departmental groupings. The largest, the Department of Molecular and Cell Biology, including some 80 active biologists not counting Adjunct professors, is located administratively in the College of Letters and Science, and is itself organized into five "Divisions," Biochemistry and Molecular Biology, Cell and Developmental Biology, Genetics, Immunology and Neurobiology.

Another big department, Integrative Biology, comprising some 40 scientists, is also located administratively within the College of Letters and Science. This Department includes a wide range of specialties which tend to center on whole organisms and populations, and includes such groups as ecology, evolutionary biology and paleontology.

A third department of biologists, the Department of Plant and Microbial Biology, including some 30 scientists, is housed in Berkeley's College of Natural Resources. It includes a large number of specialties – organized as Programs and Groups – that straddle basic and applied science.

A fourth big department, also located in the College of Natural Resources, is Environmental Science, Policy and Management (ESPM). This department brings together bench scientists with people whose central interests are in the economics and management of biological resources, such as the management of forests and of agricultural pests. Scientists who study insect vectors of plant pathogens and aquatic entomology share this department with students of mathematical ecology and forest economics, to name only a few of the enormously varied and esoteric specialties of the over 60 active members of this Department in 1999.¹³

This by no means exhausts the inventory of biology organizations on the Berkeley campus. A significant additional number of biologists work within a Graduate School of Public Health and a School of Optometry at Berkeley, bringing the total currently to about 250 biologists of all kinds. And this is without a medical school. By the accident of history the local medical school developed independently across the Bay in San Francisco, and has grown into a major school for the health sciences and become UC San Francisco, one of the nine campuses that comprise the University of California.

While there are variations among them, each of the Departments and Graduate Schools at Berkeley organizes its undergraduate teaching (if any), its programs for graduate students, and its own research activities somewhat differently. A point to stress is that departments take broad responsibility for undergraduate teaching, while somewhat more specialized groups and divisions take responsibility for graduate programs. These arrangements have a measure of structure and stability that students need. But the organization of research is more fluid, and cuts across these administrative lines keyed to teaching responsibilities.

The varied demands of administrative convenience, the organization of teaching and the different requirements of research make for a bewildering combination of units, some formal and some informal, the latter likely to be of greatest importance to the actual business of creating knowledge. It is important to stress that the reorganization was not an effort to standardize the biological disciplines in the University, to tidy up arrangements and make them administratively neater and more consistent. It was an effort to make the organization more coherent, more logical and also more flexible. What is clear is that the formal structures have been subordinated to the end of making it easier for scientists to do their work, to find other scientists with relevant ideas, and to be near the facilities they need for their work. As a result, after the reforms it was noticeable that advanced seminars in one Division were more likely to be attended by people from other Divisions and Departments than before the reorganization, as scientific information began to travel along different paths around the University.

One result of this readiness to subordinate plans and structures to the development of the science is that the "affinity groups" mentioned earlier did not survive in a formal way. But the current rough groupings by propinquity in different buildings bring together people with similar and overlapping scientific interests in an even more flexible way than the "affinity groups" in that they do not create yet another set of institutionalized boundaries around scientists who are constantly discovering relevant ideas and information across sub-disciplinary boundaries. It is interesting that the "affinity group" idea, for all its plausibility, was allowed to die as a formal part of the changes in light of the actual sentiments and behaviors of the scientists themselves.

Biology of various kinds is currently done in a large number of buildings on the Berkeley campus. The specific upgrading associated with the reorganization took the form of two new buildings and the total redesign and interior rebuilding of the oldest biology building on campus. These new buildings were designed for the needs of the new biologies, and to some extent the early ideas of physical groupings still can be seen in their use. For example, the redesigned building, Life Science Building, still brings together scientists who study whole organisms and populations, and such fields as community and population biology, population genetics, evolutionary biology/paleontology, wildlife biology and physical anthropology. Most of the buildings housing biologists also house research museums; this latter building also houses a Museum of Paleontology, a Museum of Vertebrate Zoology, and an Herbarium.

The other new buildings can no longer be sharply defined by the scientific interests of their occupants, except that the people in one tend to study plant life, and those in the other animal life in its various forms. Moreover, biology at Berkeley is currently housed in some seven different buildings on the

campus, most of them unaffected physically by the reorganization. But the variety of scientific interests, and the rapidity with which those interests change and evolve, defy all efforts to give permanent institutional form to the subdisciplines or link them stably with specific buildings and facilities.

Today, departments and divisions provide the administrative and teaching organization for biology at Berkeley, fulfilling needs which cut across the highly specialized and changing patterns of scientific inquiry and research. Essentially the reorganization has blurred but not erased the lines between subdisciplines. The departments are still responsible for all teaching done by their members. Under the reorganization administrative arrangements were designed to be comfortable – every scientist was allowed to join the department and division of his or her own choice. But the organization of teaching does not necessarily follow closely the research specialties of the scientists. This is especially the case of the basic introductory courses, which always comprise the bulk of instruction in American universities where undergraduates are not allowed to specialize until the third year, and are required to take studies in all the major branches of the arts and sciences before graduation. That alone creates a major responsibility for a volume of teaching of introductory courses in biology in which almost all biologists in the University, including the most senior full professors, take part.

VII Sticks and Carrots: Power, Persuasion and New Facilities

The story I have been telling describes a program for organizational change and reform that has been systematically developed; it is not adequately described by "garbage can" models of decision-making in an "organized anarchy" marked by "problematic goals, unclear technology, and fluid participation". On the contrary, it has been purposeful, coherent, and rational: the actors and elements of the program have been linked to one another in the service of the purposes of the whole enterprise. It has reflected the strong leadership of a chancellor and vice-chancellor who together identified a major problem facing the University, and then took sequential and coordinated actions aimed at meeting and solving the problem. Moreover this was not a trivial problem, but involved a large number of people, both on and off campus, extending over a decade and involving the expenditure of many millions of dollars. It has had the most profound consequences for teaching and research on the Berkeley campus, and for the University's contribution to science and industry more generally. Nor is this an isolated illustration of University leadership. It could be matched by the actions of the presidents of most of the leading research universities.

