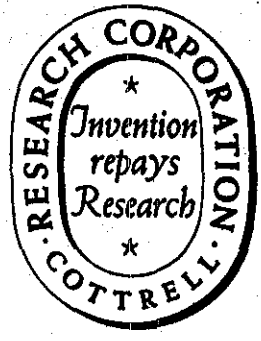
Study of Patents Resulting From NSF Chemistry Program



Research Corporation
Invention Administration Program

405 LEXINGTON AVE., NEW YORK, N.Y. 10174

STUDY OF PATENTS RESULTING FROM NSF CHEMISTRY PROGRAM

BY

RESEARCH CORPORATION
INVENTION ADMINISTRATION PROGRAM

405 LEXINGTON AVENUE
NEW YORK, N.Y. 10174

Willard Marcy, Ph.D.
Principal Investigator

Bernard M. Kosloski, B.S.(ChE), M.B.A.
Associate Investigator

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STUDY OF PATENTS RESULTING FROM NSF CHEMISTRY PROGRAM

ABSTRACT

The purposes of this study were to determine the extent to which the NSF Chemistry Program's research funding led to patented technology, to estimate the economic value of those patents, and to develop a systematic method for evaluating patents associated with other NSF supported research grants.

A procedure was developed to select the names of those principal investigators supported by NSF Chemistry grants who are also named as inventors on chemistry patents registered with the U.S. Patent and Trademark Office. An examination was then performed to determine the relevance of each grant to the associated patent. Finally, an estimate was made of the economic impact of those patents, based on licensing data obtained from patent assignees.

The study found that between 1964 and 1977 about one NSF Chemistry Program grantee in 100 produced patents related to his or her grant, and that the aggregate long-term sales of products derived from those patents is estimated to be in the order of magnitude of $20-30 million. Similar frequency of patents and their average value were found from an analysis of a set of chemistry grantees supported by Research Corporation, a private foundation. This suggests that the values found in this study for the NSF Chemistry Program represent what can be expected from basic research at academic institutions.

The procedures used in this study can be applied, with comparable effort, to evaluating patents associated with similar research grant programs at NSF and elsewhere.

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NSF CHEMISTRY PROGRAM PATENT STUDY

Introduction

Whether valuable patented inventions have resulted from academic research supported by National Science Foundation (NSF) grants has been debated among the members of the National Science Board and by Congress over the years. Although the NSF Office of the General Counsel has been recording grantee invention disclosures and the filing of corresponding patent applications, no systematic study has been undertaken by the Foundation to assess the significance of such patent activity or its value to the national economy. Recent economic and legislative developments* have given emphasis to the need for identifying and evaluating patented inventions as legitimate outputs of NSF-supported research.

The purposes of this study are to determine the extent to which NSF Chemistry Program Grants produced patented technology and to estimate the economic value of those patents. In addition, the study develops a systematic method for evaluating patents associated with research grants which can also be useful for other NSF project grant programs as well.

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* For example, The Patent and Trademark Act of 1980 gives general authorization to universities and colleges to promote inventions resulting from government-funded research.

Scope of Study

The study examined some 300 Chemistry Patents, nearly all the patents issued between 1975 and 1981 to the 3766 principal investigators supported by the NSF Chemistry Program between 1964 and 1977. To provide a basis for comparison a list of 915 basic chemistry research grantees supported by Research Corporation (RC) between 1964 and 1974 was also used.

Procedure

The first part of this study seeks to determine the number of basic research grants supported by NSF's Chemistry Program which also produced United States patents.

The second part, performed by Research Corporation (RC), investigated the economic impact of the patents found. It follows a patent commercialization process used in industry, which is summarized on Page 7.

Caveat on Baseline Estimates

This study attempts to plow new ground in an uncertain and difficult area. The data base used was constructed from best information available from NSF and U.S. Patent Office computerized files, which may have been incomplete. The time periods selected for analysis were chosen to best approximate the mainstream of grant-patent activity, within the constraints of the data. Nevertheless, the evaluation methods used are straightforward and provide a reasonable basis for arriving at the results found.

Sources of Data: Patents Related to NSF Chemistry and RC Grantees

The primary data sources used were the "NSF Chemistry Program History Tape", an unduplicated alphabetical listing of some 5600 Principal Investigators (PIs) supported by the NSF Chemistry Program between 1953 and 1977, and the U.S. Patent and Trademark Office's (PTO) computerized list of patents issued between 1974 and 1981.

Only patents which were issued after 1974 are given in the list of computerized titles of the PTO. Normally, it takes about 3 years after a grant is made to do the research, from 2 - 4 years to prepare and file a patent application based on that research, and an additional 2 to 7 years for prosecution in the PTO before a patent is issued. Based on these time requirements, we assumed that the grants awarded between 1964 and 1977 most likely contained the research which produced patents issued between 1975 and 1981.

Using the names of 3766 NSF Chemistry Program grantees (between 1964 and 1977) computerized matches were made with the names of inventors listed in the PTO's data-base files of chemical patents issued during the period January 1975 through June 1981. Similar name-matches were made using a list of 915 RC grantees receiving grants for basic chemistry research between the years 1964 and 1974.

The use of comparative data from RC in this study was considered reasonable, since the criteria used for selecting its grantees

are similar to those used by NSF, and RC is a well-known private foundation with more than a 50-year history devoted to financial support of basic research in the physical sciences at universities and colleges throughout the U.S. In fact, there were identical name-matches (some 15% overlap) found between NSF and RC groups, but grants were awarded for different academic years. It should be noted that RC grantees are younger, get less money, and their grants are rarely renewed.

Selection Criteria

The first step in carrying out this study was to determine the extent to which the basic research supported by NSF's Chemistry Program between 1964 and 1977 produced United States patents. The names of the PIs (both NSF and RC) were matched by computer against the names of inventors listed on chemical patents issued by the PTO. For each match, a grantee institution was determined by reference to the inventor's name, address and assignment of the patent. This information was later used to verify the name-identity of particular PIs and inventors.

To organize the substantive examination of the relevance of patents to grants, the patents identified from the name-matching search were obtained, reviewed, and assigned to one of three categories using the following selection criteria:

Category *	Assignment Criteria
XXX (Directly Related)	. PI and patent inventor names are identical . NSF support acknowledged in patent
XX (Probably Related)	. PI and patent inventor names are identical . Titles and/or subject matter of both grants and patents are related . Patent application date is concurrent with or follows grant award date
X (Possibly Related)	. PI and patent inventor names are identical . Titles and/or subject matter of both grants and patents are similar . Patent application date follows grant proposal date . University and geographic proximity

*See Appendix Table A-I.

Procedure for "Determining Relevance of Patents to Grants"

Each of the selected patents where a named inventor and PI are identical was examined by a subject expert for possible "relevance" of the subject matter of the patent to the research performed under the grant. About half of the patents (55 of 95) contained acknowledgements to specific NSF grant support; for these no further examination for "relevance" was considered necessary.

