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SURVEY OF DIRECTED MECHANISMS FOR INNOVATION OF UNIVERSITY RESEARCH

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SURVEY OF DIRECTED MECHANISMS

FOR INNOVATION OF UNIVERSITY RESEARCH

I. Introduction

This article will report on a survey relating to innovation of university research results, particularly of directed mechanisms (organizations, policies) at universities for transferring intellectual property rights to industry. The survey was conducted primarily in the summer of 1978. While questionnaires were sent to a few representative universities in each of a number of countries, much useful information gathering resulted from personal interviews at universities and national "research development organizations." The survey was limited in the number of countries, the number of universities and other entities surveyed in a country, and in the number of individuals interviewed.[1]

II. Background

Increasingly, developed countries are pointing to the urgent need to enhance their domestic innovation to be competitive in world markets for manufactured goods. The looming competition from Eastern Europe, China, and developing countries with lower labor costs and often extensive natural resources portends even further loss of competitiveness of domestic industries and more focus upon innovation. Innovation is seen as a means of leveraging intellectual product with capital and trained labor to produce goods and processes that compete on a technological rather than cost level.

Directed mechanisms toward enhancing innovation of university research were found to vary from country to country

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1. Footnotes are included in this article only to cover supplemental information. References to information sources are not included in the body of this report; the Bibliography will cover a listing of sources of information for interested readers.

but more from university to university.[2] Nevertheless, of universities that had reached the threshold of deciding that it was not inappropriate for the university or its faculty, research staff, and students to become involved in such directed mechanisms, three general forms of organization and a number of unique organizations were noted.

This survey focused upon directed mechanisms for achieving innovation of university research results. Clearly, much--indeed most--industrial innovation is aided by contributions from university research in the form of trained graduate students, publications in learned journals, conferences, etc. However, the "directed mechanisms" reported on here relate to specific policies and organizations for contractually transferring basic research results to industry.

III. Return on Investment in Basic Research

Return on investment (ROI), a familiar phrase to the financial community, appears to be increasingly the attitude of politicians and the public with regard to research by the scientific community. This trend, exacerbated by current economic conditions, has resulted in demands for evidence that science show a practical and/or economic value to the public.[3]

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2. *Many universities have no policies, form of organization or other mechanism for licensing of research results. Generally, this absence is due to several factors. One obvious factor is a small level of research which does not give rise to the need for an organization or other transfer mechanism. Also, at many universities, some with a substantial level of research, there simply had been no impetus to focus upon directed mechanisms for technology transfer. In such universities, the initiative for transfer of technology is left to individuals or small groups within the university. At other universities, it was argued patent licensing had the potential of inappropriately diverting faculty from the pursuit of knowledge to pursuit of patentable ideas; by establishing mechanisms to facilitate such licensing, it was alleged that would only increase that potential.*

3. *It has been observed this trend has some potential for undercutting support to curiosity-oriented, fundamental research. This can be self-defeating to ROI as the major technological breakthroughs generally result from the unexpected finding of fundamental research rather than applied research.*

For example, the so-called Rothschild Report of the UK recommended that government scientific administrators, rather than making unrestricted grants to scientists, should define practical problems requiring solutions and then make awards to scientists or other entities best suited to carry out the designated project. In the U.S., Senator William Proxmire, Chairman of the Senate Subcommittee that funds the National Science Foundation, periodically awards the foundation a "golden fleece award" for wasting taxpayers' money on a particular research grant he considers frivolous and/or unlikely to provide results benefiting the public.

Another viewpoint was heard in hearings in March of 1979 for funding for the U.S. National Science Foundation. Representative Tom Harkin asked "how many people here would vote for $100,000 to study the growth of viruses in monkey kidney cells?" Representative Harkin then observed that Dr. Jonas Salk, a few years after completion of that study, used the results in his own research and came up with a polio vaccine.

Dependent on benevolent support of the taxpayers and legislators, many government research agencies and universities have concluded that by demonstration of successful innovations of scientific research, the public's and politician's demand for ROI can be satisfied in at least partial measure, thus reducing the jeopardy to funding of fundamental research.

This ROI attitude has been a key factor leading to the establishment of many of the directed mechanisms reported in this article for innovation of university research results. Nevertheless, it appears more universities than not are passive with respect to directed innovation at the university administrative level.

IV. Forms of Organization

Organizations for direct transfer of university research results to industry were found to vary substantially from university to university and country to country. However, there are three general categories into which more organizations may be grouped. These are: (1) national research development organizations (RDO's); (2) university licensing offices (ULO's); and (3) industrial liaison offices (ILO's).

National Research Development Organizations - National research development organizations (RDO's) are government chartered to develop and exploit new technologies arising from government-funded research to commercial application. An RDO may also take on for development inventions from the public and corporations. In addition to the technology licensing function, an RDO may fund further development of an embryonic but promising concept, joint venture with industry, and act as a venture capital organization in forming a new company to exploit a particular opportunity.

University Licensing Offices - A university licensing office (ULO) is established within a university's administrative structure, typically reporting to a "patent board" of the university's governing body. A ULO normally performs only the function of licensing of potentially commercializable technology arising from the university's research program. Until the licensing volume justifies full time licensing personnel, the licensing function is often handled part-time by the university research administration manager or vice-president-research.

Industrial Liaison Office - An industrial liaison office (ILO) of a university is typically separately incorporated by the university's governing body, with offices either on the university campus or directly adjacent. The ILO's governing board will often include representatives of the industrial community. Technology licensing is performed by an ILO, but this licensing function is quite limited in countries where it is mandated results of government-funded research are to be managed by the national RDO. Primary functions of an ILO include liaison (for the university) with industry in connection with industry-sponsored research projects, renting to industry specialized research and testing equipment, brokering university faculty as consultants and coordinating conferences and workshops for industrial participants.

* * * *

There are many organizations which do not fit neatly into one of the foregoing three categories. These include, for example, an association of faculty of a number of universities (Japan), an alumni-controlled non-profit institution (U.S.), a university research institute (Norway), a for-profit company representing many universities (U.S.), a captive development company (France), and a non-profit "research and development" organization (Belgium).

Representative organizations for directed transfer of university research results to industry will be discussed in Section VIII in summary form. The Bibliography will list available references so that further information may be obtained by any interested reader about a particular organization.

