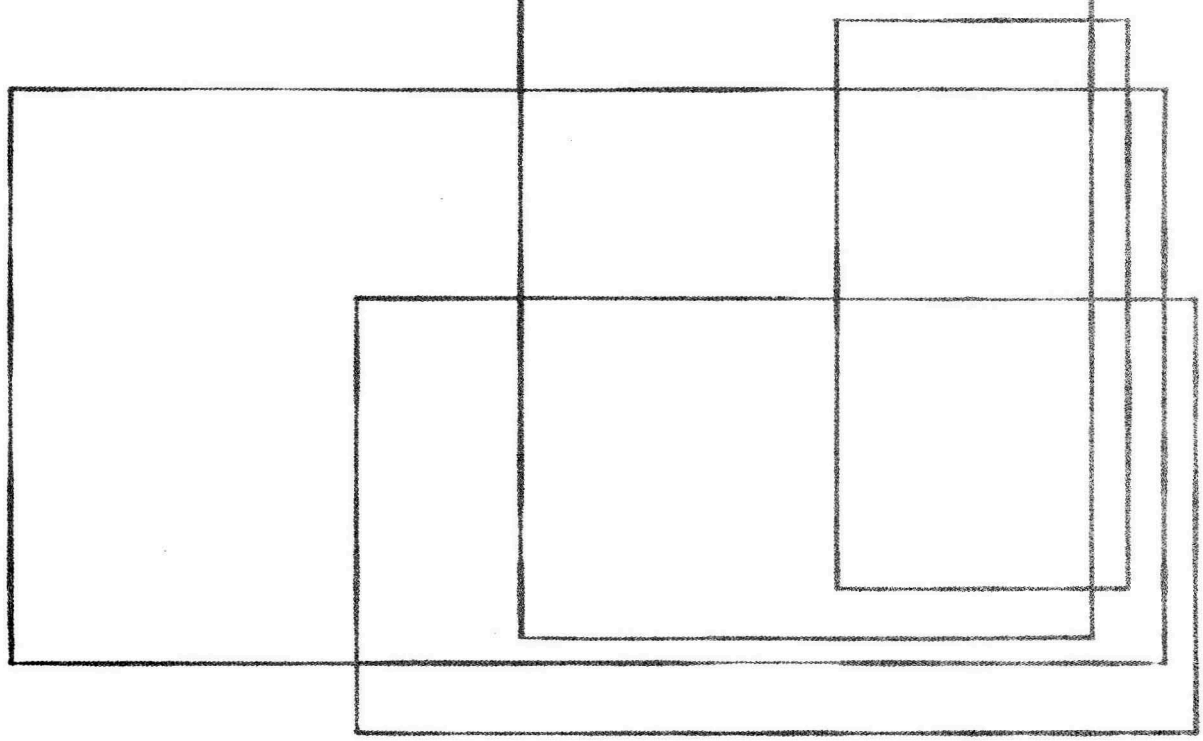
RESEARCH CORPORATION

A FOUNDATION
FOR THE ADVANCEMENT
OF SCIENCE AND TECHNOLOGY

Report for 1981



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Research Corporation: Programs for Discovery and Innovation

Dedicated to the advancement of science and technology, Research Corporation is a foundation which makes inventions "more available and effective in the useful arts and manufactures . . ." and provides "means for the extension of scientific investigation, research and experimentation . . ." This dual mission is as timely today as it was in 1912, the year Research Corporation was established by Frederick Gardner Cottrell, academic scientist, inventor and philanthropist.

Dr. Cottrell's plan was to create an organization to insure that practical use was made of discoveries resulting from research, one that would apply any resources thus generated to scholarly work in the sciences. The foundation's initial "endowment" consisted solely of rights to Dr. Cottrell's own invention—the electrostatic precipitator, a device immensely valuable for reducing industrial air pollution.

The Cottrell gift is now embodied in a diversified investment portfolio created through the sale by Research Corporation of a major portion of its interest in the precipitator business which was developed over the years and which was spun off in 1954. Research Corporation's revenues are derived from its investments and from its share of royalties on inventions assigned to it for administration by individuals and by scientific and educational institutions.

In keeping with Dr. Cottrell's concept, Research Corporation is a nonprofit institution which helps transfer university inventions from laboratory to marketplace, and which devotes its revenues to support scientific research in colleges and universities. These functions are carried out through two separate and independent activi-

ties: the foundation's Invention Administration Program and its Grants Program.

Grants Program

Research Corporation's granting activities are centered upon support of investigations in the natural sciences. The *Cottrell Research Program* supports fundamental research in the physical sciences at graduate universities and public undergraduate institutions. The *Cottrell College Science Program* supports basic research projects in the natural sciences at private, predominantly undergraduate colleges. In addition to these regular programs, the foundation occasionally supports other important scientific endeavors within its general fields of interest. Additional support for basic research comes from grants administered by Research Corporation and funded by companies, other foundations and individuals.

Invention Administration Program

Through its invention administration services for educational and scientific institutions, the foundation aids the technology transfer process by bringing new inventions into public use. Services contributed to universities, colleges and other nonprofit institutions include evaluation of faculty and staff inventions, obtaining patents on inventions assigned to the foundation and licensing them to industry. Royalties from these inventions are apportioned between the inventor, the institution, and the programs of Research Corporation.

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(1) Term Expired February 1981
(2) Joined committee February 1981
(3) Joined committee May 1981
(4) Retired October 1981

Report of the President

Technology transfer from the university to industry for the benefit of the general public has been a major concern of Research Corporation since its founding in 1912. The year just past, however, has seen more pronouncements, questioning and debates on the topic than any in the foundation's long history. Universities are awakening to their public responsibilities and self-interest with respect to bringing to commerce new knowledge from their researches. Industry is beginning to realize that the truly innovative processes and products are derived from basic research best done on the university campus.