For the remaining grantees, the examination comprised a review of the original grant proposal, each interim and final technical report and any publications resulting from the research all as contained within the grant jacket. The technical details in these documents were compared with the specifications and claims in the associated patent. Finally, a "patent relevance" judgment was arrived at by the subject expert and recorded on a special worksheet, with the substantiating evidence. For the RC grantees, since the group of PI/Inventors was small (57), and the names were well known to the examiners, the comparison made between the grant title and subject matter of the issued patent was all that was considered necessary.

The results of this part of the study as shown in Table 1 are:

- o 73 of 3766 (1.93%) NSF Chemistry Program PIs were listed as named inventors on issued U.S. patents.

- o 195 patents were issued to these 73 NSF grantees; 95 of these 195 patents were issued to 39 PIs involving technology related to research supported by NSF. The remaining 100 patents were judged not relevant to a grant made by NSF. (The 39 PIs represent 1.04% of the 3766 Chemistry PIs supported by NSF).

- o 57 of 915 (6.2%) RC grantees were named as inventors on issued U.S. patents. This higher percentage (6.2%

Table 1

COMPARISON OF RESULTS

	National Science Foundation Chemistry Program PIs	Research Corporation Chemistry Grantees
Period Covered	1964-77 (14 years)	1964-74 (11 years)
Number of Principal Investigators	3766	915
Average Duration of Grant	30 months	12 months
Number of Patents to which Grants are Relevant (Direct or Contributory)	95	16
Number of Principal Investigators on Grants which are Relevant to Patents	39	9
Number of Principal Investigators Named as Inventors on Any Patent	73	57
Median Time From Grant Award to Filing of Patent Application	5.2	6.4

compared with 1.9% for NSF) might be explained by the fact that RC grantees typically are younger first-time PIs who subsequently received support from other agencies. In fact, 7 of the 57 RC inventors are among the 73 inventors who received grants from NSF.

- 32 patents were issued to the 57 RC PIs; 16 of these 32 patents were issued to the 9 PIs whose work was judged relevant, at least in part, to the grants made by RC. The remaining patents were judged not related to RC grants. (The 9 PIs represent 0.98% of the 915 PIs supported by RC.)

- 81 of the 130 patents (61%) associated with both NSF and RC grantees are assigned to a U.S. college or university.

Economic Value of Patents

An economic assessment of each "relevant patent" was developed from information requested from universities and other patent owners to whom assignment of the patent had been made. A questionnaire was sent to obtain information on whether the patent has been licensed, date of first sale if marketed, volume of business attributed to the patented invention to date, and estimates of total volume of business over the life of the patent and over the life of the patented products or processes. Although it is too early for full commercialization of patents covering research

conducted in the 1964-1975 time period, the information on the early use of the patent itself provides a basis for estimating its potential value.

A majority of the patents examined were not licensed (Table 2). For both the NSF and the RC grantees, each "relevant patent" was analyzed as to the likelihood that commercial licensing interest could be developed.

For each patent, the technology covered, type of claims, and problems visualized in licensing the claims are summarized in Appendix, Table AII. Many of the patents are considered of doubtful licensability, i.e., they have limited commercial application, present insurmountable difficulties to protect against infringement, or have no apparent economic advantage over existing processes. The estimated economic value (sales of patented products or processes) of the NSF and RC patents to date is relatively small (Table 2 and Appendix-Table A-111). However, our conservative estimate of their total economic potential is on the order of magnitude of $20-30 million. This estimate is based on our long experience in evaluating, patenting and licensing chemical inventions from academic institutions including many which were supported by NSF.

The results of this analysis are:

- 16 of the 95 patents resulting from NSF-supported research have been licensed or assigned to an industrial company

Table 2

ECONOMIC IMPACT

	Number of Patents	
	NSF PIs	RC PIs
Number of Patents Assessed (See Table 1)	95 of 132	16 of 25
Licenses		
Licensed or assigned	16	8
Licensable	36	5
Total	52	13
	Estimated Sales	
Economic Values		
Present Sales (1)	$ 457,000	$ 260,000
Potential Sales (2)	26,000,000	5,100,000

(1) It is not possible to estimate, with accuracy, present royalties or sales related to the patents studied. In most cases, either the university assignees or the licensees contacted were unable or unwilling to furnish what they consider "proprietary" data.

(2) Based on conservative estimates of sales and licensing data projected over life of patents.

and have contributed directly to industrial technology; 36 of the remainder are considered potentially licensable.

- The total economic value of the 52 NSF patents licensed and licensable is estimated at between $20-30 million over the life of the patented products or processes, although the aggregate economic value to date of the licensed patents cannot be determined with any degree of accuracy since adequate information is not available from more than 2 or 3 licensees or assigness. The corresponding aggregate economic value of the 13 licensed or licensable patents related to RC grantees is about $5 million over the life of the patents. The economic impact of the NSF and the RC patents in this study are comparable.

Conclusions

Based upon our analysis of the findings from this study (and the knowledge gained from over 30 years of experience evaluating basic research results and chemistry patents) the following conclusions are offered:

- Few commercialized patents result from grants for basic chemical research or from the PIs who conduct the research. However, the figures for both NSF and RC are similar, suggesting that this is due more to the nature or direction of the research rather than poor performance by the investigators. The fact that about one PI in 100 on NSF-supported grants is issued a patent

relevant to that grant is about the same ratio as with RC grantees. However, 17% of the NSF patents reviewed here were licensed or assigned to industrial companies, some 20% higher than the comparable figure for patents related to RC grants.

- o The patents reviewed, which resulted from basic research grants, have had only slight impact on technology to date, but, can be expected to have considerable economic value in the long run. ($26 million, over 30 years.)

- o The methodology used in this study was based on straightforward assessment of possible patent commercialization. This methodolgy was found to be applicable to NSF post-performance Program Evaluation Studies, and can be applied to the evaluation of other scientific research grant programs as well.

- o From this study it appears the PIs' recognition of awareness of patents and their constructive use is greater today than it was only 10 to 15 years ago.

Discussion:

Interview with NSF PI

In order to shed more light on the findings and conclusions of this study, one telephone interview was conducted with a former

NSF-supported PI who is also a named inventor. Although not representative of all grantees, the interview provided a classic illustration of how basic research results diffuse into the commercial marketplace in the United States.

This investigator received a number of grants fron NSF over the past 20 years for research in various distinct areas of organic chemistry. And his very early work was supported also by Research Corporation. He stated that the RC grant - for a highly theoretical study of chemical reactivity - came at an early stage in his career. It was highly influential in causing him to continue his research interest by applying his theoretical findings in his subsequent research and led to the obtaining of research grants from NSF and other government agencies. He also worked as a consultant with support from industrial companies in unrelated areas of chemistry.

His early NSF grants were for basic research in the use of organometallic compounds to catalyze reactions in the synthesis of pharmaceuticals, flavors and fragrances. One patent was issued as a result of this work and was licensed by the university to an industrial company which is still using the patented process. The investigator stated, however, that subsequent to and as a result of publication of the work done under the original grant, he and other investigators continued in the general research area under sponsorship other than NSF. Many important improvements, including new compounds, have been made, and, he asserted, are now in commercial use.

