DOCUMENT RESUME

ED 309 116 SO 020 033

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TITLE The University, Scientific Research and the Ownership of Knowledge.
PUB DATE 85
NOTE 20p.
PUB TYPE Information Analyses (070) -- Viewpoints (120)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Business; Constitutional Law; Discovery Processes; Genetic Engineering; Government Role; Higher Education; *Intellectual Property; *Legal Responsibility; Patents; *Research and Development; *Researchers; Research Utilization; *Scientific Research; *Scientists; Universities
IDENTIFIERS Knowledge; *Knowledge Control

ABSTRACT

The concept of owning knowledge is somewhat ethereal and until recently had little relevance to academic institutions. In principle any object that is capable of being controlled is capable of being owned. The most basic control concerns decisions about whether to communicate knowledge. The philosophical foundation which is the basis of the legal recognition of intellectual property in the United States is Article One, Section 8 of the U.S. Constitution, "Progress of Science and Useful Arts." Underlying the system is, as the U.S. Supreme Court has stated, "the conviction that encouragement of individual effort by personal gain is the best way to advance public welfare through the talents of authors and inventors." At issue is what kind of knowledge should have exclusive ownership rights, and under what conditions. Patent laws do not protect basic scientific discoveries but only the method for making practical use of them. While there may be some reasons for not recognizing proprietary rights in theoretical knowledge, one may suspect that the main arguments against such recognition relate to resulting complex administrative problems. The proprietary view of knowledge could have a very damaging effect both on the way scientists share information and on how topics are selected for research. The time has come when universities have to establish policies regulating the exploitation for personal gain of knowledge obtained while doing scientific research as a member of a university community. (PPB)

THE UNIVERSITY, SCIENTIFIC RESEARCH AND THE OWNERSHIP OF KNOWLEDGE

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This paper is divided into three sections. The first contains a general analysis of the concept of ownership of knowledge and the philosophical basis for recognizing property rights in knowledge. The second examines the legal basis of such rights in the United States. The final section explores, in the light of that background, the conflict which has arisen within universities between the values underlying scientific research and the legal norms governing intellectual property.

I. Philosophical Basis

The notion of owning knowledge is somewhat ethereal and until recently had little relevance to academic institutions. Outside the formal context of the law of copyright, patents, and trade secrets, we are not likely to speak of ourselves as owning or having a proprietary interest in knowledge. It is much more natural for us to say that we possess certain knowledge than that we own it. We may manifest such possession in a variety of ways, such as by communicating it to others or employing it in what we do and make. We may also decide not to divulge or make use of what we know. We shall later see the significance of a "right of non-disclosure" in understanding the concept of ownership of knowledge.

While possession and ownership are related concepts, they are clearly different. Possession refers to having control, while ownership refers to having rights to control. We understand the difference between a thief who has physical possession of a car and the rightful owner who may never see it again. Ownership is a normative concept which implies a complex set of rights. What is included in that set may vary depending on the nature of the object involved. It may include the right to use, sell, rent, give away, abandon, consume or even destroy. Roughly speaking those rights reduce to two different kinds; positive rights of access and beneficial use and negative rights to exclude others from its use without permission.

Sometimes that bundle of rights is divided in ways that make it difficult to say precisely who the owner is. You may, for example, receive under a will the right to exclusively possess and use an object for the length of your life with provision made as to how it is to be disposed upon your death. No one else alive may have any rights in relation to that object, yet you do not fully own it. Ownership may roughly be characterized as possessing the full set of rights a particular object lends itself to or, if that bundle is divided, having the residual rights remaining after all other proprietary interests have expired. Thus a landlord is the owner of a building even though the tenant has a exclusive right of possession for a specific length of time. In some cases, such as with 99 year leases, the possession of a legally limited proprietary interest may be economically more valuable than the reversionary rights held by the owner. The distinction between owning property and having some more limited property interest will come into play when we examine how our legal system approaches intellectual property.

