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**NATIONAL MEDAL OF SCIENCE & TECHNOLOGY \ THE EAST ROOM
TUESDAY, NOV. 13, 1990 \ 2:00 P.M.**

THANK YOU. WE'RE PLEASED TO SEE SECRETARY MOSBACHER, DR. BROMLEY, AND ADMIRAL TRULY, HERE TO HELP US OUT. AND WE ESPECIALLY WANT TO GREET OUR HONORED GUESTS, THIS EXTRAORDINARY GATHERING OF SCIENTIFIC AND TECHNOLOGICAL GENIUS. WELCOME TO THE WHITE HOUSE -- AND WELCOME TO THE PRESENTATION OF THE 1990 NATIONAL MEDALS OF SCIENCE AND THE NATIONAL MEDALS OF TECHNOLOGY.

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**((THE TIMING OF THESE AWARDS IS FORTUITOUS. A YEAR AGO THIS WEEK, BARBARA AND I AWARDED MEDALS TO SOME OF THE ARTISTIC GIANTS OF OUR TIME -- ALFRED EISENSTAEDT, DIZZY GILLESPIE, AND JOHN UPDIKE, AMONG OTHERS. \\
AND WITH ALL THAT ASSEMBLED TALENT, GUESS WHAT LED THE EVENING NEWS? \\
THE ROSE GARDEN PRESENTATION OF THE NATIONAL TURKEY. \\\ So YOU'RE IN LUCK -- THIS YEAR THE TURKEY DOESN'T ARRIVE UNTIL THURSDAY!)) **

THIS GATHERING MARKS A PROUD MOMENT FOR ME -- JUST AS IT WAS WHEN THIS YEAR'S NOBEL PRIZES WERE ANNOUNCED, AND IT TURNED OUT THAT EIGHT OF THE NINE WINNERS IN SCIENCE AND ECONOMICS WERE BORN IN THE U.S.A. IT IS A TRIBUTE TO AMERICA'S FRONTIER SPIRIT, AND TO OUR NATION'S STEADFAST RESOLVE AND SENSE OF THE FUTURE. FOR WHEN IT COMES TO LEADERSHIP IN SCIENCE AND TECHNOLOGY -- BEST IN AMERICA MEANS BEST IN THE WORLD.

///

AMERICA'S TRADITION OF EXCELLENCE HAS LONG BEEN NURTURED BY A TRADITION OF FREE INQUIRY -- AIMED AT THE SIMPLE GOAL OF BETTER UNDERSTANDING OURSELVES AND OUR WORLD. IN THE 1945 REPORT THAT LED TO THE FOUNDING OF THE N.S.F., THE NATIONAL SCIENCE FOUNDATION, VANNEVAR BUSH WROTE THAT: "AS LONG AS SCIENTISTS ARE FREE TO PURSUE THE TRUTH WHEREVER IT MAY LEAD, THERE WILL BE A FLOW OF NEW SCIENTIFIC KNOWLEDGE TO THOSE WHO CAN APPLY IT TO PRACTICAL PROBLEMS."

AND SO IT IS TODAY. MORE AND MORE, NEARLY EVERY PRODUCT, FROM ELECTRONICS TO AGRICULTURE, INCORPORATES THE LATEST IN TECHNOLOGY. AND MORE AND MORE, OUR NATION DEPENDS ON BASIC SCIENTIFIC RESEARCH TO SPUR ECONOMIC GROWTH, LONGER AND HEALTHIER LIVES, A MORE SECURE WORLD, AND A SAFER ENVIRONMENT.

TODAY, OUR GOVERNMENT MUST HELP CARRY THAT RESEARCH FORWARD, AND CONTRIBUTE TO THE DEVELOPMENT OF GENERIC TECHNOLOGIES THAT BUILD ON BASIC DISCOVERIES.

IF AMERICA IS TO MAINTAIN AND STRENGTHEN OUR COMPETITIVE POSITION, WE MUST CONTINUE NOT ONLY TO CREATE NEW TECHNOLOGIES, BUT LEARN TO MORE EFFECTIVELY TRANSLATE THOSE TECHNOLOGIES INTO COMMERCIAL PRODUCTS. IN THIS WAY, WE CAN HELP LEVERAGE THE R & D OF THE PRIVATE SECTOR -- HELPING WHOLE INDUSTRIES ADVANCE IN AN INCREASINGLY COMPETITIVE GLOBAL MARKET.

THE BUDGET HIGHLIGHTS OUR ADMINISTRATION'S COMMITMENT TO SCIENCE AND TECHNOLOGY.

WE WON DOUBLE-DIGIT INCREASES FOR BOTH NASA AND THE N.S.F., AND EXPANDED FUNDS TO INVESTIGATE GLOBAL CLIMATE CHANGE. WE REMAIN COMMITTED TO DOING EVEN MORE: DOUBLING THE N.S.F. BUDGET OVER FIVE YEARS, AND EXTENDING THE TAX CREDIT FOR R & E -- RESEARCH AND EXPERIMENTATION.

AND WE'RE GOING TO KEEP RAISING AMERICA'S SIGHTS: SPACE STATION FREEDOM WILL GIVE US A PERMANENT PRESENCE IN EARTH ORBIT, AND THE SPACE EXPLORATION INITIATIVE WILL TAKE US TO THE MOON AND MARS AND BEYOND -- BACK TO SPACE, BACK TO THE FUTURE, AND THIS TIME -- BACK TO STAY. \\\

30 YEARS FROM NOW, WHEN THE NOBEL PRIZES ARE ANNOUNCED -- I WANT AMERICA TO BE WELL-REPRESENTED.

AND 30 YEARS FROM NOW, WHEN THE MEDALS OF SCIENCE AND OF TECHNOLOGY ARE BESTOWED -- I WANT TO SEE AMERICA GRACED BY A GROUP AS ACCOMPLISHED AS THAT HERE TODAY.

MANY OF TODAY'S HONOREES SERVE AS PRIME EXAMPLES OF HOW WE CAN EFFECTIVELY TRANSLATE BASIC SCIENCE INTO COMMERCIAL TECHNOLOGY. I THINK OF MILLIE DRESSELHAUS, ARGUABLY THE MOST PROMINENT WOMAN PHYSICIST AND ENGINEER OF HER GENERATION, WHOSE WORK HELPED TO REVOLUTIONIZE SEMI-CONDUCTORS.

OR ALLAN CORMACK, WHOSE PIONEERING EFFORTS EARNED HIM A NOBEL PRIZE -- AND MADE "CAT-SCANS" A HOUSEHOLD WORD. AND SCHOLARS AS DIVERSE AS BOSTON'S BARUJ BENACERRAF -- OR SEATTLE'S DONNALL THOMAS -- WHOSE CONTRIBUTIONS TO IMMUNOLOGY MAY LEAD TO NEW ANSWERS IN OUR BATTLE AGAINST CANCER AND AIDS. SCIENTISTS LIKE YOU HAVE HELPED AMERICA TO UNDERSTAND THAT AIDS IS A DISEASE -- NOT A DISGRACE.

AND SCIENTISTS LIKE YOU HAVE HELPED AMERICA TO APPRECIATE OUR RESPONSIBILITY TO THOSE WHO ARE LIVING WITH HIV AND AIDS: THEY DESERVE OUR COMPASSION. THEY DESERVE OUR CARE. AND THEY DESERVE MORE THAN A CHANCE -- THEY DESERVE A CURE. \\\

ANOTHER LEGACY OF THESE PRESTIGIOUS MEDALS AND THE WORK THEY HONOR MUST BE THE CULTIVATION OF EXCELLENCE IN SCIENCE AND MATH IN CLASSROOMS ACROSS AMERICA.

THE NATIONAL SCIENCE SCHOLARS PROGRAM WE PROPOSED SOON AFTER TAKING OFFICE HAS NOW BEEN ENACTED -- AND WILL ENCOURAGE BUDDING SCHOLARS OF TODAY TO BECOME THE SCIENTISTS OF TOMORROW. GUIDING OUR EFFORTS IS AN AMBITIOUS BUT CRITICAL GOAL FOR THIS DECADE: "BY THE YEAR 2000, U.S. STUDENTS WILL BE FIRST IN THE WORLD IN SCIENCE AND MATH."

THIS WEEK IS EDUCATION WEEK, AND ITS THEME IS "EDUCATING EVERYONE TAKES EVERYONE" -- A FITTING MOTTO FOR THE CHALLENGES THAT LIE AHEAD. IF WE ARE TRULY TO REMAIN A WORLD LEADER IN SCIENCE AND TECHNOLOGY, THEN WE MUST ACHIEVE A RENAISSANCE OF QUALITY IN OUR SCHOOLS -- WE MUST TAP THE TALENT, ENERGY, AND COMMITMENT OF ALL OUR FAMILIES, BUSINESSES, AND UNIVERSITIES.

THE PEOPLE WE HONOR TODAY ARE AMERICAN TRAILBLAZERS, REAL-LIFE PIONEERS WHO PRESSED THE VERY LIMITS OF THEIR FIELDS. YOU HAVE DISTINGUISHED NOT ONLY YOURSELVES -- BUT ALSO YOUR NATION. AND THAT'S WHY AMERICA CONTINUES TO NEED AND WANT -- AND APPRECIATE -- YOUR CREATIVITY, YOUR GENIUS AND YOUR DIVERSITY. THANK YOU. CONGRATULATIONS. AND GOD BLESS THE UNITED STATES OF AMERICA.

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McNally/Dooley
Nov. 7, 1990
Draft One (B:SCIENCE)

PRESIDENTIAL REMARKS: NATIONAL MEDAL OF SCIENCE & TECHNOLOGY
THE EAST ROOM
TUESDAY, NOV. 13, 1990, __:___.M.

Thank you. We're pleased to see Secretary Mosbacher,
Secretary ^{Wathen's} ~~Sullivan~~, and Dr. Bromley here to help us out. And we
especially want to greet our honored guests, this extraordinary
gathering of scientific and technological genius.

Welcome to the White House -- and welcome to the presenta-
tion of the 1990 National Medals of Science and Technology. \\\

((The timing of these awards is fortuitous. A year ago this
week, Barbara and I awarded medals to some of the artistic giants
of our time -- Alfred Eisenstaedt, Dizzy Gillespie, and John
Updike, among others. \\\ And with all that assembled talent,
guess what led the evening news? \\\ The Rose Garden presenta-
tion of the National Turkey. \\\ So you're in luck -- this year
the Turkey doesn't arrive until Thursday!)) \\\

This gathering marks a proud moment for me -- just as it was
when this year's Nobel Prizes were announced, and it turned out
that eight of the nine winners in science and economics were born
in the U.S.A. It is a tribute to America's frontier spirit, and
to our Nation's steadfast resolve and sense of the future. For
when it comes to science and technology -- best in America means
best in the world. \\\

America's tradition of excellence has long been nurtured by
a tradition of free inquiry -- aimed at the simple goal of better
understanding of ourselves and our world. In the 1945 report

that led to the founding of the N.S.F., the National Science Foundation, Vannevar Bush wrote that: "As long as scientists are free to pursue the truth wherever it may lead, there will be a flow of new scientific knowledge to those who can apply it to practical problems."