Later NSF grants were made to this investigator for research in an entirely different field of chemistry; two closely related patents have now been issued and are assigned to his university. These patents have not yet been licensed, and it appears from this study that neither will have substantial commercial appeal.

As an aside, the investigator volunteered the observation that in his early work, some 20 or more years ago, he gave little thought to possible commercial use of any discoveries he might make, let alone to pursuing patents. He said that scientific research workers, in those days, were naive about patenting and commercialization of research results, but that this situation is much changed today. His present perspective is that academic chemists are obligated to be constantly aware of such commercial (technological) applications inherent in all their basic research work whether supported by government or industrial funding.

Qualitative Observations

During this study a number of observations were made that did not lend themselves to tabular summaries or quantitative evaluation. One such observation relates to the long-term nature of basic research in chemistry. As shown in Table 1, five to seven years was the median time from the Research grant to filing for the first patent incorporating the results of the research performed under the grant. After the patent is issued, finding industrial licensees may take 1 to 3 years. For these licensees to develop

and market products may take as long as 10 to 15 years additional time. This lapse of time explains why early economic impact resulting from research supported by NSF grants cannot be expected via the patenting-licensing-commercial development route.

Another observation concerns the route for commercially utilizing basic research results via the obtaining and licensing of patents. The effectiveness and efficiency of this activity is not entirely adequate and needs improvement. Other routes exist, however, which are exemplified by the serendipity and slow diffusion of research to patent information in the organometallic case previously discussed. This route is slow because it depends to a large extent on chance.

The study also found that academic chemists today are more aware of the need to find economic benefit from basic research results than they were 15 to 20 years ago. This conclusion is apparent in this study from the increased number of patents which are assigned to universities and colleges covering recently obtained research results, as compared to the infrequent number of patents assigned to universities some 30 years ago. This trend is confirmed by the ten-fold increase in grantee disclosures reported for all grantees, not just chemistry, to NSF's Office of the General Counsel over the past twenty years (Table 3).

Although there is insufficient evidence to determine whether patent incentives alone appreciably increase academic innovation in chemistry, this study of the NSF role in supporting patented

Table 3

NSF Grantee/Contractor Invention Disclosures*
1961 to 1982

FY	Number of Disclosures	FY	Number of Disclosures
1961	7	1972	59
1962	9	1973	85
1963	20	1974	78
1964	36	1975	159
1965	37	1976	156
1966	34	1977	122
1967	61	1978	94
1968	46	1979	111
1969	62	1980	107
1970	53	1981	95
1971	55	1982	101

*For all NSF grantees, not just chemistry.

Source : NSF Office of the General Counsel.

chemistry inventions provides a method for evaluating in future years the changes in the patent output attributable to NSF's Chemistry Program grantees.

This evaluation of chemistry patents associated with NSF-supported research provides a useful baseline for measuring changes over time in patent output, not only for making further patent studies for chemistry, but also for other NSF-supported research grant programs.

APPENDIX

R E S E A R C H C O R P O R A T I O N

Assessment of Patents Associated with NSF Chemistry Grants

RELEVANCE OF PATENTS TO GRANTS

SUMMARY OF ANALYSES

NSF Grant Number	Key	Institution	U.S. Patent Number	Is patent related to research performed under this NSF Grant: Directly	Contributed	No
GP-8869	x	Univ.of Alabama	3886180		x	
GP-8869	x	Univ.of Alabama	4006160		x	
PO-38313	x	Boston Univ.	4046790			x
PO-38313	x	Boston Univ.	4163756			x
PO-38313	x	Boston Univ.	4225511			x
GP-5297	x	Georgia Inst. Tech.	4045545			x
GP-5297	x	Georgia Inst. Tech.	4081524			x
PO-29118	x	Princeton Univ.	4032419			x
GP-8672	x	Boston College	3959232			x
77-15385	xxx	Stanford Univ.	4136062	x		
PO-42186	xxx	Stanford Univ.	4271041	x		
GP-6492	xx	Purdue Univ.	4082810		x	
GP-6492	x	Purdue Univ.	3984479		x	
GP-6492	x	Purdue Univ.	4078002		x	
PO-17926	x	Univ.of Florida	3962206			x
PO-17926	xx	Univ.of Florida	4098627			x
PO-31884	x	Univ.of Tennessee	3966491			x
GP-3818	x	Iowa State Univ.	4003966			x
GP-3818	xx	Iowa State Univ.	4066719			x
GP-26050	xxx	Ohio University	4059679	x		
76-17237	xxx	Texas A&M Univ.	4180551	x		
PO-20273	xxx	Stanford Univ.	3872168	x		
75-17018	xxx	Stanford Univ.	3872218	x		
75-17018	xxx	Stanford Univ.	3985770	x		
7517018	x	Stanford Univ.	4073778			x
GP-4400	x	Harvard Univ.	3867460			x
GP-4400	xx	Harvard Univ.	4122093			x

RELEVANCE OF PATENTS TO GRANTS

SUMMARY OF ANALYSES
(Continued)

NSF Grant Number	Key	Institution	U.S. Patent Number	Is patent related to research performed under this NSF Grant: Directly	Contributed	No
GP-4400	x	Harvard Univ.	4214099			x
GP-7193	xxx	U. Cal-Berkeley	4001279	x		
GP-7193	xxx	U. Cal-Berkeley	4043979	x		
72-04616	xxx	U. Cal-Berkekey	4080337	x		
77-00452	xxx	U. Cal-Berkekey	4113959	x		
PO-33533	xxx	U. Cal-Berkekey	4128556	x		
GP-23759X	xxx	Penn. State Univ.	3993550	x		
GP-5663	x	Penn. State Univ.	4116987			x
75-19171	xxx	Univ. of Illinois	4230828	x		
76-20664	xxx	Univ.of Rochester	4107076	x		
GP-9485	xx	Univ.of Akron	3933681			x
GP-9485	xx	Univ.of Akron	3984483			x
PO-09485	x	Univ.of Akron	4180692		x	
PO-18587	xxx	Univ.of Akron	3985830	x		
PO-18587	xxx	Univ.of Akron	4108945	x		
GP-12382	xx	Univ.of Illinois	3870612	x		
75-15232	xxx	Univ.of Minnesota	4252723	x		
77-11389	xxx	Cal. Inst. Tech.	4271033	x		
75-19086	xxx	Cal. Inst. Tech.	4169030	x		
GP-4948	x	Michigan State Univ.	3992435			x
77-04973	xxx	Univ.of Delaware	3922299	x		
77-04973	xxx	Univ.of Delaware	3960932	x		
77-04973	xxx	Univ.of Delaware	3988358	x		
GP-3442	xxx	Univ.of Delaware	4128554	x		
GP-3442	xxx	Univ.of Delaware	4175187	x		
GP-5528	x	Brandeis Univ.	4034045			x
GP-5525	x	Brandeis Univ.	4097609			x
GP-12832	x	Univ.of Wisconsin	4010095			x
PO-18575	x	Iowa State Univ.	3882011		x	
GP-7238	xx	Stanford Univ.	3598845	x		