It is tempting to seek to compare the differing forms of organization. Probably more significant than the form of organization, however, is the entrepreneurial character of the individuals in the organization, and the available incentives. (In Section VI, the royalty incentive is discussed.)

V. Other Forms of University/Industry Interaction

This paper will deal with the directed mechanisms for enabling innovation of research results of universities. For completeness, other means of bringing university research results to industry and forms of university/interaction are briefly mentioned here.

Graduated Students - The first and most obvious means of technology transfer from a university to industry is the graduated student, who carries with him or her the knowledge gained during his or her stay at the university.

Publications - Another primary transfer mechanism is the publication in technical journals, textbooks, theses, etc., of university research results.

Research Contracts - Further direct technology transfer to industry occurs through industry funding of research at a university.

Technical Conferences - The role of technical conferences and professional society conferences should not be underestimated--where it is said more knowledge is exchanged through the personal contacts enabled by such conferences than the formal papers presented.

Industry Affiliates Programs - In the U.S., a few universities have "industrial affiliates" programs. At Stanford University in California, for example, a company that joins the Chemistry and Chemical Engineering Affiliates program pays an annual fee and, in return, participates in periodic conferences arranged for the affiliate members on relevant topics, participates in exchanges of research scientists, receives early copies of publications, etc.

Consultants - University scientists are employed as consultants by industry, typically as individuals, although at some universities, through ILO's.

Industrial Parks - A number of universities have established contiguous industrial research parks, which provide an opportunity for cross-fertilization of research ideas between industry and university personnel. As scientists that do not continue their education become in time more or less technologically obsolete, particularly in fields such as electronics, it is a major advantage for a high technology company to be located near a research university with educational programs available.

Research Institutes - Research institutes in the vicinity of a university perform a useful function as an intermediary between results of basic university research and applications of industry.

VI. University Policies

This survey focused on two areas of university policy significant to an organization directed to innovation of university research results. These policy areas were of ownership of research results, including patents, and of royalty distribution.

Ownership - Policy with regard to ownership of patent and other proprietary rights of research conducted at a university varied but with some commonality within a country.

A 1977 survey by the Society of University Patent Administrators (SUPA) of U.S. and Canadian universities revealed that for "unsponsored" inventions, 36 of 58 universities took title, while in 11 universities, the inventor took title. In cases where the research was funded by an external research sponsor, the ownership question typically was covered in a patent clause of the funding agreement, and the institution would have prior agreement with the researchers in order to carry out its obligations under the clause.

In the UK, inventions developed with government funding support are assigned to NRDC, and university faculty inventors generally had first presumption of title to other inventions.

Generally, U.S. public (state) universities control ownership of faculty inventions while U.S. private universities--based on a small sample--in more cases than not had a policy of first presumption of title to faculty inventors.

In West Germany, tenured university faculty have full ownership to their unsponsored inventions and make independent licensing arrangements with industrial licensees although their university may share in royalty income based on the amount of university resources involved in the invention. For untenured university scientists, it appears the university can obtain title (with a share to the inventor) if it will undertake patenting and licensing. As German universities have not undertaken licensing programs, this policy has not been tested.

Some universities varied their policy of ownership of inventions based upon whether or not university facilities were used and whether their invention was "duty related." Generally, inventions not conceived with research sponsor support, not involving use of university facilities, and not duty-related were owned by the inventor.

For universities with a policy of title to inventor, the university licensing program, to be successful, required a reasonable royalty sharing policy and demonstrated competence in licensing.

Royalty Distribution - Royalty distribution policies varied substantially. The 1977 SUPA survey of 48 U.S. and Canadian universities revealed 23 different royalty-sharing policies. Inventors' shares ranged widely with the median at 33% of net royalty income. Several universities were grouped at a net 50% and several at a gross 15%, but there was otherwise little commonality.

Few inventions will cover the costs of licensing and administration; many will not bring in any income at all.[4] However, the fortunate occurrence of one or more very large royalty producing inventions will reduce those costs to a proportionately small percentage. For average university inventions, on the order of 50% of gross income would not be an unreasonable allocation to cover licensing program costs. However, factoring in the possibility of one or more very large royalty-producing inventions would reduce the percentage significantly.

An important factor to consider in royalty distribution arrangements is a distribution to the laboratory where the invention originated. The laboratory director

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4. Assuming reasonable judgment in evaluating inventions, average invention quality and diligent licensing effort, it appears an agreement with industry can be reached for perhaps one-third of inventions which are accepted for licensing and for which patent filing and other expenses are incurred. Of this one-third, perhaps one in ten will eventually provide over $25,000 cumulative royalty income and one in two hundred over $1,000,000. (See also Section VI.)

at a Danish university noted that, absent a laboratory share, there was little incentive to encourage diversion of laboratory faculty, staff or students from laboratory tasks to preparing invention disclosures, dealing with patent attorneys, consulting and cooperating in licensing arrangements with industry. From an equity point of view, it was noted that an inventor has derived support from what has been done before in a laboratory, its equipment, interaction of colleagues, etc., and that there is thus a basis for distribution of a share of royalty income to a laboratory. Such unrestricted funds can be used by the laboratory as seed money for new research projects for which other funding is not available, sending junior faculty and students to technical conferences for which there is inadequate laboratory funding, etc.

At some universities, the amount of royalty distribution is negotiated on a case by case basis. Such a policy was generally limited to organizations that had few license agreements. Organizations with a reasonable volume of licensing appeared to have found it necessary to have standard royalty distribution arrangements, particularly standard percentages to the inventor.

In some cases, no royalty distribution to an inventor is guaranteed in advance, but there is a possibility of receiving a financial "award" when an invention is successful, with the amount and the timing of the award determined by the organization's management. Such awards also could be made to individuals who were not inventors pursuant to patent law, but who had contributed to the innovation.

Distribution of royalties to individual inventors was considered by some universities to have potential for diverting individuals from their scholarly pursuits. It was also observed with respect to royalty payments to inventors that there might arise dissension in an academic laboratory when, after years of contribution by many laboratory personnel to a particular line of research, an individual who fortuitously happened on the key invention would be the only individual rewarded and contribution of the others not recognized. It was further noted this could lead to the lack of collegiality and the maintaining of research results secret so that a patent application could be filed before a colleague.

In general, however, most universities felt it appropriate to reward inventors with a share of royalty income. In some countries, for example Germany and Norway, Federal law requires the distribution to an inventor. In Norway, however, the employee-inventor law does not apply to university faculty.