I have tried to say something about why I believe that Berkeley and big American research universities more generally are not adequately described by theories of university leadership which stress the impotence of institutional leaders, their largely illusory and symbolic role, and the somewhat random, non-purposeful character of their responses to the problems that they face. If we look at this question somewhat differently, we might ask why the writing on leadership in higher education generally is so gloomy about the prospects of university leaders achieving very much under modern conditions. I would venture three reasons, without having any good sense of their relative importance.

First, much of the analysis of leadership and change in higher education by American and European scholars is focused on the reforms introduced by Western European governments into the organization of their national systems of higher education since World War II. These have been for the most part "global efforts", centrally initiated and applying to a whole set of institutions. And they have on the whole achieved rather less than was intended, for reasons which I think the studies of Cerych (1984) and others have made clear. That experience, and the well-documented studies of those reform efforts have helped to give a gloomy cast to the discussions of leadership in higher education generally.

Second, in the United States students of leadership have looked at American college and university presidents across a wide range of institutions, and have been more impressed with the constraints on them than with their discretion or resources for accomplishing very much.

It is true that in most American colleges and universities there is not a consensus around the values of competitive excellence, nor the discretionary resources of development programs in the service of those values. Instead, many interests, both on and off campus – departments and disciplines, faculty unions, student groups, trustees, intrusive legislative committees and state bureaucracies, political forces, etc. – push and pull the college presidents in ways that make difficult their initiation of sustained purposeful programs of any kind. The leading research universities, both public and private, remain an important exception of this generalization.

Third, I suspect that observers have been looking at the president's role as if it were a cross-section of a thick cable, made up of many differently colored strands or wires, each strand representing another program or activity, and all together in cross-section representing a heterogeneous collection of

issues, solutions and problems, showing little coherence or purpose, as described in March's "garbage can" model of decision-making. But in the research university, I think this model is misleading. For if we cut this rope vertically along the dimension of time, we see that each strand extends backwards and forwards, moving along in its own coherent, purposeful, even rational way, each marked by its own set of actors and purposes which are largely insulated from other strands, even as they intertwine. So what appears as a random or haphazard set of problems, programs, evasions and solutions in cross-section when viewed at a given moment, looks more like a set of purposeful programs, each being pursued in relative isolation within the boundaries of the same institution, when viewed along the dimension of time. And the variety of these purposeful programs, in values and participants, will be greater the more comprehensive and varied the role of the university in society at large.

It is the multiplicity of these activities, governed by different norms and purposes, and pursued in different ways, that defines the comprehensive university. And it is of some interest to consider how these activities, apparently governed by different and even incompatible values, can be pursued so intensively on the same campus, under the general authority of the same president or chancellor. The key, I think, lies in the forms of institutional insulation of activities governed by different values, and the ways in which they are brought together in the office of the president. For example, on the Berkeley campus itself, at the same time as this reform of biology was developing, a series of other initiatives and actions were being taken by the same Chancellor which could also have illustrated the nature of leadership in a modern research university. For example, alongside this program for revitalization of biology, the Chancellor initiated a change in the academic calendar from a quarter system to a semester system, requiring a review of every course and program on campus. At the same time, the Chancellor ended a long-standing separation of student services and the academic program at Berkeley, and brought together those heretofore separated functions and activities under a single academic vice chancellor. One major activity of this new office was a set of "outreach programs" to secondary schools in the San Francisco Bay Area, particularly those which enrolled large proportions of minority students. This effort was designed to increase the number of qualified minority students who came to Berkeley by strengthening their secondary school education and their preparation for higher education. At the same time, the campus was conducting a critical review of its School of Education in which the Chancellor took a leading role.

I mention these activities because they all came together in the Office of the Chancellor, although they were carried on quite separately and in some ways were highly insulated from one another. I doubt if any of the distinguished biologists involved in the renewal of their discipline at Berkeley knew very much about the outreach programs to the Bay Area inner city high schools. There were of course some overlaps, but on the whole the constituencies for these activities were quite different.

The biology revitalization program, the outreach programs to minority high schools, and a variety of other initiatives too complex to summarize here are insulated from one another within the University – they do not involve the same people or compete for the same resources – they are linked in the larger environment and therefore in the Chancellor's office. These various strands, serving different ends and values, may be not competitive, but supportive, closely intertwined as they move along the dimension of time. My point here is that it is the task of university leadership to tend various strands of university policy and to weave them together. I need hardly say that it is more difficult to do that if those activities are competing for the same resources.

Let me return to the issue I raised at the outset. Does the analysis of this deviant case, deviant at least from the broad proposition of the powerlessness of university leadership, allow us to specify a little more closely the conditions under which institutional leadership can be exercised effectively? Let me suggest two such conditions:

First, changes which a university president or chancellor initiates and coordinates are more likely to be achieved if they reflect shared values within the academic community. In the present case, we have seen a broadly shared and intense commitment among administrators and academic staff alike to the value of competitive excellence, to scientific achievement, and to the national and international standing that such achievement gains for individual scientists, departments, and the university as a whole.

