Nuclear Winter
11713 Alba Rd
Ben Lomond, Ca. 95005
August 16, 1984

Mr. George Keyworth
Science Advisor to Pres. Reagan
The White House
Washington D.C.

Dear Sir:

I recently read in the Washington Post that you have approved a national research program to find out whether a nuclear war would cause the world wide weather catastrophe called "nuclear winter".

Are all the proposed experiments really necessary? The setting of "city sized fires", for instance, to measure intensity and ability to throw soot into upper atmosphere sounds dangerously irresponsible and wasteful.

Why must you begin all over again - why not check the calculations of American & Russian scientists,

two independent studies already completed?

The article says it is a "non-political scientific mission". I hope so! But Lawrence Livermore Lab and Defense Nuclear Agency, using public funds have vested interest in keeping their agencies alive where private scientists using their own and private grants have nothing to gain except the truth about how to keep this planet alive.

I would appreciate a response to these questions:

1. Is this study begun - and proceeding?
2. What can and are you doing to assure a purely scientific detached from partisan interest attitude is maintained?
3. Have the previous studies been carefully checked? What justification have you

found for making further studies? (I am not asking for scientific data but whether you have real reason to believe the previous studies are "off.")

4. In setting up your studies are you considering A - the number of nuclear weapons (worldwide) that could be detonated, B - the speed of delivery systems making it possible to detonate them all in a matter of a few hours. C. the combination of soot, debris, radioactive fallout, damage to Ozone layer etc

As a concerned citizen vitally interested in preserving Life on Planet Earth I eagerly await your response.

(Mrs). Virginia M. Barstadt

Nuclear Winter

Aug. 20, 1984

Dr. George A Keyworth
Presidental Science Adviser
The White House
Washington D.C.

copies: Dr. Richard Turco, Dr. Owen Teon, Dr. Thomas Ackerman,
Dr. James Pollack

Ref: Nuclear Winter Theory

Dear Dr. Keyworth:

Even without "Nuclear Winter" a thermonuclear war would mean the death of society! Nuclear winter simply serves to place the exclamation point at the end of the sentence.

We have a plan that we hope you will review and comment on and that we believe if adopted would greatly reduce the risk of war. As we see it, peace can only be assured if the problems associated with thermonuclear stockpiles and future world energy can both be solved. Not only do we see the problems interconnected but we also see the solution equally interconnected and we believe that a new, bold approach is needed that addresses both problems.

Our approach is therefore a way of providing the source of future world energy through country cooperation and with the fuel for this energy being the existing stockpiles of thermonuclear devices that are the true targets of any arms control/disarmament negotiations.

We have so far received strong technical confirmation from the scientific community that the approach we are advocating is both technically sound and involves a minimum of risk. We are also aware that a major stumbling block to the adoption of the concept is the public's blind fear of thermonuclear devices and with most having the belief that if you don't talk about them, somehow they don't exist.

What we believe must happen is a re-education of the public as to the benefits that can be derived from the vast potential energy of the existing devices as coupled to a disarmament program envolving country cooperation. Our present fear is thermonuclear devices exploding 10,000 ft. in the air but this fear disappears if the devices are exploded 10,000 ft. below the ground. Perhaps the public can be made to feel the same -- with the right PR.

Presently broad range peace meetings are taking place in Geneva. Why not consider tabling the plan as presented for a possible joint study/feasibility project between the U.S. and Russia?

Please feel free to contact us if you have any questions.

Sincerely,

Dan L. Curtis
1956 Ardmore Ave.
Manhattan Beach, Calif. 90266
(213) 545 6320

John Rangus

John Rangus
Santa Monica, Calif.

CORNELL UNIVERSITY

Center for Radiophysics and Space Research

SPACE SCIENCES BUILDING
Ithaca, New York 14850

Telephone (607) 256-4971

Laboratory for Planetary Studies

June 13, 1974

Mr. Dan L. Curtis
1956 Ardmore
Manhattan Beach, California 90266

Dear Mr. Curtis:

Thank you very much for your kind letter of May 23. I agree that we share some of the same thoughts about the cosmos. I have read the writings of your grandfather and, as you know, he played a major role, in his debate with Harlow Shapley, in establishing the extragalactic nature of the spiral nebulae, and thereby in greatly expanding our vision of the universe.