RELEVANCE OF PATENTS TO GRANTS

SUMMARY OF ANALYSES
(Continued)

NSF Grant Number	Key	Institution	U.S. Patent Number	Is patent related to research performed under this NSF Grant: Directly	Contributed	No
GP-7238	xx	Stanford Univ.	3904698	x		
71-03456	xxx	Stanford Univ.	3884945	x		
71-03456	xxx	Stanford Univ.	4055603	x		
77-02704	xxx	Stanford Univ.	4219489	x		
GP-7238	xx	Stanford Univ.	4117234	x		
PO-33486	xx	Stanford Univ.	4189431	x		
GP-2616	xxx	Arizona State Univ.	3967931	x		
GP-2838	xx	Univ. of Chicago	3893803			x
GP-2838	x	Univ. of Chicago	4242238			x
GP-2838	x	Univ. of Chicago	4134904			x
GP-2838	x	Univ. of Chigago	4174345			x
GP-2838	x	Univ. of Chicago	4217279			x
GP-2838	x	Univ. of Chicago	4163774			x
GP-2838	x	Univ. of Chicago	4183852			x
GP-2838	x	Univ. of Chicago	4226770			x
GP-32522	x		3996470			x
GP-32522	x		4029411			x
GP-26147	x	Univ.of Akron	3994993		x	
GP-26147	xx	Univ.of Akron	4136136	x		
GP-26147	xx	Univ.of Akron	4139695			x
GP-26147	xx	Univ.of Akron	4138441	x		
GP-26147	xx	Univ.of Akron	4153584			x
GP-26147	xx	Univ.of Akron	4246373	x		
GP-26147	xx	Univ.of Akron	4215022			x
GP-26147	xx	Univ.of Akron	4081590			x
GP-26147	xx	Univ.of Akron	4210737	x		
GP-26147	xx	Univ.of Akron	4151343			x
GP-26147	xx	Univ. of Akron	4229325			x
GP-26147	xx	Univ. of Akron	4276394	x		
GP-26147	x	Univ. of Akron	4153773			x

RELEVANCE OF PATENTS TO GRANTS

SUMMARY OF ANALYSES
(Continued)

NSF Grant Number	Key	Institution	U.S. Patent Number	Is patent related to research performed under this NSF Grant: Directly	Contributed	No
PO-21305	x	Purdue Univ.	3962053		x	
GP-32578	x	Ill.Inst.Tech.	4025537			x
PO-23265	xxx	Temple Univ.	4241149	x		
GP-25988	xx	Temple Univ.	3932298	x		
GP-25988	xx	Temple Univ.	4011046	x		
GP-23265	xx	Temple Univ.	4066567	x		
GP-23265	xx	Temple Univ.	4138358	x		
GP-23265	xx	Temple Univ.	4176918	x		
GP-23265	x	Temple Univ.	4170477	x		
76-20866	xxx	M.I.T.	4113435	x		
GP-30484	xxx	M.I.T.	3892839	x		
GP-30484	xxx	M.I.T.	3904501	x		
GP-30484	xxx	M.I.T.	3954585	x		
GP-30484	xxx	M.I.T.	3992424	x		
GP-30484	x	M.I.T.	3983182			x
PO-30484	xx	M.I.T.	4076916	x		
PO-30484	xx	M.I.T.	4113772	x		
PO-30484	xx	M.I.T.	4144374	x		
PO-30484	x	M.I.T.	4110474			x
PO-30484	x	M.I.T.	4187252			x
GP-4023	xxx	Boston Univ.	4052536	x		
GP-8186	x	Boston Univ.	4262066			x
CHE76-14304	xx	Vanderbilt Univ.	4089881	x		
73-04771	xxx	Univ.of Pennsylvania	4016331	x		
PO-41766	x	Univ.of Pennsylvania	4204216		x	
PO-41766	x	Univ.of Pennsylvania	4272903		x	
PO-32433	x	Univ.of Tennessee	3966491		x	
PO-32433	x	Univ.of Tennessee	4063005		x	
GP-33456X	x	Rice Univ.	3992221			x
PO-33456	x	Rice Univ.	4165974			x

RELEVANCE OF PATENTS TO GRANTS

SUMMARY OF ANALYSES
(Continued)

NSF Grant Number	Key	Institution	U.S. Patent Number	Is patent related to research performed under this NSF Grant: Directly	Contributed	No
GP-4335	xx	Purdue Res.Found'n	4008388		x	
GP-4335	xx	Purdue Res.Found'n	3997298			x
76-03694	xxx	Cal.Inst.Tech.	3860450	x		
GP-33851	x	Indiana Univ.	4043905	x		
PO-33582	x	Univ.of Mississippi	3985723			x
GP-4414	x	Vanderbilt Univ.	3988369			x
73-08473	xxx	Univ.of Delaware	4216065	x		
GP-25334X	x	Univ.of Pennsylvania	3873823			x
GP-25334X	x	Univ.of Pennsylvania	4044252			x
PO-25334	x	Univ.of Pennsylvania	4209690			x
GP-8992	x	Cal. Inst. Tech.	3901950			x
GP-43982	x	City Univ.of N.Y.	4230546			x
PO-28485	xx	U. Cal-Berkeley	4113590	x		
PO-28485	x	U. Cal-Berkeley	4043934			x
76-07410	xxx	M.I.T.	4197419	x		
76-07410	xxx	M.I.T.	4231947	x		
76-07410	xxx	M.I.T.	4245131	x		
PO-33948	x	Kansas State Univ.	3954809			x
72-04216	x	Kansas State Univ.	4044154			x
PO-33948	x	Kansas State Univ.	4151178			x
GP-6466	x	M.I.T.	3899523			x
PO-32031	x	U. Cal-San Diego	4043934			x
GP-5659	x	Univ.of Iowa	4000187			x
GP-5659	xx	Univ.of Iowa	4259519			x
GP-13785X	x	Columbia Univ.	3970685			x
GP-13785X	x	Columbia Univ.	4049697			x
GP-6508	xx	Columbia Univ.	4131746			x
GP-6508	x	Columbia Univ.	4224352			x
GP-6508	x	Columbia Univ.	4183965			x
GP-6508	x	Columbia Univ.	4215006			x

RELEVANCE OF PATENTS TO GRANTS

SUMMARY OF ANALYSES
(Continued)