The result of these awakenings is closer contacts between industry and the university, including financial support from industry for university research within certain relatively narrow areas. Indeed, some enlightened corporate leaders realize the necessity of supporting a broad range of fundamental research for the sake of the research itself —this as a basis for the new technology which will ultimately follow.

Such support of science was urged by Professor Frederick Gardner Cottrell who envisioned an endless cycle of research made possible by commercializing the useful results of scholarly investigation. Some part of the rewards from the process would be used to fund further work in the sciences. Research Corporation was founded by Cottrell to carry

new knowledge from their researches. Industry is beginning to realize

out that concept, and has developed into the leading nonprofit organization providing technology transfer counseling and services to colleges, universities and other nonprofit laboratories.

The foundation's program of grants in support of basic research, evolved in keeping with Cottrell's ideas, while not the largest in terms of resources, certainly has been the most innovative and, for its size, the most effective. Innovative too has been the foundation's Program Support effort to encourage corporate funding of truly basic research in college and university laboratories. These programs are discussed in greater detail in subsequent sections of this report.

Transition in Leadership

In anticipation of my retirement, the Board of Directors has unanimously designated John P. Schaefer, President of the University of Arizona, to become the seventh President of Research Corporation at a time no later than July 1, 1982. Dr. Schaefer pursued an active career as a faculty member and research scientist prior to becoming an administrator. He has compiled an enviable record in advancing the status of the faculty, programs, research and overall development of his institution during his ten years as president. I know of no person better qualified to assume the post of President of Research Corporation.

Before this report goes to press I will have completed 14 full years as chief executive of the foundation. With this lengthy period of service now drawing to a close, I shall briefly review the changes which have taken place and the accomplishments recorded in recent years. The latter are the work of the entire organization; no single individual is due all credit for any one of them.

At the close of Research Corporation's 1967 fiscal year, shortly after the untimely death of former president J. William Hinkley, the foundation staff included 14 officers and professionals. Five members administered the foundation, four conducted the Grants Program, and five oversaw the Invention Administration Program with the help of a con-

sultant. Growing demands, particularly upon the latter program, have brought about a sizable increase. At the end of the 1981 fiscal year the foundation's officers and professional staff numbered 22, down somewhat from a peak of 26: four in grants, 13 in invention administration, one in Program Support and four in general administration.

At the end of fiscal 1967, Research Corporation's total assets were slightly more than $11 million and its total income (including patent royalties to be paid to institutions and inventors under its Invention Administration Program) about $2.1 million. The 1982 fiscal year begins with total assets of $46.3 million, and total revenue of $10.3 million.

The Invention Administration Program: 1967 and 1981

Research Corporation had invention administration agreements with 195 educational and scientific institutions in 1967, as compared to 284 at the end of fiscal 1981. Approximately the same number of invention disclosures were received in both years—366 in 1967 as compared to 355 in 1981. Some 45 inventions were accepted by the foundation in 1967 for patenting and licensing in the U.S. and other countries as warranted. More rigorous acceptance criteria, in effect for several years, led to the acceptance of just 30 inventions in 1981.

In 1967 some 21 royalty-bearing licenses were concluded with manufacturers willing to pursue research, development and marketing of products based on accepted inventions. Eighteen such licenses were concluded in 1981. Gross royalties received on previously licensed inventions, however, revealed a marked difference. These royalties amounted to $1,186,319 in 1967 (largely from inventions that had been donated to the foundation), as compared to $6,580,597 in 1981 (entirely from inventions administered on behalf of other institutions in cooperation with the foundation). Thus, in 1967, $1,053,136 was retained by the foundation to help carry out its programs for advancing academic science and technology, and $133,183 was forwarded directly to institutions and inventors under existing cooperative agreements. In

ranted. More rigorous acceptance criteria, in effect for several years,

1981 a total of $4,482,011 was returned directly to institutions and inventors, and $2,098,586 was retained by the foundation.

Large royalties from the donated inventions of earlier years not only made possible a larger Grants Program and variety of grants-making efforts, but helped strengthen the Invention Administration Program. The staff, now 13 professionals, reached a maximum of 15 in the 1970s; the cost of the program, less than one half million dollars in 1967, was more than two million dollars in 1981.

The Grants Program: 1967 and 1981

In 1967 approximately $2.3 million was paid out for grants, while in fiscal 1981 the total of grants paid was $2.5 million. The year 1967 saw some 97 Frederick Gardner Cottrell project grants in the natural sciences approved totaling $407,991, an average of $4,206 per grant. By contrast, 228 Cottrell grants were approved in the last fiscal year in the aggregate amount of $2.6 million, or an average of $11,487 per grant. Another difference was that there were no grants from outside organizations in support of basic research through foundation programs in the 1960s. In 1981 grants in the amount of $354,456 were made from funds contributed for this purpose by industrial companies, other foundations and individuals.

Apart from the foundation's long-standing Cottrell programs in the natural sciences, sweeping changes have taken place in the foundation's grants-making activities since 1967. The early years of this period witnessed an expansion of programs coincident with increased financial resources including large royalties from donated inventions. Grants programs were brought into being to fund research in areas other than physics, chemistry and related disciplines, and older undertakings terminated with the expiration of the patents (and associated royalties) which supported them.

These increased financial resources made possible the appointment of a special officer for the Williams-Waterman Program for research in

applied nutrition and the establishment of a fourth regional office to help the entire Grants Program. The grants staff, four professionals in 1981, numbered six from 1969 to 1976.

The Williams-Waterman Program, created from patent royalties on the synthesis of vitamin B_1 and carried on by the foundation for a time after the patent expired, made 26 grants in 1967 totaling slightly more than one-half million dollars. During the same year, the Brown-Hazen Program, originating from royalties on the first effective antifungal antibiotic, granted $167,000 to 25 investigators in various biomedical areas. A few years later the same program was making grants totaling more than $500,000 annually. Directed toward support of medical mycology in later years, the Brown-Hazen Program continues in modest degree today through the annual Gilbert Dalldorf Fellowship in Medical Mycology administered cooperatively with the Infectious Diseases Society of America.