With best wishes,

Cordially,

Carl Sagan

Revised PLAN
7/4/84

We (a small group of scientists and engineers) are trying to promote a plan that we believe will lead to significant arms reduction combined with a virtually unlimited energy source for the world's future. While the emphasis in the plan is on the technical aspects of the energy production, as this is the cornerstone of the concept, our real goal is an attempt at world disarmament and with energy as secondary but as the "carrot" which we hope will induce world leaders to accept the coupled disarmament agreement.

Our real fear is the world's continued excalation toward WW III. Our hope in our quest is the adoption of a plan that reduces both the existing stockpile of thermonuclear weapons on both sides, provides an alternative use for them rather than our destruction and achieves a stable energy base for long term, peaceful co-existance.

Right now we have an oil glut. But how long is that going to continue? Once it is realized that the world's oil supplies are truly close to exhaustion (certainly in our children's lifetime), then world instability leading to panic and WW III (assuming it hasn't already happened by accident) is believed to be a very strong possibility. It would seem that now is the time to make some plans for the future rather than let the future dictate to us.

It is realized that the plan we are proposing is very controversial and would have to be thoroughly investigated before adoption. One criticism that has already been raised is that Russia would never agree to it (reasons not given by the critic). This criticism did raise an interesting point, however, in that, assuming Russia proposed it to us, what would our reply be to them?

Before getting into the plan proper, it might be worth while to give you some idea of where I come from besides being at the present time a senior staff engineer at Hughes Electro-Optics. Enclosed is an excerpt from "American Scientist" on my grandfather, Dr. Heber D. Curtis, with whom I identify very closely. The "Great Debate" described was between the two formost astronomers of their time as to whether or not our galaxy was unique or simply was one of many. My grandfather argued correctly in the "Great Debate", against great opposition, that ours was only one of a vast number. To me, Heber's position and contribution to knowledge were equivalent to

Biography of American Scientists

country. He was initially passed over for the chairs of physical chemistry and mineralogy in the Sorbonne and was defeated when he applied for membership of the Académie in 1902. He was however later admitted in 1905. The only reason he seems eventually to have been given a chair (in 1904) was that he had been offered a post in Geneva and was seriously thinking of leaving France. Partly this may have been because his political sympathies were very much to the left and because he was unwilling to participate in the science policies of the Third Republic.

Pierre Curie was possibly one of the first to suffer from radiation sickness. No attempts were made in the early days to restrict the levels of radiation received. He died accidentally in 1906 in rather strange circumstances — he slipped while crossing a Paris street, fell under a passing horse cab, and was kicked to death.

The Curies' daughter Irène Joliot-Curie carried on research in radioactivity and also received the Nobel Prize for work done with her husband Frédéric.

CURTIS, Heber Doust (b. June 27, 1872; Muskegon, Michigan; d. Jan. 9, 1942; Ann Arbor, Michigan) American astronomer.

Curtis obtained his AB (1892) and AM (1893) from the University of Michigan, where he studied classics. He moved to California in 1894 where he became professor of Latin and Greek at Napa College. There his interest in astronomy was aroused and from 1897 to 1900 he was professor of mathematics and astronomy after the college merged with the University of the Pacific. After obtaining his PhD from the University of Virginia in 1902 he joined the staff of the Lick Observatory where he remained until 1920 when he became director of the Allegheny Observatory of the University of Pittsburg. Finally, in 1930 he was appointed director of the University of Michigan's observatory.

Curtis's early work was concerned with the measurement of the radial velocities of the brighter stars. From 1910 however he

Curtis, Heber

was involved in research on the nature of 'spiral nebulae' and became convinced that these were isolated independent star systems. In 1917 he argued that the observed brightness of novae found by him and by George Ritchey on photographs of the nebulae indicated that the nebulae lay well beyond our Galaxy. He also maintained that extremely bright novae (later identified as supernovae) could not be included with the novae as distance indicators. He estimated the Andromeda nebula to be 500000 light-years away.