NSF Grant Number	Key	Institution	U.S. Patent Number	Is patent related to research performed under this NSF Grant: Directly	Contributed	No
GP-6508	x	Columbia Univ.	4243823			x
GP-6508	x	Columbia Univ.	4271324			x
GP-6508	x	Columbia Univ.	4255293			x
GP-6508	x	Columbia Univ.	4275087			x
GP-6508	x	Columbia Univ.	4260830			x
GP-6508	x	Columbia Univ.	4250049			x
PO-18911	xx	Univ.of Georgia	3776926			x
GP-5743	xx	Univ.of Georgia	3862142			x
GP-8229	xx	Univ.of Georgia	3879420			x
PO-18911	xx	Univ.of Georgia	3880882			x
PO-34496	xx	Univ.of Georgia	3925417			x
GP-8229	xx	Univ.of Georgia	3925421			x
GP-8229	xx	Univ.of Georgia	3960897			x
PO-18911	xx	Univ.of Georgia	3528898			x
PO-18911	xx	Univ.of Georgia	3584067			x
PO-29383	x	U. Cal-Berkeley	3865865			x
GP-8942	x	Univ.of Florida	3954758			x
GP-8943	x	Univ.of Florida	4113949			x
72-00427	xx	Princeton Univ.	3947488		x	
PO-40332	xx	Princeton Univ.	3989691		x	
72-00427	xx	Princeton Univ.	4020073		x	
76-16506	xxx	Princeton Univ.	4067823	x		
76-16506	xxx	Princeton Univ.	4172955	x		
76-05685	xxx	Princeton Univ.	4237306	x		
PO-14609	xxx	Univ.of Wisconsin	4007211	x		
PO-32038	xxx	Univ.of Wisconsin	4051157	x		
GP-6612	x	Yeshiva Univ.	4172949			x
GP-6612	x	Yeshiva Univ.	4100174			x
GP-6612	x	Yeshiva Univ.	4112114			x
GP-6612	x	Yeshiva Univ.	4123550			x

RELEVANCE OF PATENTS TO GRANTS

SUMMARY OF ANALYSES
(Continued)

NSF Grant Number	Key	Institution	U.S. Patent Number	Is patent related to research performed under this NSF Grant: Directly	Contributed	No
GP-6612	x	Yeshiva Univ.	4145443			x
GP-6612	x	Yeshiva Univ.	4151297			x
GP-6612	x	Yeshiva Univ.	4177280			x
75-21340	xxx	Iowa State Univ.	4276195	x		
CHE76-01783	x	U. Cal-Berkeley	4183864			x
GP-5073	xxx	Univ.of Wisconsin	3973167	x		
PO-13975	xxx	Univ.of Wisconsin	4055783	x		
PO-35602	xxx	Univ.of Wisconsin	4060708	x		
PO-38495	xx	Harvard Univ.	3870612			x
GP-31449	xx	Univ.of Illinois	3960840			x
74-01345	xxx	Univ.of Wisconsin	4133821	x		
PO-28586	x	M.I.T.	3950135	x		
PO-28586	x	M.I.T.	3950446			x
74-20946	xxx	M.I.T.	4088675	x		
74-20946	xxx	M.I.T.	4164444	x		
73-08472	xx	Purdue Univ.	4022950			x
74-24394	xxx	Univ.of Wisconsin	4007009	x		
PO-42924	x	Iowa State Univ.	3983020			x

R E S E A R C H C O R P O R A T I O N

Assessment of Patents Associated with
Research Corporation Chemistry Grants

RELEVANCE OF PATENTS TO GRANTS

SUMMARY OF ANALYSES

Institution	U.S. Patent Number	Is patent related to research performed under this RC Grant: Directly	Contributed	No
Wheaton College	3989725		x	
Wheaton College	4076740		x	
Wheaton College	4082795		x	
Wheaton College	4082798		x	
Wheaton College	4144244		x	
Univ. of Tennessee	3966491		x	
Johns Hopkins Univ.	4246173		x	
Univ. of Delaware	4123379		x	
Iowa State Univ.	3882011		x	
Iowa State Univ.	3881997		x	
Western Kentucky Univ.	3862801		x	
Western Kentucky Univ.	3867170		x	
Univ. of Southern Calif.	4137509		x	
Univ. of Alabama	4243829		x	
Univ. of Alabama	4258206		x	
Princeton Univ.	4260842		x	

R E S E A R C H C O R P O R A T I O N

Assessment of Patents Associated with NSF Chemistry Grants

ANALYSIS OF COMMERCIALIZATION OF PATENTS

Patent Number	Type & Number of Claims	Technical Field	Comment on Licensability
4,006,160	Process	Organic Synthesis	Process claims only - limited to synthesis of two classes of compounds having limited commercial applications.
3,886,180	Process(1)	Organic Synthesis	Process limited to synthesis of a single compound with limited commercial application.
4,271,041	Product(16)	Inorganic Chem.	Claims are easily avoided product-by-process ones. Products appear to be very expensive.
4,136,062	Product(3)	Precious Metals Catalysts	Very expensive palladium-gold catalysts with only very specialized applications.
4,078,002	Process(11)	Organic Synthesis	Process claims only; no product claims - difficult to police, although the patent has considerable commercial potential -- assigned to Aldrich-Boranes, Inc..
4,082,810	Product(8)	Organic Synthesis	Process claims only. Commercially useful -- assigned to Aldrich-Boranes, Inc. and is probably in commercial use in conjunction with above Patent No. 4,078,002 which is closely related.

ANALYSIS OF COMMERCIALIZATION OF PATENTS
(continued)

Patent Number	Type & Number of Claims	Technical Field	Comment on Licensability
3,984,479	Process Product	Organic Synthesis	Assigned to Aldrich-Boranes, Inc. Process and product appear to have limited commercial applications.
4,059,679	Process(2)	Zeolites and Catalysts	Many competitive products; limited uses.
4,180,551	Process(6) Product(1)	Zeolites and Catalysts	Product claim is based on process claims which are easily avoided by slightly altering reaction conditions.
3,872,168	Process(13)	Organic Synthesis	Process claims only; no product claims - difficult to police. Synthetic procedures not economic for large scale syntheses of materials in common use. Primarily useful for laboratory or pilot plant production of specialty chemicals.
3,872,218	Process(5)	Catalyst Product'n	Process claims only - difficult to police. Could be licensed to catalyst manufacturers, but catalyst product is useful primarily for small scale organic reactions, and would not be useful for large scale syntheses.

ANALYSIS OF COMMERCIALIZATION OF PATENTS
(continued)

Patent Number	Type & Number of Claims	Technical Field	Comment on Licensability
3,985,770	Process (8)	Catalyst Product'n	Process claims only - improvement on previous Patent No. 3,872,218, but no appreciable economic or licensing advantage over previously patented catalysts. Licensable to catalyst manufacturers, but only for limited commercial use of special chemicals.
4,001,279	Product(23)	Organic Synthesis	Product has a complicated structure and is difficult to synthesize. Has limited application of solubilizing insoluble reagents.
4,043,979	Product(3)	Organic Separation	Product has a complicated structure and is difficult to synthesize. Has very limited application in resolving racemic mixtures.
4,080,337	Product(13)	Organic Compounds	Compounds are too expensive for commercial applications and too toxic for clinical use.
4,113,959	Process(5)	Organic Separations	Process would only be used in research applications by individual researchers.
4,128,556	Product(3)	Organic Compounds	Compounds are too expensive for commercial applications and too toxic for clinical use.