And so it is today. More and more, the country depends on basic scientific research to spur economic growth, longer and healthier lives, a more secure world, and a safer environment. And our government must help carry that research forward, and contribute to the development of technologies that build on basic discoveries. In this way, we can help leverage the R & D of the private sector -- helping whole industries advance in an increasingly competitive global marketplace.

The new budget highlights our Administration's commitment to science and technology. We won double-digit increases for both NASA and the N.S.F., and expanded funds to investigate global climate change. We remain committed to doing even more: Doubling the N.S.F. over five years, and making permanent the tax credit for R & E -- research and experimentation. And we're going to keep raising America's sights: NASA's Space Exploration Initiative will take us to the Moon and Mars and beyond -- back to space, back to the future, and this time -- back to stay. \\\

So in the next budget, we're going to put it to Congress again. We're going to say: "Put our money where our future is. Stop funding pork-barrel projects in your home districts and let our scientists and engineers go to work for America." \\\

30 years from now, when the Nobel Prizes are announced -- I want America to be well-represented. And 30 years from now, when the Medals of Science and Technology are bestowed, I want America to be graced by a group as accomplished as those here today.

I think of Mildred Dresselhaus, arguably the most prominent woman physicist and engineer of her generation, whose work helped to revolutionize semi-conductors. Or Allan Cormack, whose pioneering efforts earned him a Nobel Prize -- and made "CAT-scans" a household word. And scholars as diverse as Boston's Baruj Benacerraf -- or Seattle's Donnall Thomas ^{-- another Nobel laureate} -- whose contributions to immunology may lead to new answers in our battle against cancer and AIDS. Scientists like you have helped America to understand that **AIDS is a disease -- not a disgrace**. And somewhere out there -- along with the gratitude of planet Earth -- one of these Medals is waiting for the man or woman who **discovers the cure to this deadly scourge. **

Another legacy of this prestigious medal and the work it honors must be the cultivation of excellence in science and math in classrooms across America. The National Science Scholars program we proposed soon after taking office has now been enacted -- and will encourage budding scholars of today to become the scientists of tomorrow. Guiding our efforts is an ambitious but critical goal for this decade: "By the Year 2000, U.S. students will be first in the world in science and math."

This week is education week, and its theme is "Educating Everyone Takes Everyone" -- a fitting motto for the challenges

that lie ahead. If we truly are to achieve a renaissance of quality in our schools, we must tap the talent, energy, and commitment of all our families, businesses, and universities.

The people we honor today are American trailblazers, real-life pioneers who pressed the very limits of their fields. You have distinguished not only yourselves -- but also your Nation. And that's why America continues to need and want -- and appreciate -- your creativity, your genius and your diversity.

Thank you. Congratulations. And God bless the United States of America.

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Adm. Truly - Staffed for
Watkins Castle-Del. 3:00 pm
X Cathy Fenton

McNally/Dooley
Nov. 7, 1990
Draft Two (B:SCIENCE)

PRESIDENTIAL REMARKS: NATIONAL MEDAL OF SCIENCE & TECHNOLOGY
THE EAST ROOM
TUESDAY, NOV. 13, 1990, 2:00 P.M.

Jackie
Clawson
2870

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McMillan

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awards

Edwin M. McMillan
Professor of Physics Emeritus
University of California
Berkeley, CA

Citation: For his scientific achievements including the identification of the first transuranic element (neptunium) and the invention of the phase stability principle incorporated in the synchrotron.

Summary of Achievements

During 1932-1934, the field of nuclear physics was being transformed by a succession of startling discoveries--the neutron, positron, induced radioactivity--and the technology of accelerators was entering a stage of rapid development.

Lawrence's Radiation Laboratory, then an adjunct to the Physics Department with close ties to the Chemistry Department, was a leading laboratory in nuclear physics and was the scene of dynamic activity. The burgeoning field of nuclear physics and the excitement at the Radiation Laboratory was a great attraction to McMillan and he joined the small staff in 1934.

He distinguished himself immediately as an innovative and careful experimenter with an exceptional command of the theoretical background of nuclear physics. In an early investigation of gamma rays from nuclear disintegrations he accomplished the first unambiguous demonstration of the anomalous absorption of gamma rays by the creation of electron pairs.

McMillan took a keen interest in the operation and improvement of the cyclotron, then an almost entirely empirical art. He helped to rationalize the understanding of cyclotrons and was responsible for substantial improvements in ion sources, magnetic field shaping, beam extraction, and power and control systems.

News of the discovery of fission by Hahn and Strassman in early 1939 created great excitement and stimulated a flurry of experimental activity in the Radiation Laboratory, as it did in many other places, to confirm and to elucidate the new process. McMillan undertook a simple experiment--measurement of the range of fission fragments by their penetration of a stack of foils in contact with a thin layer of a uranium compound exposed to neutrons from a cyclotron target. The results of the range measurement were routine. Investigation of the residue in the uranium layer proved to be another story.

Intrigued by the inconsistency of this assignment with his observation that the active body did not recoil from the target, McMillan turned to a chemical investigation of the problem and

enlisted the collaboration of Philip Abelson. They soon found that the key to understanding the chemistry was the state of oxidation of the material. The similarity of the chemistry of element 93 and uranium, which made the identification so difficult, led to the suggestion that there was a second "rare-earth" group of elements starting with uranium. It also led McMillan to propose the name "neptunium" for element 93 and to reserve the name "plutonium" for the not yet identified element 94. McMillan next sought to make this identification as a product of deuteron bombardment of uranium. He produced an alpha-active substance which he was able to say on the basis of chemical tests was not protoactinium (91), uranium (92) or neptunium (93), but he could not make the final identification of element 94 because he left the Radiation Laboratory for the first of several urgent wartime positions.

In the early summer of 1945, McMillan's thoughts reverted to the problem of accelerators. Up to the time when peacetime research gave way to the mobilization of scientists and their equipment for war duty, a succession of accelerators, and in particular cyclotrons, of increasing energy were built and used in a wide variety of programs. Although the huge magnet for the next projected cyclotron was built, it was clear that the road to higher energies would be a difficult one, and, unless there was a new idea, would soon reach an absolute block. The overriding problem of accelerator technology was how to circumvent the energy limit. McMillan conceived a solution that was startling in its simplicity and that would prove to be far reaching in practice. This is called the principle of phase stability. There is no in-principle limit to this process. The door was opened to design accelerators for electrons, protons or heavier ions of any energy. The large accelerators, which are at the forefront of particle research today, are based on three fundamentals--the principle of phase stability, the earlier invention of the cyclotron and the more recent invention of strong focusing.

In parallel with his remarkably productive research career McMillan taught as a faculty member in the Physics Department at Berkeley where he gained a reputation for clarity and simplicity in his teaching and for an astonishingly wide range of knowledge.

agreement, in general terms at least, on what kinds of steps need to be taken.

George Bush

The White House,
November 17, 1989.

Note: H.R. 2710, approved November 17, was assigned Public Law No. 101-157.

**Statement by Press Secretary Fitzwater
on the President's Telephone
Conversations With Allied Leaders
November 17, 1989**

President Bush this morning telephoned the President of France, François Mitterrand, to discuss his views on the upcoming Malta meeting and events in Eastern Europe. President Bush wanted the unique perspective provided by the French President. They discussed a number of issues regarding the impact of recent events in Eastern Europe on the countries of Western Europe. The two Presidents agreed to talk again after the EC [European Communities] summit and before the Malta meeting.

President Bush also called the Prime Minister of Canada, Brian Mulroney, to discuss the Malta meeting and his views on these issues. President Bush and Prime Minister Mulroney have very similar thinking on these issues. President Bush and Prime Minister Mulroney will talk again after the Malta meeting.

In addition, Chancellor Kohl of West Germany telephoned President Bush this morning to discuss the events in his country and Eastern Europe.

**Remarks at the Thanksgiving Day
Proclamation Signing Ceremony
November 17, 1989**

Welcome to the Rose Garden on this lovely day. Mr. Wickliffe, my old friend

Peter, and everybody else. I just want to thank you for joining me as I participate for the first time in a tradition as old as the American Presidency: the signing of the annual Thanksgiving Day proclamation.

Two hundred years ago, George Washington signed the original proclamation for a day of thanksgiving: a day of thanks for the bounty we enjoy—[laughter]—and, above all, for the blessings of freedom. And that's why I'm so pleased to welcome the young Americans and recent newcomers to our country who are here today. [Laughter] Like every American—come on, this is serious stuff—[laughter]—you, too, are descendants of the first Pilgrims united by a love of liberty. And this year, especially, as that yearning for freedom inspires millions around the world, giving thanks for the freedoms we enjoy takes on a special meaning.

That brings me to another traditional moment involving our special guest over here today—the guy in the cage there, who seems understandably nervous. [Laughter] It is my great privilege to receive the traditional Thanksgiving turkey. Millie has been put upstairs, looking wistfully out of the window, I'm sure. But let me assure you, and this fine tom turkey, that he will not end up on anyone's dinner table, not this guy—he's granted a Presidential pardon as of right now—and allow him to live out his days on a children's farm not far from here.

And finally, let me ask all of you to remember another American tradition. Let this holiday time spent with family and friends remind us that helping others less fortunate than ourselves may be the best way we have of giving thanks.

And so, thank you all for coming. God bless you, and may the whole country have a very, very happy Thanksgiving.

And now I will sign the proclamation.

Note: The President spoke at 11:56 a.m. in the Rose Garden at the White House. In his remarks, he referred to Peter P. Stewart, chairman of the National Thanksgiving Commission; John Wickliffe, president of the National Turkey Federation; and Millie, the Bushes' dog.

Health and Human Services, 1978-1983; associate professorial lecturer in the department of economics at George Washington University, 1976-1978; health service fellow for the National Center for Health Services Research at the Department of Health, Education and Welfare, 1975-1978; faculty associate for the Survey Research Center for Social Research at the University of Michigan, 1974-1975; associate research scientist for the Institute of Public Policy Studies and School of Public Health, 1973-1975; senior research associate for the Urban Institute in Washington, DC, 1971-1973; executive director of the Governor's Council of Economic Advisers in Baltimore, MD, 1969-1970; staff economist for the President's Commission on Income Maintenance Programs in Washington, DC, 1968-1969; and research associate in the department of economics at the University of Michigan, 1968.

Dr. Wilensky graduated from the University of Michigan (A.B., 1964; M.A., 1965; Ph.D., 1968). She was born June 14, 1943, in Detroit, MI. Dr. Wilensky is married, has two children, and resides in Washington, DC.