Curtis's view was opposed by many, including Harlow Shapley who proposed that our Galaxy was 300000 light-years in diameter, far larger than previously assumed, and that the spiral nebulae were associated with the Galaxy. In 1920, at a meeting of the National Academy of Sciences, Curtis engaged in a famous debate with Shapley over the size of the Galaxy and the distance of the spiral nebulae. Owing to incomplete and incorrect evidence the matter was not settled until 1924 when Edwin Hubble redetermined the distance of the Andromeda nebula and demonstrated that it lay well beyond the Galaxy.

CURTIUS, Theodor (b. May 27, 1857; Duisburg, now in West Germany; d. Feb. 8, 1928; Heidelberg, now in West Germany) German organic chemist.

Curtius gained his doctorate under Adolph Kolbe at Leipzig and later became professor at Kiel (1889), Bonn (1897), and Heidelberg (1898). Two reactions are named for Curtius; the first, discovered in 1894, is a method for the conversion of an acid into an amine via the azide and urethane, and the second, discovered in 1913, is a method of converting an azide into an isocyanate. Curtius also discovered diazoacetic ester, which was the first known aliphatic diazo compound (1883), hydrazine (1887), and hydrazoic acid (1890).

Copernicus and Galileo as they tried to convince their doubters that the sun did not revolve around the earth and that we were not the center of the universe.

The plan for an almost unlimited source of world energy and a way of achieving arms reduction leading to disarmament and lasting peace without fear is really the successful adoption by world governments of three steps and with Step I as presented below. As Step I is probably the most difficult to grasp and to convince the public, world leaders and the technical community of, many words have been spent describing it and some of our counter arguments to commonly raised objections are included. This is where it is felt it would be more productive to have a face to face discussion in order to present counter arguments at the time objections are raised. It is obviously impossible to address every objection to Step I, as well as Step II and III, in a letter presentation.

STEP I

As background, about 10 years ago Project PNE (peaceful nuclear explosions) was dropped from government funding as being too unpopular with various pressure groups in this country and because nothing much seemed to be happening with it. Russia, on the other hand, has been actively pursuing a PNE plan of their own. A recent article in DISCOVER magazine is enclosed with sections as marked discussing the demise of the U.S. PNE program as referred to in the article as Project Plowshare.

While we agree that most of the PNE applications in the U.S. and especially ground level excavations were ill advised, one program, in our opinion, should have been allowed to continue -- at least as a study. This application was the exploding of thermonuclear devices at great depths in the ground (8 to 10 thousand feet) as a means of storing the resultant heat so that it could be tapped at leisure to generate electrical power. In the final days of the program a report was written (see excerpts attached) describing in great detail both how the project could be accomplished with minimum technical risk and at a resultant power cost level comparable with 1970 oil prices.

As discussed by phone with Mr. Burnham of Batelle Northwest, one of the principal authors and editors of the attached PNE 1550, the most serious problem leading to the demise of the project in 1973 was that the tests that had been conducted as well as the future site of the geothermal power plant were and would be in territorial United States.

This created a field day for certain pressure groups who argued that the ground shock waves caused by the underground blasts and the possibility of accidental radioactive gas venting to the surface was too high a price to pay for the power that could be generated. And this was even before TMI.

Mr. Burnham agreed with our position that if the power generating site could be located someplace else than in the United States, much of the pressure group and public opposition would have abated. As part of their program Mr. Burnham said that he and others had toured the world looking for a more suitable site without success. They were handicapped, he admitted, by the ground rule requiring that the site must have both geothermally hot rock (to augment the energy released by the thermonuclear explosions) and be sufficiently near large population centers to provide consumers for the power generated.