In principle any object which is capable of being controlled is capable of being owned. We own discrete physical objects, e.g., land and personal property, to which access is easily controlled. Some highly mobile physical substances, such as air and stream water, are almost impossible to individuate or control in this manner, and the concept of ownership becomes problematical. A farmer may be entitled to a certain quantum of water from a navigable stream adjacent to his or her property but not literally be the owner of some determinate body of water.

The most basic control we have over our knowledge concerns decisions about whether to communicate it. If we do communicate what we know, the subsequent movement of that knowledge is determined by the behavior of those to whom we make our communication. We may seek to limit its access by imposing conditions of confidentiality, but there are clearly risks that it will be further dispersed in ways not authorized or contemplated. In addition to directly communicating what we know, we make use of our knowledge in what we do and make. In some cases others are able to decipher the knowledge which provided the basis of our activities. Of course we have gained most of our knowledge from others and hence we have little control over its dissemination or the use made of it. Most knowledge is in this sense in the public domain. Still there can be important kinds of information or knowledge which only we possess.

One of the peculiarities of knowledge as property is precisely that it is capable of being fully possessed at the same time by an indefinitely large number of persons. Knowledge also differs from other objects in not being capable in any ordinary sense of abandonment or destruction. Nor can exclusive possession be easily regained once it has been communicated. Even if a person never disclose to others certain information he or she may not be completely assured of having exclusive possession if there are other ways of gaining access to it.

Sometimes the value of knowledge is dependent on it being widely shared. This is especially so in cases requiring cooperation and coordination among persons, e.g., the importance of everyone having inoculations, or following the rules of the road in driving. In competitive situations, on the other hand, it may be in our interest to exclusively possess knowledge, e.g., that a painting being sold at auction is an authentic Rembrandt, or the formula for making a popular soft drink. In still other situations, knowledge may become a valuable commodity for which others are willing to pay, e.g., a physician's knowledge of how to treat an illness.

The decision to recognize certain things as property is a function not only of the degree of difficulty involved in controlling them, but of the degree of value and scarcity they possess. The easier it is to exercise control, and the greater its perceived value and scarcity, the more likely it will be recognized by society as constituting property and protected by social and legal norms. In deciding to provide legal protection a society has also to take into account the administrative costs of establishing reliable legal standards and implementing them.

That society judges something to be worthy of being socially or legally respected as property does not answer the question of who should have what specific rights in relation to the object in question. Things can be owned collectively by society as a whole, by particular groups or entities within society, or by individuals. In a society with collective ownership, the rights of individuals and groups will mainly be rights to access and use. If a community owns something collectively it claims the right to exclude non-members from access, as well as the authority to regulate the access by members. Under a system of private ownership, it is the individuals or groups within the community that are recognized as having the authority to determine who has access and are entitled to beneficial use.

What forms of knowledge ought to be recognized as constituting property, and who should have proprietary rights in it? Among the factors relevant in establishing social policy are 1) how difficult and costly it was to acquire the knowledge, and 2) how important it is that the knowledge be shared. The more difficult and expensive it is to acquire certain kinds of knowledge, the more it can be argued that the possessor of such knowledge is entitled to receive some reward or compensation for disclosing it. The more important it is for others to obtain that knowledge, the more grounds there is to impose a duty to freely share on those who possess it.

There are some forms of important information to which people generally have easy access, and which are shared freely. We learn a lot of detailed information about the communities in which we live--where to buy various things, where to go for entertainment, what areas may be dangerous to walk alone in at night. A stranger entering such a community would need to gain access to such kind of information. An entrepreneur might seek to gain economically from that need by presenting information of that kind in the form of a travel guide. The author of such a guide can, under many legal systems, obtain copyright protection for his or her particular presentation of that information, but not of the informational content as such. Others are free to make use of the information contained in the guide or develop independently their own guides.

Under normal circumstances we would expect there to be a free disclosure of such kinds of information when requested by a stranger we meet on the street. Who can be said to own such knowledge? While admittedly we would not ordinarily speak of anyone owning knowledge in this type of situation, how would the concept of ownership apply? We have already seen that a crucial test of ownership is found in the right to exclude others from access without permission. Anyone who it can be said to have a right to that information can be said to be a joint owner of that knowledge. In this sense one can be said to be the owner of knowledge which one does not presently possess. The knowledge in such cases is jointly owned by all the members of the community who have a right to know.