Another development during this period was the successful conclusion of litigation upholding the validity of the Jones-Mangelsdorf patent on a revolutionary method of producing hybrid seed corn. The invention made possible the Donald F. Jones Program in cytogenetics of major world food crops. At about the same time, the Charles H. Townes Fund for fundamental research in physics was activated with a portion of the royalties received from the Townes maser-laser patent.

It is interesting to read from a 1967 report of Research Corporation's Vice President—Grants of his concern for the inadequacy of federal funding for academic research, especially for younger investigators:

> During the past three or four years, the growth in federal funds for research has fallen substantially behind the increasing demands from expanded numbers of faculty members and students. Hardest hit are the young people just getting started. They are finding it increasingly difficult to get money for investigations of their own choosing . . . In 1967 the NSF was able to fund only about a third of the research covered by applications for research grants, and it is anticipated that the money crunch will get worse before it gets better . . .

The statement is at least as appropriate today as it was 14 years ago.

Retrenchment

With the declining total return from investments experienced by most nonprofit institutions in the 1970s and the expiration of patents donated to the foundation, it became necessary to close one regional grants office, and to eliminate two professional positions in the Invention Administration Program and two in the Grants Program. The Williams-Waterman and Brown-Hazen Programs were terminated, as were the Donald F. Jones and Charles H. Townes Programs.

With the exception of 1970, the annual deficits which had begun in earlier years continued throughout the entire period. The excess of grants and expenses over revenues, in general from one to two million dollars annually, was met by drawing on capital funds. (The cumulative expenditures from principal to support grants-making activities and operating expenses for fiscal 1968 through 1981 totaled $19.6 million.)

Such drawdowns of capital, which are a spend-out of investment assets, cannot continue indefinitely unless an institution believes that its programs in the near term are of far more value than they are likely to be in the distant future. Thus, while the continued expansion of programs could have been beneficial, it is also true that retrenchment could provide future benefits for academic science and technology.

Although several program evaluations were undertaken and completed during the 1970s, the most comprehensive was that of the Committee on Goals and Objectives of the Board of Directors. This thorough report was submitted at the meeting of the board on June 15, 1979, and provided both a historical perspective and a careful review of current programs. The report attempted to estimate the effect of the continued drawing down of principal funds, the alternative necessity to achieve a balanced budget, and the impact on programs which might result. Also included were royalty forecasts for inventions administered by the foundation and investment performance. The eight principal recommendations of the committee were adopted by the board as guidelines for the early 1980s.

Those directives, under which the foundation has retained its major programs while striking a better balance between income and expense, are being implemented. The invasion of investment assets of recent years is being progressively reduced to preserve the foundation's capacity to sustain its programs in support of academic science and technology. In order to give the Board of Directors adequate advice on patent matters, crucial if the foundation is to succeed, the Patent Committee of the board was established. This committee advises on matters related to accepting, protecting, and managing inventions consistent with the foundation's philanthropic objectives, and meets frequently to consider in detail the Invention Administration Program and its current activities.

In Closing

Although it is difficult to put down an assignment of many years standing as President of Research Corporation, I do so secure in the knowledge that the foundation employs both a highly qualified professional staff and officers who have served it with distinction. To my successor, Dr. Schaefer, will fall the obligation of carrying out to the limit of the foundation's resources its dual objectives of making inventions "more available and effective in the useful arts and manufactures and for scientific purposes . . ." and providing means for the extension of "scientific investigation, research and experimentation . . ." All those concerned with the growth of science and technology necessary to insure the welfare of our society can wish only for his success.

JAMES STACY COLES

Grants Program

The times are less harsh than we are prone to recognize. Though academic research has its financial problems, they are not unsolvable. Nor are they new. Basic research in the United States has been chronically underfunded because the national temperament is such that there is little public appreciation of the fact that the societal benefits are very real if long delayed. A consequence of this mentality is that pressures mount for the private sector to pick up the slack as federal funding of basic research contracts. At this writing, for example, it appears probable that basic research funds for the physical sciences distributed by the National Science Foundation will be cut by 12 to 18% in the fiscal year ahead. As one of the few private sector organizations fostering scholarly investigation in these areas, Research Corporation encounters the resulting pressures in the form of more applications seeking more extensive support.

The foundation embraces the opportunity of playing a growing role in assuring that the most capable of the country's academic researchers can sustain both their research and the associated teaching of the next generation of scientists. At the same time, however, the foundation's commitment of $3.2 million to its Grants Program in 1982 is far less than one percent of the anticipated federal *cutback* in basic research fund-

ing. That disparity dictates that every grant be well placed, and that the thrust of our grants be reexamined to assure that neither tradition nor whimsy determines what we do.

Meeting new challenges created by shifting trends in government and academe is a process with which the foundation is familiar. The architect of Research Corporation's flexible approach to support of academic research was Charles H. Schauer, now retired, who established a formal grants program with a full-time professional staff at the close of World War II.

Principles for Making Grants

The key granting principles Schauer conceived were unique: novel concepts which have proved basically sound and have been taken up in varying degrees by many government and private sector agencies. Adapting those principles as opportunities changed, Schauer and his successor, Sam C. Smith, shepherded the foundation's work through grants programs in such varied fields as the physical sciences (a traditional area of activity), basic and applied nutrition, cytogenetics of cereal grains and medical mycology. The critical precepts in all of the foundation's grants activities have been as follows:

- Award grants only in response to formal proposals representing the most significant and most challenging research that applicants can conceive. Promote daring and a spirit of venturesomeness without undue fear of failure.
- Examine first the importance of the suggested research and the thoroughness with which the experimental attack has been thought out. Then assess the personal and professional qualities of the applicant and the institutional setting.
- In granting provide a budget meeting the true needs of the project to assure its successful prosecution. Give grantees maximum freedom to control the course of research after a grant is made.