Currently, two broad sets of values underpin institutional change in leading research universities, in Europe and the US. (Other values, notably "efficiency" and "market-responsiveness" are pressed on the universities by governments). One of these is academic "excellence", in research universities usually equated with recognized scientific or scholarly achievement. The other is "equity", the movement toward increased equality of access and educational achievement among previously disadvantaged social and ethnic groups in the population. Where these values are seen to be at odds, as is very often the case, the resulting lack of consensus in the academic community partly accounts for the weakness and indecisiveness of implementation of "top-down" reforms, and the resulting widely recognized failure of so

many modern efforts to achieve intended changes and reforms in Western systems of higher education (Cerych, *ibid.*). Many of the post-war efforts at reform initiated by governments, both in Europe and in the United States, have had equity as a major driving force or value, so many that we have come to assume that all reforms initiated or fostered by top leadership must embody equity values, and will most likely fail in the face of strong guild resistance and commitments to the maintenance of academic standards. But in the case of biology at Berkeley there was no reference by any actor to "equity" as a relevant issue at all; all the actors, including government agencies and politicians, were single-mindedly committed to reversing the decline in the quality and standing of the biological sciences at Berkeley and moving on toward greater strength. And the arguments among the actors have been arguments not over ends but over means: for example, should we radically modify the departmental structure immediately, or create new laboratory space and "affinity groups" in new buildings, while postponing decisions about departmental organization? That kind of argument, and the compromises that it entails, involving certain immediate benefits to all actors while postponing other controversial issues, is a familiar organizational response to conflict over means, a response that is not so effective for reconciling fundamental conflicts over the ends of policy and the purposes of institutions.

The second condition for successful university leadership that emerges from this story is that leaders must have some discretion in order to be effective: they must have the authority to make decisions, and the resources to implement them. By authority I mean that the president or chancellor must have the legal power to take important decisions, and that his exercise of those powers will ordinarily be accepted as legitimate by relevant audiences inside and outside the university, and particularly by the academic staff.

The Chancellor at Berkeley, like his counterparts at other American research universities, but unlike most university presidents, rectors and vice-chancellors elsewhere, has large formal powers, both over budgets and appointments. He appoints not only the vice-chancellors and their administrative staffs, but also the senior academic administrators – the provosts and deans. They, in turn, through authority delegated to them by the Chancellor, appoint department chairmen and the academic review and promotion committees. As we have seen in the case of biology, the Chancellor can intervene (in this case through his Advisory Council on Biology) to take the power to appoint search committees out of a department and place it in the hands of a committee advisory to him.

The Chancellor also has great power over budgetary allocations on his campus, at least at the margins. A large part of the budget, of course, is committed to the salaries of tenured faculty, and to the support of existing programs and facilities, and he has limited discretion in those areas in the short run, though much over time. But in the large and costly areas of support services which do not involve tenured faculty, the Chancellor has broad discretion in appointing staff members and allocating funds and space.

Now it is true that when departments are functioning "normally" – and at Berkeley, as in other leading research universities, that means competing successfully for academic honors, research support and distinguished faculty – they have considerable autonomy in the management of their own affairs. The stronger a department is, the more autonomy it has in making its own appointments, determining the size and character of its own programs, and in naming its own chairmen. All of this is consistent with Burton Clark's proper stress on the "bottom-heaviness" of universities, rooted in the power of the operating units, which in turn flows from their command of a body of esoteric knowledge and the means of teaching and extending it (Clark, 1983b, p. 17). Ordinarily, Berkeley, like research universities everywhere, is governed through a process of continuous consultation among all the concerned and competent actors, with the issue of formal power and authority only one, and often not always even a major, element in the outcomes, i.e., in the decisions made and policies pursued. It is a mark of a weak or a second-rate university when its president intervenes often into the details of the routine operation of the departments.

But when things go wrong in a department – i.e., when there is evidence that its scholarly qualities and national reputation are beginning to slip – another mark of a strong university is the readiness of its president to intervene firmly to put things right. He can do this in various ways, depending on the importance of the unit and the gravity of the problem. If the unit is small or the problem not especially pressing, the remedy may be nothing more than the appointment (through a dean) of a new strong chairman from within the department or from within the same discipline in another university, who understands what needs to be done. But where the unit is large and important, and the decline in quality is sharp, both conditions met by biology at Berkeley, the Chancellor may exercise his power to take the department(s) into "receivership". This concept, borrowed from bankruptcy law, implies that the direction of a firm (or of a university department or group of departments) is taken out of the hands of its own

management, and given over to others who are empowered to take such actions as are necessary to make the unit successful again, or to preside over its dissolution.

This power to put a department or a discipline into receivership is held by all American university presidents, and is not uncommonly used. In Berkeley, during the late 1970s and early 1980s, five schools or departments in addition to the biological sciences were taken into receivership. The reasons for a department becoming a problem for central administration and the object of special attention leading to its being taken into receivership, are varied. The department may have allowed the quality of its staff and their teaching and research to slip; it may have become highly factionalized for personal or academic or political reasons so that it cannot make decisions or govern itself, or it may be pursuing a direction of development in its intellectual commitments to teaching and research which are at odds with what central administrators or disciplinary leaders see as desirable for the standing and reputation of the university or its ability to attract able students, or serve the larger society. But something in such departments has "gone wrong", something which the department or group of departments cannot or will not remedy by themselves.

Academic receivership can take several forms. In some cases it involves the direct intervention and control by a senior university administrator – or dean or a provost. In others it takes the form of the appointment of a new chairman from another discipline within the university, or from another discipline outside the university, with instructions to deal with the perceived problems. In still other cases an individual or group from within the troubled department may be appointed with special power and instructions to make changes in the direction or operation of the unit.

Central administrators in American colleges and universities ordinarily take an interest in the academic standards (and standing) of a department by playing a role in the appointment of new faculty members, and in the tenuring and promotion of existing staff. But ordinarily they do not intervene in shaping the direction of the intellectual life of a "normal" department. A department or school in a leading college or research university ordinarily determines its own intellectual direction as reflected in the distribution of fields and sub-disciplines represented in its staff and the emphasis given to different areas of research. But a department is taken into receivership by the central administration in order to affect the direction of development and academic balance of that department or area; it may or may not also be concerned about the quality of appointments or promotions. In the case of biology at Berkeley, the general quality of the scientists on the faculty was high, and in many departments it was superlative. What was at issue was the broad direction of development of the biological sciences in the university, a direction that could not be planned or determined by any one department. The shaping of the direction of development of the science in the university was accomplished by giving powers, especially over the allocation of resources among sub-disciplines, to a small group of distinguished biologists charged with effecting agreed-upon changes of emphasis, and the coordination of the several units of the discipline in the university.¹⁴