Such community owned knowledge is to be differentiated from the collectively owned knowledge of a society. It differs in that there is no one delegated the authority to determine who shall have access. Each member of a community must decide for him or herself who is entitled to know. With collectively owned knowledge agents of the government acting on be-

half of the community may exclude members from access to certain kinds of information on such grounds as national security.

What values underlie the institution of property? Our analysis up till now has clearly been predicated on the social utility of property rights. The social usefulness of property rights is so pervasive that it is difficult to conceive of a society which recognized no such rights. Of course what objects to recognize as constituting property, what precise rights to recognize in relation to those objects, what limitations should be placed on those rights as well as who should be the owner of those rights can be subject to serious dispute. While considerations of social utility are basic in answering these questions, other values, such as justice and fairness are also relevant.

Justice is based on giving people what they deserve, what they are entitled to and what they have the right to expect. Someone who makes a socially valuable contribution may deserve to be rewarded as a matter of justice. The recognition by society of proprietary rights in the products of one's labor can be considered one way of fulfilling a justice based obligation.

Considerations of fairness are closely related to justice. To many it seems unfair for people to able to derive the benefit of the work of others without at least contributing in some proportionate way to the costs involved. Without such contribution the beneficiaries could be considered "free loaders" who are unfairly enriching themselves at the expense of others.

For our purposes we will assume that justice, fairness and utility are the basic values underlying the recognition of property rights. While they are distinct values they function in closely interrelated ways. In many situations justice, fairness and social utility will mandate the same result. Thus it can be argued that those who through hard work come up with socially valuable discoveries are entitled to some compensation or reward as a matter of justice, fairness and utility. In other situation a tension may appear between considerations of justice, fairness and utility. This is not to say that these are wholly independent values. John Stuart Mill for one argued in fact that principles of justice actually form the most basic part of the requirements of utility. Without necessarily accepting Mill's position it can be argued that the concept of social welfare or utility cannot be fully analyzed independently from notions of justice and fairness. Perceptions that one is being treated un-

justly or unfairly are clearly a major sources of dissatisfaction and unhappiness. If, in addition, justice and fairness are viewed as intrinsically valuable, their realization will not only be a means for achieving welfare but form a constitutive part of it.

Since knowledge is generally valuable, we want both to encourage the discovery and development of new knowledge and to see that the distribution of such knowledge is made to all those who may benefit. We want to accomplish this while being just and fair to all those concerned. The problem is, of course, how to achieve these goals.

In the following section we will examine how our legal system has sought to deal with these problems. The final section will then explore how the norms relating to the free sharing of knowledge which govern university based scientific research, comes in conflict with the norms of commercial enterprises seeking to exploit such knowledge for private gain.

II. Legal Basis

The philosophical foundation which underlies the legal recognition of intellectual property in this country is under Article One, Section 8 of the U.S. Constitution, "Progress of Science and Useful Arts." The clause clearly embodies a utilitarian justification for recognizing such rights. It does not speak of the natural or moral rights of authors and inventors to receive the benefits of their creations, but of the power of government to recognize some limited rights in order to achieve a certain goal. Underlying the system is, as the United States Supreme Court has stated, "the conviction that encouragement of individual effort by personal gain is the best way to advance public welfare through the talents of authors and inventors."[1]

The rights involved are created by the legislature as a matter of social policy rather than recognition of some moral or natural rights held by individuals as a matter of justice. If Congress were to decide that the promotion of science and useful arts did not require recognizing such proprietary rights, it would not appear violative of any constitutional provision. That constitutional question has never arisen though, as Congress has, since the very founding of the country, considered it important to recognize such proprietary rights. Most of the colonies had patent laws and Congress during its very first session in 1790 passed such a law. While the establishment of proprietary rights in knowledge is a matter of policy, courts in overseeing whatever legislation is passed can evaluate

such laws to see that they do not violate principles of justice and fairness. Thus if patent laws provided that only white males were entitled to receive proprietary rights in their creative work, it would clearly be violative of the equal protection provision of the constitution.