- Always secure guidance from a number of knowledgeable sources regarding both the proposed research and the applicant.
- Augment these evaluations with those of a professional scientific staff who regularly visit colleges and universities to learn the strengths and weaknesses of both applicants and their institutions.
- In deciding on which applicants to recognize with an award, rely on the majority judgment of an advisory committee dominated by scientists who are currently active in research.

Of these principles, the last three warrant special comment because they are the means by which all of the others are implemented.

The Part of Referees

The non-foundation experts and mentors who are asked to assess the merits and limitations of research proposals perform a task crucial to the grants-making process. A minimum of five referees suggested by the applicant are asked for confidential review of the proposed research (and of the applicant in those cases where they have served as mentors). Additional referees may be called upon at the discretion of the foundation staff or the advisory committee.

The referee analyses, which become a part of the proposal as review continues, reflect not only fairness and intellectual honesty, but a willingness to volunteer time and talent in the interests of vigorous research. The foundation is deeply grateful for the several thousand evaluations it receives annually from scientists in academic institutions, industry and government research facilities. High standards of scholarship and ethics are conspicuous in their analyses, qualities the foundation greatly values.

The Foundation's Regional Directors

Every phase of Research Corporation's Grants Program draws heavily on the skills of Regional Directors Brian Andreen in the Mid-

west; R. Scott Pyron in the East, and Hal H. Ramsey in the West. They visit some 150 schools a year to engage in frank, detailed discussions with applicants and prospective applicants, grantees, and the faculties and administrators of science. These exchanges not only allow the regional directors to bring insights to the review process that few agencies can call upon, but equip them to make major contributions in formulating the objectives, guidelines and procedures of the foundation's Grants Program.

Regional directors function as "friends-in-court" when working with academic researchers who apply for grants. When dealing with applicants the regional directors' objective is to draw out the most venturesome, scientifically significant research possible. In working with grantees they facilitate that research with a minimum of bureaucratic impedimenta. It is from them that the sense of collegium among the foundation's grantees derives. On their backs rides the burden of the foundation's reputation for vigor, insight and skill as a patron of individually conceived basic research.

The Role of the Advisory Committee

Research Corporation's Cottrell Program Advisory Committee plays an unusual role in the foundation's grants-making activities. It is dominated by scientists from outside the foundation, and its recommendations on applications are majority decisions unaltered by the foundation staff. Non-foundation committee members, carefully selected to assure expertise in the physical sciences, are active researchers known for consistently keen judgment of proposals, fairness, deep understanding of the problems of academic research, unusually broad scientific interests, and persuasiveness in a committee setting. They serve five years without compensation and agree to forgo applying to the foundation for research support during that period.

The time required to serve on the committee is far greater than most scientists are willing or able to devote to sustaining the vigor of the

basic research of others. Members evaluate each of several hundred proposals a year at home and meet three times a year to resolve their differences. At these meetings the vote on each application is deferred until every member who chooses has commented on its merits and weaknesses. The foundation and the country's academic research community owe them a debt of gratitude for volunteering so much in service to the advancement of science.

This year's committee roster included physicists G. King Walters of Rice University, T. Michael Sanders of the University of Michigan, and Stuart J. B. Crampton of Williams College. The chemists were Jerrold Meinwald of Cornell University, Michael P. Doyle of Hope College, Donald T. Sawyer of the University of California at Riverside, Charles A. Arrington, Jr. of Furman University, and Glenn A. Crosby of Washington State University.

Grants in the Year Ahead

In the coming year the foundation will expand its program of basic research grants through augmented resources of its own and through additional funds contributed by industry, individuals and sister foundations deeply committed to generating new scientific knowledge. Research Corporation's capacity to help meet the needs of academic science has grown considerably during the past year as a result of the generosity of a growing number of donors. Their contributions have supplemented the foundation's grants budget by 25%, a major enlargement of resources for support of first-rate basic research at a time when the need is particularly acute.

With the anticipated change in the foundation's leadership, a review of programs is being undertaken to determine whether new opportunities can be identified. In the interim, grants will follow the pattern of recent years. A substantially larger number of grants will be possible during the coming year, however, as a result of the increases in available resources noted above. Basic work in the physical sciences by

academicians mounting their first independent research programs will be funded at universities and public institutions. Basic research in the natural sciences by faculty members at any stage of their careers will be supported at private liberal arts colleges.

Summary of Grants Program—1981

Grants paid during 1981 totaled $2,481,274; $900,421 was approved for future payment. Grants approved are published regularly in the Research Corporation *Quarterly Bulletin.* A full list of 1981 grants is available on request.

	Balance payable 10/31/80	Approved in 1981	Paid in 1981	Balance payable 10/31/81
Cottrell Research Program (Physical sciences)	$267,115	$1,716,139	$1,530,095	$453,159
Cottrell College Science Program (Natural sciences)	395,941	903,036	862,715	436,262
Other grants activities	22,722	76,742	88,464	12,000
	$685,778	$2,695,917	$2,481,274	$900,421

KENDALL W. KING
Vice President—Grants Program

Invention Administration Program

The biotechnology revolution, subject of glowing promises, intense debate and major efforts by many research establishments not to be left behind, is emerging from the laboratory. Successful attempts to harness living organisms may bring enormous progress in two fields in the next few years: health care and the production of complex chemicals and chemical products. Possibilities in the more distant future include food crops genetically engineered for high yields, disease and perhaps saline resistance, and plants that produce their own nitrogen fertilizer. There may also be improved livestock; new food supplements; better ways of recovering oil; methods to clean up spills and solve other environmental problems; biomass technology that produces economical energy, and a host of other exciting discoveries.