Nomination of Carol M. Marshall To Be Superintendent of the Mint of the United States at San Francisco

November 17, 1989

The President today announced his intention to nominate Carol Mayer Marshall to be Superintendent of the Mint of the United States at San Francisco, the Department of Treasury. This is a new position.

Since 1986 Ms. Marshall has served as the president of Carol Mayer Marshall and Associates in San Francisco, CA. Prior to this, she served as the vice president of Public and Private Consultants, Inc., 1981-1986; an attorney with Washburn and Kemp, 1985-1986; assistant to the president of the Investment Development Fund, 1979-1981. She purchased, renovated, and sold single family homes in San Francisco, CA, 1977-1979. Ms. Marshall was a partner with Planning Research Consultants, Inc., 1973-1977.

Ms. Marshall graduated from George Washington University (B.A., 1960), and the University of California (J.D., 1975). She was born August 27, 1935, in Cincinnati, OH. Ms. Marshall has one child and currently resides in San Francisco, CA.

Remarks at the Presentation Ceremony for the National Medal of the Arts

November 17, 1989

The President. Excuse the delay. We've been out there trying to calm the national turkey, which has all worked out very well. [Laughter] No double entendres around here about that, either. [Laughter]

Thank you—all of you—for being here today for the fifth annual presentation of the National Medal of the Arts. It is a great pleasure and an honor for Barbara and me to welcome you to the White House. I just want to thank the National Council on the Arts; the Committee on the Arts and Humanities; as well as John Frohnmayer, our new and distinguished Chairman of the NEA; and of course, Hugh Southern for the support and encouragement of America's cultural life.

Dante once wrote that "Art imitates nature as well as it can, as a pupil follows his master; and thus it is a sort of grandchild of God." Well, as this, "grandchild of God," art embraces our values in history, gives meaning to our existence, and illuminates the basic human truths which give us purpose. In a way, art defines our civilization. But in another more personal way, art opens entire new worlds for each of us, letting us see and hear and even feel life through the mind of someone else, from new perspectives. And instead of seeing a single world, we can see as many worlds as there are artists and writers, dancers and musicians.

The diversity of art in this nation is truly a product of the diversity of our democracy. The American arts, like a many-faceted mirror, have been a colorful reflection of this nation's history. The music of the frontier led to the blues of the bayou, and the swing bands of the cities. The primitivism of the early painters gave way to the ro-

manticism of the Hudson River school and, later, American impressionism and abstract expressionism. In architecture, Americans see everything from the Federal style to postmodernism. Modern photography and filmmaking have their roots in the tintypes of the Civil War era. And from our earliest writings to this week's best seller list, we've seen American poetry, novels, short stories earn a unique place in the literature of the entire world. Cities like New York and Los Angeles have become art capitals of international importance; and regional orchestras, museums, dance troupes, and opera companies have enjoyed spectacular successes.

We need to make this great diversity of art more a part of the lives of all Americans. And we need to begin this effort in our schools so that our young people will have a sense of their heritage and the creativity of the present. We need to make special efforts to reach out to those who do not regularly participate. The work of the National Endowment is especially important in these areas.

Today, we honor a group of men and women whose creative ideas, talent, and passion have added so much to the rich tapestry that is our nation's cultural heritage. Their work is not just of the mind but of the heart and of the soul. And some have challenged us; some have amazed us; and some have brought remarkable beauty of sight and sound to us. But all have helped us to think and to dream and to understand ourselves and our world a little better.

Today, we honor **Alfred Eisenstaedt** for his photography, **Dizzy Gillespie** for his jazz innovations, **John Updike** for his prose, Katherine Dunham for her dance and choreography, Walker Hancock for his sculpture, Czeslaw Milosz for his poetry, Robert Motherwell for his paintings, and Leopold Adler for his historic preservation. And we honor someone whose great talent and energy will live on, long after the sounds of his music has faded, and that is the late Vladimir Horowitz.

And we honor the patrons of the arts, those who understand that without the artistic creativity of its people no nation can be whole, and those whose dedication, energy and commitment have sustained that creativity over the years. We honor

Martin Friedman of the Walker Art Center in Minneapolis, Leigh Gerdine of Webster University in St. Louis, and the Dayton Hudson Corporation.

And now I will ask John Frohnmayr if he will read the citations for the National Medal of the Arts to our recipients. John, all yours.

Mr. Frohnmayr. Thank you, Mr. President.

Leopold Adler II is a nationally recognized expert in historic preservation, one who has changed the face of his hometown, Savannah, Georgia. He was the driving force behind two remarkable revitalization experiments. One refurbished the historic section of Savannah, and the other renovated low-income housing in the Victorian district. Mr. Adler has also served as a trustee for almost a decade for the National Trust for Historic Preservation.

The citation reads:

"To Leopold Adler for his civic leadership in preserving for all time the beauty of Savannah, Georgia, and for making that city a model of the art of historic preservation."

Katherine Dunham is an outstanding dancer and choreographer. The Dunham Company, the first black professional dance company in America, performed throughout the world from 1938 through 1963, presenting the dance, music, and folklore of Third World countries and the United States. For over 30 years, Ms. Dunham has maintained the only permanently self-subsidized dance troupe in America. She also founded the Dunham School of Arts and Research in New York City.

The citation reads:

"To Katherine Dunham for her pioneering explorations of Caribbean and African dance, which have enriched and transformed the art of dance in America."

Alfred Eisenstaedt is the quintessential photojournalist who pioneered the introduction of the candid camera technique into news reporting. After emigrating from West Prussia in 1935, he joined the original photography staff of the new magazine, *Life*. Mr. Eisenstaedt's most famous photo is that of a sailor kissing a nurse in Times Square at the end of World War II. As a photographer, he has won almost every major national professional award.

Are Nobel Prizes for U.S. Vestiges of 'Golden Age'?

Many See Dominance in Science Nearing End

By Malcolm Gladwell
Washington Post Staff Writer

Last week was a triumphant one for American science.

On Wednesday, U.S.-trained researchers swept the Nobel prizes for physics and chemistry, capping an extraordinary Nobel season in which all but one of the nine academic winners were U.S.-born and all were products of U.S. universities.

But at a time when American science is facing its worst funding crisis since World War II, this year's Nobels were also an occasion for melancholy. As is the Nobel custom, all the awards were for work done 20 and 30 years ago, when American science was at its zenith.

Few feel the work being done today in the sciences will fare as well. Indeed for many the 40-year dominance of the prizes by the United States—during which time 30 of the 65 cited for chemistry were U.S. scientists, as were 61 of the 95 cited in medicine and 47 of the 87 in physics—is nearing an end.

"The period in which my colleagues and I carried out these experiments we refer to as the golden age," said Henry Kendall of the Massachusetts Institute of Technology, who shared this year's physics prize for work done in the late 1960s. "We have long since regarded it as vanished."

"The gloom comes out of looking at Washington and saying this is absurd," said Harvard biologist Walter Gilbert, a 1980 Nobel laureate. "The strength of American science has been due to an enlightened government policy over the past 30 years. That compact has now been destroyed. We no longer have a government that believes it has a responsibility to create new knowledge for the benefit of society."

Scientists are hardly objective on the subject of their own funding needs. The best scientists at the best schools—those who tend to win Nobel prizes—continue to get handsome research grants, and the total allotment for U.S. research continues to rise—albeit not by as much as scientists would like.

Even the most apocalyptic members of the scientific community concede that the size and wealth of the U.S. research establishment continues to dwarf that of the rest of the world.

Still the depth of pessimism among those on whom the country's scientific future depends has opened a serious debate about how well the machinery of U.S. research is now being managed.

What was it about the American system that caused the extraordinary flowering of genius over the past 40 years? And are scientists correct in assuming that that intangible quality is imperiled by funding cutbacks?

The success of the U.S. scientific community in winning awards like the Nobel has its roots in the country's post-war prosperity, which enabled the United States to devote enormous resources to science at a time when its chief competitor—Europe—was rebuilding from the war. After 1957, when the Soviet Union launched the first man-made Earth satellite, a panicky United States sharply increased its funding of science.

The resource-rich United States not only developed its scientific talent but became a magnet for the rest of the world's most creative researchers. Among those who came here as refugees from Hitler's Europe alone were eight Nobel lau-

reates and four who would go on to win prizes. Numerous others have come since: 19 of the 62 U.S. laureates in medicine since the end of World War II, for example, were born elsewhere.

Many scientists also believe that the culture of U.S. academe and the organization of research has lent itself ideally to creative, groundbreaking work.

Where post-graduate education exists in Europe, for example, it tends to be concentrated at research academies, which are run under the direction of senior scientists and receive block grants from the government.

In the United States, by contrast, researchers in a given discipline tend to be scattered at many different institutions. And research grants are made not to institutions but to individuals.

As a result, in the United States researchers tend to be able to pursue their own ideas at a younger age than in Europe, a crucial consideration given that most prize-winning scientists tend to do their best work during their late 20s and early 30s.

In addition, the diversity of the U.S. scientific establishment, with scores of competing institutions and dozens of sources of money, permits the exploration of ideas that would be too far-fetched or risky for a more conservative system. And it is the seemingly far-fetched ideas that often result in award-winning work.

"The real breakthroughs are the things you never expected to find," said Burton Richter, a 1976 physics laureate from Stanford University. "They can't be predicted and they very often start from an idea that no one agrees with."

Many scientists say, however, that the funding crunch imperils the ability of the system to continue to reward the young and the idiosyncratic—that aspect that has proven so attractive to the rest of the world and so adept at encouraging brilliance.

It isn't that scientists aren't getting funded. Overall levels are increasing. But the rate of increase has not kept pace with the explosion in science.

For example, a decade ago the National Institutes of Health deemed 13,000 research ideas worthy of pursuit and funded 90 percent of them—about 11,700. This year a record 22,500 are expected to win approval but the NIH has money for only 20 percent of them, leaving many younger researchers and less popular ideas out in the cold.

"To get funded these days you have to have all 12 people on a [NIH] reviewing committee agree that an idea is a good one," said Robert Root-Bernstein, a physiologist at Michigan State University. "But I bet that if you look back you couldn't find even one of 12 physicists during Einstein's time who thought that his ideas were any good."

"I see us being more and more oriented to stay within the mainstream, to go for the sure bet, the things that we know are going to pay off," said William Brinkley, a biologist at the University of Alabama at Birmingham. "When the money is tight, the risky science is the first to go."

"We have come of age scientifically in the post-war period," said Harvard University physicist Gerald Holton. "But the projections for the future are ominous. The thing to do is not to congratulate ourselves, but to worry about what will happen next."



Massachusetts Institute of Technology

VANNEVAR BUSH

science *the endless frontier*

A report to the President on a
Program for Postwar Scientific Research

By Vannevar Bush

Director of the
N.S. Office of Scientific Research and Development

July 1945

Reprinted July 1960

National Science Foundation, Washington, D. C.

We have no national policy for science. The Government has only begun to utilize science in the Nation's welfare. There is no body within the Government charged with formulating or executing a national science policy. There are no standing committees of the Congress devoted to this important subject. Science has been in the wings. It should be brought to the center of the stage—for in it lies much of our hope for the future.