The power of university presidents (in UC called chancellors) to put a department or a discipline into receivership, whether or not it is used, substantially affects the balance of power between departments and the central administration of the university. While it appears to be a major invasion of departmental autonomy – an autonomy rooted in "the extreme division of labor" leading "to a pronounced fragmentation of authority" (Premfors, 1984) – I think it can be shown that the exercising of this presidential power ordinarily engenders little opposition on the part of the academic staff outside the affected department(s). And this is for two reasons: first, the autonomy of the departments and schools insulates them from the action of central administration on any one of the others; its effects are not felt (and often are not even known) outside the affected department. Secondly, it is an "unusual" action taken against the department where things are not going well; and the action is taken in the name of academic excellence and the reputation of the university as a whole, values which gain widespread support in research universities.¹⁵

It should be emphasized that the president's power to put one or more departments into receivership rests on an appeal to values shared throughout the institution. The Chancellor at Berkeley had the power and authority to put the development of biology there into the hands of a small group of elite scientists in order to raise the quality of research and teaching in the discipline. He would have had a great deal more trouble with the academic staff and other constituencies if he had tried to weaken or abolish departmental or Academic Senate prerogatives in order to lower standards – for example, in the service of greater access by less well-qualified students. So the authority exercised by a chief campus officer is attached as much to the intent and purposes of an act as it is to the substance of the act itself.

The Chancellor at Berkeley also had to have discretionary resources, both money and staff, to carry out his plan. And finally, he had to have a supportive political environment which shared with the University and its leadership a common conception of what the University is there for, what its role in the larger society is.

In 1999, the Advisory Council is still functioning much as it did when it was created nearly seventeen years ago on Daniel Koshland's initiative, clearly a permanent addition to the decision-making scene at Berkeley. When new appointments in biology are to be made at Berkeley, either by addition or replacement, the Council makes the crucial decision about what scientific specialty should be reflected in that appointment, and in what department the appointment should be made on campus. The appointment in that specialty is then offered by the Council to one or another of the biology departments, which has the option of refusing it, in which case it is offered to another department. As formerly, it is rarely refused. The Council also suggests the names of the biologists who might be appointed to the search committee, which tend to be accepted by the department; the department itself can also nominate people for the search committee. The Dean of Biology has the ultimate authority to name the search committees for the new appointment, but deans have learned over time that the distinguished members on the Council have done most of the work that formerly fell on a dean's shoulders, have consulted all the right people, and have made the most appropriate recommendations. So the deans are likely to accept the suggested nominations for the search committees. If the Council in effect names the specialty to be filled and also the members of the committee which is to search for a scientist who works in that area, the quality, not only of that appointment but of the balance and future of the biological sciences at Berkeley, is likely to be assured.

The Advisory Council is a central instrument for the maintenance of quality in the biological sciences through its attention to new appointments. But the reorganization also attended to the issue of the granting of life-time tenure that accompanies the promotion of Assistant Professors to the rank of Associate Professor. Currently, an Assistant Professor in biology at Berkeley will be nominated for promotion by his or her Division, but the nomination will be voted on by a whole Department, in light of a recommendation on the candidacy coming from a special committee of the Department composed chiefly of qualified scientists outside the candidate's own Division. That avoids the dominance of the parochial interests of the subdisciplines organized in the Divisions. All of that, like the intervention of the Chancellor's Advisory Committee in relation to new appointments, is designed to avoid the dangers of the complacency (and consequent mediocrity) always threatening a group of able people strongly identified with one another and with their common fields of interests, in this case their scientific specialties.

In an recent interview Professor Koshland (1998) has reflected on the reform:

Q: Has such a reorganization on a major research campus ever been done on such a scale?

A: I don't think there's ever, anywhere, been a reorganization of this magnitude—200 biology professors! It's hard enough to change a department! But we had two things going for us, a carrot and a stick. The carrot was the new facilities; the stick was that we needed to really change ourselves. People hate to change. Some of the faculty, some of my friends, denounced me. "This is absolutely the most stupid, the most terrible thing you've ever done." And I'm sure there are some who still say it was a bad idea.

So [initially] there was a big fuss over the reorganization. But we had the clear support of over 80 percent of the faculty for everything we proposed. The 20 percent who vociferously denounced us also shifted because we modified our plans – some of their complaints were legitimate. The great thing about [Vice- Chancellor] Rod Park and [Chancellor] Mike Heyman was that with 20 percent of their faculty screaming "This is awful!," most administrators would have given up. But they didn't. One of the things I most enjoyed about this whole project was how the faculty pitched in; they spent a lot of time on this. At any one time, 85 different faculty members were working hard on the plan. A lot of people think that professors just give lectures and do their research and never get involved in projects like this. They do, and they did.

An important element in the success of the efforts at reorganization was the informal political process that brought the bulk of the various biology departments and their members around to supporting the reform, or at least to accepting it. It was a combination of iron will on the part of the Chancellor and Vice- chancellor/Provost,¹⁶ the central role of Professor Koshland and a few others of the highest scientific standing, and the political skills involved in their talking and listening to every biologist who had something to say about the proposals, hearing their concerns and fine-tuning the plan in response, visibly receptive to new ideas, doing everything possible except dropping the reform. It was made clear, not least

by the Provost and Chancellor, that such would not happen, and their dogged persistence in moving ahead was evidence of the power of academic leadership.

While the power was there at the top and exercised, it only succeeded because of a combination of scientific authority embodied in Koshland and his colleagues together with their genuine willingness to listen and persuade. Their effectiveness at persuasion was based in part on their political skills, but even more on their moral authority; the reform was clearly not simply a matter of their defense of turf or personal advantage – they were scientists of distinction beyond needing to worry about that.¹⁷ Moreover their power as very high status scientists was reinforced by the reports of the equally top ranked scientists brought in from other universities at the very beginning to make a broad assessment of the situation. So the ordinary biologists at Berkeley came to see that most of the leading biologists were in favor of the reorganization on purely scientific grounds, and gradually came to believe that the proposals would strengthen the field at Berkeley, raise its national standing, its competitive power to recruit and hold the best scientists, and the ability of its members to write successful proposals for research support from federal agencies and private industry.¹⁸ The role of the scientific distinction and reputation of the leadership of the reform cannot be overestimated. It could not have been led even by the senior administrators in biology – the deans and provost – though their support for its implementation was vital.