Eagerness to nurture and develop biotechnology—recombinant DNA techniques, preparation and use of hybridomas, large-scale enzyme production and tissue culturing to name some of the more spectacular areas—has already had many repercussions. New ventures have mushroomed, academe is examining with trepidation its traditional concepts of scholarly research and academic freedom, and the business world is searching for opportunities to capitalize on what promises to be a bonanza. At the same time, public policies relating to safety are under

study and deep concern is being expressed about a looming shortage of bioscientists and technologists.

A powerful impetus to industrial involvement was the June 1980 United States Supreme Court ruling in the Chakrabarty case that a modified *Pseudomonad* bacterium could be patented; applied broadly, the decision may allow the patenting of any living organism produced using genetic engineering techniques. Another positive factor in stimulating industry interest was the passage in December 1980 of Public Law 96-517 prescribing that nonprofit organizations and small businesses can retain title to inventions arising from federally funded research, thus facilitating their transfer for public use.

In short, truly seminal scientific discoveries of recent origin and government policies designed to hasten industrial innovation are resulting in a proliferation of research at educational institutions with industry as interested onlooker and often a participant. Many of these institutions have sought the services of the foundation's scientists and engineers in evaluating, patenting and licensing their biological discoveries as a prelude to industrial development.

In 1976 the foundation received, evaluated and accepted its first invention involving the use of recombinant DNA techniques, this to produce attenuated *Escherichia coli* bacteria. Made by Roy Curtiss III of the University of Alabama at Birmingham, the discovery is basic to many of the new developments now being reported. The Invention Administration Program staff, thus alerted to things to come, has closely followed successive events with the aid of close contacts with the scientists who have submitted inventions in this broad field for evaluation and possible patenting and licensing.

Following the foundation's acceptance of Dr. Curtiss' invention, the administration of a second landmark discovery was undertaken in 1977. It involves the use of synthetic adapter molecules which act as promoters to facilitate the joining of two or more DNA sequences. These adapters are easily made and versatile in their applications in recombinant DNA syntheses. They are expected to have a major impact

in aiding gene synthesis and in making possible otherwise difficult gene splicing techniques.

Between 1977 and 1980 a number of other biological discoveries were added to the foundation's technological inventory—all useful in research and all with potential for commercial applications. These include additional types of promoter molecules and a new method for synthesizing complementary DNA containing intact genetic information for introduction into host microorganisms.

Inventions received for evaluation in 1981 embrace a number that apply in a specific manner the basic biotechnologies described in earlier disclosures. A method for detecting prostatic cancer using monoclonal antibodies, a vaccine against dental caries, and methods for modifying *Bacillus subtilis* to produce hormones, vaccines, and enzymes are among discoveries just accepted for administration. A promising hybridoma produced through the fusion of two human cells, also under consideration by the foundation, is expected to reduce undesirable side effects of substances produced by hybridomas created by fusing mouse and tumor cells.

The foundation anticipates increasing use of its Invention Administration Program (IAP) over the next decade to speed the introduction of more new biotechnological advances into public use, thus proving once again the prescience of Frederick Gardner Cottrell in furnishing in 1912 in the public interest a mechanism for bridging the gap between the academic research laboratory and the industrial producer.

Institutional Relations

An important part of the foundation's services includes personal visits with faculty researchers and institutional administrators. While these visits need not be frequent, they are helpful at periodic intervals for bringing into focus changes in federal laws, in the policies and regulations of the agencies that fund research, and in economic and market conditions affecting academic inventions.

ration Program (IAP) over the next decade to speed the introduction

The invention administration staff made as many of these visits as possible during the year, placing particular emphasis on the more active institutions and those researcher-inventors whose discoveries are being patented and licensed. Intensive patent awareness programs were presented at the request of a number of institutions to help develop a better understanding of the use of the patent system in bringing new discoveries to industry and the public.

Modernized invention administration agreements had been concluded with 124 institutions by the end of the year. These agreements provide for the distribution of royalties and beneficial ownership of inventions by the foundation, and outline the rights and duties both of Research Corporation and the nonprofit organizations it serves. New agreements were concluded with six institutions not previously served. The total number of agreements in effect at the end of the year was 284 compared with 282 at the end of 1980.

Evaluation and Patenting Activities

During 1981 the IAP staff evaluated a total of 355 inventions received from 87 institutions. The corresponding numbers for the previous year were 374 and 101. Institutions having agreements with the foundation submitted about 87% of the total. Some 6% of the discoveries were received from institutions which do not have such agreements, and the remainder, about 7%, came from individuals who endorse the foundation's chartered purpose of supporting the advancement of academic science and technology. A total of 30 inventions (as compared to 36 in 1980) met the foundation's standards for originality and potential usefulness, and were accepted for patenting and licensing.

Except for a mechanical invention—a stratified charge internal combustion engine—all of the accepted disclosures involve chemical, biochemical or biotechnological discoveries. Diagnostic test methods comprise eight of the inventions, 11 involve synthetic drugs or their uses, three are methods for producing commercially useful chemical entities,

from 87 institutions. The corresponding numbers for the previous year

and one is a biomedical device. As mentioned previously, six of the disclosures describe genetic engineering or hybridoma processes and products.

On assignment of the accepted inventions to the foundation, 24 patent applications were prepared and filed in the U.S. Patent and Trademark Office. Applications covering the remaining inventions were in preparation at the end of the year. Nine divisional or continuation patent applications covering previously accepted inventions were also prepared and filed. To take advantage of possible foreign marketing, 35 patent applications were filed in Canada and other countries, including Patent Cooperation Treaty and European Patent Community nations.