There are areas of science in which the public interest is acute but which are likely to be cultivated inadequately if left without more support than will come from private sources. These areas—such as research on military problems, agriculture, housing, public health, certain medical research, and research involving expensive capital facilities beyond the capacity of private institutions—should be advanced by active Government support. To date, with the exception of the intensive war research conducted by the Office of Scientific Research and Development, such support has been meager and intermittent.

For reasons presented in this report we are entering a period when science needs and deserves increased support from public funds.

Freedom of Inquiry Must Be Preserved

The publicly and privately supported colleges, universities, and research institutes are the centers of basic research. They are the wellsprings of knowledge and understanding. As long as they are vigorous and healthy and their scientists are free to pursue the truth wherever it may lead, there will be a flow of new scientific knowledge to those who can apply it to practical problems in Government, in industry, or elsewhere.

Many of the lessons learned in the war-time application of science under Government can be profitably applied in peace. The Government is peculiarly fitted to perform certain functions, such as the coordination and support of broad programs on problems of great national importance. But we must proceed with caution in carrying over the methods which work in wartime to the very different conditions of peace. We must remove the rigid controls which we have had to impose, and recover freedom of inquiry and that healthy competitive scientific spirit so necessary for expansion of the frontiers of scientific knowledge.

Scientific progress on a broad front results from the free play of free intellects, working on subjects of their own choice, in the manner dictated by their curiosity for exploration of the unknown. Freedom of inquiry must be preserved under any plan for Government support of science in accordance with the Five Fundamentals listed on page 32.

The study of the momentous questions presented in President Roosevelt's letter has been made by able committees working diligently. This report presents conclusions and recommendations based upon the studies of these committees which appear in full as the appendices. Only in the creation of one over-all mechanism rather than several does this report depart from the specific recommendations of the committees. The members of the committees have reviewed the recommendations in regard to the single mechanism and have found this plan thoroughly acceptable.

THE WAR AGAINST DISEASE

In War

The death rate for all diseases in the Army, including the overseas force has been reduced from 14.1 per thousand in the last war to 0.6 per thousand in this war.

Such ravaging diseases as yellow fever, dysentery, typhus, tetanus, pneumonia, and meningitis have been all but conquered by penicillin and the sulfa drugs, the insecticide DDT, better vaccines, and improved hygienic measures. Malaria has been controlled. There has been dramatic progress in surgery.

The striking advances in medicine during the war have been possible only because we had a large backlog of scientific data accumulated through basic research in many scientific fields in the years before the war.

In Peace

In the last 40 years life expectancy in the United States has increased from 49 to 65 years largely as a consequence of the reduction in the death rates of infants and children; in the last 20 years the death rate from the diseases of childhood has been reduced 87 percent.

Diabetes has been brought under control by insulin, pernicious anemia by liver extracts; and the once widespread deficiency diseases have been much reduced, even in the lowest income groups, by accessory food factors and improvement of diet. Notable advances have been made in the early diagnosis of cancer, and in the surgical and radiation treatment of the disease.

These results have been achieved through a great amount of basic research in medicine and the preclinical sciences, and by the dissemination of this new scientific knowledge through the physicians and medical services and public health agencies of the country. In this cooperative endeavor the pharmaceutical industry has played an important role, especially during the war. All of the medical and public health groups share credit for these achievements; they form interdependent members of a team.

Progress in combating disease depends upon an expanding body of new scientific knowledge.

E. Donnall Thomas
Clinical Director Emeritus
Fred Hutchinson Cancer Research Center
Seattle, WA

Citation: For his pioneering work in the science and application of transplantation biology to successful bone marrow transplantation in man for the treatment of cancer and related conditions.

Summary of Achievements

E. Donnall Thomas has combined a career as laboratory investigator, clinician, teacher and clinical investigator in a fashion rarely found. He persevered in the development of successful bone marrow transplantation in man where others initially attracted to the technique left the field. In the early days complications which could not be explained based upon human biological knowledge were considered too difficult to overcome. Dr. Thomas overcame those problems through bringing insights from the laboratory to the clinical setting. Extending the donor pool to matched but unrelated individuals has made the technique possible as a lifesaving procedure to a significant proportion of individuals originally precluded from this treatment because they lacked an immunologically matched donor sibling or parent. The fundamental approach of marrow transplantation through manipulation of stem cells and their introduction into a new body provides a vehicle for gene transfer as well as an important management technique in the treatment of inherited disorders of hemoglobin synthesis and other genetic problems. Application of transplantation has opened up new research avenues in immunosuppression, the continuing efforts to solve the problem of graft-versus-host disease, and the management of the immunocompromised patient. Dr. Thomas and his colleagues not too long ago performed a significant proportion of all transplants undertaken in the world. Today that fraction has decreased considerably because of the development of other units elsewhere throughout the world, all of them heavily dependent on the experimental results reported by Dr. Thomas and his colleagues, and many directly dependent for their success upon training with Dr. Thomas in his laboratory and clinics in Seattle.

Baruj Benacerraf
Chairman, Department of Pathology
Harvard Medical School
and
President & Chief Executive Officer
Dana-Farber Cancer Institute
Boston, MA

Citation: For his fundamental contributions to the understanding of the immune system, including much of the work which forms the basis of knowledge of transplantation immunology and regulatory function in the immune response.

Summary of Achievements

Baruj Benacerraf has made fundamental contributions to all aspects of immunology, including immunochemistry, immunogenetics, cellular immunology and immunopathology over a span of 40 years. Among his most important contributions is the discovery that antigens need to be processed by antigen presenting cells before immunogenic fragments are generated and presented to T-derived lymphocytes in close association with molecules of the major histocompatibility complex.

In 1963, Dr. Benacerraf initiated studies which demonstrated that immune responsiveness is under the control of genes of the major histocompatibility complex. These surface molecules were later shown, as predicted by Dr. Benacerraf, to function as carriers of processed peptide antigens which are recognized in association with the major histocompatibility molecules themselves by the T-cell receptor. These contributions have been essential to the understanding of transplantation immunity and the regulatory function of T-lymphocytes in the immune response.

In addition to his contributions in immunogenetics and cellular immunology, Dr. Benacerraf was responsible for the discovery of (1) the Fc receptor of immunoglobulins which explained the binding of these molecules to phagocytic cells, (2) the role of immune complexes in glomerulonephritis, and (3) the heterogeneity of immunoglobulin isotypes in relation to their function.

Furthermore, Dr. Benacerraf has been responsible for the training of a very large number of immunologists in the United States and abroad. The list of scientists trained over the last 30 years in Dr. Benacerraf's laboratory reads as a "Who's Who in Immunology." Among these are numerous professors, chairmen of departments and heads of laboratories, as well as members of the National Academy of Sciences.

~~Jim Kossel~~

Jackie ~~Clawson~~ Clawson 2870

Mildred S. Dresselhaus
Institute Professor
Massachusetts Institute of Technology
Cambridge, MA

Citation: For her studies of the electronic properties of metals and semimetals, and for her service to the Nation in establishing a prominent place for women in physics and engineering

Summary of Achievement

Mildred Dresselhaus is the most prominent woman physicist and engineer of her generation. Her most important research accomplishments have been in the area of the optical properties of metals and semimetals. Her magnetoreflexion studies of bismuth provided experimental substantiation for the band structure of this prototype semimetal. Dr. Dresselhaus's experimental and theoretical contributions to the understanding of the electronic structure of graphite with and without intercalants have had great impact both in the United States and abroad, especially in Japan. Her studies of the staging in graphite intercalation compounds provided important information about the interplay between their structural and electronic properties. These studies of two-dimensional metals have become especially important with the advent of the high temperature superconductors which, like graphite, are lamellar. She began her career with important measurements of the properties of conventional superconductors and has recently returned to that field with the advent of high temperature superconductors.

As a role model for women in science and engineering, her impact has been enormous. As Professor of Electrical Engineering and Computer Science since 1968 and as Professor of Physics since 1983, she has educated an entire generation of MIT women and encouraged them to pursue science and engineering careers. In large part because of her, the fraction of MIT freshman that are women has grown by a factor of three to four. Her list of breakthroughs is impressive: she is one of only two women to have been President of the American Physical Society; she was the first woman Professor of Electrical Engineering and Computer Science; she is the only woman Institute Professor at MIT; she was the only woman Director of an NSF Materials Research Laboratory; and she has served on a wide variety of governmental and National Academy committees. All while maintaining a vibrant research program.

Allan M. Cormack
University Professor
Tufts University
Medford, MA

Citation: For his scientific work including the development of computer assisted tomography; and as a scholar and teacher, especially of undergraduates.

Summary of Achievements

In 1979 Allan M. Cormack (jointly with G. N. Hounsfield) was awarded the Nobel Prize in Physiology or Medicine with the citation, "For the development of computer assisted tomography." This work revolutionized medical diagnosis, and "CAT-scan" is now a household word. In 1963 and 1964 he developed the theory and an experimental confirmation of the fact that from a series of X-ray transmission profiles one can compute the variable X-ray coefficients in objects; for example, human bodies. Further, he suggested that this general method had important applications in precise radiology and radiotherapy. In *Science*, [186, 207 (1974)] it was noted that the "remarkable" paper of 1963 contained "the essence of computerized axial tomography." These historic papers point out the applicability of this method to positron emission tomography (PET scanning) which was then in an embryonic stage.

Tomographic reconstruction methods now have widespread applications of which only two will be cited. Magnetic resonance imaging was originally based on the same principles of image reconstruction. Crystallographic electron microscopy is based on a mathematical equivalent of the same principles.

In presenting the accomplishments of Cormack, one should not review only the widely known work on computer assisted tomography. From his first work in 1945, he has contributed in the areas of nuclear and particle physics, mathematics, and most recently, radiotherapy planning.

It is important in describing Cormack's work to note that throughout the 40 years of splendid research, he has also been an exemplary teacher of many students. He prefers to teach undergraduate students, and has had a most positive impact on both young physicists and engineering students. In these days of "scientific and technological illiteracy," the importance of such a scholar in the classroom is absolutely essential.

McNally/Dooley
Nov. 7, 1990
Draft One (B:SCIENCE)

PRESIDENTIAL REMARKS: NATIONAL MEDAL OF SCIENCE & TECHNOLOGY
THE EAST ROOM
TUESDAY, NOV. 13, 1990, 2:00 P.M.

Thank you. We're pleased to see Secretary Mosbacher, Secretary Sullivan, and Dr. Bromley here to help us out. And we especially want to greet our honored guests, this extraordinary gathering of scientific and technological genius.