Those scientists who held strong reservations when the reorganization plan was first mooted did not distrust Koshland and his colleagues, but worried about how the reform would affect them and their departments, especially if their departments were still of high standing in the country and did not seem to need much improvement. To those members of the best biological departments at Berkeley the argument was made that while their older scientists were still earning high standing for their departments in national assessments, the best new young scientists were not coming to Berkeley. For members of weaker departments it was possible to reassure almost all about the security of their own tenure and situations, plus making the promise of better facilities, new labs and buildings – badly needed new facilities which would be forthcoming if and only if the reform were accepted by the Berkeley biologists. Otherwise, it was made clear, the State of California which provides a significant portion of the capital growth funds for UC would not put up money for the new facilities. In the event, the State's provision was not sufficient; additional funds came from a state-wide bond issue and from private contributions.

I doubt that State government budget officers knew what was happening scientifically, but they heard and liked the idea of a reform that they were told would improve the quality of those big departments at Berkeley. And they probably had been coached by the Chancellor to withhold money for new buildings unless the biologists on campus went along with the reform. So it was a combination of carrots and sticks, tough determined leadership together with the political process informally taking place within the biological community at Berkeley, plus the conditional promise of new buildings and facilities, that led to the implementation of this major reorganization of biology at Berkeley.

VIII What were the central factors making for the success of the reorganization?

In retrospect, these might be summarized as follows:

*. Some of the leading biologists at Berkeley in the late 1970s and early 1980s were sensitive to indicators that the development of the science at Berkeley was not satisfactory in all respects and in all areas of the subject. There was a readiness among them to attend to the falling status of some departments in some national assessments, and the inability of some departments to recruit a satisfactory proportion of the ablest young biologists to fill openings. This sensitivity to indicators of decline, and a self-critical stance on the part of some of the most distinguished members of the faculty, were crucial.

*. Indispensable to success was the immediate, firm and continuing support of a leading dean of biology who was a respected biologist and who shortly was appointed Provost of the University. This Provost, the second senior administrator in the University, with special responsibility for the academic quality of the whole University, had the full confidence and support of the newly appointed Chancellor who had appointed him, and who threw his very considerable power and authority behind whatever plans the leaders of the biological community developed. These top administrators in American research universities ordinarily have far more power and discretion than their counterparts in most other countries and universities; they hold their posts without limit of tenure, are appointed by the President of the University with the approval of a lay Board of Regents, and do not have to anticipate returning to a chair after a short term of office.

* The early confirmation, by an outside committee of nationally recognized scientists, of the critical assessment of Berkeley biology by Berkeley's own scientists helped to give them credibility, both among scientists and administrators.

* The appointment of the very powerful nine person Chancellor's Advisory Committee for Biology which was given powers, overriding existing procedures, to decide on how to allocate biology positions to needed specialties, and to appoint (technically, to advise on) the search committees for these new appointments in biology, was perhaps the single most important administrative action behind the reorganization.

* The leaders of the reorganization were able to make a commitment that all biologists then on the faculty would find departmental homes under the new arrangements. Moreover, almost all were allowed to choose their new divisional and departmental affiliations, as well as the location of their offices and labs in the new or upgraded buildings. This naturally eased anxieties.

* The process of fine-tuning the reorganization and winning the support or acquiescence of the scientific community took several years, and had the determined support of the Provost academically and the Chancellor in respect of the resources involved in the reorganization. That eventually came to some \$150 million, roughly two-thirds from state sources and a third from the University's own resources and private gifts. Raising those funds, especially the portion from private sources, involved a major effort by the Chancellor, since the University had till then not raised private funds of that magnitude.¹⁹ The ability of the Chancellor to promise a major upgrading of the building and other infrastructure for biology on condition that the scientists affected would accept the reorganization was the carrot that won over many who were uneasy about the effects of the reorganization.

* The transformation of biological science, and the research interests of the new young biologists of various kinds joining the University, all seemed to confirm the wisdom of the reorganization, as did the intense interest in Berkeley's experience that developed among other leading research universities, such as Cal Tech.

In summary, the main changes in the biological sciences at Berkeley now as compared with conditions pre-reorganization, 1979- 1999, are these:

1. There have been major changes in the departmental structure of the biological sciences at Berkeley, reducing their numbers, loosening their boundaries and making them more permeable to new ideas and to change.

2. There have been fundamental changes in how the members of the biological community at Berkeley are appointed and promoted. The reorganization increased the emphasis on scientific merit as over departmental loyalty, and has succeeded in keeping Berkeley quality in biology high in the face of rapid change and fierce competition for top scientists from other universities and industry.

3. There have been very substantial improvements in the facilities for doing biological science at Berkeley. Some improvement of facilities was likely to have been made in any event, but the magnitude of the upgrading was certainly affected by the reorganization.

4. The slide in the national standings of some of the biological departments at Berkeley was arrested and reversed. Berkeley now has very high standings in these national assessments that are surely a function of the reorganization and its related changes.

5. The reorganization has encouraged and enabled biologists at Berkeley to work with people of similar interests, who are now more likely to be located in the same buildings, using similar or common facilities and instruments. Even if they are not in the same divisions or even in the same big departments, they can work across departmental lines more easily.

6. There have been large and continuing investments by the University in both infrastructure and in recruiting and retaining the best biologists. This has increased the chances of having proposals funded by outside – often federal – agencies.

7. By now there is nearly complete acceptance of the reorganization, even by those who initially were skeptical or opposed it. We find generally high morale among biology communities at Berkeley, in part because of the rapid developments in the science everywhere, and in part out of a belief that the

University is going to support Berkeley scientists in the national and international competition for people and resources.