Some 36 U.S. patents covering 30 inventions accepted in previous years were issued during 1981. Twenty-nine of these related to chemical, biomedical, pharmaceutical and agricultural inventions and seven to mechanical devices, electrical and electronic instruments and materials. A total of 62 foreign patents was issued in 19 other countries.

Patent Licensing

Patent licensing negotiations increased in length and complexity as compared with previous years, reflecting the higher level of technology represented by recent inventions. As a result, fewer royalty-bearing licenses (18 covering 15 inventions) were concluded in 1981 compared with 1980 (21 covering 15 inventions). Some 11 U.S. and four foreign companies became licensees in 1981. Royalty-free, nonexclusive licenses covering 12 inventions were granted to the United States Government in accordance with the terms of federally funded grants that supported the research that produced the discoveries.

Gross royalties in 1981 reached an all-time high of $6,580,597, an increase of about 29% over the 1980 figure of $5,092,171. The continued growth in licensee sales of a widely used anticancer drug and an antibacterial burn ointment accounted for the major part of the increase. Rapidly increasing sales of two newly marketed inventions, a superior

Patent licensing negotiations increased in length and complexity as

nutrient for growing mushrooms and a telemetering system for heart pacemakers, also contributed substantial amounts.

Since 1978 the gross royalties received by the foundation have reflected invention administration activities entirely on behalf of other scientific and educational nonprofit organizations; for 1977 and prior years, royalties included various amounts from inventions donated to Research Corporation as contributions to the advancement of science.

Royalty Sharing on Institutional Inventions

The foundation's invention administration agreements provide for shares of gross royalties to be distributed to both institutions and inventors. In 1981 institutions received $2,457,031 and inventors and other recipients $2,024,980. The gross royalties and their distribution for 1981 are given in the table below where they can be compared with corresponding amounts for the preceding four years.

	Fiscal Year				
	1981	1980	1979	1978	1977
Gross royalties	$6,580,597	$5,092,171	$4,036,257	$1,279,624	$1,364,498
Distributions to institutions	2,457,031	1,979,707	1,814,668	569,326	649,700
Distributions to inventors and other recipients	2,024,980	1,446,031	767,787	191,367	183,366
Total distribution	4,482,011	3,425,738	2,582,455	760,693	833,066
Net royalties for support of foundation programs(1)	2,098,586	1,666,433	1,453,802	518,931	531,432
Number of institutions sharing royalties	38	39	40	44	38

(1) The annual operating expense of the Invention Administration Program exceeded net royalties for the years 1977 through 1980.

Patent Committee

Three meetings of the Patent Committee of the Board of Directors were held during the year. Matters discussed included changes in finan-

cial and personnel requirements resulting from the introduction of new and more complex technologies and from changes in patent legislation; the appropriateness of establishing cooperative relationships with government agencies and other nonprofit scientific research organizations; and the possibility of litigation to enforce patent rights in certain cases. The committee made a number of important recommendations for strengthening and improving Invention Administration Program services.

Personnel

During the year Robert Goldsmith was appointed Assistant Vice President—IAP for Administration. In this new position Goldsmith will be responsible for the development and implementation of internal administrative procedures, the administration of existing licenses, and administrative matters relating to federal government granting agencies and institutions served by the foundation.

The year cannot be summarized without noting the continued dedication of both the professional and support staffs to making the Invention Administration Program successful. The year's results reflect their fine work.

WILLARD MARCY
Vice President—Invention Administration Program

A list of the 284 institutions with which Research Corporation has invention administration agreements is available on request.

Program Support

The ascent of the United States to world preeminence in science and technology in the 20th century challenges this nation as never before. Are the academic and industrial sectors up to maintaining leadership in generating and applying new knowledge? Although it is generally conceded that our productivity and rate of innovation may have declined in some industries with respect to other nations, it is now being increasingly recognized that the key to the future lies in more—not less—reliance on technological advance.

Any such advance must depend upon discoveries resulting from basic, frontier, research. Our colleges and universities need renewed support of their science components in order to conduct such research and to train tomorrow's scientists, engineers and managers. Industry's concern for immediate profits must give ground to the need to foster the effort required for future economic vigor.

Outstanding Scientists, Innovative Projects

Research Corporation has developed over many years a unique grants program for the support of the nation's top academic scientists in the early development of their most innovative ideas and has achieved an

outstanding record thereby: 17 of the foundation's grantees have later won Nobel Prizes. Research Corporation grantees are found at the forefront of many new spheres of science. The stimulation and development of students and faculty members, both in the classroom and the laboratory, that come from performing significant exploratory research are without parallel in honing fine minds. It is upon these wellsprings—dedicated young researchers and new fundamental knowledge—that our future progress depends.

With the help of an experienced, scientifically trained staff and an advisory committee drawn from active research scientists, the foundation each year identifies 200-300 investigators and projects which appear to present the greatest potential for future contributions. The review process also makes use of confidential written evaluations by the best of the country's industrial and academic scientists, many of whom are former grantees.

Corporate, foundation and individual donors have validated Research Corporation's unique system for eliciting, selecting and supporting the most significant work of the nation's outstanding scientists by increasing contributions 69% over 1980. This has made possible the support of 48 new investigators and their projects in addition to those funded by Research Corporation, a new record.

Sources of Support

A total of $518,063 was contributed by corporations, foundations and individuals in 1981. New contributions were received from Joseph H. DeFrees; Celine Karraker; Conoco Inc.; Pennwalt Corporation; M. J. Murdock Charitable Trust, and the Atlantic Richfield, Greenwall, William and Flora Hewlett, Northwest Area and Schering-Plough Foundations.

Research Corporation expresses its appreciation to the contributors listed on page 35 for their generous support of the research projects selected in the foundation's current effort to expand high quality basic

research at colleges and universities. Investigators throughout the academic science community applaud this example of responsible citizenship.