ANALYSIS OF COMMERCIALIZATION OF PATENTS
(continued)

Patent Number	Type & Number of Claims	Technical Field	Comment on Licensability
3,993,550	Process(23)	Organic Synthesis	Photochemistry is not generally practical in industrial applications
4,230,828	Product(9)	Organic Catalysts	Catalysts have limited applicability and are useful mainly for products can be made by alternative routes. No obvious advantages over existing processs.
4,107,076	Process(33)	Catalyst for Water Gas Reaction	Unfavorable economics.
4,180,692	Process(2)	Organic Synthesis	It is difficult to supersede existing processes without significant cost advantages.
3,985,830	Product(14) Process(7)	Polymer Chemistry	Process appears to be expensive to conduct. There are competing polymers already in use.
4,108,945	Product(7)	Polymers	Licensed in Great Britain and West Germany. Many competing products in U.S.
3,870,612	Process(4)	Analytical Chem.	Difficult to detect use, circuitry.
4,252,723	Process(17)	Organic Syntheses	General synthesis for isatins which are intermediates for dyes and pharmaceuticals. Patent claims easily avoided, and use hard to detect.

ANALYSIS OF COMMERCIALIZATION OF PATENTS
(continued)

Patent Number	Type & Number of Claims	Technical Field	Comment on Licensability
4,169,030	Process(15)	Catalysis	Light driven catalytic process to produce hydrogen fuel from water. Unfavorable economics. May be ahead of its time.
4,271,033	Product(13) Process(6)	Organic Synthesis Catalysts	No obvious markets.
3,922,299	Process(2)	Organic Synthesis	Synthesis specific for vinylic organic compounds.
3,960,932	Process(9)	Organic Synthesis	It is difficult to supersede existing processes without significant cost advantages.
3,988,358	Process(8)	Organic Synthesis	It is difficult to supersede existing processes without significant cost advantages.
4,128,554	Process(4)	Organic Synthesis	Existing processes have significant cost advantages.
4,175,187	Process(8)	Organic Synthesis	Existing processes have significant cost advantages.
3,882,011	Apparatus(18)	Analytical Chem.	Patent is licensed to an instrument manufacturing company. Sales will be modest as the instrument is useful only for specialized purposes and many competitive devices are available.

ANALYSIS OF COMMERCIALIZATION OF PATENTS
(continued)

Patent Number	Type & Number of Claims	Technical Field	Comment on Licensability
3,598,845	Process(3) Product(3)	Organic Synthesis	Product is a steroid intermediate. No apparent economic advantage over existing processes. Use of product would be impossible to detect since it is an intermediate and not the final product.
3,884,945	Process(5)	Organic Synthesis	Process is a steroidal cyclization reaction. Difficult to supersede existing process without significant economic advantages.
3,904,698	Product(1)	Steroid Synthesis	Product claim is for an intermediate. Patent rights are impossible to enforce since the intermediate is converted to a known product capable of being synthesized by other means.
4,055,603	Product(1)	Organic Synthesis	Same as the other Johnson patents.
4,117,234	Product(3)	Steroid Synthesis	Use of product would be impossible to detect since it would be only an intermediate.
4,189,431	Process(7)	Steroid Synthesis	No apparent advantage over existing processes.

ANALYSIS OF COMMERCIALIZATION OF PATENTS
(continued)

Patent Number	Type & Number of Claims	Technical Field	Comment on Licensability
4,219,489	Product(8)	Steroid Synthesis	No apparent economic advantage over existing processes. Difficult to detect infringement since claimed products are merely intermediates.
3,967,931	Process(8) Apparatus(14)	Liquid Chromatography	The detector gave inconsistent results
4,136,136	Product(19) Process(10)	Polymer Chemistry	Mainly process claims for making specialized polymers having no obvious advantages over existing ones.
4,138,441	Process(3)	Polymer Chemistry	Mainly process claims for making specialized polymers, having no obvious advantages over existing ones.
4,246,373	Process(7)	Polymer Chemistry	Mainly process claims for making specialized polymers, having no obvious advantages over existing ones.
4,210,737	Process(4)	Polymer Chemistry	Mainly process claims for making specialized polymers, having no obvious advantages over existing ones.
4,276,394	Product (16) Process(9)	Polymer Chemistry	Mainly process claims for making specialized polymers, having no obvious advantages over existing ones.

ANALYSIS OF COMMERCIALIZATION OF PATENTS
(continued)

Patent Number	Type & Number of Claims	Technical Field	Comment on Licensability
3,994,993	Process Product	Organic Polymer Synthesis	Assigned to Firestone Tire & Rubber Co. Process has moderate scale commercial application.
3,962,053	Process(3)	Organic Synthesis	Process claims only. Probably licensable to manufacturers of specialty chemicals for production of nitro compounds active against plant pathogens. Commercial potential is above average.
3,932,298	Product(6)	Liquid Crystals	No obvious advantages over existing compositions.
4,011,046	Process(31)	Analytical Chem.	The detection of optically active materials using liquid crystal detectors has limited application.
4,066,167	Product(17) Process(1)	Instrument	Specialized dosimeter having very limited uses.
4,138,358	Product(12)	Liquid Crystals	No obvious advantage over existing products.
4,170,477	Process(10) Product(1)	Inorganic Synthesis	Process is for synthesizing polysulfur nitrides which may be used as an alternative to printed circuit boards. Existing processs are too well established for these boards.
4,176,918	Product(12)	Liquid Crystals	No obvious advantage over existing products.

ANALYSIS OF COMMERCIALIZATION OF PATENTS
(continued)

Patent Number	Type & Number of Claims	Technical Field	Comment on Licensability
4,241,149	Apparatus(8) Process(3)	Electrolysis	Highly specialized electrolytic cell having very limited market.
4,113,772	Process(6) Product(2)	Organic Synthesis	Limited Market. Process yields products having moderate scale commercial applications.
4,076,916	Process(8) Product(1)	Polymer Chemistry	No obvious applicatons.
3,892,839	Process(4)	Formation of Nitrosyl Tetra-fluoroborate	Limited Market
3,904,501	Process(12)	Carbon Monofluorides	Limited civilian market. High cost free radical plasma synthesis
3,954,585	Process(13)	Same as above	Same as above
3,992,424	Products(9)	Fluorinated Or-ganometallic Materials	Free radical plasma synthesis: essentially no civilian uses.
4,113,435	Apparatus(14)	Fluorination Reactor	Reactor is cryogenically controlled and likely to be very expensive.
4,144,374	Product(7)	Polymer Chemistry	No obvious applications.

ANALYSIS OF COMMERCIALIZATION OF PATENTS
(continued)

Patent Number	Type & Number of Claims	Technical Field	Comment on Licensability
4,052,536	Product(1)	Solar Energy Conversion	Practical Application involves extensive further research and development. Probably economically non-competitive unless cost of alternatives increases substantially.
4,089,881	Product(38)	Organometallic Catalysts	Catalyst solutions looking for a problem. Such inventions are hard to license.
4,204,216	Product(14) Process(13)	Conducting Polymers	Licensed
4,016,331	Process(10) Product(2)	Composite film Materials having metallic surface properties.	No obvious application.
4,222,903	Product(7) Process(6)	Conducting Polymers	Licensed
4,008,388	Apparatus(46)	Analytical Chemistry	All claims refer to an apparatus or a combination of apparatuses in a mass spectrophotometer system. The market for such a system is limited, but the unit price is large so total sales might be appreciable.
4,063,005	Product	Electrochemistry	Cathode for use in molten sale electyrochemical battery systems. Long-range commercial applications possible.