Welcome to the White House -- and welcome to the presentation of the 1990 National Medals of Science and Technology. \\\

((The timing of these awards is fortuitous. A year ago this week, Barbara and I awarded medals to some of the artistic giants of our time -- Alfred Eisenstaedt, Dizzy Gillespie, and John Updike, among others. \\\ And with all that assembled talent, guess what led the evening news? \\\ The Rose Garden presentation of the National Turkey. \\\ So you're in luck -- this year the Turkey doesn't arrive until Thursday!)) \\\

This gathering marks a proud moment for me -- just as it was when this year's Nobel Prizes were announced, and it turned out that eight of the nine winners in science and economics were born in the U.S.A. It is a tribute to America's frontier spirit, and to our Nation's steadfast resolve and sense of the future. For when it comes to science and technology -- best in America means best in the world. \\\

America's tradition of excellence has long been nurtured by a tradition of free inquiry -- aimed at the simple goal of better understanding of ourselves and our world. In the 1945 report

that led to the founding of the N.S.F., the National Science Foundation, Vannevar Bush wrote that: "As long as scientists are free to pursue the truth wherever it may lead, there will be a flow of new scientific knowledge to those who can apply it to practical problems."

And so it is today. More and more, the country depends on basic scientific research to spur economic growth, longer and healthier lives, a more secure world, and a safer environment. And our government must help carry that research forward, and contribute to the development of technologies that build on basic discoveries. In this way, we can help leverage the R & D of the private sector -- helping whole industries advance in an increasingly competitive global marketplace.

The new budget highlights our Administration's commitment to science and technology. We won double-digit increases for both NASA and the N.S.F., and expanded funds to investigate global climate change. We remain committed to doing even more: Doubling the N.S.F. over five years, and making permanent the tax credit for R & E -- research and experimentation. And we're going to keep raising America's sights: **NASA's Space Exploration Initiative will take us to the Moon and Mars and beyond -- back to space, back to the future, and this time -- back to stay.** ///

So in the next budget, we're going to put it to Congress again. We're going to say: "Put our money where our future is. Stop funding pork-barrel projects in your home districts and let our scientists and engineers go to work for America." ///

30 years from now, when the Nobel Prizes are announced -- I want America to be well-represented. And 30 years from now, when the Medals of Science and Technology are bestowed, I want America to be graced by a group as accomplished as those here today.

I think of Mildred Dresselhaus, arguably the most prominent woman physicist and engineer of her generation, whose work helped to revolutionize semi-conductors. Or Allan Cormack, whose pioneering efforts earned him a Nobel Prize -- and made "CAT-scans" a household word. And scholars as diverse as Boston's Baruj Benacerraf -- or Seattle's Donnell Thomas -- whose contributions to immunology may lead to new answers in our battle against cancer and AIDS. Scientists like you have helped America to understand that AIDS is a disease -- not a disgrace. And somewhere out there -- along with the gratitude of planet Earth -- one of these Medals is waiting for the man or woman who discovers the cure to this deadly scourge. \\\

Another legacy of this prestigious medal and the work it honors must be the cultivation of excellence in science and math in classrooms across America. The National Science Scholars program we proposed soon after taking office has now been enacted -- and will encourage budding scholars of today to become the scientists of tomorrow. Guiding our efforts is an ambitious but critical goal for this decade: "By the Year 2000, U.S. students will be first in the world in science and math."

This week is education week, and its theme is "Educating Everyone Takes Everyone" -- a fitting motto for the challenges

that lie ahead. If we truly are to achieve a renaissance of quality in our schools, we must tap the talent, energy, and commitment of all our families, businesses, and universities.

The people we honor today are American trailblazers, real-life pioneers who pressed the very limits of their fields. You have distinguished not only yourselves -- but also your Nation. And that's why America continues to need and want -- and appreciate -- your creativity, your genius and your diversity.

Thank you. Congratulations. And God bless the United States of America.

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EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

November 7, 1990

MEMORANDUM TO: ED McNALLY
FROM: STEVE OLSON
SUBJECT: TALKING POINTS FOR PRESIDENTIAL SPEECH

Ed: Here are a set of talking points for the President's speech next Tuesday. If you need more information, I'm at 2734.

o A former recipient of the Medal of Science, Leon Lederman, has written: "One takes up fundamental science out of a sense of pure excitement, out of joy at enhancing human culture, out of awe at the heritage handed down by generations of masters, and out of a need to publish first and become famous." You have certainly all succeeded in this last venture. But the Medals of Science and Technology acknowledge that you also have succeeded at the others.

o This is a proud moment for me -- to see the array of scientific and technological genius gathered here in the White House -- just as it was when this year's Nobel Prizes were announced, and eight of the nine winners in science and economics turned out to have been born and educated in the United States. It is a tribute to this country's frontier spirit -- to its steadfast resolve and sense of the future -- that the United States has for decades led the world in science and technology.

o But in recent years that lead has occasionally faltered. Other countries have focused their resources and have come to equal -- or even surpass -- the United States in particular areas of science and technology. In part, this was to be expected, as other countries recognized the benefits to be gained from science and technology. But the United States must not lose sight of the traditions responsible for its success.

o The most powerful of those is the tradition of free inquiry, directed by the scientific community itself, aimed at the simple goal of better understanding ourselves and the world. In Science: The Endless Frontier, the 1945 report that led to the establishment of the National Science Foundation, Vannevar Bush wrote that "As long as . . . scientists are free to pursue the truth wherever it may lead, there will be a flow of new scientific knowledge to those who can apply it to practical problems." That statement remains as true today as it was 45 years ago. More and more, the country depends on basic scientific research as a spur to economic growth, a more secure world, longer and healthier lives, and a safer environment.

o Since last February, an equally distinguished committee of private sector scientists and engineers has been reporting directly to me -- the President's Council of Advisors on Science and Technology. The Council has been meeting monthly and has covered issues ranging from economic competitiveness to mathematics and science education, from global change to supercomputing. And that Council is itself chaired by a National Medalist of Science, my science advisor Allan Bromley.

o The input that I get from them is critical. More and more of the decisions made by the federal government involve large components of science and technology. So I have to get the best possible advice, and for that I have to rely on the best scientists and engineers that this country has to offer.

Science and Mathematics Education

o [Ed: I have a large amount of material on science and mathematics education, but since OPD is providing you with some of this, I thought I would wait and see what they provide.]

cc: Allan Bromley
Ken Yale

o At the same time, the government must do more than sponsor basic research. It must carry that research a step forward and contribute to the development of generic, precompetitive technologies that build on basic discoveries. These technologies do not give an advantage to any one company, but they help whole industries and economic sectors advance in the global marketplace. In this way, the government can leverage the research and development of the private sector, so that businesses can develop products and services that are internationally competitive.

o The budget that I sent to Congress last January highlighted this Administration's commitment to science and technology. It proposed doubling the size of the National Science Foundation over five years, moving ahead on NASA's Space Exploration Initiative and Mission to Planet Earth, expanding the U.S. Global Change Research Program to reduce the many uncertainties surrounding climate change, and making the research and experimentation tax credit for businesses permanent. That budget reflected a guiding principle behind my Administration: the idea that support for science and technology is one of the most important investments we can make in the future of this country.

o In recent years, we have invested too little in this vital resource. Already, Japan and Germany spend a greater fraction of their gross national products on research and development, and the gap has been growing. That is a trend we have to reverse.

o The Congress fulfilled some of the requests in the budget I submitted, but many others it ignored. So in the next budget we're going to go back to Congress and we're going to say to them, "Put our money where our future is. Stop funding pork-barrel projects in your home districts and let scientists and engineers go to work for this country."

o In the last few months, government-wide groups under the Federal Coordinating Council for Science, Engineering, and Technology have been looking at two critical areas of science and technology -- high-performance computing and mathematics and science education -- to propose future directions in which the government can go. And we are planning to do this for other areas of science and technology in the future.

o Our intention is to make sure that the United States maintains its preeminence. When the Nobel Prizes are announced 30 years from now, I want Americans to be well-represented. When the Medals of Science and Technology are bestowed in the future, I want to make sure that the country is honored by a group as distinguished and accomplished as this one.

PCAST

o This year is the hundredth anniversary of Dwight D. Eisenhower's birth, and Eisenhower was the first President to establish a committee of scientists and engineers who reported directly to him. He later wrote, "Without such distinguished help, any President in our time would be, to a certain extent, disabled."

11/6/90

Presidential Remarks: Science and Technology Medals

The President is scheduled to honor winners of the Science and Technology Medal on November 13. Because this event falls during American Education Week, it may be appropriate to weave an education theme into the President's remarks. The following points may be relevant:

- o The legacy of this prestigious medal and the accomplishments it honors must begin with cultivating excellence in science and mathematics education in schools across America.
- o Guiding our efforts is an ambitious but critical goal for this decade: "By the year 2000, U.S. students will be first in the world in science and mathematics achievement."
- o The National Science Scholars program, an initiative I proposed soon after taking office and Congress recently enacted, will encourage our budding scholars to be tomorrow's accomplished scientists.
- o This week is American Education Week; this year's theme: "Educating Everyone Takes Everyone." What a fitting motto for the challenge that lies before us. The talent, energy and commitment of all our workers, parents, and citizens must be tapped if we truly are to achieve a renaissance of quality in our schools.

c: Barrie Tron

→ Commerce - Technology Heroes?

Timothy Garton Ash

Roger R. D. Revelle
 Director Emeritus
 Scripps Institution of Oceanography
 University of California
 La Jolla, CA
 and

Richard Saltonstall Professor of Population Policy Emeritus
 Harvard University
 Cambridge, MA

Citation: For his pioneering work in the areas of carbon dioxide and climate modification, oceanographic exploration presaging plate tectonics, and the biological effects of radiation in the marine environment, and studies of human population growth and global food supplies.

Summary of Achievements

Roger Revelle has made major contributions during his long scientific career. Four important areas: carbon dioxide and the "Greenhouse Effect," oceanographic exploration presaging plate tectonics, biological effects of radiation, and population and global food resources are outlined below.

Carbon Dioxide and the "Greenhouse Effect." Revelle studied the buffer mechanism of sea water as a student of oceanography. Revelle and his coauthors found that only half of the CO₂ released by fossil fuel and other anthropogenic activities go into the ocean, not 98% as had been thought. Revelle and Suess pointed out that the other half would stay in the atmosphere with potentially serious effects. Consequently, Revelle organized a program to measure CO₂ on top of Mauna Loa in Hawaii and at the South Pole. These measurements were started in 1957 by C. D. Keeling and continue today. They constitute the principal source of data upon which all subsequent atmospheric CO₂ studies have been based.

In 1965, the President's Science Advisory Committee under Revelle's leadership published the first authoritative U.S. government report in which CO₂ from fossil fuel was officially recognized as a potential global problem. In 1977, Revelle chaired a National Academy of Sciences committee which found that about 40% of the anthropogenic CO₂ has remained in the atmosphere, 2/3 of that from fossil fuel, 1/3 from the clearing of forests. These show that the CO₂ content will rise over the century to five times the preindustrial value. Since 1977, Revelle has written 15 papers on this subject. His recent studies concern the rise in global sea level and the relative role played by the melting of glaciers and ice sheets versus the thermal expansion of the warming of surface waters.