In many universities, it was entirely up to the individual inventor to see to filing and licensing of his or her invention, without a basis for sharing with the university.

In some situations, it was required that a portion of any royalty income be paid to the government agency which may have funded the invention at the university. For example, the Norwegian government science agency must approve a licensing agreement by the University of Trondheim's research organization, SINTEF (Selskapet for Industriell og Teknisk Forskning), with industry and can claim 50% of income until the science agency's investment in the research project is recovered, and then 25% of income thereafter. This income, however, is the net after the distribution to the employee-inventor and recovery of SINTEF's investment. There have not been any cases at SINTEF where license income has resulted in a distribution to the science agency at the 25% level. A "payback" policy such as this was considered in most countries as counter-productive to innovation by its effect on incentive.

At Stanford University, a private U.S. institution, the individual scientist, the scientist's academic department, and the University itself are recognized as equal entrepreneurial participants in a research enterprise, each with budget and resource raising responsibilities. This has led to a distribution of net royalties (net of 15% administrative charge and out-of-pocket expenses) in equal thirds among the three entities.

Specific situations where royalty distribution to university inventors may have caused problems in diversion of research, reduced collegiality, etc., were not forthcoming during this survey. In several actual situations, however, individuals named on a patent application voluntarily agreed to share the "inventor royalty distribution" with co-workers who contributed to the research, but who technically were not inventors according to patent law. In other situations, university inventors waived their share to their department, or laboratory, or to the university.

It was generally acknowledged by those responsible for a university technology licensing program that the potential for receipt (or control) by a scientist of royalties from licensing a university discovery was a significant factor in encouraging invention disclosures and participation in a licensing program. Many observed that the driving forces for a faculty member's research clearly were the search for new knowledge and peer recognition. These are the prime motivators leading to discoveries of significance, rather than the prospect of receiving and/or controlling royalty income. It is after the scientist has come up with the discovery that the prospect of royalties as an incentive becomes a factor.

VII. Economics of Licensing of University Inventions

Can a university expect that the revenues from licensing of inventions of its faculty, students and research staff will be greater than the cost of patent filing, administration and overhead costs of a licensing office? The answer appears to be "maybe."

A number of universities in the U.S. have had ULO's for many years. With few exceptions, a ULO is economically viable only if one or more "big hit" inventions has come along. Some universities began their ULO with the advent of a "big hit," while many are not-so-patiently waiting. The few exceptions have been economically viable through a combination of: (1) a substantial base of research where the university controls title to inventions, (2) an entrepreneurially-focused licensing program, and (3) appropriate incentives for inventors and their laboratories.

An RDO will generally be better equipped to fully exploit the "big hit" invention than a ULO. The "big hit" invariably has a strong worldwide patent position and a major market. A strong patent position with worldwide coverage is not a natural result of an important discovery. It requires an aggressive and intelligent patent management effort, with adequate financial resources to sustain the patenting program pending the receipt of royalty income, which income may not begin to flow--if at all--for five or more years.

The great majority of university inventions, however, have a more modest patent position and smaller market. Successful licensing of this larger category of inventions appears to more often result when there is an enthusiastic inventor with transferable knowhow, the appropriate incentives are in place, and the invention is brought to industry promptly, with exclusive rights available. Licensing support close to the inventor's laboratory is also a key factor.

Where (1) the prospective patent position is strong and (2) other technological alternatives are significantly less attractive, an invention can be licensed at relative leisure and non-exclusively. However, in most cases, the licenseable value of an undeveloped university invention (other than the "big hit" category) appears to be inversely proportional to the elapsed time from its discovery. And when the prospect of exclusive rights (at least for a limited term) are not offered to prospective industrial licensees, the probability of licensing is significantly reduced.

VIII. Representative Forms of Organization

Information in summary form is given here about organizations which are directed to innovation of university

research. L'Institut Pasteur, not strictly speaking in this category, is briefly mentioned because of its unique production company. The Bibliography will reference sources of further information for the interested reader.

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Agency Nationale de Valorization de Recherche (France) - The Agency Nationale de Valorization de Recherche (ANVAR), the national research development organization of France, was established in 1968. ANVAR seeks to make arrangements with industry for innovation of technology developed under support of government funded research in addition to inventions proferred to ANVAR to manage by private inventors, companies, universities, and others.

ANVAR to date has not assumed directly the industrial joint venture or new enterprise development financing functions carried out by NRDC of the UK. However, ANVAR acts as a catalyst in encouraging industrial research funding by government research agencies and venture capital funding by other funding sources, thus indirectly covering functions similar to NRDC.

ANVAR leverages its staff (approximately 70) by using private patent attorneys which are selected on the basis of technical background, competence, and convenient location to the inventors.

The French government research funding policy comes under the policy direction of the Delegation Generale Recherche Scientifique Technical (DGRST). Funds are distributed through the various ministries--for example, the ministry of universities, ministry of agriculture, ministry of health, and ministry of industry.

The principal source of research grants to universities and the national scientific research organization Centre National de Recherche Scientifique (CNRS) comes from the Minister des Universities. Research policy and research project funding decisions are left to research councils at each university. In turn, licensing policy is left up to the universities; one development option is ANVAR. ANVAR estimates that perhaps one-half of the commercially useful technology from French universities are proffered to ANVAR for licensing. However, ANVAR handles all inventions of CNRS and other French government research laboratories.

ANVAR's royalty sharing policy for universities does not provide for a distribution of royalty income to the inventor's laboratory of the university, but solely to the inventors and to ANVAR. University research councils were beginning to question this distribution policy.

An interesting experiment of ANVAR is their regional support program. This involves on the order of 15 separate ANVAR "provinces" which serve to bring ANVAR representatives closer to their inventing clients. A regional office may involve representative(s) of the regional Chamber of Commerce and academics as technical consultants.

It is ANVAR policy to award any exclusive license rights to a French company, except in situations where "reasonable" license arrangements are not possible.[5]

Centre for Industrial Consultancy and Liaison (United Kingdom) - The Centre for Industrial Consultancy and Liaison of the University of Edinburgh (CICL) was established in 1969 and has a current professional staff of three. As with other industrial liaison offices, CICL makes consultancy arrangements with industry for university faculty. CICL also makes contractual arrangements with industry for university research and contractual arrangements involving use of university experimental equipment. CICL, in addition, promotes and administers conferences and courses at the university for industry participants. Beginning in 1973, an aggressive licensing program was initiated.