ANALYSIS OF COMMERCIALIZATION OF PATENTS
(continued)

Patent Number	Type & Number of Claims	Technical Field	Comment on Licensability
3,966,491	Apparatus(6)	Electrochemistry	Limited and specialized applications, primarily military. Low commercial potential.
3,860,450	Process(10)	Microelectronics	Process claims only. Probably licensable to electronic firms, but sales potential is low due to the existence of competitive products made by other processs.
4,043,905	Apparatus	Analytical Chemistry	Useful for specialized chromatographic separations of organic chemicals. Primarily analytical laboratory usage.
4,216,065	Apparatus(6)	Selective Electrode for Amino Acids	Not useful for routine analyses; mainly a research tool.
4,113,590	Process(16)	Nitrogen Fixative	Catalyst probably too expensive.
4,197,419	Product(12) Process(12)	Organic Synthesis Catalysts	Too limited a number of applications.
4,231,947	Product(12)	Organic Catalysis	Too limited a number of applications.
4,245,131	Process(12)	Organic Synthesis	Too limited a number of applications.
4,020,073 (see 4,947,488)	Process(9)	Organic Synthesis	Process produces intermediates only. Final products have limited commercial appeal and would be expensive; difficult to police for infringement.

ANALYSIS OF COMMERCIALIZATION OF PATENTS
(continued)

Patent Number	Type & Number of Claims	Technical Field	Comment on Licensability
3,989,691	Process(8)	Organic Synthesis	Process claims only. Produces an intermediate compound useful in the production of certain quinine derivatives. Limited market.
3,947,488	Process(7)	Organic Synthesis	Process claims for known products are easily avoided by slight alteration of reaction conditions.
4,067,823	Products(6)	Organic Synthesis	Limited commercial applications.
4,172,955	Process(4)	Organic Synthesis	Limited commercial applications.
4,237,306	Process(4)	Organic Synthesis	Limited commercial applications.
4,007,211	Process(19)	Organic Synthesis	Useful for difficult and complicated synthesis of organic molecules such as steroids and prostaglandins; not economically attractive for large scale synthetic work; difficult to detect use.
4,051,157	Process(15)	Organic Synthesis	Limited application to synthetic organic chemistry; if a real need appears in the future this could be a valuable invention.
4,276,195	Process(14)	Transition Metal Complex Catalysts	No product claims. Process could be used without detection.

ANALYSIS OF COMMERCIALIZATION OF PATENTS
(continued)

Patent Number	Type & Number of Claims	Technical Field	Comment on Licensability
3,973,167	Apparatus(27)	Analytical Instruments	Spark source for use with a spectroscope. Limited market; competitive products available; electrical circuitry, easily circumvented.
4,055,783	Apparatus(20) Process(2)	Analytical Instruments	Accessory to existing analytical instrumentals; limited market.
4,060,708	Device(23)	Analytical Chem.	Device appears to be too complicated for use in routine analyses.
4,133,821	Product(11)	Organic Compounds	Many competing compounds, and very limited applications.
4,164,444	Process(10)	Biochemical Synthesis	No known commercial use. Processs would be solely for research purposes.
4,088,675	Process(22)	Biochemical Synthesis	No known commercial use. Methods could be used for laboratory syntheses only.
4,088,178	Process(22)	Biochemical Synthesis	No known commercial use. Processs would be solely for research purposes.
3,950,135	Process	Analytical Chemistry	Process has been superseded by more modern methods now available.

ANALYSIS OF COMMERCIALIZATION OF PATENTS
(continued)

Patent Number	Type & Number of Claims	Technical Field	Comment on Licensability
4,007,009	Process(15)	Analytical Chem.	Process claims only. Licensing potential essentially nil as practice of the invention would be in the analytical research laboratory where detection would be impossible. In addition use of the process is limited to special and unusual situations rather than general cases.

R E S E A R C H C O R P O R A T I O N

Assessment of Patents Associated with NSF Chemistry Grants

ECONOMIC VALUE OF PATENTS

SUMMARY OF RESPONSES FROM INSTITUTIONS OR PATENT OWNERS

Patent No.	Relevance	Is Patent Licensed		Estimated Sales (in thousands of dollars)		
		Yes	No	Total To Date	Total until Patent Expires	Total assuming patent may be licensed later
3886180	Contributory	-	x	none	50 - 100	100
4006160	Contributory		x	none	50 - 100	100
4136062	Direct	-	x	-	-	Licensing doubtful
4271041	Direct	-	x	-	-	Licensing doubtful
3984479	Contributory	(8)		50	100 - 200	1,000
4078002	Contributory	(8)		50	100 - 200	1,000
4082810	Contributory	(8)		50	100 - 200	1,000
4059679	Direct	-	x	-	-	Licensing doubtful
4180551	Direct	-	x	-	-	Licensing doubtful
3872168	Direct	-	x	-	-	100
3872218	Direct	x	-	27.2	55.0	200
3985770	Direct	x(1)		see 3872218 entry above		
4080337	Direct	-	x	-	-	Licensing doubtful
4113959	Direct	-	x	none	50 - 100	200
4128556	Direct	-	x	-	-	Licensing doubtful
4001279	Direct	-	x	none	50 - 100	100
4043979	Direct	-	x	none	50 - 100	100
3993550	Direct	-	x	-	-	Licensing doubtful
4230828	Direct	-	x	-	-	Licensing doubtful
4107076	Direct	-	x	none	-	Licensing doubtful
4180692	Contributory	Info not yet obtained from univ.				100
3985830	Direct	x(2)	-	none	none	500
4108945	Direct	x(10)	50	100 - 200		500
3870612	Direct	x(3)		none	none	Not being licensed

ECONOMIC VALUE OF PATENTS

SUMMARY OF RESPONSES FROM INSTITUTIONS OR PATENT OWNERS
(Continued)