He thought that our first innovation (Step I) was a good one as long as the economics checked out (which we believe they do). The cornerstone of our three step plan is that the power generation site be chosen to be at or near the most remotely located spot on Earth. Our choice for this spot is one of the very remote south pacific islands having a substantial geothermal activity at a depth of 8 to 10 thousand feet. The site location could then be roughly 5000 miles from the nearest continent and perhaps 1000 miles from any substantial island population. The exact site location, of course, would have to be negotiated by treaty and with other possibilities being the continental shelf of Anartica or the volcanic islands of Iceland (see inclosed letter response to a DOE letter). Mr. Burnham agreed that it might have made a significant difference if such suggestions had been made at the time of the project's demise. He also agreed that the major critical objections such as ground shock problems, underground water contamination and public hazards resulting from an accident would be virtually eliminated. He also thought that our suggestion of placing the power generating plant on a floating barge at the site would significantly reduce their cost estimate planned for the project in terms of eliminating the cost for dismantling the power plant in order to move it to a new geothermal location. His main negative comment was "How do you get the power to the consumer? You certainly can't string power lines either over or under 5000 miles of ocean." The answer to this is our Step II to follow.

One major technical criticism of Step I that has been raised (see DISCOVER article, page 230) is that thermonuclear explosions produce an appreciable abount of tritium, which is radioactive with a half life of 12.3 years. For example, a one megaton thermonuclear explosion produces about 2×10^7 curies of tritium. This is to be compared with a projected atmospheric tritium release per year of 10^7 curies in the year 2000 from projected world processing plant releases using present reprocessing technology (1973 symposium report, "Noble Gases" QD162-S2). As tritium is lighter than air, scientists are not overly concerned with this release as it will rapidly rise into the upper atmosphere where it will harmlessly decay.

The main concern of world scientists at the symposium was the continuing build up of the isotope Krypton 85 which is also produced in nuclear power plants and vented from world fuel rod reprocessing plants at approximately 10^7 curies/yr (1970 rate) and with only a slightly smaller half life than tritium (10.7 years instead of 12.3). As ^{85}Kr is heavier than air, it accumulates in the atmosphere at sea level. The concern of the world scientists is that the level now of ^{85}Kr has increased at sea level about 1000 times between 1950

and 1973 and it was predicted by numerous papers at the symposium that based upon projected world nuclear power plant operation (conventional) and using the existing fuel rod reprocessing technology, that by the year 2000 the level of ^{85}Kr will have reached 1000 picocuries/M^3 in the world atmosphere. In contrast to the present 10^7 curies/year of ^{85}Kr being released, a one megaton thermonuclear device produces only 57 curies of ^{85}Kr.

Our solution to the present ^{85}Kr problem (as was also suggested in PNE-1550) as well as to the present venting of the other non-condensible radioisotopes including tritium from fuel rod reprocessing plants would be the proposed thermonuclear cavity power station. In this approach, <u>all</u> non-condensible gases would be simply recycled from the steam power plant condenser back to the thermonuclear cavity via a conventional compressor. At the time the plant is floated on its barge to a new geothermal site, the gases would be sealed off in the cavities and would be left to complete their radioactive decay.

Therefore, environmentalists should welcome the proposed Step I as a cleaner alternative to the present nuclear power plants with conventional reprocessing plant venting. Step I provides nuclear energy without atmospheric polution. There is, of course, always the possibility of an accident such as occurred at Three Mile Island. But with TMI there is no place to dispose of the radioactive liquids and non-condensible radioactive gases resulting from the accident (the present predicament still facing the operators). With a thermonuclear cavity powerplant as outlined in PNE-1550, however, the cavity is always available as a dump site. Therefore, the only way any gas could be vented to the atmosphere is if a steam pressure line should rupture which would only allow a very small fraction of gas to escape. The bulk of the gas would always be safely contained underground.

A final argument is offerred in support of the implementation of Step I. There is only a finite amount of energy available on Earth and we are fast depleting the conventional forms. Except for nuclear energy, the non-fossile fuel forms can never produce more than a small fraction of the amount needed at even our present consumption level. Even fission nuclear energy including breeders is limited as the amount of fissionable U-235 will only last in the order of 100 years.

The only real source for future energy, in our opinion, is thermonuclear as proposed in Step I. Having spent several years working on the dream of controlled fusion, I am extremely pessimistic about its future. The amount of energy released in a thermonuclear explosion, however, can be from a hundred to a thousand and more times the energy available from the fission trigger. Multiplying this by another factor of 10 because of energy augmentation of geothermal rock means that the present supply of fissionable material would last from 1000 to 10,000 times as long if used as a thermonuclear trigger rather than in its present use in fission nuclear power plants. Instead of the start of the predicted energy starvation for the world in a hundred or so years, there could be an abundance of energy for the next 10,000 years.