The belief in the value of a patent system as a incentive for encouraging new inventions and discoveries is widely shared, although not universally so. Some economists argue that patent protection is a form of monopoly and as such undesirable. In addition, they question whether it is necessary. It has been argued that most research is now conducted by large corporations who already have sufficient incentives to make new inventions. Being first with a new product by itself creates a substantial advantage over competitors. Fritz Machlup, one of the leading authorities on the economic analysis of knowledge came to what many would consider the surprising conclusion that "...neither the theoretical nor the empirical evidence thus far presented can support the claims frequently made for the patent system as an important, or even the chief, factor in technological and economic progress." Machlup did not propose however that we abandon the patent system as it is already well established and he did not claim he established that it was not socially useful.

The granting of exclusive rights for a limited time can be seen as a compromise between giving the creator of new knowledge full and unlimited ownership rights and giving the public free access. One way of looking upon the patent law is that it is a kind of contract between the government and an individual in which, in exchange for public disclosure of one's invention, a person is given exclusive rights to make use of it for a limited period of time. Under common law doctrine, which still plays a vital role, a company's trade secrets, i.e., knowledge it uniquely possesses which gives it an advantage over competitors, are legally recognized as property. Such trade secrets can include patentable inventions as well as other forms of knowledge such as customer lists, new product plans, and cost and pricing data. The company is protected against wrongful disclosure to competitors by former or present employees. Trade secret protection however does not prevent a competitor from independently discovering such knowledge and even obtaining, where applicable, a patent for exclusive rights to use that knowledge. A company sometimes has to decide whether to seek the limited protection provided by patent law or to rely on the protection of trade secrecy, which in principle is unlimited in time. The law, while wanting to encourage disclosure, does not mandate it. The fundamental right of non-disclosure is respected and that right can be said to underlie the law of intellectual property.

The right of non-disclosure is somewhat difficult to characterize. That limited right is not sufficient to make one the sole owner of the knowledge one possesses as others are entitled to independently gain access to it as well. As one does not have a duty to disclose what one knows to others, it does not constitute jointly or collectively owned knowledge either. The basic right of non-disclosure seems more like a right of privacy or autonomy than what we ordinarily consider a property right. It is a right of possession rather than of ownership because others have the right to gain possession as well without obtaining permission.

At issue is what sorts of knowledge should have further exclusive ownership rights, under what conditions. As has been indicated our patent laws do not protect basic scientific discoveries but only the method for making practical use of them. Roughly speaking the patent law only protects knowledge when it constitutes recipes for making things. This limitation in our patent law has profound effects. Can it be justified? One can argue that in terms of the basic values of justice, fairness and social utility this restriction is not justified.

While at an earlier time most advances were derived from craft and guild know how, today theoretical research is a major source of technological developments. Thus the new bio-technology clearly arose out of basic theoretical discoveries and would not have occurred without them. In terms of merit or entitlement there is no reason to believe that those who made the basic discoveries are not at least as deserving of the fruits of their labor as those who made the technological developments. Without such compensation those responsible for the technological development can be considered "free loaders" who benefit from the labors of those who undertook the more basic research. This seems fundamentally unfair.

In terms of social utility it can be argued that the present patent system fails to provide adequate incentives for doing basic research. Basic research usually bears only an indirect and uncertain relation to practically useful products. In the long run, however, such research is highly beneficial to society. The economist Frank Knight has argued that the patent system misdirects rewards for innovation by rewarding the "routinizer" who usually only takes the last step in the creative process and not those doing the pioneering work.[2] This judgment may be somewhat overdrawn as technological discoveries can involve a great deal of their own kind of creativity. Still the patent system provides little incentive

to undertake basic research as compared with technologically cultivating existing theoretical knowledge.

While there may be some reasons of principle for not recognizing proprietary rights in theoretical knowledge one may suspect that the main arguments against such recognition relate to the complex administrative problems that would arise.