Patent No.	Relevance	Is Patent Licensed		Estimated Sales (in thousands of dollars)		
		Yes	No	Total To Date	Total until Patent Expires	Total assuming patent may be licensed later
4252723	Direct	Info not yet obtained from univ.				Licensing doubtful
4271033	Direct	-	x	-	-	Licensing doubtful
4169030	Direct	-	x	-	-	Licensing doubtful
3922299	Direct	-	x	none	200 - 400	500
3960932	Direct	x(4)	-	none	50 - 100	500
3988358	Direct	x(4)	-	none	50 - 100	500
4128554	Direct	-	x	-	-	Licensing doubtful
4175187	Direct	-	x	-	-	Licensing doubtful
3882011	Contributory	(9)		10	50 - 100	100
3598845	Direct	-	x	-	-	Licensing doubtful
3884945	Direct	-	x	-	-	Licensing doubtful
3904698	Direct	-	x	-	-	Licensing doubtful
4055603	Direct	-	x	-	-	Licensing doubtful
4117234	Direct	-	x	-	-	Licensing doubtful
4189431	Direct	-	x	-	-	Licensing doubtful
4219489	Direct	-	x	-	-	Licensing doubtful
3967931	Direct	-	x	-	-	Licensing doubtful
3994993	Direct	(12)	50	200 - 500		1,000
4136136	Direct	-	x	-	-	Licensing doubtful
4138441	Direct	-	x	-	-	Licensing doubtful
4210737	Direct	-	x	-	-	Licensing doubtful
4246373	Direct	-	x	-	-	Licensing doubtful
4276394	Direct	-	x	-	-	Licensing doubtful
3962053	Contributory	-	x	100	500 - 1,000	5,000
3932298	Direct	-	x	-	-	Licensing doubtful
4011046	Direct	-	x	none	50 - 100	200
4066567	Direct	-	x	none	25 - 50	100

ECONOMIC VALUE OF PATENTS

SUMMARY OF RESPONSES FROM INSTITUTIONS OR PATENT OWNERS
(Continued)

Patent No.	Relevance	Is Patent Licensed		Estimated Sales (in thousands of dollars)		
		Yes	No	Total To Date	Total until Patent Expires	Total assuming patent may be licensed later
4138358	Direct	-	x	-	-	Licensing doubtful
4170477	Direct	-	x	-	-	Licensing doubtful
4176918	Direct	-	x	-	-	Licensing doubtful
4241149	Direct	-	x	none	25 - 50	100
3892839	Direct	-	x	none	25 - 50	100
3904501	Direct	-	x	-	-	Licensing doubtful
3954585	Direct	-	x	-	-	Licensing doubtful
3992424	Direct	-	x	-	-	Licensing doubtful
4076916	Direct	Info not yet obtained from univ.				Licensing doubtful
4113435	Direct	Info not yet obtained from univ.				500
4113772	Direct	Info not yet obtained from univ.				500
4144374	Direct	Info not yet obtained from univ.				Licensing doubtful
4052536	Direct	-	x	-	-	Licensing doubtful
4089881	Direct	-	x	none	25 - 50	100
4016331	Direct		x	-	-	Licensing doubtful
4204216	Contributory	Info not yet obtained from univ.				1,000
4222903	Contributory	Info not yet obtained from univ.				1,000
3966491	Contributory	Info not yet obtained from univ.				1,000
4063005	Contributory	Info not yet obtained from univ.				500
4008388	Contributory	(11) 20		500 - 1,000		2,000
3860450	Direct	-	x	none	50 - 100	200
4043905	Direct	Info not yet obtained from univ.				100
4216065	Direct	-	x	none	50 - 100	200
4113590	Direct	-	x	-	-	Licensing doubtful
4197419	Direct	Info not yet obtained from univ.				Licensing doubtful
4231947	Direct	Info not yet obtained from univ.				Licensing doubtful
4245131	Direct	Info not yet obtained from univ.				Licensing doubtful

ECONOMIC VALUE OF PATENTS

SUMMARY OF RESPONSES FROM INSTITUTIONS OR PATENT OWNERS
(Continued)

Patent No.	Relevance	Is Patent Licensed		Estimated Sales (in thousands of dollars)		
		Yes	No	Total To Date	Total until Patent Expires	Total assuming patent may be licensed later
3947488	Contributory	-	x	-	-Licensing doubtful	
3989691	Contributory	-	x	none	50 - 100	200
4020073	Contributory	-	x	-	-	Licensing doubtful
4067823	Direct	-	x	none	50 - 100	200
4172955	Direct	-	x	none	50 - 100	200
4237306	Direct	-	x	none	50 - 100	200
4007211	Direct	-	x	-	-	Licensing doubtful
4051157	Direct	-	x	50	100 - 500	1,000
4276195	Direct	-	x	-	-	Licensing doubtful
3973167	Direct	(6)		50	100 - 150	200
4055783	Direct	-	x	none	25 - 50	100
4060708	Direct	-	x	-	-	Licensing doubtful
4133821	Direct	-	x	-	-	Licensing doubtful
3950135	Direct	-	x	-	-	Licensing doubtful
4088178		Info not available from MIT				Licensing doubtful
4088675	Direct	Info not available from MIT				Licensing doubtful
4164444	Direct	Info not available from MIT				Licensing doubtful
4007009	Direct		x	-	-	Licensing doubtful
				Total Estimated Sales		26,300

ECONOMIC VALUE OF PATENTS

SUMMARY OF RESPONSES FROM INSTITUTIONS OR PATENT OWNERS
(Continued)

Patent No.	Relevance	Is Patent Licensed		Estimated Sales (in thousands of dollars)		
		Yes	No	Total To Date	Total until Patent Expires	Total assuming patent may be licensed later

(1) Licensed with Patent No. 3872218
(2) Licensed to foreign companies
(3) This patent is licensed non-exclusively to Beckmann Instruments which apparently is not actively developing this technology.
(4) Still under development
(5) Licensed with Patent No. 3960932
(6) This patent is jointly owned by Wisconsin Alumni Research Foundation and Fisher Scientific Co. As joint owner Fisher Scientific is developing the invention, without the necessity of a license, through Jarrell-Ash, one of its divisions.
(8) Assigned to Aldrich-Boranes, Inc.
(9) Assigned to Pine Instrument Company
(10) Licensed in Great Britain and West Germany
(11) Assigned to Universal Monitor Corporation
(12) Assigned to Firestone Tire & Rubber Co.

R E S E A R C H C O R P O R A T I O N

Assessment of Patents Associated with Research Corporation Chemistry Grants

ECONOMIC VALUE OF PATENTS

SUMMARY OF RESPONSES FROM INSTITUTIONS OR PATENT OWNERS

Patent No.	Relevance	Is Patent Licensed		Estimated Sales (in thousands of dollars)		
		Yes	No	Total To Date	Total until Patent Expires	Total assuming patent may be licensed later
3989725	Contributory	x	-	50	500 - 700	1,000
4076740	Contributory	x	-	(These patents are all assigned		
4082795	Contributory	x	-	to Ciba-Geigy Corporation)		
4082798	Contributory	x	-			
4144244	Contributory	x	-			
3966491	Contributory	-	x	none	-	500
4246173	Contributory	-	x	-	-	Licensing doubtful
4123379	Contributory	-	x	none	-	1,000
3882011	Contributory	x(1)	-	10	50 - 100	100
3881997	Contributory	-	x	-	-	Licensing doubtful
3862801	Contributory	x	-	200	500 - 700	1,000
3867120	Contributory	x	-	(These patents are assigned to Xerox Corp.)		
4137509	Contributory	-	x	-	-	Licensing doubtful
4243829	Contributory	-	x	none	100 - 200	500
4258206	Contributory	-	x	none	100 - 200	1,000
4260842	Contributory	-	x	none	-	1,000

(1) Licensed to Pine Instruments Company