IX What implications does the reorganization of biology at Berkeley have for other universities, elsewhere in the United States and in Europe?

Much of what comprised the reform of biology at Berkeley was visible to any interested participant or onlooker. They were structures, people and decisions at Berkeley that came together around this reform process over a decade and a half. But less visible were a set of fundamental values that no one would mention because all the participants simply assumed them. In looking at Berkeley through a comparative prism, these underlying values and assumptions distinguish American universities from their counterparts overseas, and most particularly in Europe. One is the intense institutional competition for people, resources and above all, for prestige and academic status, and the related climate within the university of the striving for competitive excellence. Third is the high level of institutional autonomy, mentioned at a number of places above, which allows institutions, departments and scholars/scientists to actively compete with one another. Fourth is the high degree of academic mobility at every rank, which allows institutions to compete for scientists at other universities, and which motivates universities to improve their competitive position to be able to attract and retain leading scientists, both new and established. And fifth is the climate within the research university which determines that the appointment and promotion of academic staff is almost wholly determined by the individual's research achievement (or promise, for younger scientists). European institutions share with American counterparts some but not all of these basic attitudes and values, which in American research universities comprise a normative system of mutually reinforcing elements, so strong and pervasive as to be outside the notice of almost all the participants.

The reform of biology at Berkeley cannot be understood without reference to the strong force of institutional competition for students and scholars, for resources, and for prestige. The modest decline in the standing of some of the biological sciences at Berkeley in the late 70s was enough to create a level of anxiety that fueled the radical efforts described in this paper taken over the next decade to reverse that decline. Where that spirit of competitiveness between institutions is weak or absent, a university lacks the institution-wide motivation to initiate or accept the radical reforms necessary to reverse it. European governments on the whole have tried to reduce inequalities among their universities by discouraging a level of competitiveness among them which might increase those inequalities, especially by putting additional resources into the weaker institutions to bring them up to the level of the leading institutions, and by putting restrictions on academic mobility and the awarding of differential academic salaries. However successful those efforts – and of course substantial differences in academic distinction among European universities remain – that policy necessarily damps down the competitive spirit which animates so much of the actual life of American universities.

The changes at Berkeley required an extraordinary degree of institutional autonomy, a degree of autonomy which allowed the basic organizational and academic decisions to remain largely in the hands of the scientists and administrators at Berkeley. Academic decisions were taken wholly within the Berkeley campus, while the key financial decisions were made cooperatively by the President of the University of California, Berkeley administrators, State government officers, both executive and legislative, and private donors. There was little or no reference throughout this story to agencies of the federal government. By contrast, on the whole and with exceptions, most European universities have for many years been accustomed to major academic decisions being made, or at least approved, in a central ministry or its equivalent, and have not been able to take the large organizational and academic initiatives on their own that academic and administrative leaders did at Berkeley. This autonomy allows American universities, and especially the leading research universities, both public and private, to raise resources on their own to place at the service of reform efforts. This does not mean that American universities are independent of external resources; it does mean that the universities can plan and initiate programs of change and then seek additional funds without having to persuade funding sources, who are usually distant from the scene and not highly knowledgeable about it, of the value of a proposed reform from the very beginning. Even when universities need help, funds and support from external sources, especially governments, it is important whether they have the discretionary funds to plan and initiate projects. This is an element in the still exceptional entrepreneurial European universities. (Clark, 1998) Entrepreneurship gives those universities that freedom to plan and initiate. The ability of a university to raise (and retain) money from diverse sources for its own purposes is central to the freedoms described in

this paper. Nothing constrains that freedom more than the prohibition that most European governments place on university tuition charges.

These conditions together, together with other historical and structural conditions, empower the strong American university president (Trow, 1990). The conditions of strong university leadership in the service of academic excellence are today rarely found outside the great American research universities – for reasons embedded in the history and development of higher education in the U.S. and elsewhere (Trow, 1993). And that, briefly, is why it is broadly true that institutional leadership is less powerful and effective in universities outside of North America.²¹

Finally, in this paper I have been looking at developments in biology at Berkeley for what they can tell us about university leadership. But it may be useful, at the end of this exercise, to remind ourselves that university leadership exists to serve biology and its sister disciplines, not the other way around. So it may be appropriate to return to a question I raised at the outset, that is, how have research universities in different countries, with their different forms of organization and governance, responded to the very rapid growth of knowledge in biology over the past few decades, and to similar rapid advances in other areas of knowledge that strain their physical and organizational structures?

More specifically, how do universities with relatively weak institutional leadership – presidents, or vice chancellors, or rectors who are really chairmen of their academic senates, without internal staffs or discretionary funds or a tradition of activism – respond to problems arising out of the internal developments of the disciplines, and especially those that arise out of scientific revolutions such as we are experiencing currently in biology? I suspect that in western Europe small groups of elite scientists in those fields respond to rapid scientific change by bypassing their university "leaders" by dealing directly with central government funding agencies in their search for research support, new institutes, new buildings and equipment.

But however these countries, their governments or universities or scientific communities respond to rapid scientific advances, a further question arises: what difference does that make for the development of science or for the character of their universities? One hypothesis worthy of investigation would be that the major contributions to science are made by small elite sub-communities of scientists who in most modern societies make their own informal arrangements with public or private funding sources, and do not need the strong presidents and elaborate governance structures of American research universities. These latter may be necessary to hold together the diverse activities of big comprehensive universities in the United States, and especially to maintain the quality of elite research activities within what are institutions of mass higher education, housing academic work of quite varied standard within a single institution (Trow, 1976). The strong American president may be less necessary in the traditional more homogeneous European university made up of autonomous faculties teaching students already doing more advanced and specialized studies. But as European universities move toward mass higher education, housing a more diverse student body and range of activities, and come in that way to resemble American universities, they may come to suffer more from their weak leadership. The movement everywhere in Europe toward strengthening institutional leadership reflects awareness of that problem, though its solution is constrained by traditional patterns of university governance and funding.