There would be enormous problems deciding what kinds of theoretical knowledge were patentable, resolving conflicts over claims of priority in discovery, determining questions of infringement and methods of compensation. Many inventions are based on a large number of theoretical discoveries which further complicates the problem. The administrative costs of the present patent system are already quite substantial and would be greatly increased if the coverage of the system were expanded in this manner.

One way of avoiding some of these administrative problems, would be to place a tax, based on a percentage of the profits obtained by patented inventions, and with the proceeds establish a fund. The main purpose of the fund would be to support basic research. Such a fund could also serve to reward those who have made fundamental contributions.

One consequence of the non-patentability of theoretical knowledge is that most commercial corporations do not engage in basic research. With a few notable exceptions, such as the Bell Labs, corporations consider it too risky an investment. They are uncertain whether their researchers will come up with knowledge that can turn out to be socially useful. There is also the fear that others can freely appropriate that knowledge in obtaining their own patents.

If other institutions in our society, specifically universities, were not committed to the furtherance of basic knowledge, the problem of the undersupport of basic research would be considerably greater. Even within universities much of the research undertaken is an adjunct to the function of transmitting knowledge and supervising graduate students seeking advanced degrees. Up until the Second World War scientific research was essentially subsidized by universities themselves. Since then the government has been a major source of funds for scientific research. Because the distinction between basic and applied scientific research is sometimes unclear much basic research has been done under grants nominally classified as applied research. The Reagan administration, as part of a

general policy of cutting back on government programs, has sought to reduce such support. Universities anticipating this decline of government support began looking for alternative sources of funding. It was about this time that the potential of the new bio-technology became a subject of a great deal of publicity and venture capitalists were exploring ways of exploiting its commercial possibilities.

III. The University Context

Universities and commercial enterprises are clearly different kinds of institutions, having distinctive goals and norms. The problem is one of regulating their interaction so as not to adversely affect the institutional integrity of either.

If anything is considered fundamental to the ethics of scientific research as conducted within a university community it is that there be a full and free sharing of knowledge. Scientific progress is based on a collaborative process in which many individuals make contributions of varying degrees of significance. Until certain hypotheses are critically scrutinized by others within the relevant community there is little grounds for accepting these beliefs as authentic knowledge. It is true that at certain stages of their work scientists may be secretive in order to insure that they will receive the recognition and honors given those who make original contributions. Still, they are clearly committed to public disclosure as soon as they are satisfied with the quality of their work.

Commercial enterprises, on the other hand, are not committed, as a matter of principle, to the free sharing of their knowledge. While they may share certain kinds of information through trade associations as a matter of policy, it is an accepted part of the norms of fair competition for companies to take advantage of their trade secrets. Those secrets can be among the most important assets a company possesses. As we have already indicated a commercial enterprise often has a choice between obtaining a patent on its inventions or relying on trade secrecy protection. Even when a company applies for a patent, it seeks to disclose as little as necessary in its claim. Finally, a company that does receive a patent may decide not to use nor license others in the use of that new knowledge when it is judged not in the economic interest of the company to do so. Companies have even been know to purchase the patents of others for the very purpose of preventing their introduction into the market.

The fundamental theoretical discoveries made in the 1950's concerning the genetic structure of DNA were followed in the 70's by the development of recombinant DNA techniques which make it possible to genetically engineer new micro-organisms. This new bio-technology is not only potentially beneficial to society, but is expected to be a source of great economic wealth. As we have already seen the United States Supreme Court has held that the products of such bio-engineering are patentable which further increases their economic value.

Much of the work in this area has been done by academically based molecular biologists. Some leading scientists have left academic institutions to carry out their research and development activities in newly created commercial enterprises such as Genentech, Biogen, Cetus, and Genex or with established pharmaceutical manufacturers. In other cases specialties have developed between universities and commercial corporations such as Harvard and Washington University of St. Louis with Monsanto, Massachusetts General Hospital with Hoechst, and M.I.T. with an Institute established by an industrjalist Edwin Whitehead. In exchange for providing substantial financial support, the companies receive a variety of things, ranging from patent rights or exclusive licenses to, in the case of the Whitehead Institute, participation in faculty appointments and control of research areas. In addition, they may exercise varying degrees of control over publication of results.[3]

Aside from these special arrangements, a large number of university-based molecular biologists have developed connections with commercial enterprises as consultants, working during the time they are considered free from their university responsibilies. Such interaction between academically based scientists and commercial enterprises is not new. What is perhaps unusual is the extent of the involvement, the rapidity with which it has evolved and the potential economic benefits. Basic scientific research does not generally lead in such an immediate and direct way to large scale commercialization. This has raised in a dramatic way some basic policy issues concerning university/industry relations in general and specifically whether certain values underlying the conduct of basic scientific research are being put in jeopardy.