For consulting arrangements, it is optional for university faculty to work with CICL. For consultancies handled by CICL, CICL obtains a consulting fee which is negotiated depending on the amount of the consultancy--typically ranging between 10% and 20%.

For conferences promoted by CICL, CICL and the group that would put on the conference negotiate in advance a division of surplus over cost. However, CICL takes all financial risks for an unsuccessful conference.

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5. *This policy of first preference to domestic industry is generally followed by other RDO's and universities which were asked about such a policy. None had a specific written policy to this effect.*

As NRDC handles inventions arising from the principal research funding sources of the UK, the base of research on which to draw for inventions by CICL is greatly reduced. Nevertheless, CICL was able to financially break even in 1978, with higher licensing revenues forecast for future years. Such licensing by UK universities may be increasing, as the UK government appears to be moving toward a policy of allowing universities to license results of government funded research.

CICL's patent licensing program has been voluntary, but it is expected to become compulsory after a new law that will make the university a legal owner of inventions made by its employees. Net income is divided with the inventors (50%), department or unit (20%), patent program 30%.

CICL is responsible to a board of management which includes the Secretary to the University and the University President as ex-officio members. Membership also includes faculty and industry representatives. The CICL has the unique feature of being organized similar to an academic institute, whereby its professional staff can obtain tenure, as compared to other administrative staff within the university which are not eligible for tenure.

Danish Invention Center (Denmark) - The Danish Invention Center (DIC), established in 1972, is a non-profit government supported organization based in Copenhagen, with six subsidiary offices in other locations in Denmark. DIC nominally operates under the Technological Institute of Copenhagen, which is a "technological service center intended to develop, adapt, and transfer new technology is support of trade and industry in Denmark." Clients of the Technological Institute are Danish industry and the government, with about half of its budget from government grants and half from income for its services to industry.

DIC is supported by the government under a basic subsidy, which subsidy was planned to reduce to zero by 1982/83. However, there is some emphasis that government support be provided for the production and innovation activities of the DIC, with self-financing not to be a primary goal.

The DIC has a prototype workshop for manufacture of prototypes or experimental work with financial support of clients. The DIC also arranges exhibitions of Danish technology for client industrial organizations. DIC acts as licensing agent for Danish inventors, including inventors of universities and companies. University licensing has not been a significant income producer as yet. University

inventors are not obliged to proffer their discoveries to the DIC. DIC makes arrangements directly with the university inventor(s), incurs patent and licensing expenses at DIC risk, and returns 70-100% of net royalty income to the inventor(s), retaining 10-20%.

Government Agency Licensing (U.S.) - In the United States, some government agencies which sponsor research at universities will take title to an invention developed at a university, rather than permit the university or inventor to license the invention. If the agency files for patent protection on the invention, it licenses the invention directly or through the National Technical Information Service (NTIS).

The inventory of patents held by the government from all sources (including universities) now totals close to 30,000. Of these, a very small percentage has been licensed (about 5%) compared to university licensing experience (30%-50%). The practice of taking title by government agencies has come under strong criticism. There are over 20 differing patent policies of the various government agencies which administer research contracts and grants.

Bills have been introduced in both the House and Senate of the U.S. Congress to allow universities and small business to retain rights in their inventions which may have been derived under government support. These legislative attempts to accomplish similar purposes have failed in prior years. However, these bills are given a reasonable chance of passage in the present Congress. (Senate bill S414 (H2414), University and Small Business Patent Procedures Act)

Japan Engineering Development Company (Japan) - The Japan Engineering Development Company (JED) was established in 1967 for the purpose of promoting innovation of research of universities, not only of Japanese universities but universities in other countries.

JED was established by a group of Japanese professors, and its staff is of emeriti professors. The shareholders of JED are a large number of professors from universities throughout Japan. The Board of Advisors to JED is composed of chief officers of several major Japanese companies.

From its inception, it was the intent of JED to introduce not only inventions of Japanese universities to industry, both Japanese and foreign, but to introduce inventions of foreign universities to Japanese industry.

The agreement that JED makes with foreign universities or other organizations is administered along the following lines. The foreign organization submits an invention for evaluation under the agreement. If JED accepts the invention, it files and prosecutes patent applications in Japan (and in other countries that may be agreed upon) with JED's agreement to make its best efforts to license the technology to Japanese companies. If royalty income is received, the foreign organization receives 70 percent, and JED 30 percent, of the net income after deduction of patenting and licensing expenses.

Leuven R&D (Belgium) - Leuven R&D (LRD) was established by the University of Leuven in 1972 as a non-profit organization to administer industrial contract research at the university and act as agent for the university in administering agreements with industry for innovation of research of the university.

LRD is not intended to conduct research with its own staff as SINTEF of Norway's University of Trondheim, but LRD does provide limited research assistance in the form of technical personnel to university laboratories when technicians of particular qualifications are not on the university staff but are needed for an industrial research agreement.

Although a separate organization, LRD is closely interwoven with the university and, because of its establishment concurrent with receiving its first industry development contracts, it has not needed any capitalization.

A fixed percent of LRD's "turnover" is allocated to the university, but the larger distribution goes to the laboratory responsible for the research under an industrial development contract. These contracts provide for participation of LRD in income which might be realized by the industrial research sponsor as a result of a successful innovation based on contract research findings. LRD, in effect, buys and sells the 20% of university faculty time which is permissible to use for consulting.

The current procedure for allocating expenses and income of industrial research contracts is as follows. From the annual contract income, overhead charges of 5% and 12% are allocated to the university and LRD, respectively. After then deducting the direct contract expenses, the remainder is allocated to the university laboratory responsible. Of this amount, the laboratory may distribute 30% to individuals, which sum may be less or greater than the 20% of their time allocated, depending on other expense/income items for the account of the laboratory such as patent filing expenses and royalty income.

LRD has also founded new companies. For example, LISCO (Leuven Industrial Software Company) was established by LRD with the aim of marketing computer-aided design programs developed at the university to the electronics industry. LISCO has recently been incorporated in the U.S.A. Complementary computer-aided design technology from other universities is being considered for marketing by LISCO; thus, in this situation, enabling LRD to benefit from technology from universities other than the University of Leuven.