Oceanographic Exploration Presaging Plate Tectonics. As Director of the Scripps Institution of Oceanography, Revelle initiated, planned and led a series of important oceanographic expeditions. Four noteworthy discoveries were made on two of these expeditions, MIDPAC (1950) and CAPRICORN (1952-1953): (1) the extreme thinness of deep sea sediments; (2) the high upward heat flow through the sea bottom; (3) the young age (60 million years) of sea mounts; and (4) the existence of enormous fault zones (now called transform faults).

These discoveries brought then prevalent conceptions of earth history and seafloor structure into question and anticipated the acceptance of plate tectonic theory.

Revelle and Maxwell measured the thermal conductivity of deep sea floor sediments and found these to be about equal to measurements of heat flow on land. This contravened the common conception that heat flow beneath the ocean should be much lower than heat flow from the continents. Revelle and Maxwell concluded that the heat must come from the decay of small amounts of radioactive materials throughout a thick column of rock and that heat must be carried outward by a convective churning of the rocks of the Earth's mantle. Revelle encouraged V. Vacquier's magnetic surveys and studies of transform faults and provided opportunities for other scientists including Bullard, Dietz, Mason and Maxwell to conduct important geophysical research. Heat flow, magnetic survey and other data served as the empirical basis for the conception of sea floor spreading and plate tectonic theory.

Biological Effects of Radiation. Revelle led the oceanographic and geophysical components of Operation Crossroads, the first postwar atomic test at Bikini Atoll in 1946 and resurveyed the island in 1947 to study the diffusion of radioactive wastes and the environmental effects of atomic radiation. Revelle continued his studies in this area as chair of the Oceanography and Fisheries Panel of the National Academy of Sciences Biological Effects of Atomic Radiation Committee. The report of this committee was the first public report to consider the question of radioactive waste disposal in the sea, a subject pursued in subsequent publications by Revelle and Schaefer.

Population and Global Food Resources. Revelle served as first Science Advisor to the Secretary of the Department of the Interior (1961-1963) and worked on problems of the environment, world population growth and the social and economic development of poor nations. Revelle organized and led a study of soil conditions in the Punjab Basin of West Pakistan which effectively doubled the agricultural yield of the region. As first Director of the Harvard Center for Population Studies, Revelle and his coauthors conducted studies of human fertility and the interactions among growing populations, their resources and their environment. Revelle conducted important studies of water resources and energy use in rural India, and Revelle and Thomas suggested improvements in the efficiency of the High Aswan Dam for irrigation. Revelle's most recent work concerns the improvement of agricultural production in West Africa.

Revelle's contributions to science cannot be evaluated without considering his administrative achievements and his promotion of international scientific cooperation. During World War II, Revelle directed the oceanographic work of the Navy Bureau of Ships and was largely responsible for the growth of the Navy's program on submarine warfare. He was one of a small group of officers who promoted the establishment of the Office of Naval Research, and he served as first Director of ONR's Geophysics Branch. Revelle was Director of the Scripps Institution of Oceanography for 14 years. He conceived and helped found the University of California, San Diego.

Karl Folkers
Ashbel Smith Professor and
Director of the Institute for Biomedical Research
The University of Texas at Austin
Austin, TX

Citation: For his discoveries and leadership in combining basic chemical research and clinical medicine to achieve new treatments of diseases which have enhanced the quality of life and extended survival rates for countless people.

Summary of Achievements

Multiple major discoveries on diverse subjects produced over an inordinately long time period independent of places and persons exemplify Karl Folkers' outstanding career. In three separate locations, three distinct careers, and three different research programs his work actively spans over half a century. Today, basic-clinical research is his primary activity, in pursuit of his lifelong dream of more closely linking chemistry, medicine and disease. At Merck and Company from 1938 to 1962 it was vitamins and antibiotics. At Stanford Research Institute from 1963 to 1968 it was the basic chemistry of Coenzyme Q₁₀ (CoQ₁₀) and co-initiation of CoQ₁₀ for patients with muscular dystrophy. At the University of Texas at Austin from 1968 to present, it has been CoQ₁₀ for patients with congestive heart failure and the establishment of an important strategy of design for the development of peptide antagonists by the utilization of D-unnatural amino acid residue substitutions in biologically active small synthetic peptides.

Karl Folkers has narrowed the gap between chemistry and medicine on the many diverse subjects of vitamins, antibiotics, coenzyme Q and peptide hormones or analogs. His outstanding career has been one of spirited intellectual perseverance, unrelenting courage, success and an inordinate amount and number of solid timeless certainties.

Stephen C. Kleene
 Professor Emeritus
 University of Wisconsin
 Madison, WI

Citation: For his leadership in the theory of recursion and effective computability and for developing it into a deep and broad field of mathematical research.

Summary of Achievements

Stephen Kleene's name is inextricably bound with the theory of recursion and effective computability which he founded and helped develop. Today it flourishes as an important part of pure mathematics with applications within both mathematics and computer science. Indeed it provides the theoretical underpinnings for the abstract study of computability, and it is hard to see how theoretical computer science could have reached maturity as an intellectual discipline without Kleene's basic conceptual contributions and foundational work.

The singling out of the class of "partial recursive functions" (though extremely natural in retrospect) is a fundamental step. All the basic regularities are for the class of partial recursive functions, and an adequate theory cannot be developed if only the more obvious class of total recursive functions is considered.

The development of the arithmetical hierarchy is another very important step. In all sorts of branches of mathematical endeavor, there is an analogous hierarchy which plays a similar fundamental role. For example, there is the Levy hierarchy in classical set theory, and the analytical hierarchy (also due to Kleene) in theory of projective sets of reals. In each case, the formal properties established are patterned to a large extent on the theory of the arithmetical hierarchy developed by Kleene.

The fact (due to Kleene) that the notion of "well-ordering" is complete in the class of Σ_1^1 relations is the key that unlocks the behavior of the first level of the analytical hierarchy. The highly successful work of Moschovakis, Martin and others in understanding the higher levels of the analytical hierarchy on the basis of the axiom of projective determinacy can be viewed as fashioning highly technical substitutes for this connection at the higher levels of the analytical hierarchy.

Finally, Kleene's development of the method of "realizability" is an extremely important tool in the study of the intuitionistic mathematics of Brouwer and his disciples. To put it gently, many classically inclined mathematicians find the writings of Brouwer and his school obscure. Not only does realizability provide a

powerful (though admittedly incomplete) window into intuitionism for the classical mathematician, but it has provided one of the most effective tools for the metamathematical investigation of intuitionistic formal systems.

Daniel E. Koshland, Jr.
Professor of Biochemistry and Molecular Biology
University of California, Berkeley
Berkeley, CA
and Editor, Science Magazine

Citation: For profoundly influencing the understanding of how proteins function through his induced-fit model of enzyme action. His incisive analysis of bacterial chemotaxis has led to a deeper understanding of the molecular basis of memory and adaptation.

Summary of Achievements

Daniel Koshland has profoundly influenced the understanding of how proteins act as catalysts and signal transducers. He was the first to perceive that proteins are dynamic structures and that their flexibility is at the heart of their biological function. In the 1950's, he introduced the concept of induced fit in enzymatic catalysis. Until then, proteins were thought to be rigid structures; the interaction of substrates with enzymes was viewed in terms of the lock-and-key analogy. Koshland showed that phosphoryl transfer enzymes could not operate in this manner. Hexokinase, for example, would rapidly hydrolyze ATP in the absence of glucose if active sites were fully formed prior to the binding of their substrates. He proposed that substrate binding is a dynamic process involving conformational rearrangements of the enzyme. Koshland's highly creative and original hypothesis was confirmed years later by x-ray crystallographic studies. In many kinases, for example, the active site cleft closes on binding substrate. Koshland's induced-fit model stimulated many investigators to look for conformational changes in protein function. It was a prescient concept that proved to be highly fruitful, as exemplified by subsequent work showing that the activity of many proteins is allosterically regulated.

Koshland's studies of bacterial chemotaxis have likewise been highly incisive and significant. Bacteria move towards nutrients and away from noxious substances. Does a bacterium compare the concentration of an attractant at one end of a cell with that at the other or does it compare the concentration of attractant now with that of a few moments ago? In other words, is the sensing mechanism spatial or temporal? In 1972, Koshland answered this central question by carrying out an ingeniously simple experiment which revealed that sensing is temporal: a bacterium detects a spatial gradient of attractant not by comparing the concentration at its head and tail, but by traveling through space and comparing its observations through time. He subsequently purified several cell-surface chemoreceptors, the first elements of the signal transduction system. Koshland's biochemical analysis of these detectors demonstrated that they integrate information impinging on the bacterium; their output is determined by both repellent and attractant stimuli. He also found that reversible methylation of these receptors enables bacteria to adapt--that is, to respond to changes in the intensity of stimuli rather than to their absolute level. Koshland's lucid analysis of the molecular circuitry and logic of bacterial chemotaxis is a source of inspiration to those seeking to understand the molecular neurobiology of higher organisms.

Koshland has also contributed richly to the scientific life of the country. He has done a superb job as Editor of Science since 1964. He has attracted outstanding articles that communicate important advances over the entire spectrum of science and reviews that present their import to the nonspecialist. The reporting of public policy issues has been accurate and perceptive. The cohesiveness of the scientific community and public understanding and support for science are critically dependent on effective communication. Koshland has done this remarkably well while carrying out first-class research on how molecules mediate sensory processes. Over several decades, Koshland has combined the pursuit of the public good with inquiry into fundamental processes of nature.

John McCarthy
Professor of Computer Science
Charles M. Pigott Professor in the School of Engineering
Stanford University
Stanford, CA

Citation: For his fundamental contributions to computer science and artificial intelligence, including the development of the LISP programming language; the mathematical theory of computation; the concept and development of time-sharing; the application of mathematical logic to computer programs that use commonsense knowledge and reasoning; and the naming and thus the definition of the field of artificial intelligence itself.

Summary of Achievements

John McCarthy has had an extraordinary impact on the field of computer science, especially the field of artificial intelligence. In fact, he gave the field of artificial intelligence its name, coining the term in connection with the Dartmouth Summer Research Project on Artificial Intelligence held in the summer of 1956. McCarthy organized this seminar, the first occasion that brought together most of the individuals thinking about how to make computers behave intelligently.

Building on concepts embodied in other computer languages, McCarthy's efforts to develop an algebraic programming language for computation with symbolic expressions led in 1958 to the development of LISP, the programming language that is even today the most fundamental tool of those working in the field of artificial intelligence.

McCarthy based LISP on his mathematical theory of computation, in itself another substantial contribution to the field of computer sciences. This theory provided the basis for one of two current approaches to proving computer programs correct.

McCarthy also contributed to another fundamental conceptual breakthrough in computer science, one that led to substantial developments in the way we use computers: that of time-sharing. McCarthy's initial proposals were further developed by others and contributed to the development of time-sharing systems.