One of the basic issues raised by joint ventures between universities and businesses is control over publication. It seems an almost necessary concomitant that some control will be exercised. The companies will want to have at least a preview in order to have their patent attorneys consider the desirability of disclosing certain details. They

might want to delay publication until a patent application has been made, although this is not essential.

While some short delay in publication may be acceptable, anything further may constitute a threat to the norms governing scientific research. The idea of a corporation exercising veto power over the publication of some scientific results would constitute an affront to established norms. What is more likely are requests by the business involved to withhold some results. This also jeopardizes the integrity of scientific research. Perhaps the greatest danger is that scientists will over time come to appreciate the proprietary point of view and will consider these kinds of restrictions justified. Scientists employed by commercial enterprises have learned to live with and perhaps accept as justified various kinds of restrictions of this nature.

It is interesting to note that some significant changes have already been reported in scientists' attitudes towards patents and free communication of knowledge. When Stanley Cohen and Herbert Boyer of Stanford University invented the gene-splicing technique in 1973, they had no thought of patenting it and only through the urging of the University's patent counsel did they agree to do so. They consented only on the basis that the University become the exclusive beneficiary. Cohen later commented "My initial reaction...was to question whether basic research of this type could or should be patented and to point out that our work had been dependent on a number of earlier discoveries by others."[4] Cesar Milstein, who shared the Nobel Prize for his contribution to the development of monoclonal antibody technology or hybridoma, did inquire as to whether the method should be patented. The policy of his sponsor, the British Medical Research Council, was to make such new methods freely available to others. He later was reported as saying "We were too green and inexperienced on the matter of patents...We were mainly concerned with the scientific aspects and not giving particular thought to the commercial applications."[5]

A number of incidents have been reported in which scientists have become less free in sharing their ideas. A committee at the University of California at San Francisco reported that so many of their scientists were also employed by Genentech that "people were loath to ask questions and give suggestions in seminars or across the bench, for there was a feeling that someone might take an idea and patent it, or that an individual's idea might be taken to make money for someone else."

In another case two research scientist at UCLA, Golde and Koeffler, gave Gallo, a researcher at the National Cancer Institute, a valuable sample of cancerous cells they had succeeded in growing. It was then passed on by Gallo to a scientist friend working for a bio-technology company who found a way to make use of those cells in the production of interferon. A dispute later arose as to whether permission was given for that further dissemination of the cells. After the incident, Golde is reported as saying "Everything has changed. The exchange of materials is different. They now have value. To send out a cell line for some experiment, is like sending out a 20-carat diamond to cut some glass."[6] Nicholas Wade states, "Gallo, whose policy of making cells freely available to other researchers was well known, now says he will send nothing out unless he owns it entirely or has written permission from everyone involved."[7] A law suit by Golde and the University of California against Hoffmann-La Roche and Genentech, which was finally settled out of court, arose out of this incident.

Concern over patentability can also effect decisions as to areas of research. Leading scientists may shift their areas of research, as well as that of their graduate students, based not on considerations of theoretical importance for the advancement of knowledge but of economic profitability. If a patent on a certain method and product of genetic engineering has already been obtained other researchers may become hesitant to do further research in that specific area. There could be problems concerning patent infringement. One would have to carefully study the precise claims contained in the patent in order to see whether one can "design around" them. Scientific progress often depends on a continuous process involving slight refinements and improvements. The patent law may inhibit this from taking place. Even if a scientist came up with a significant improvement, which is itself patentable, the chances are he or she would have to enter into a licensing arrangement with the holder of the basic patent to make use of it.