While the American "strong presidency" may be neither possible nor as necessary elsewhere, every advanced nation has to ask the question of where authority and resources are best located to respond to problems of rapid scientific advance (and decline) of the kind I have described. That authority must have certain characteristics to be effective. First, it must be able to see the movement of scientific progress as it is happening, and not just after the fact; therefore, it must have (or have access to) scientific expertise of a high order. It must be able to modify or create organizational arrangements for a science across a whole university; that requires more authority and resources than a senior professor or departmental chairman ordinarily commands, and is usually beyond the powers of a committee. Decision-makers must have intimate knowledge of the academic scientists in their own institution, of their individual strengths and limitations, and of their willingness and capacity to contribute to new knowledge in a fast-moving discipline. It has to be close enough to the research frontier to know what is happening there, yet far enough away not to be inhibited by collegial friendships and departmental loyalties from taking drastic action (such as putting one or more departments into receivership) that some senior scientists will certainly oppose.

The presidents of American research universities and their senior academic administrators have that combination of qualities, however effectively they use them. What are the "functional substitutes" for a strong president in other countries with advanced research universities? Perhaps the partnerships between small groups of elite scientists who know where a discipline is going and who is taking it there,

together with central science research funding bodies headed by former scientists, comprise the necessary combination of deep knowledge, broad authority and large resources. A research question well worth pursuing, with clear implications for public policy, is: what form do such arrangements take in different countries, and how effectively do they work?

Every university is unique in various respects, however much it resembles others in other respects. Its history, culture, modes of governance and finance, its leadership styles all are substantially or subtly special to itself. That is why it is difficult to apply the experience of one university directly to others, even of the same type in the same country. And obviously, it is far more difficult to apply Berkeley's experience to European than to American universities. Already, as I note above, a number of major American research universities have expressed interest in Berkeley's experience, and have begun to go down a similar path, but with as yet unknown outcomes.

Berkeley's experience itself changes the situation for others, if only in its having succeeded. No other university has to be a pioneer on uncharted waters as Berkeley was. Berkeley has shown that under the right conditions this kind of major organizational overhaul of a whole scientific discipline within a single university is possible, and other universities, and their leaders, can learn and take heart from Berkeley's experience. The situation beyond the borders of the United States is somewhat different. As I have stressed, most European universities do not have the necessary powerful administrative leadership, nor the sticks or carrots we have seen in the Berkeley story. For example, they usually cannot produce such attractive incentives as we saw in Berkeley tied specifically to a major reform of this kind. The political skills employed by Professor Koshland and his colleagues to persuade his colleagues are rare in any society and university.

This does not mean that similar reorganizations in European universities are not possible where they have not already been accomplished. Things are changing, in European countries no less than in the United States. In many countries more autonomy over academic affairs has been granted to the universities themselves, more freedom to make internal modifications of the kind described in this paper. On the other hand, while university rectors and presidents have been strengthened in some countries, the academic community in most European countries – and especially the leaders of faculties and the full professors – are still more powerful, especially to stop changes from occurring, than are their counterparts in the US. And similarly, European rectors and deans, still usually elected by the professoriat with relatively short defined terms and restricted authority, are less powerful than their American counterparts. It may be that European universities do not need the fundamental changes that accompanied the reorganization of Berkeley's biology departments. It is for them to say whether they feel that anything needs to be changed, and if so how that is to be accomplished. In any event, this brief summary of Berkeley's experience is intended to be helpful to them in their very different circumstances.

Postscript 2000:

The foregoing describes the ways in which one American research university responded to the development of a branch of science that had made obsolescent the boundaries of its traditional subdisciplinary departmental lines. The reform of biology at Berkeley in the eighties made it easier for biologists of various kinds working on related problems to find each other and work together. In 1999 the University took the next step. It announced plans to raise a half billion dollars to build and equip two new buildings that would bring together scientists from different disciplines working on common biology-related problems. If the earlier reform broke down the boundaries between subdisciplines within biology, the new reform is intended to break through the boundaries between biology and related sciences and technologies, notably physics, chemistry, and branches of engineering, and provide teaching and laboratory space for scientists of whatever kind and training who want to work on common problems.

But unlike the earlier reform, the new one will not involve any substantial organizational changes; no departments are being combined, nor are there to be any changes in the ways in which new scientists are recruited or promoted. The basic organizational reforms were made in the 80s and 90s, which makes this new development across disciplinary and departmental lines relatively easy. At Berkeley, departmental lines are finally seen to be irrelevant to doing science, though they remain useful administrative units.

Andantes

1. Portions of this paper were originally published as "Leadership and organization: The case of biology at Berkeley," in Rune Premfors, ed., Higher Education Organization, Almqvist and Wiksell International, Stockholm,

1984, pp. 148-178. However, this version reports substantially new materials about the biological sciences at Berkeley during the entire period between the late 1970s and the present with new interpretations. I much appreciate the help of Professor Daniel Koshland in reconstructing the events summarized here, and in reviewing the essay for factual accuracy, though the interpretations are my own. I also appreciate the editorial help of Rogers and Ellen Jane Hollingsworth