McCarthy's greatest scientific contribution is the "reasoning program" approach to artificial intelligence pioneered in his 1960 paper on this subject, in which facts and problems are presented as sentences of mathematical logic. McCarthy is today the leader in the active field of common sense reasoning. His papers on circumscription provide artificial intelligence with a rigorous foundation for non-monotonic reasoning.

In summary, John McCarthy has made more fundamental contributions to the fields of computer science and artificial intelligence than any person living today.

Robert V. Pound
Mallinckrodt Professor of Physics Emeritus
Harvard University
Cambridge, MA

Citation: For his pioneering experiments in nuclear magnetic resonance, including the study of quadrupole interactions and negative spin temperatures, and for the demonstration of the gravitational shift of γ -ray photons.

Summary of Achievements

Robert Pound made major contributions to the development of radar systems during World War II when he served on the staff of the MIT Radiation Laboratory. He was responsible for balanced microwave mixers and frequency stabilization of microwave oscillators. He is the author of Volume 16 of the Radiation Laboratory Series (McGraw Hill, New York, 1948) on "Microwave Mixers."

Pound's expertise, bordering on wizardry, in the field of electronics also played a key role in the first successful experimental demonstration of nuclear magnetic resonance in condensed matter. This work was carried out jointly with E. M. Purcell and H. C. Torrey in the fall of 1945 and published as a letter in the Physical Review in January 1946. A similar demonstration was independently made at about the same time by a group at Stanford University under the leadership of the late Felix Bloch. It is a matter of record that F. Bloch and E. M. Purcell shared the Nobel Prize for Physics in 1952 for this discovery. Pound was also a coauthor of a fundamental paper on "Relaxation Phenomena in Nuclear Magnetic Resonance Absorption," with N. Bloembergen and E. M. Purcell. This is one of the most frequently quoted physics papers in the scientific literature and is often referred to as BPP. Pound also developed the first tunable radiofrequency spectrometer for the detection of nuclear magnetic resonance. This device was for a number of years known as the "Pound Box." He used it for a fundamental pioneering study of the effects of nuclear electric quadrupole moments in magnetic resonance.

He joined E. M. Purcell and N. F. Ramsey in a series of basic experiments, which introduced the concept of negative spin temperature and inverted populations in magnetic resonance in the years 1950 and 1951. This work later stimulated the development of masers and lasers. Another fundamental contribution by Dr. Pound is concerned with the experimental demonstration of the gravitational red shift of γ -ray photons and of the second order Doppler shift by thermal motion of such photons. Pound pioneered studies of the Mossbauer effect in the United States. Pound's extensive explorations in the fields of magnetic resonance and the Mossbauer effects have been influential on the national and international level.

Pound has a somewhat retiring personality, shunning the limelight, but he has set an example of high moral standards in the profession. His former Ph.D. students are now occupying leading positions at educational and industrial research institutions in the United States. His substantial contributions to physics and microwave technology have strengthened the scientific prestige of the United States.

John D. Roberts
Institute Professor of Chemistry, Emeritus
California Institute of Technology
Pasadena, CA

Citation: For his pioneering studies in nuclear magnetic resonance spectroscopy and reaction mechanisms in organic chemistry.

Summary of Achievements

John Roberts has contributed to chemistry in an extraordinary range of ways: as research scientist, as teacher at both the professional and undergraduate levels, and as spokesman and senior statesman.

In research, Robert's work has defined what is now modern physical organic chemistry: that is, a style of chemical research involving the integration of molecular spectroscopy, quantum mechanics, kinetics, and other techniques of physical chemistry with organic synthesis, and application of this hybrid discipline to the study of relations between the structure and reactivity and properties of organic molecules. If the idea that organic chemistry and physical chemistry share a common border now seems self-evident, it is in major part because Roberts demonstrated the utility of research techniques drawn from the latter in solving problems of the former.

His accomplishments in research are fundamental to modern organic chemistry. Their pedagogical impact may be even more important than the molecular detail they provide. The very idea that organic chemists could actively and productively use quantitative spectroscopy and calculational quantum mechanics in research was not part of the organic paradigm before Roberts. His approach to these areas of physical chemistry--to understand them in qualitative terms, to demonstrate their value in practical mechanistic research, and to explain them to others in terms simple enough for anyone to understand--has been spectacularly successful. His short books on molecular orbital calculations and spin-spin splitting were, for example, remarkably influential in introducing these unfamiliar techniques to a somewhat reluctant and apprehensive scientific community.

Roberts brought his intellectual approach to chemistry to the undergraduate level with his highly successful text with Margerie Caserio. This book was one of the first to integrate spectroscopy, reaction mechanisms, and more traditional subject material in an undergraduate-level course. As such, it played a strong role in shaping the current style of chemical teaching.

Over the years, Roberts has also played a central role in chemistry as spokesman. His credentials as research scientist and teacher, his familiarity with both academic and industrial research, and his characteristically forceful, direct, and honest method of dealing with people, all make him especially effective. In a world in which being personally memorable is often as important as scholarship, Roberts represented (and continues to represent) chemistry with great success.

Roberts' career has touched every aspect of chemistry. He is one of the intellectual founders of modern chemical science, and a man who has contributed very broadly to it.

Roberts, as much as any person, has defined the methods now used to study complex molecular structures and reactions. His work has fused organic chemistry and physical chemistry. The discipline that emerged from his research--modern physical-organic chemistry--provides the intellectual base for much of organic chemistry and biological chemistry, and has been very influential in neighboring fields such as polymer science, organometallic chemistry, catalysis, and materials science. His books permanently changed the way in which chemists thought about molecules.

He has been one of the most influential teachers and spokesmen for chemistry for 30 years.

Patrick Suppes
Lucie Stern Professor of Philosophy
Stanford University
Stanford, CA

Citation: For his broad efforts to deepen the theoretical and empirical understanding of four major areas: the measurement of subjective probability and utility in uncertain situations; the development and testing of general learning theory; the semantics and syntax of natural language; and the use of interactive computer programs for instruction.

Summary of Achievements

The scientific research of Patrick Suppes has concentrated on the development and use of mathematical models in psychology and related social sciences, together with extensive experimental work testing the validity of various models. The research has been mainly concentrated in four areas: (1) theory of fundamental measurement with emphasis on measurement of subjective probability and expected utility, as well as on general foundational questions; (2) stochastic learning models, especially those derived from stimulus-response theory; (3) semantics and syntax of natural language, especially in children's language; and (4) use of computers for instruction, with emphasis on the development of interactive theorem provers, and on relevant psychological models of performance and learning, including the study of response latencies and eye movements. In addition, Suppes has written a number of papers on axiomatic methods in the empirical sciences including classical mechanics, special relativity, and quantum mechanics.

Suppes' scientific contributions have led a major movement over a four-decade period aimed at increasing the rigor, scope, and depth of theoretical behavioral science, and he has exhibited an unusually effective skill in interfacing original theory with experiments. Beyond that he has been successful in making applicable, via interactive computer programs, the knowledge he and his colleagues have discovered about classroom learning. He was a primary founder of the field of computer-assisted instruction, but, unlike some others, his applied work has always been informed by detailed, specific behavioral theories coupled with extensive empirical data collected in his laboratories. Initially, these applications took the form of demonstration programs at various levels in the educational system. Ultimately that led to the founding of a corporation that develops, tests, and distributes complete computer systems to schools throughout the world.

His is a most unusual blend of behavioral science scholarship and research, of deep philosophical contributions, and entrepreneurship. His breadth coupled with great scientific depth should be a model to the young.

Herbert W. Boyer
Professor of Biochemistry and Biophysics
University of California
San Francisco, CA

Citation: For his contributions to the basic research of the development of recombinant DNA technology. This seminal breakthrough has opened new vistas in experimental biology, and it has led directly to the development of the biotechnology industry.

Summary of Achievements

Dr. Boyer was a pioneer and continues to be an authority in the field of restriction endonucleases, the key enzymes necessary for genetic engineering and biotechnology. These enzymes and the technology of their use are basic to advances in the biomedical sciences and their application to the study of human diseases. In the early 1970's Dr. Boyer's laboratory discovered and characterized the restriction endonuclease EcoRI, whose unique enzymatic properties provided the basis for the first genetic engineering experiments. Together with Dr. Stanley Cohen's laboratory at Stanford University, Dr. Boyer first demonstrated that microbial genomes could be dissected in a precise fashion by EcoRI restriction endonuclease and then be recombined in vitro with novel genomes. These new constructs could then be recovered as viable replicating hybrids after being inserted into bacteria. This project provided the springboard for the pioneering genetic engineering of eucaryotic (non-microbial) genes with microbial genes and their recovery as hybrid replicating genomes in bacteria. This project demonstrated that non-microbial genes could be "cloned" in bacteria and would replicate in perpetuity by the bacterial cell. It was critical to demonstrate that (1) the manipulation of the eucaryotic and microbial genes could be managed to yield recombinant molecules in productive amounts, and (2) that eucaryotic DNA would not be discriminated against by the microbial-cell (i.e., it would be duplicated by the microbial host's replication machinery). These experiments revolutionized the biological and medical sciences as well as provided the scientific basis for the "biotechnology industry." Until the advent of this technology individual genes of multicellular organisms could not be isolated and studied at the molecular level. Herbert Boyer's group has continued to contribute to the development of genetic engineering. They developed one of the most widely used plasmid molecules for this technology and pioneered the use of synthetic DNA in genetic engineering. This led to the synthesis and expression of the gene for human somatostatin - the achievement of the first synthesis of a human protein in bacteria.

Dr. Boyer has continued to study the molecular mechanisms of the action of restriction endonucleases and the functional role of individual amino acids in those functions. More recently, in collaboration with Dr. John Rosenberg of the University of Pittsburgh, he and his colleagues have determined the first three-dimensional structure of a protein-DNA cocrystal, the EcoRI endonuclease and its DNA substrate. The extension of this work may provide new insights into the structural basis of enzyme action and possibly, in the future, allow for the design of synthetic endonucleases of new specificities.

George F. Carrier
T. Jefferson Coolidge Professor
of Applied Mathematics Emeritus
Harvard University
Cambridge, MA

Citation: For his achievement and leadership in the mathematical modeling of significant problems of engineering science and geophysics, and their solution by the application of innovative and powerful analytical techniques.

Summary of Achievements

George Carrier has earned his reputation as a great applied mathematician on the basis of his achievements in applying mathematics to the solution of important and challenging problems of engineering and geophysics. His remarkable skill in stripping nonessentials from apparently intractable technical problems, formulating them incisively, and then using imaginative and powerful mathematical techniques to solve them has led to the understanding of a wide variety of natural and man-made phenomena, ranging from supersonic flow and combustion, to tornados and tsunamis, to firestorms and the threat of nuclear winter. Deep physical insight into the underlying physics and mechanics combined with extraordinary mathematical prowess are the hallmarks of his many contributions, which characteristically have produced concrete, technical results of direct relevance and applicability to industry, the environment, and national defense. A charismatic research mentor and teacher, Carrier has led generations of applied mathematicians to the frontiers of their discipline, showing through his papers, textbooks, and special lectures how mathematics can do the very best for engineering and science.