STEP II

Step II is much simpler to grasp as it is simply the conversion at the remote island of electrical power as it is generated to stored energy in the form of hydrogen with a 70% energy conversion efficiency by direct electrical dissociation of sea water. The hydrogen would be liquified at small additional cost (with an abundance of energy present) and transported by cryo-ships* to ports of the world where it would be initially burned to again produce electricity for distribution using conventional power generating equipment converted to using hydrogen instead of oil. Eventually, it is assumed that a hydrogen economy would develop where car engines, etc. would operate on hydrogen as the present world oil supply is depleted. Excerpts from a 1975 book "The Hydrogen Economy" by Dr. J. O'M Bockris are included to show the practicality of the hydrogen approach as well as its advantages. Missing in the book was a good method by which the source of energy was going to be provided for the hydrogen economy. After reviewing the material, Dr. Bockris reply was that he thought our approach was "brilliant".

* See cryo-ship/hydrogen distribution cost estimate on last page of "The Hydrogen Economy" excerpt.

STEP III

Step III is again simple in concept but because it is primarily political rather than technical, it is probably the most difficult to actually implement. Step III is no less than achieving a joint effort between the U.S. and Russia (with perhaps China as a participant) in the development and implementation of Steps I and II leading to the use of <u>both</u> nation's present stockpile of thermonuclear devices on say an equal energy basis as the fuel for the implementation of the two steps. It is, of course, essential to the success of the total plan that Step I lead to the development of a world power plant rather than only for the use of a single country. <u>It must be a joint effort.</u>

There are, of course, many practical problems associated with the implementation of Step III but we feel all can be overcome through world government negotiations. And it should be obvious that if WW III is to be prevented in the future, some type of joint program between the U.S. and Russia must be developed.that is connected with arms reduction. We simply feel that our proposed joint effort program, because it uses the promise of virtually unlimited energy as the carrot, has a far better chance of success in light of the present and continued intransigent position of both sides in terms of any type of a program envolving arms limitation or disarmarament. We don't believe that any of the present thermonuclear devices will <u>ever be peacefully dismantled and that the only way to eliminate them from the Earth is to provide another use other than our destruction.</u>

In conclusion, we are sure that you won't disagree that disarmament (arms reduction) is the most pressing issue of our times. Every avenue that has any possibility of reducing world tensions <u>must</u> be explored as the alternative is unthinkable. In view of this, we will give up any amount of our time and use every means at our disposal to this end. We are, of course, hoping for your support but

would appreciate any comments.

If you have any specific questions, we would welcome them and do our best to supply an answer(s).

We would also appreciate any names and addresses that you could provide of others who you believe might also like to receive a copy of this material.

Sincerely,

Dan L. Curtis
1956 Ardmore Ave.
Manhattan Beach, Calif. 90266
(213) 545 6320

PNE - 1550
NUCLEAR EXPLOSIONS — PEACEFUL APPLICATIONS (TID-4500)

A FEASIBILITY STUDY OF A PLOWSHARE GEOTHERMAL POWER PLANT

APRIL 1971

AMERICAN OIL SHALE CORPORATION
BATTELLE - NORTHWEST
WESTINGHOUSE ELECTRIC CORP.

U. S. ATOMIC ENERGY COMMISSION
LAWRENCE RADIATION LABORATORY
NEVADA OPERATIONS OFFICE

ACKNOWLEDGMENTS

This feasibility study was a joint effort of American Oil Shale Corporation (AOS) and the Atomic Energy Commission (AEC). Battelle-Northwest (BNW) and Westinghouse Electric Corporation (W) aided American Oil Shale in its portion of the work while the AEC assigned its part to the Lawrence Radiation Laboratory (LRL) and the Nevada Operations Office (NVOO).

The study was planned and directed by a Steering Committee made up of the following: D. H. Stewart, cochairman (BNW), M. M. Williamson, cochairman (AEC Washington), C. E. Chapin (LRL), D. W. Sherwood (NVOO), and J. B. Burnham (BNW). The editors were J. B. Burnham (BNW) and C. E. Chapin (LRL).