2. The Vice-chancellor, Roderick Park, was, in partnership with Professor Koshland, a prime mover of the reorganization. He was himself a biologist, and knew many of the actors in the reorganization effort. Without his strong commitment the reorganization would not have been possible. The strong personal friendship between Park and Koshland which developed in connection with the reorganization was a significant factor in its success.
3. From an interview with Professor Daniel Koshland done in connection with the award to him of the 1998 Albert Lasker Medical Sciences Special Achievement Award. It can be found on the Net at <http://www.laskerfoundation.org/library/koshland/index.html>
4. From a conversation between Professor Koshland and Russell Schoch, published in *The California Monthly*, the alumni magazine of the University of California, Berkeley, December 1991.
5. As always in such cases, there was a fortuitous element at the beginning. In another interview, Professor Koshland has confessed that in answer to this question from the Vice-chancellor, his own reply was that on the whole things were all right. He was speaking from his experience as a member of a very strong biology department. His wife, also a Berkeley biologist though in a different department, contradicted him and said quickly, "They are very bad." That led to more questions from then Dean Park, which led to the replies by Koshland quoted from the interview.
6. By contrast, James March argues that since leadership in the university cannot accomplish much anyway, the individual characteristics of top administrators scarcely matter so long as they are competent managers (March, 1980).
7. It may be noted that the Chancellor's authority and actions were at variance with Corson's Dual Organization Model (Corson, 1960; Premfors, 1984). The Chancellor, like other university presidents, is responsible for both academic and support services; the reforms in biology at Berkeley tied them together especially closely.
8. The University makes six to eight new appointments in biology every year, reflecting a turnover of about three percent annually. In five years this means thirty to forty new appointments; if they are the right people they can have a significant impact on the discipline at Berkeley.
9. Nominal but still important, in that many biologists wanted membership in specific departments which had high status by virtue of the membership in them of certain highly distinguished biologists. That is partly why the new departments created by the reform are so large.
10. In an interview with the author, Feb. 4, 1999.
11. Here we see the power of the common commitment to excellence at Berkeley, which on occasion can override almost all other formal rules and structures of authority. See note 18 below.
12. In principle, the several Chancellors of UC campuses communicate with state government only through the President and his administrative staff. But Berkeley, the oldest and most prestigious of UC campuses, has its own supporters in the state capitol to whom the Chancellor can appeal directly. However, he can only do that with the approval and cooperation of the President and his senior staff. The arguments that the Chancellor used to persuade legislators and alumni to support a new building for biology say much about the relations of the University to its social, economic, and political environments. There are three main arguments he used:
 1. State support for a new biology building was necessary to maintain the high standard of UC Berkeley as the leading publicly supported university in the United States. This was an appeal to the pride of Californians in their state university, and especially in Berkeley.
 2. The new research facilities were needed to enable Berkeley to contribute to the emerging bio-tech industry, and in other ways to the economy of the state, as it had in the past.
 3. New lab facilities were needed if Berkeley were to provide an effective education and training to students who looked forward to biology-based jobs in industry and agriculture. This was an appeal to the concerns of many Californians that the state university be able to provide a modern "relevant" education for its ablest youth that would prepare them for good jobs and successful careers.
13. It may be useful illustratively to quote from ESPM's Mission Statement (from the General Catalogue, UC Berkeley, 1997-99, p. 240).

"The Department of Environmental Science, Policy and Management (ESPM) brings together a range of biological, physical, and social sciences to provide educational, research and extension programs in: fundamental processes of ecosystem functioning; identification, protection and sustainable uses of forest, rangeland, and managed ecosystems; insect biology; interactions of natural resources, human economics, and social systems. The department is organized into four divisions for the promotion of research programs. These divisions are: Ecosystem sciences, Forest Science, Insect Biology, Resource Institutions, Policy and Management.

The multidisciplinary strength and strong vertical integration, from the molecular to the landscape levels, offers students in ESPM an educational opportunity for future leadership roles in conservation and

management of natural resources. ESPM provides [undergraduate] majors in which students can develop interdisciplinary educational backgrounds to address the science, policy, and management of natural resources."

14. Compare Premfors' summary of Lane and Fredriksson (1982): "Whatever is done in terms of reforms or the introduction of planning systems will be of little or no consequence, 'because no real coordination of departmental interests is possible or feasible'" (Premfors, 1984). That is, of course, a commentary on weak institutional leadership. The power of a president to put a department into receivership sharply, if temporarily, tightens "the loose coupling" which ordinarily links the several parts and elements of universities (Weick, 1976), at least the coupling between the president's office and the specific units affected by the action.
14. On the role of "competitive excellence" as a value in American universities, and in the University of California in particular, see Smelser, 1974.
15. At that time, the Vice-chancellor also held the title of Provost, emphasizing his responsibility for the academic administration of the campus. But Chancellors have nearly complete freedom in naming the offices and titles of their senior staff, as well as their occupants.
16. In sociological terms, we see here academics who are "cosmopolitans," whose reputations were gained through their research and publication and extend far beyond their own institutions, acting at least temporarily as "locals," that is, like academics whose lives are largely confined to teaching and administration in their own institutions and who work within its administrative councils and committees. When "cosmopolitans" function as "locals", even temporarily, they can use the authority they have gained outside, in their scholarly or scientific disciplines, to achieve considerable influence on internal issues. This essentially was and is the story of the Chancellor's Advisory Committee, the key instrument of the reorganization of biology at Berkeley. It is not irrelevant that "cosmopolitans," secure in their own academic status, often look for new people to bring to the university who are as good or better than they are. That is not always the case in the appointment of new academic staff to universities.
17. I have argued elsewhere that the central value at Berkeley, shared by administrators and academic staff alike, is a commitment to a continuing institutional effort to gain and hold the highest academic standing in every scholarly and scientific field. Academics at Berkeley are inclined to support any administrative initiative which promises to make the campus more distinguished and more competitive for able people and other resources. Similarly, administrators are inclined to support any initiative from the academics which is seen as working in the same direction. The close cooperation between Professor Koshland, representing the scientific community, and the top two Berkeley administrators, described in this paper, is evidence of that shared value and what can be done in its service. See Trow, 1998, pp. 265-286.
18. Gaining the commitment of state government for a major portion of these funds required the active support and intervention of the President of the University.
19. In many American colleges and universities there is a shared and strong commitment to a single value, such as competitive excellence, which will override other values and interests when mobilized behind a program for reform. This is true of research universities particularly, but a concern for excellence in teaching in a small number of elite liberal arts colleges is another such overriding value (Clark, 1970); and the wish for institutional survival in some endangered American colleges is a third (Cheit, 1973). All of these call for strong leadership.

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