Patent law is highly complex and there is a great deal of discretion exercised by the Patent Office and the Courts in its administration. At the beginning stages of a new technology the tendency is permit broad claims. As the technology develops claims are more narrowly defined. Thus the Cohen-Boyer patent is quite broad but there are indications that the Patent Office is taking a more restrictive view with hybridomas. It is also interesting to note that Cohen and Boyer were not able to obtain patents in most European countries because they published their work before filing their patent claim.[8]

In addition to having a patentable subject matter one must establish that the invention is new, useful and non-obvious. An invention which would have been obvious to someone of ordinary competence in the field is not patentable. If inventions which are not genuinely new and non-obvious could be patented the public would in effect be deprived of the free use of what it already knew or what was an obvious extension of what it knew. Because of the rapid developments taking place in biotechnology it may be difficult to say at a particular point in time what is new and non-obvious. A considerable number of contested patent claims and court suits is likely to arise.

If scientists, within academic institutions, take the intricate requirements of the patent law into account in structuring their research projects, there will be a significant departure from established practice. The proprietary view of knowledge could have a very damaging effect both on the way scientists share information and on how they make decisions as to what areas to explore. While the actual practices of scientists never fully conformed to the normative ideals, the potentially great economic rewards involved here adds a new and possibly destructive dimension.

How serious are these dangers? The dramatic examples cited constitute anecdotal information and there is some danger of overgeneralizing from a few cases. A survey was done of microbiologists at six leading research universities and 15 bio-technology firms for the Office of Technological Assessment of the United States Government. Two of the questions asked were "Has the way university research is done or the quality of university research been affected by the relationships?" and "Has Collaboration among university researchers been affected by the relationships?" About 85% of the respondents maintained that neither the quality of the research being done nor collaboration among university researchers has been adversely affected by these recent developments.[9] It is not fully clear what inferences we should draw from that survey. Does the fact t at 15% felt it was adversely affected have any significance? There is clearly a need to explore in a more systematic way what is taking place before one decides what can and should be done.

Assuming that such changes are taking place are they necessarily undesirable? Will it distort judgments about research areas and hence retard further basic scientific discoveries? While it may be reasonable to assume it would have some adverse effect one cannot be certain. The increase in competitiveness among scientists and universities resulting from

proprietary rights in knowledge could conceivably result in greater knowledge both basic and applied.

Concern over changes in the way scientists conduct their research however is not based solely on consideration of possible undesirable consequences. Those changes puts into question certain basic institutional values identified with a university and which forms part of the way of life of scientists working in such communities.

This was revealed in a dramatic way in 1980. Harvard University administrators conceived a plan for establishing a biotechnology company in partnership with its own professors. A memorandum in support of the proposal cited a number of benefits. One was the substantial financial gain to the university; another the fact that micro-biologists were in any case going to get involved with industry and the university could be an effective adviser and negotiator for the faculty; and third such a company could avoid the drawbacks of commercial companies with their "excessive secrecy requirements, undue direction of the work of scientists, and total separation from the atmosphere of a research university."[10] One of the drawbacks cited concerned the possibility that such a venture might encourage faculty members to shift their areas of interest to what was commercially marketable. Another major drawback related to the feelings of resentment that would arise among those faculty members in micro-biology who were not to be included in the enterprise.

Ten members of the Cellular and Developmental Biology Laboratory objected to such an arrangement. It would, as one said, "deflect the University from its central and essential function: to advance learning, to foster free and searching inquiry into fundamental problems, and to communicate that learning, and the spirit of free inquiry, to the oncoming generation of students."[11] This is a succinct statement of the institutional values which are at stake.

A different kind of objection was raised by Walter Gilbert, a Nobel Prize winner who left Harvard to become president of Biogen, a biotechnology firm. He essentially complained that it would constitute unfair competition. "I have my own company and I would resent being put in the position of having to compete against Harvard for the best people and the best work. I might have to push Harvard to the wall in some cases of competition."[12] He also pointed out that the logical extension of the university's involvement would be "...to convert other areas of the university over to profit-making ventures, start a law firm in the law

school, have the English department write advertising copy, develop a way for the doctors to earn extra profits at the medical school...The idea is completely mad at a certain level." The proposal was dropped within a month after being presented to the faculty.