Principal authors were C. E. Chapin (LRL), D. W. Sherwood (NVOO), W. H. Comtois (W), P. T. Walton (AOS), D. H. Stewart (BNW) and J. B. Burnham (BNW). Many others too numerous to mention in each of these organizations contributed significantly to this report; their efforts are gratefully acknowledged.

Utah Power and Light and Southern California Edison companies supplied economic forecasts and advice which are greatly appreciated. Important geophysical data was supplied by D. E. White and J. W. Feiss of the U.S.G.S.

Among those rendering important technical assistance, guidance, and advice are the following: J. S. Kelly, W. L. Oakley, J. K. Davy, and A. H. Ewing (all AEC Washington); R. P. Dixon and M. W. Wallace (AOS); G. C. Werth and F. Holzer (LRL); A. D. Thornbrough (NVOO); and F. G. Dawson and J. C. Fox (BNW). The authors sincerely appreciate the time and effort donated by these individuals and the many others who made the study possible.

1.0 SUMMARY

This study explores the factors involved in using a novel energy source -- the heat in the earth -- to produce electric power. In contrast to drilling for naturally occurring steam, this concept aims toward extracting heat directly from a heat source composed of hot rock. It does not rely on a naturally occurring steam reservoir or circulation system.

The basis of the concept is the use of nuclear explosives to fracture large quantities of the hot rock. Heat would be extracted from the fractured region by piping water to it and creating steam that would be used to run a turbine-generator and produce electricity. The system would be closed by recycling the condensed steam from the power plant back to the fractured region. The hot rock is expected to be deep enough so that even very large explosions can be contained, and the closed design of the system will guard against the release of radioactivity to the environment.

Numerous locations of hot rock are expected west of the Continental Divide, but the prospecting techniques for finding such locations have not yet been fully developed. The energy in these heat sources, if it can be efficiently recovered, is sufficient to produce a large amount of electric power. The actual development of such a source depends on the cost of fracturing the source rock, the efficiency with which the heat can be extracted, and the quality of the steam that can be produced.

This study shows that there is no technical reason why electricity cannot be produced from geothermal heat sources with the aid of nuclear explosives. The study also identifies the problems involved and the areas in which further research is necessary before this method of producing electric power can be demonstrated to be competitive with other methods of producing electricity.

As the quantity of heat required to operate the 200 MW power plant over its 30-year lifetime is large, a number of nuclear explosives will be required. It is shown to be advantageous to fire the explosives in an array so that the fractures produced by the explosions connect with

one another. This will increase the efficiency of the heat extraction and will provide more fractured volume than would be the case if each explosive were fired in isolation.

The important factors in determining the cost of fracturing hot rock with explosive arrays are the number, diameter, and depth of the emplacement holes, the water-supply holes, and the steam-extraction holes; the associated piping; the yields, diameters, and costs of the explosives; public safety; the amount of fracturing and fracturing enhancement; multiple-emplacement schemes; and the financing charges. Rough estimates of array costs have been made. Some combinations of the above parameters have total costs that are competitive with other methods of producing electric power; other combinations are not as economic. The sensitivity of the array costs to the above parameters is shown.

In developing various explosive arrays, this study employs three different methods of protecting the power plant against the ground motions produced by the explosions. The first, or reference, method assumes that all the explosions necessary to support the power plant during its lifetime will be detonated before the plant is built. In this case, no seismic protection is needed. The second method uses a hardened plant and allows arrays to be fired every 10 years. The third method uses a mobile plant that can be moved a safe distance away from the explosion points. A waterway and barge were studied with this end in mind. The power costs for any of these methods may prove to be competitive, 5 to 7 mills per kilowatt-hour, under certain conditions (see "Costs and Economic Analysis"). The mobile-plant method appears to have the most favorable power costs.

The heat transfer is expected to be adequate for extracting the heat, but the flow of fluids in the fractured region is a major uncertainty. Further research on the extent and quality of the fracturing and the fluid flow in these fractures is needed.