L'Institut Pasteur (France) - The Pasteur Institute (PI) has a unique and successful organization for innovation of basic research, involving a "captive" production company. The Pasteur Institute, established in 1888, is composed of two major components--a non-profit research foundation, and a production corporation, which corporation was established in 1973. It has a staff of approximately 900.

The research foundation receives income from the government (approximately 50%), research services (approximately 30%), and the production company (approximately 20%). The research foundation receives an 8% royalty on all products manufactured and sold by the production company. PI licenses its technology directly and uses the services of ANVAR.

Massachusetts Institute of Technology (U.S.) - The Massachusetts Institute of Technology (MIT), a prominent U.S. research university, has operated a ULO from 1961.[6] It is currently staffed by five full time (and one half time) professionals with a support staff of three.

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6. An April 1979 study of U.S. university patent development practices by Washington State University reported these responses to the question, "What types of technology transfer or patent development organizations does your university utilize?"

33	--	*Research Corporation*
27	--	*Your university itself*
16	--	*Local corporation established by your university*
10	--	*Battelle Development Corporation*
6	--	*University Patents, Inc.*
6	--	*Other separate outside organizations*

Fifty-six universities responded; 31 used more than one patent development mechanism.

Gross income from licensing in MIT's last fiscal year (1977-78) was $1.1 million. The significant portion of this total came from one invention. MIT has had several inventions which could be classified as "big hits"; in particular, the "computer memory core" and synthetic penicillin.

MIT ownership policy considers that MIT retains title to inventions arising from research at MIT. The inventor will retain title if university facilities are not used and the invention does not fall under terms of a research agreement by a sponsor with MIT.

MIT shares 35% of the first $50,000 gross royalty income with the inventor, 25% of the next $50,000, and 15% thereafter.

MIT, with its experience of "big hits," is not a typical ULO.[7] Another major U.S. research university, obviously without a "big hit," gross less than $25,000 in its last fiscal year.

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7. MIT is a private U.S. university. Most public (state) universities administer research through a separate non-profit research foundation. A separate foundation is generally for administrative purposes (and also for tax-related and other reasons--see Bibliography for further information). They perform ULO functions but are rarely ILO's as defined in this article.

An example is Iowa State Research Foundation, which has had an active ULO function for many years. One professional (with assistant) handles licensing. Royalty income at Iowa State in 1978-79 was $366,000, of which about 75% was attributable to one invention. Iowa State has a similar ownership policy to MIT. Iowa State inventors receive 15% of net royalty income.

National Research Development Corporation (Great Britain) - NRDC appears to have been the first national RDO. It was established in 1949 for the purpose of "encouraging the development of technical innovation within the United Kingdom within the public interest." In addition to licensing inventions of UK government laboratories, universities, and others, NRDC finances industrial joint venture innovation projects and founds/finances new companies.

NRDC, with a staff of about 200, has achieved a net surplus over the past 10 years. For the fiscal year ending 31 March 1978, the net surplus before tax was in excess of 9 million pounds.

The major revenue producer for NRDC has been the cephalosporin antibiotics. NRDC is also recognized for its role in establishing the UK's hovercraft industry. By financing in the UK computer industry during that industry's critical period in the mid-sixties, NRDC played a major role in the success of what is now ICL, the UK's principal computer manufacturer.

NRDC has first refusal to proprietary rights of results of research which is government funded. In addition, NRDC receives a very large number of voluntary proposals from private individuals, of which less than 1% are eventually accepted by NRDC for exploitation.

Because NRDC automatically has first refusal to research results of government-funded research, UK universities have a very limited base of research from which to establish a campus licensing program. This policy has caused dissatisfaction in some UK universities which consider NRDC is overconservative in which inventions it will take on for licensing.

Judging from a 1978 Licensing Executives Society conference at Cambridge University, some companies also consider that NRDC is overly conservative in the development projects that it chooses to fund. This is a difficult situation for NRDC because NRDC's stewardship responsibilities require them to tread the fine line of judgment in which new discovery has reasonable potential of a commercial new product or process opportunity to be taken on.

NRDC reports it has been difficult in recent years to identify enough quality opportunities in which to invest, as NRDC clearly has adequate capital available to invest. NRDC also finds that the present economic conditions have resulted in a climate of conservatism by companies to invest their resources in speculative development of embryonic new opportunities from universities and public sector laboratories offered for license by NRDC.

For cases handled by NRDC that derive from university research, NRDC distributes 50% of the net income (net of out-of-pocket costs) to the university. NRDC on occasion funds a related university project and, if royalty income is substantial, will also deduct that expenditure.

It is at the discretion of each university as to how to distribute the 50% of net license income received from NRDC. At some universities, including Oxford and Cambridge, the inventors, rather than the university, make arrangements directly with NRDC.

For inventions of government laboratories, NRDC makes no royalty distribution although a tax-free award can be made to laboratory employee-inventors with NRDC funds.

In addition to joint ventures with industry, NRDC has established new ventures such as Compeda Ltd. (computer aided design) and Gensys Ltd. (construction industry computer software).

As with other RDO's, NRDC brings technology first to UK industry. If a UK company does not manufacture overseas, NRDC will license, for example, a U.S. company for the U.S., but reserves, when appropriate, selling rights for a UK company.

NRDC can deny without reason a nonexclusive license request. In the U.S., nonexclusive licensing for inventions from certain government agencies is required unless development is not obtainable without exclusive rights. NRDC recognizes that required nonexclusive licensing policies for new technology can act to freeze out smaller companies from participation. It is also difficult to have meaningful diligence provisions in nonexclusive licenses for technology which requires considerable investment to bring to the market. NRDC thus has freedom to take the best licensing course in the UK public interest to assure both timely innovation of new technology and participation by smaller companies.

Research Corporation (U.S.) - Research Corporation (RC) was established in 1912 as a non-profit foundation for the advancement of science and technology. Its founder, F.G. Cottrell, along with his associates, endowed RC with patent rights on his electrostatic precipitator for industrial gas cleaning. RC objectives are to make inventions "...more available and effective in the useful arts and manufactures..." and "to provide means for...scientific investigation, research and experimentation..."

RC, based in New York City, has invention agreements with well over two hundred institutions. However, as utilization of RC services is optional, and a number of universities have initiated in recent years ULO's or ILO's, many of the invention agreements are inactive.