How considerations of fairness relate to these kinds of situations is complex and depends in part on one's point of view. Is it fair to a university if a scientist, who is being provided with research resources, chooses to leave when that work becomes commercially valuable? Scientific researchers working for commercial enterprises are usually regulated by contractual agreement as to what use they can make of the results of their research once they leave. Even without contractual agreement a court might on equitable grounds prevent a scientist from making unfair use of the knowledge obtained while employed. The law has however to balance notions of fairness against the importance of not unduly restricting an individual's freedom to make changes in employment.

Would a university be protected under the laws of trade secrecy? That protection is generally limited to profit making businesses. It has been reported, however, that five states have developed a broader concept of trade secrets under which the results of basic research carried out within a university might be protected. Whether that is or is not a desirable development is difficult to say. The time has perhaps come when universities will have to establish policies regulating the exploitation for personal gain of knowledge obtained while doing scientific research as a member of a university community.

Much of the basic research done within universities in molecular biology has been funded by the federal government. Up until 1980 the federal government was entitled to receive the rights to all patentable inventions arising out of government sponsored research. In 1980 an amendment to the Patent Law was passed which gave universities, as non-profit institutions, the right to hold such patents. The government only retains for itself the right to use those inventions without paying any license fees. The purpose of the change was to provide more of an incentive to develop and commercially exploit the inventions which resulted from government support. Most large universities now have their own patent counsel and arrangements with companies which specialize in commercially exploiting newly patented inventions.

While the main function of universities is to advance human knowledge, they do compete with one another. The competition among univer-

sities over obtaining valuable patent rights is an additional factor which may affect the way colleagues located at different universities cooperate with each other. This competition is not only on the institutional level. It is common practice for a university to give the researchers who made the patentable discovery a certain percentage of the proceeds obtained through licensing agreements.

This raises the question of what use should be made of the money received under such licensing agreements? Perhaps it should be said that it may not turn out to be as much as some people expect. While royalties from the Cohen-Boyer patent have already produced two million dollars, later and more narrowly defined patents are likely to produce less.

Assuming that a university does receive substantial royalty fees, what should be done with the money? The basic values of justice, fairness, and social utility again come into play. The inventor deserves as a matter of justice some reward for the contribution made which benefits the university. Some proceeds should also be given to the discipline or area in which the work was carried on. Inventing is now largely a social activity and colleagues have probably, directly or indirectly, made some contribution to the discovery. This money would also serve as an incentive for doing further research in that area. As a matter of fairness It might be appropriate for a portion of the royalties to be given to colleagues in related disciplines whose basic non-patentable knowledge was essential to the discovery. Is there any responsibility to distribute a portion of those funds to further research in disciplines which are completely unrelated to the scientific enterprise? How that question is answered reveals in some small way a university's conception of itself as a community. Values of community are perhaps distinct and not reducible to the values of justice, fairness and social utility.

ENDNOTES

[1]Mazer v. Stein 347 U.S. 201, 219 (1954). Quoted by Edward Dumbauld, The Constitution of the United States (Norman, Ok.: University of Oklahoma Press, 1964).

[2]Risk, Uncertainty and Profit (Boston: Houghton Mifflin Co., 1957). Discussed in Ward S. Bowman, Jr. Patent and Antitrust Law (Chicago: The University of Chicago Press, 1973), pp. 28-31.

[3]See Background Paper by Nicholas Wade in The Science Business Report of the Twentieth Century Task Force on the Commerialization of Scientific Research, (New York: Priority Press, 1984).

[4]Ibid., p. 31.

[5]Op. cit.

[6]Ibid., p. 36.

[7]Op. cit.

[8]Commercial Biotechnology: An International Analysis. See Chapter 16, "Intellectual Property Law."

[9]Commercial Biotechnology: An International Analysis, p. 413 ff.

[10]The Science Business, p. 42.

[11]Ibid., p. 44.

[12]Op. cit.