In engineering science, Carrier has been active throughout his career in the solution of significant technological problems. His very early papers on the mechanics of the rolling of plastic materials had an immediate industrial impact that led to extraordinary manufacturing savings. He has made seminal contributions to the technologies of viscometry, gyroscopy, and centrifugal isotope separation. Again, early in his career, he initiated an enduring involvement in naval matters by his pioneering studies of the effect of underwater explosions of submarine shells. He was also an important contributor to the engineering of space vehicles, dealing especially with problems of atmospheric re-entry and the associated supersonic flow of reacting, radiating gases and their interaction with ablating structures. During the last quarter-century Carrier has produced a major series of papers in the field of combustion, particularly relevant to the performance of internal-combustion engines. Here

the full flower of Carrier's matchless talents has been brought to bear on penetrating analyses of highly complex systems, involving aerodynamic, chemical, and thermal processes in multiphase mixtures.

Carrier's manifold contributions to geophysics started in 1950, in his paper on wind-driven circulation in ocean basins, and have continued to this day. He has deduced quantitative results for the mixing of ground and sea water that results from the diffusion of tides into permeable islands (like Hawaii). His oceanographic studies have explained the mechanics of water waves on sloping beaches and in confined harbors, with results directly pertinent to ship handling and deployment. He has analyzed the behavior of ocean currents, in general, and the Gulf Stream in particular. He explained the dynamics and evolution of tsunamis as they are generated by earthquakes, travel across the ocean, and strike islands or continental boundaries. In Carrier's atmospheric research, hurricanes and tornados have been of special interest, and his comprehensive studies of the exceptionally intricate energetics and motions of hurricanes as they interact with land and sea are milestones of the field. Most recently, large fires, firestorms, and, on a global scale, nuclear winter, have also received the penetrating, insightful Carrier treatment.

As important as the impact has been of the many specific solutions to scientific and technological problems that Carrier has produced, of equal significance are his contributions to applied mathematics itself. His problem-solving papers provide vivid illustrations of how to invoke similarity, dimensional, and scaling considerations to assess the relative importance of energies, forces, and responses involved in complex phenomena, seeking out those that are essential for basic understanding, and reserving for later elaboration those that are less central; establishing succinct mathematical models and formulations elegantly tailored to the problems under consideration; exploiting, and often inventing, sophisticated mathematical techniques to extract, with striking finesse, crisp quantitative solutions to the governing differential and integral equations; and, finally, providing perceptive interpretations of the results. Even more explicitly, he has published and lectured widely on applied mathematical methods, promulgating the boundary-layer approach, singular perturbation methods, and complex variable techniques, among others. His papers and lectures on methodology, as well as the three textbooks on applied mathematics that he co-authored, have been extremely influential in the training and education of applied mathematicians everywhere.

In summary, George Carrier has made vital and lasting contributions to engineering science, geophysics, and applied mathematics. The scientific and technical enterprise of the United States has benefited enormously from his powerful physical insights and his superb mathematical problem-solving skills. He has endowed engineers, scientists, and mathematicians with these great gifts.

Biological Sciences

Edward B. Lewis
Thomas Hunt Morgan Professor of Biology Emeritus
California Institute of Technology
Pasadena, CA

Citation: For his demonstration and exploration of the genetic control of the development of body segments by homeotic genes.

Summary of Achievements

Edward Lewis, with exemplary insight, originality, personal commitment and ingenuity has pursued the genetics of embryogenesis and morphogenesis in *Drosophila* for four decades. During the first three of those decades his work attracted comparatively little attention, but this lack of trendiness did not discourage him. In recent years the importance of Lewis' discoveries in the field of developmental genetics has become widely recognized.

The Caltech biologist is noted for having discovered the Bithorax Complex, a cluster of master regulatory genes that controls much of the growth and development of the organism, starting very early in embryonic life. Lewis showed that mutations in these so-called homeotic genes result in one body part being changed into another homologous part. From this he inferred that the normal homeotic genes carry out a more profound function: control of the normal organization of the body and all its parts.

Lewis' extensive genetic analysis of the Bithorax Complex encouraged David Hogness and his colleagues at Stanford University to choose it as the target for the first attempt to clone homeotic genes. The techniques and concepts developed in the ensuing collaboration of the Lewis and Hogness laboratories have guided the entire field since then. One of the most important consequences of this work, and one that Lewis predicted in a general way long ago, was the finding of a region of homology among many homeotic genes, the so-called homeobox. The study of homeobox-containing proteins, which have also been found in mice and human beings, is one of the most active areas in biology today; and it owes its origins and growth to the remarkable work of Lewis.

Edward Lewis is a scientist's scientist. His work, done mostly by his own hand, constitutes a landmark contribution to biology. It has opened up a vast field of intense activity in the area of developmental biology of a wide range of organisms. As a human being of conscience and dedication, he ranks at the top.

Elkan R. Blout
Professor and Director, Division of Biological Sciences
Harvard School of Public Health
and
Edward S. Harkness Professor of Biological Chemistry
Harvard Medical School
Boston, MA

Citation: For his pioneering studies of protein conformation and devotion to the scientific enterprise of this Nation.

Summary of Achievements

Elkan Blout was one of the originators of the proposition that poly- α -amino acids would be excellent models of proteins for physical chemical and biological studies. This insight into the possibility of using these as protein models proved to be fruitful beyond one's greatest expectations. The first X-ray crystal structure of the α -helix was performed on a poly- α -acid, proving Pauling's hypothesis. Through his efforts, all the conformations of proteins, the α -helix, β -sheet, and random coil, became available for very fruitful studies. A survey of the literature today would discover that the number of papers on poly- α -amino acids to be between 10,000 and 20,000. Thus he produced some of the seminal papers on this topic which became a field unto itself.

Another field in which Dr. Blout was an innovative founder was the use of optical rotatory dispersion and circular dichroism to determine the conformation of proteins. His papers of the 1950's showed the great potential of using the chiroptical properties of proteins to measure their conformation and the conformational changes they were capable of undergoing. This seminal work has likewise blossomed forth, and today the most popular and widely used method to determine the secondary structure of polypeptides (e.g. hormones) and proteins is circular dichroism.

A third area to which Dr. Blout has contributed significantly is in the synthesis and study of cyclic peptides for the study of β -turns in proteins. As approximately one third of the amino acid residues in globular proteins reside in β -turns, this work has developed into another active field in the protein conformation area.

In an age of microspecialization in science, researchers like Elkan Blout stand out as examples of how a truly innovative and inquisitive mind can make major contributions to a variety of scientific fields.

Nick Holonyak, Jr.
Center for Advanced Study
Professor of Electrical and Computer Engineering
University of Illinois
Urbana, IL

Citation: For his contributions as one of the Nation's most prolific inventors in the area of semiconductor materials and devices, and for his role as research mentor while working at the forefront of solid-state science and technology.

Summary of Achievements

Nick Holonyak is an outstanding experimental physicist who combines a sound understanding of solid-state physics with a remarkable intuition for how this knowledge can be fruitfully applied. His several hundred publications and patents are evidence of his exceptional productivity. Time and again Dr. Holonyak has come up with an idea or learned something that might perhaps be possible, and in a few days he would have it running in his laboratory. He is friendly and enthusiastic, easy to talk with, and absolutely honest. Throughout his teaching career he has turned out a steady stream of excellent students, which speaks well for his ability as an instructor.

Dr. Holonyak was not only the coinventor of the PNP thyristor, he was largely responsible for its development from a laboratory curiosity into the basic component of electrical power control equipment, now widely used in HVDC power transmission and variable speed motor controls.

His academic career has been directed mainly to advancing the understanding of electrooptical phenomena in III-V semiconductor devices, and in crystal preparation techniques which have led to efficient light emission and laser operation in the visible region of the spectrum. Quaternary alloys of III-V semiconductors were developed by his group as a means of varying the energy gap without introducing lattice strain. He and his students have conducted extensive investigations of quantum-well phenomena associated with direct and indirect band edges in these semiconductor systems and have applied these results to the fabrication of lasers in a wide variety of III-V alloy systems.

Dr. Holonyak's many accomplishments in advancing scientific knowledge in solid-state physics, his application of this understanding to the fabrication of operational devices, and his ability have inspired his students toward comparable achievements.

Leonid Hurwicz
Curtis L. Carlson Professor of Economics
Regents' Professor Emeritus
University of Minnesota
Minneapolis, MN

Citation: For his pioneering work on the theory of modern decentralized allocation mechanisms.

Summary of Achievements

Leonid Hurwicz has made foundational contributions to econometrics, demand theory, optimization theory, and stability theory. However, he is probably best known for his pioneering work on the theory of decentralized allocation mechanisms. He formalized the now conventional approach of making the allocation mechanism a variable, rather than a datum. Although previous authors had extolled the informational efficiency of the market mechanism, Hurwicz was the first to formalize this property and determine the implicit assumptions underlying the validity of the arguments. Hurwicz provided the first proof of the information efficiency of the competitive allocation mechanism.

Hurwicz informally emphasized the importance of individual incentives in determining the actual behavior of allocation mechanisms. He formally modelled the concept of "incentive-compatibility" and showed that for finite economies, the market mechanism is not incentive-compatible. The model Hurwicz introduced was based on the idea that an individual may safely manipulate an allocation mechanism by pretending to be a nonmanipulative individual with different private characteristics, much as a prospective buyer will pretend to have only mild interest and limited means during purchase negotiations. The market mechanism is not incentive-compatible when individuals acting in this fashion can have a perceptible influence on prices. An allocation mechanism is incentive-compatible only if it provides no incentives for this sort of manipulation. Hurwicz showed that no decentralized allocation mechanism which achieves Pareto optimal allocations for finite neoclassical environments can be incentive-compatible.

This concept of incentive-compatibility was later applied to voting mechanisms where it led to an important line of research in social choice theory. Subsequently, the concept was applied to Bayesian models, where it continues to stimulate a huge volume of published research. Hurwicz's model of a decentralized allocation mechanism also lends itself to the study of less sophisticated forms of self-interest. This idea was pursued by Hurwicz and others to obtain more positive results on the possibility of incentive-compatible allocation mechanisms. This indicates that their appearance was a major event in the history of economic thought.

In addition to his seminal papers, Hurwicz has continued to contribute to subsequent developments in the areas of informational efficiency and incentive-compatibility. His courses and lectures in the U.S. and abroad have promoted the importance of research in these areas and encouraged the interest of numerous students and younger scholars.

It is problematic to attribute to a single individual the foundational ideas for a body of research as vast as modern decentralization theory. However, to the extent that this can be done, there is no doubt that the individual is Leonid Hurwicz.