DAVID G. BLACK, JR.
Vice President—Program Support

Participating Organizations in Support of Basic Research

Atlantic Richfield Foundation

Conoco Inc.

Crown Zellerbach Corporation

Joseph H. DeFrees

Dow Chemical U.S.A.

Foremost-McKesson Foundation, Inc.

The Greenwall Foundation

Hercules Incorporated

The William and Flora Hewlett Foundation

Hooker Chemical Corporation

Celine Karraker

The Lubrizol Corporation

M. J. Murdock Charitable Trust

Northwest Area Foundation

Pennwalt Corporation

Pioneer Hi-Bred International, Inc.

Schering-Plough Foundation, Inc.

Stauffer Chemical Company

The Thrasher Research Fund

United States Steel Foundation, Inc.

Westinghouse Educational Foundation

Financial Report

For many years Research Corporation has been guided in managing its investments by policies and procedures initiated by the Finance Committee and approved by the foundation's Board of Directors. The responsibilities assumed by the Finance Committee include splitting the investment funds into segments to achieve management diversification; selecting and appointing firms to be employed as investment managers, and monitoring the funds. The objectives of monitoring are to assure the requisite quality of individual investment vehicles; to maintain a minimum of 25% of the total managed funds (excluding substantial holdings in Research-Cottrell, Inc.) in fixed income securities; and to measure the performance of individual managers on the basis of total return.

Over the years these policies and procedures have been translated into action by the selection of one manager for the fixed income portion of the funds and four different managers for the equity portion. In designating managers for the equity funds, the committee has been motivated to take advantage of the investment expertise of firms with complementary rather than identical investment philosophies and strategies. To this end it has chosen two firms which manage individual portfolios and has also placed assets in two large and well-regarded mutual funds.

These four managers march to different drummers: during one phase of the market cycle manager A may excel and manager B may lag the averages; during another phase their positions may be reversed. This diversity of philosophy and style has proved salutary indeed. In the last five years the foundation's managed equity funds in total have consistently outperformed the Dow-Jones and Standard and Poor's 500 averages, even though one or more of the fund segments may have temporarily lagged these indexes from time to time.

Research-Cottrell, Inc.

As the beneficiary of the Cottrell electrostatic precipitator invention for controlling air pollution by cleaning industrial stack gases, the foundation was the organizer and parent of Research-Cottrell, Inc., and once owned that company in its entirety. At the present time Research Corporation retains a sizable block of Research-Cottrell stock even though its holdings were long ago reduced to a minority position well within the restrictions imposed by law on ownership of a company's stock by a private foundation. The Finance Committee determined several years ago that the Research-Cottrell shares remaining in the possession of the foundation represented too large a portion of its investment assets—too many eggs in one basket. It was recommended that a portion of this holding be sold, the proceeds of such sale to be reinvested in other securities to provide the foundation with a greater degree of investment diversification.

After exploring alternative courses of action, the committee authorized toward the end of the 1981 fiscal year the sale of some of the foundation's Research-Cottrell shares under Rule 144 of the Securities and Exchange Commission. That rule permits disposition of a limited number of unregistered shares under restricted and controlled circumstances. At fiscal year end the foundation had reduced its holding of the company by 6%. It is expected that this limited divestment program will continue into fiscal 1982.

The 1981 Financial Year

While it should be kept firmly in mind that Research Corporation's investment assets—and the grants and operating services these assets are able to support—continue to be eroded in a devastating manner by inflation, it seems appropriate to note some favorable developments as well. Gross royalties generated by the Invention Administration Program, dividend and interest income from the foundation's investment portfolio, and contributions from donors all reached historic highs in 1981 as measured in current dollars. Another important record was set with the $4,482,011 of patent royalty receipts distributed directly to those inventors and institutions originating successful discoveries.

Less happily the costs of operating the foundation mounted inexorably despite intensive efforts to control personnel and other expenditures. While the amount required in 1981 to cover administrative and program costs again exceeded dividends, interest income and royalties, the resulting invasion of the foundation's endowment funds was significantly less than that required in nine of the last ten years.

For the first time in recent history, royalties remaining with the foundation in 1981 exceeded the direct costs of operating the Invention Administration Program and thus contributed modestly to funds available for advancing academic science and technology. In the upcoming 1982 fiscal year it is expected that both gross and net royalties from the invention administration portfolio will attain new highs with a favorable outlook for further substantial gains in succeeding years.

In closing it is both appropriate and timely to express the appreciation of the foundation for the many hours the Finance Committee members have devoted throughout the year to protecting and enhancing Research Corporation's investment funds—funds that provide a large share of the wherewithal for the grants and operating programs mounted by the foundation. It should be noted that these hours are contributed with no recompense by individuals with full-time career commitments of their own, a good example of the voluntarism now being urged upon the private sector in behalf of the public weal.

Administration Program and thus contributed modestly to funds avail-

The importance of successfully husbanding these funds grows in light of the curtailment of National Science Foundation and other federal agency support for academic science. Although Research Corporation's limited programs cannot substitute for massive amounts of public monies, shrinkage of government funding makes even more important the foundation's ability to contribute to the health and vitality of scientific research.

BAYARD R. HAND
Vice President—Finance

The full list of investments held by the foundation is available on request.