RC has been an important source of research funding support to scientists, making a large number of small grants, typically in the $5,000-$10,000 range. A particular focus is upon "seed money" support to young faculty members, not yet in position to compete effectively with established scientists for major research grants. Reduced revenues in recent years have caused a cutback in grant funding from $4.2 million in 1972 to $2.5 million in 1978.

The Invention Administration program, with a professional staff of about 15, evaluates, secures proprietary protection, and licenses inventions submitted. (368 invention disclosures were offered to RC in 1978.) All expenses are incurred by RC at its risk with royalties allocated among the inventor, the institution and RC, the inventor's share depending on the patent policy of the institution. In 1978, of $1,279,624 gross royalties, $569,326 was distributed to institutions and $191,367 to inventors.

SINTEF (Norway) - The Selskapet for Industriell og Teknisk Forskning (SINTEF) of Norway's technical university was established in 1951 as an industrial liaison office for the university. It has evolved into a substantial (around 850 full-time workers) contract research organization, which draws upon both the university's and SINTEF's competence and resources in carrying out its program of research.

Cooperation by university faculty with SINTEF is voluntary. SINTEF is generally allowed to use university facilities (laboratories, instruments, libraries, etc.) without charge. The university utilizes many SINTEF scientists as part-time teachers and thesis advisors. The university's computing center is run by SINTEF on behalf of the university.

Involvement of students in SINTEF projects is not usual, but "spin off" or exploratory research related to SINTEF projects is common.

The university's professors constitute the "general assembly" of SINTEF, and appoint its board of directors.

Despite the potential for either the university or SINTEF adversely affecting the other's functioning--such as diverting the university from its primary role of education--the relationship apparently has been synergistic and of mutual benefit.

Licensing has not been a major activity as intellectual property rights have generally been left with research sponsors. In 1970, Norway adopted an employee-inventors rights bill, similar to Germany's, which poses unique administrative problems. For example, SINTEF clients in many instances must deal directly with SINTEF employees to obtain rights to inventions.

University faculty may offer inventions to SINTEF for licensing. If SINTEF obtains income for the inventors, expenses are recovered and net shared with the inventors. Licensing activity for the university has been, to a large degree, considered a service.

Toronto Innovations Foundation (Canada) - The University of Toronto Innovations Foundation (TIF) is one of the newest organizations directed toward innovation of university research, having been established in 1979. TIF's form of organization and licensing procedures resulted from a comprehensive study of features of other university licensing programs. The focus of TIF is as a business-oriented organization, directed to bridging the innovation gap from the university laboratory to the marketplace.

The Board of Directors (12) are to include at least three from the university and at least five from industry, commerce and government. TIF intends to both license University of Toronto technology and to "start up" new companies and take equity positions in such new ventures in exchange for technology and financial support, when appropriate. In its start-up function, TIF anticipates providing initial financing and technical and business expertise until the venture is at a stage where other financing can be obtained.

TIF is being funded by a private foundation contribution, in addition to "membership contributions" from Canadian financial institutions. "Members" will have the right of first refusal, on a rotational basis, for investment in new venture companies, or in existing companies, if investment is required to commercialize a technological opportunity.

Unikontakt (West Germany) - Unikontakt is at present the only German ILO, founded at Ruhr-University Bochum and also affiliated with Dortmund University. Unikontakt also can act as an ILO for other universities.

Consulting for industry has been a private matter for German university scientists. However, without a contact point at a university, it was observed to be difficult for industry to reach appropriate consultants or to make arrangements for research or other services of the university which could be applied to benefit of industry. Unikontakt was thus formed with the following main functions:

-- preparing, presettling, and, if necessary, supervising projects between university and extra-university partners, including the search for public sponsorship for the project;

-- procuring advisory services and usage of university equipment for practical problems;

-- conferences, seminars, and congresses that enforce the flow of information between research and application and stimulate joint research projects;

-- assistance to project partners and especially to university members in securing and realizing patent rights.

In Unikontakt experience, licensing of already-developed inventions are of significantly less benefit to industry in comparison to the collaborative university-industry research interaction.

University Patents, Inc. (U.S.) - University Patents Inc. (UPI) was established by the University of Illinois Foundation in 1964 to administer and market products developed in university laboratories. Through contractual agreements, it acts as the exclusive licensor for a number of U.S. universities and, in addition, receives technology for licensing from other entities. The university agreements provide for distribution of 60% of gross royalty income from an invention to the university.

In 1968, UPI acquired Regal Rugs, Inc. In years which the patent and licensing function of UPI has operated at a deficit, the steady earnings made by Regal Rugs have been of great significance to UPI's cash flow. UPI now manages inventions for 11 universities and, after distribution of income to its client universities, is now operating close to break-even.

The University of Illinois Foundation is now only a minor shareholder in UPI, a publicly-held company. UPI, now located in Norwalk, Connecticut, has a full-time staff of seven in Norwalk. It utilizes consultants (approximately seven at present) located at campuses of their various university clients.

Wisconsin Alumni Research Foundation (U.S.) - The Wisconsin Alumni Research Foundation (WARF) was established in 1925 by alumni of the University of Wisconsin following a controversial resolution by the regents of the university. This resolution, in effect, considered external gifts, donations, subsidies, etc., for research as "tainted money" which could not be accepted. The result was to limit researchers at the university primarily to state support, which was rarely sufficient.

WARF was then established to manage the university's patents and to use any funds derived therefrom to stimulate, promote and provide funds for scientific investigation and research at the University of Wisconsin. WARF is governed by a board of trustees chosen from alumni of the University of Wisconsin whose members contribute their time. Members are typically executives of major companies.

A Wisconsin inventor receives 15 percent of the net income that might be received for his or her invention. Other net income is granted to the university in accordance with WARF's charter. Approximately $100 million has been so granted from 1925 to the present with the current annual level approximately $4.5 million.

In addition to patent royalties, income has been obtained from investments (largely in common stocks of young, growing companies). These investments now provide the major portion of WARF income. Other sources of WARF revenue are gifts, including real property, which WARF manages. The 1978-79 total annual gross royalty income approximated $1.1 million, of which 60% was attributable to a single invention (an anti-coagulant).

WARF is staffed by 7 professionals, of which 3 are involved full time in patenting and licensing functions. By intent, there are no staff members (or trustees) who are also on the university faculty or staff. Both WARF and university spokesmen have indicated there has been a close cooperation between WARF and the university.