Balance Sheets

October 31, 1981 and 1980

	1981	1980
ASSETS		
Cash	$ 219,976	$ 274,142
Temporary cash investments at cost (which approximates market)	534,064	574,519
Dividends and interest receivable	277,960	301,921
Royalties receivable	1,205,100	855,796
Receivable for sale of Research-Cottrell, Inc. capital stock (Note 3)	302,267	
	2,539,367	2,006,378
Investment fund		
Uninvested cash	551,564	137,592
Marketable securities at cost (at market $36,066,000 and $36,983,000, respectively)	34,461,155	33,113,988
Receivable for securities sold	221,975	842,513
Payable for securities purchased	(1,088,321)	(920,455)
	34,146,373	33,173,638
Investment in capital stock of Research-Cottrell, Inc. at cost (at market $7,511,000 and $11,902,000, respectively; Note 3)	719,547	765,710
Other assets	497,183	335,646
TOTAL ASSETS	$37,902,470	$36,281,372
LIABILITIES AND FUND BALANCE		
Grants payable	$ 900,421	$ 685,778
Royalties payable	1,356,408	955,557
Federal excise tax payable (Note 4)	75,117	85,654
Accounts payable	83,624	78,971
TOTAL LIABILITIES	2,415,570	1,805,960
FUND BALANCE (Note 2) (see statement annexed)	35,486,900	34,475,412
	$37,902,470	$36,281,372

The accompanying notes are an integral part of the financial statements.

Statements of Revenue, Grants and Expenses

Years ended October 31, 1981 and 1980

	1981	1980
REVENUE		
Gross royalties from patents	$ 6,580,597	$5,092,171
Dividends and royalties from Research-Cottrell, Inc.	194,783	208,500
Other interest and dividends	2,975,075	2,382,306
Contributions—unrestricted	1,000	
restricted, including endowments of $153,000 and $167,000, respectively	518,063	307,125
TOTAL REVENUE	$10,269,518	$7,990,102
GRANTS AND EXPENSES		
Grants approved—		
from unrestricted funds	$ 2,340,061	$2,634,414
from restricted funds	355,856	253,772
Royalties distributed to institutions, inventors and other recipients	4,482,011	3,425,738
Operating programs		
Invention administration	2,033,011	1,773,609
Science advancement	555,014	515,056
Program support	102,252	103,160
General and administrative expenses	939,456	928,198
Federal excise tax (Note 4)	78,000	89,000
TOTAL GRANTS AND EXPENSES	$10,885,661	$9,722,947
EXCESS OF GRANTS AND EXPENSES OVER REVENUE	$ 616,143	$1,732,845

The accompanying notes are an integral part of the financial statements.

Statements of Changes in Fund

Years ended October 31, 1981 and 1980

	1981	1980
FUND BALANCE at beginning of year	$34,475,412	$33,834,668
Add (deduct)		
Excess of grants and expenses over revenue	(616,143)	(1,732,845)
Gain on sale of Research-Cottrell, Inc. capital stock (Note 3)	474,249	
Net gain on sales of marketable securities	1,153,382	2,373,589
FUND BALANCE at end of year (including $67,989 of restricted funds and $530,427 of endowment funds in 1981)	$35,486,900	$34,475,412

The accompanying notes are an integral part of the financial statements.

Notes to Financial Statements

1. Summary of significant accounting policies of Research Corporation (the Foundation):

   (a) *Security Valuation*—The Foundation carries its investments at cost. Gains/losses on sales of securities are computed on the first-in, first-out (FIFO) method.

   (b) *Income and Expenses*—Interest income is recorded as earned; dividends are accrued as of the ex-dividend date. Grants are recorded at the time of approval by the Board of Directors.

   (c) *Pension Plan*—The Foundation has a noncontributory pension plan covering substantially all of its employees. The total pension expense for the fiscal years 1981 and 1980 was $297,020 and $312,784, respectively, which includes amortization of prior service cost over a period of 20 years. The actuarial present value of vested accumulated plan benefits was $3,324,000 and of non-vested accumulated plan benefits was $3,078,000 computed as of January 1, 1981 assuming a 6% rate of return. The plan's net assets available for benefits on that date were $3,628,222. The Foundation's policy is to fund pension cost accrued.

2. At October 31, 1981, approximately $318,611 of the unrestricted fund balance has been designated by the Foundation for specific purposes including $250,622 for the administration of the Dalldorf Fellowship in Medical Mycology.

3. The investment in Research-Cottrell, Inc. of $719,547 at October 31, 1981 represents 653,100 shares of outstanding capital stock (13.6% of the shares outstanding). During the year ended October 31, 1981, the Foundation sold 41,900 shares of Research-Cottrell, Inc. capital stock at a gain of $474,249.

   Based on audited financial statements as of October 31, 1981, the equity of the Foundation in the net assets of Research-Cottrell, Inc. exceeded its investment by approximately $13,097,000. The stock of Research-Cottrell, Inc. owned by the Foundation is not registered with the Securities and Exchange Commission. The closing price of unrestricted stock of the same class on the American Stock Exchange on December 15, 1981 was $15.00 per share.

   In November 1981 the Foundation sold an additional 70,500 shares of Research-Cottrell, Inc. stock at a gain of $782,333.

   Mr. Charles H. Schauer is a member of the Board of Directors of the Foundation, and is also a member of the Board of Directors of Research-Cottrell, Inc.

4. Research Corporation is a private foundation exempt from income tax under section 501(c)(3) of the Internal Revenue Code. As a private foundation it is subject to a 2% Federal excise tax on net investment income, as defined.

5. The Foundation has a lease agreement for office space at an annual rental of $120,000, plus escalation charges, which expires on April 30, 1986.

Auditors' Report

Board of Directors,
Research Corporation,
New York, New York

We have examined the balance sheets of RESEARCH CORPORATION as of October 31, 1981 and 1980 and the related statements of revenue, grants and expenses and of the changes in fund for the years then ended. Our examinations were made in accordance with generally accepted auditing standards and, accordingly, included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the aforementioned statements present fairly the financial position of Research Corporation at October 31, 1981 and 1980, and the results of its operations and changes in its fund balance for the years then ended, in conformity with generally accepted accounting principles applied on a consistent basis.

COOPERS & LYBRAND

New York, December 16, 1981

RESEARCH CORPORATION
405 LEXINGTON AVENUE, NEW YORK, NEW YORK 10174-0370