IX. Summary

-- Increased emphasis on innovation of university research was observed in all countries surveyed, with most ULO's, ILO's and RDO's or other forms of organization having been established in the last 10 years.

-- Three forms of organization directed to innovation of university research results were observed to be most common: the national research development organization (RDO), the university licensing office (ULO), and the industrial liaison office (ILO). Several other unique organizations were also observed. Fifteen organizations were described in summary detail. It was also noted many universities have no organization and/or were relatively passive with respect to directed efforts to innovation of university research.

-- University policies with respect to ownership of inventions varied although public universities generally retained ownership of inventions.

-- Royalty distribution arrangements varied widely, although rarely was there not a policy which included sharing of royalty with the inventor. Sharing of royalty with the inventor's laboratory or department was common.

-- Generally, ILO's did not emphasize intellectual property licensing, due often to a national RDO which covered this function and also not to retaining provisions for royalties in industrial research agreements. Leuven Research and Development (LRD) is an interesting exception, emphasizing in its collaborative arrangements with industry the sharing by royalty or equity of successful results of university-industry collaboration.[8]

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8. As an editorial observation, an optimal organization for innovation of university research would appear to be of the ILO form, with a policy of negotiating a sharing with a company of results of a successful collaboration, similarly to LRD. An advisory board of prominent individuals from industry would be helpful. A "venture capital" function as proposed by TIF would be quite complementary. An organization legally separate from the university will be required in many countries for administrative and tax-related reasons. Appropriate incentives and rights to ownership of inventions conceived at the university would be of critical significance.

-- Government research agency involvement in the innovation process through either retention of ownership in inventions, or required payback of royalty income, or required non-exclusive licensing appeared to act as disincentives or absolute bars to innovation.

-- Economics of a ULO were generally not favorable to a university in the absence of one or more fortuitous major income producing inventions. This principle also applied to the university licensing element of RDO's.

KEY TO ABBREVIATIONS

ANVAR	Agency Nationale de Valorization de Recherche (France)
CICL	Centre for Industrial Consultancy and Liaison (UK)
CNRS	Centre National de Recherche Scientifique (France)
DGRST	Delegation Generale Recherche Scientifique Technical (France)
DIC	Danish Invention Center (Denmark)
ILO	Industrial liaison office
JED	Japan Engineering Development Co. (Japan)
LISCO	Leuven Industrial Software Company (Belgium)
LRD	Leuven Research & Development (Belgium)
NRDC	National Research Development Corp. (UK)
NTIS	National Technical Information Service (US
PI	Pasteur Institute (France)
RC	Research Corporation (US)
RDO	Research development organization
ROI	Return on investment
SINTEF	Selskapet for Industriell og Teknisk Forskning (Norway)
TIF	Toronto Innovation Foundation (Can
ULO	University licensing office
UPI	University Patents, Inc. (US)
WARF	Wisconsin Alumni Research Found

atent awareness will lead to an earlier
entification of inventive concepts

all federal granting agencies to maximize
stment in grants dollars

basic assumptions:

- Inventions can arise from university research
- These inventions can be put to practical use

Techniques to be tested:

- Assist faculty to recognize and disclose inventions
- Acquaint university community with role of patents in innovation

(Slide 1)

PATENT AWARENESS PROGRAM:

FOUR PHASES

- Review of ongoing research
- Seminars
- Continuing support (monthly visits)
- Report of results

An Overview

Roles of faculty researcher: teach, acquire and disseminate knowledge

Connections between these roles and invention, patents and innovation

Recognizing An Invention

Recognition is a critical step in innovation process

Characteristics of inventions: newness, usefulness

- Either newness or usefulness should alert the researcher
- Not necessary that these characteristics coexist initially

(Slide 4)

AN INVENTION IS

Something new and useful which may be...
- A solution to a problem
- Something that satisfies a need
- A better way of doing something
- An improvement to an existing development

(Slide 5)

THE PROCESS OF INVENTION INCLUDES

- Mental act: the "conception" (an end result and the means to obtain it)
- Physical act: the "reduction to practice" (proving by demonstration that result is obtained)

Good records are vital

- As an aid to recognizing inventions
- As the only acceptable means to establish conception and reduction to practice

Disclosing the Invention

A disclosure is a written description of an invention

- Two functions: explain invention, state its use

Applying for patent, then publishing, means that:

- An incentive to develop, usually required by academic inventions, can be provided to industrial firms
- The incentive to develop is a preferred marketing position assured through a time-limited exclusive license

(Slide 8)

BENEFITS OF PATENTING

- Provides incentives to industry to develop
- Gives public new products, processes not otherwise available
- May provide financial return
- Retention of control by patentee can prevent abuses
- Disseminates knowledge
- Stimulates further research by others

Misconception: "If you publish you can't patent; if you want to patent you can't publish" - not true if proper time sequence is followed

Publication before filing a patent application causes immediate forfeiture of foreign rights

- Six months after publication you lose the right to patent in West Germany and Japan
- One year after publication you lose the right to a patent in the United States

If you file first in the United States, you preserve the foreign patent rights for one year regardless of a later publication

To summarize, we have considered the recognition and disclosure of inventions, patenting and publishing, and the options open to the academic inventor

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Washington Merry-go-Round

U.S. has tariffs beef with Japan

By JACK ANDERSON

WASHINGTON — Two influential Texas Democrats, silver-haired Sen. Lloyd Bentson and silver-tongued trade troubleshooter Bob Strauss, were arguing recently about the multibillion-dollar licking American businessmen are taking from their Japanese counterparts.

The senator, concerned for his cattle-raising constituents, complained to Strauss that the Carter administration was letting the Japanese get away with murderous tariffs on American beef. This has pushed the price of sirloin steak as high as $45 a pound in Japan. The current trade negotiations, said Strauss a bit defensively, "are a step in the right direction and I'm not going to say any more than that."

The normally mild-mannered Bentson was moved to sarcasm by Strauss' claim. The slight increase in the shipments of American beef to Japan, Benston said, merely means that the Japanese have increased their per-capita beef consumption from "a thin patty to a quarter-pounder."

The Texas senator's disgust reflects a growing concern in Congress that the Japanese are winning their biggest victory over the United States since Pearl Harbor.

While the Japanese government's protectionist policies put the cost of imported oranges at a dollar each and push American beef toward the price range of caviar, Japanese manufacturers have no trouble undercutting American automobile and television makers in this country.

We now import $11.6 billion more in goods from Japan than we export in a year, a situation that costs thousands of American jobs, adds fuel to inflation and drives the dollar's value down. A confidential memo prepared by the staff of the congressional Joint Economic Committee pin-

ANDERSON

points the cause as far as trade with Japan is concerned.

"Japanese barriers to U.S. exports is one case where there is more fire than smoke," the memo states. The committee staff suggests that an upcoming congressional investigation may prove to be so "inflammatory" that it may "fuel the growing mood of protectionism in the country and the Congress."

For example, the eyes-only study shows that the Japanese government's grain-buying agency charges buyers of imported grain twice the actual import price, while American cigarettes receive a 500 percent markup.

And while Datsun and Toyota are treated just like any other auto makers in the United States, American manufacturers run into all sorts of difficulties trying to sell their cars in Japan.

Two years ago, the secret report notes, American firms scored a major production breakthrough of phosphate fertilizers, widely used in Japan. But the Japanese Ministry of International Trade and Investment began, "informally asking major Japanese customers to buy Japanese," the report states. The U.S. firms subsequently lost about 30 percent of their business in Japan.

The Japanese set tariffs on high-technology products at triple the rates charged by other free-trading nations, while encouraging their own manufacturers to organize monopolistic cartels for research and production of this badly needed equipment.

Already worried about bad publicity in this country, the Japanese have hired dozens of high-powered agents, including former CIA Director William Colby, to help influence public opinion in hopes that nothing will be done to bring the one-sided profiteering to an end.

The Japanese aren't overlooking the American media, either. Costly junkets and other freebies are arranged for American reporters; newsmen who might be expected to write favorable stories are given red-carpet treatment, while those who might be critical find it hard to get interviews with top officials.

One veteran correspondent told our associates Jack Mitchell and Les Whitten that some American reporters in Japan are actually getting payoffs from the Japanese government in return for sympathetic stories.

Mailbag

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The fading guidelines

The Carter Administration may maintain a brave face in public, but in its strategy sessions it should recognize the fact that its wage-price guidelines program is coming to pieces. It would be better for the Administration to write off the whole unfortunate experiment as a failure than to try to keep up the pretense of effectiveness.

The guidelines, of course, have never been more than window dressing. The real hope of stopping inflation lies in fiscal and monetary discipline—in a shrinking federal deficit and strict limits on the growth of money supply. But even as window dressing, the wage-price control program has lost conviction. The breathtaking rise of 1.3% in wholesale prices in January inevitably will work through the chain and emerge as double-digit inflation at the consumer level. The big unions that will negotiate major agreements this year—the Rubber Workers and the Teamsters, for instance—will want to make up for what inflation has cost them before they begin talking about the 7% raises the guidelines prescribe (page 22).

At this point, the Administration will be under mounting pressure to do one of two things: Either make the controls compulsory or relax the wage guideline to permit increases that match the rate of inflation. The President should firmly reject both choices.

Mandatory controls do not work for more than a short time. They can check the wage-price spiral briefly, but in doing so they create distortions in the market and continuing misallocations of resources. The result is shortages, black markets, and, eventually, an inflationary explosion.

Bending the guidelines to accommodate higher wage increases would make the control apparatus part of the inflation process. It would give the Administration's blessing to wage increases that are bound to keep the wage-price spiral spinning.

Before taking either step, the Administration should acknowledge that the control program is one more failure in the long history of attempts to stop inflation by dealing with symptoms rather than causes.

Japan's money machine

Japan has been an eager participant in the five years of negotiations among the world's major trading nations that finally have produced a package of liberalizing agreements. But now that the negotiators are nearly ready to bring their codes home for ratification, the Japanese are still trying to exclude key government agencies from the new rules.

Perhaps the most crucial test of Japan's good faith in these negotiations will be whether or not it agrees to allow free international bidding on purchases by Nippon Telegraph & Telephone Public Corp. and by roughly 140 other Japanese government-controlled corporations. The combined budget of these operations comes to about half the size of the Japanese government's total national budget of $170 billion. NTT alone controls directly and indirectly about $2 billion worth of procurement.

The agreement calls for open international bidding procedures in government procurement. But, says Japan, it has not yet been determined that NTT's buying falls in that category.

This is just one more example of the way Japan has used interrelated companies and nontariff barriers to shut its markets to imports. U. S. producers who have tried to sell in Japan have encountered taxes, testing requirements, licensing, and a wide variety of other regulations that shut the door to U. S. goods. Meanwhile, Japan runs enormous trade surpluses that have been one of the reasons for the decline of the dollar.

NTT has always followed a rigid "buy Japanese" policy. Recently, a subcommittee of the House Ways & Means Committee singled out the company as a flagrant example. NTT, the subcommittee remarked, "does not appear to have any awareness of the incredibly serious trade problems between our two nations or that NTT procurement policies are one of the sorest points in our bilateral trade. . . ." This is an issue on which the U. S. should make no concessions.

Chicken Little says

The Energy Dept. that Secretary James Schlesinger has built seems to believe that the way to solve a problem is to dramatize it. Predictably, its reaction to the relatively small shortfall in oil supplies, caused by the Iranian revolution, was to talk of an "oil crisis" and forecast gasless Sundays.

Doomsday forecasting is a good way to get attention, as Chicken Little demonstrated when he declared that the sky was falling. But a Cabinet officer who demands attention should be prepared to make constructive use of it, and Schlesinger's thinking apparently did not extend that far.

And so the net effect of the dramatics was to start a modest wave of hoarding. So far, it has not had serious effects on supplies because not many consumers seem to take Schlesinger seriously. But with enough encouragement from the Energy Dept., it could become a panic.

Actually, the loss of Iran's production is not comparable to the 1973 embargo, although Schlesinger does not seem to see a difference. The 1973 cutoff was abrupt and deep. It was accompanied by a quadrupling in prices, a violently disruptive move.

The Iranian shortage is troublesome mainly because the U. S. did not let domestic prices adjust to the new world price. The easiest response to Iran's shutdown would be to let the open market determine the price, but the U. S. cannot do this now, because the switch from a controlled price to a free price would be too inflationary for the economy to take at this time.

There are things the Energy Dept. could be doing—such as shifting consumers from oil to natural gas and encouraging the development of small increments of new supply. It should be doing them instead of crying havoc.