System performance and optimization are also analyzed in this report. A turbine design what will accept the wide range of steam conditions caused by a cooling fractured region is presented. The optimum pipe sizes

are selected to minize losses and expense. The main item influencing plant operation and expense is the quality of the steam produced. It appears to be feasible to design a system that will completely contain any radioactivity in the steam.

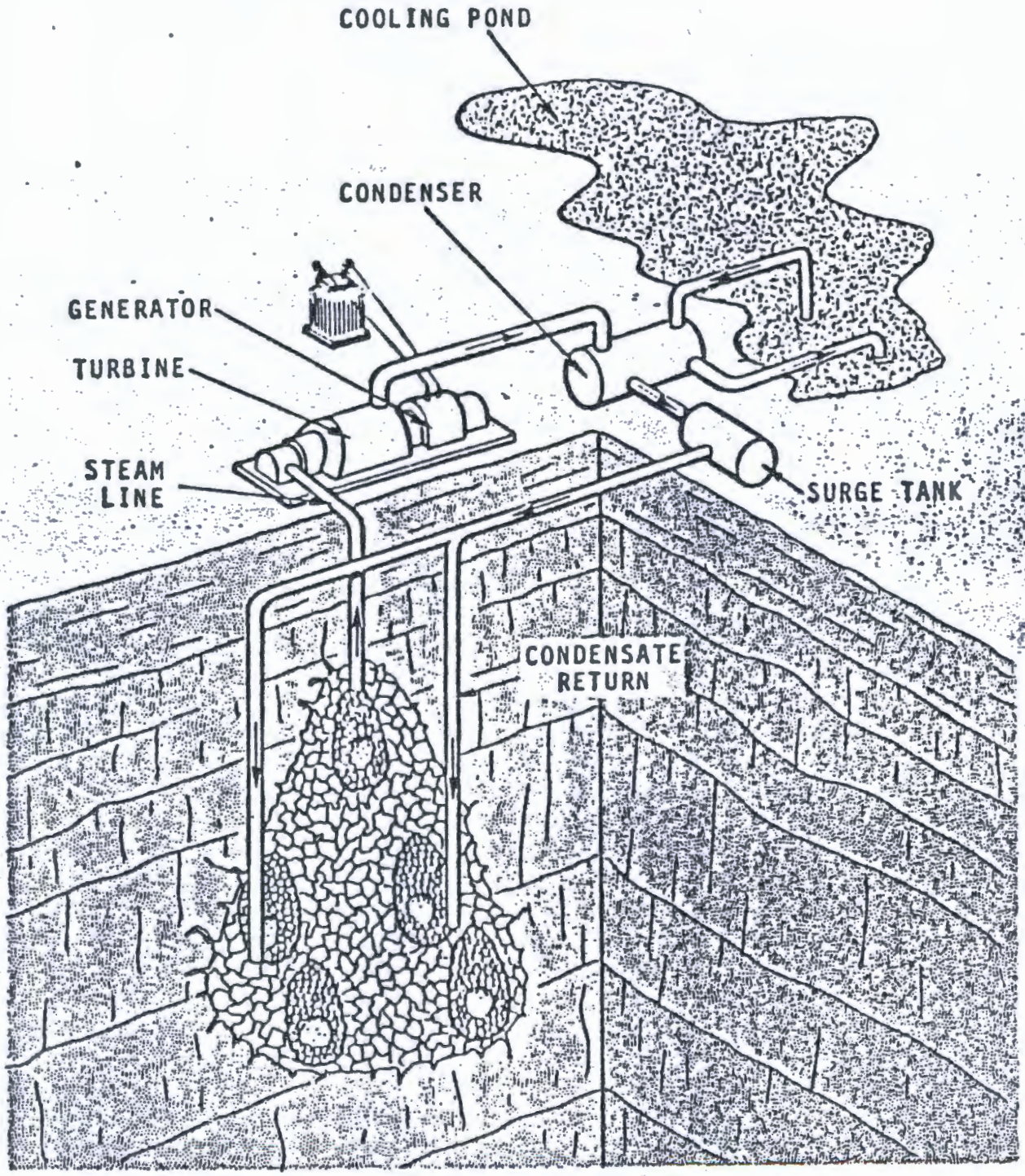


Figure 2.1. The Plowshare concept of geothermal-heat extraction

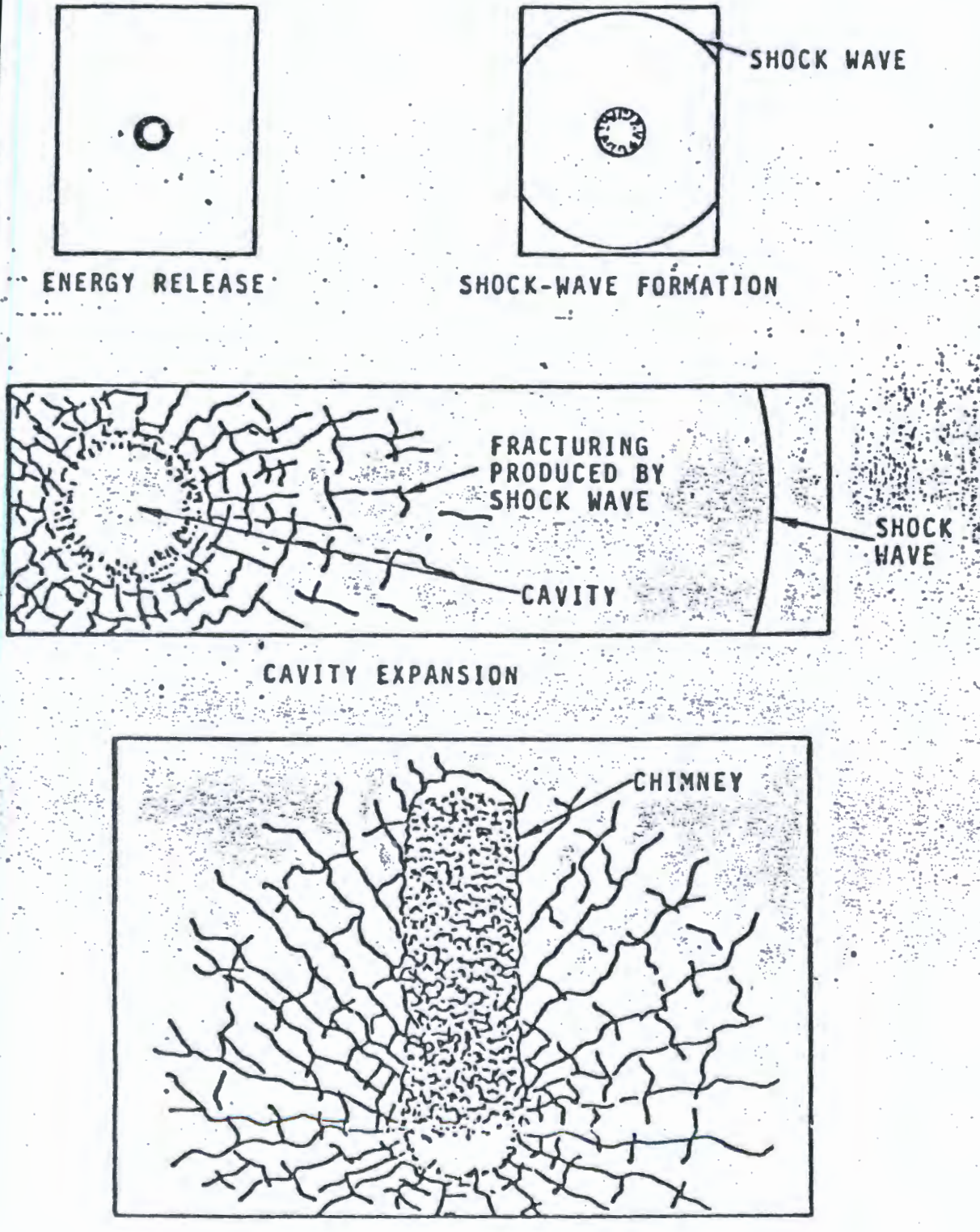


Figure 4.1. Cavity and chimney formation.

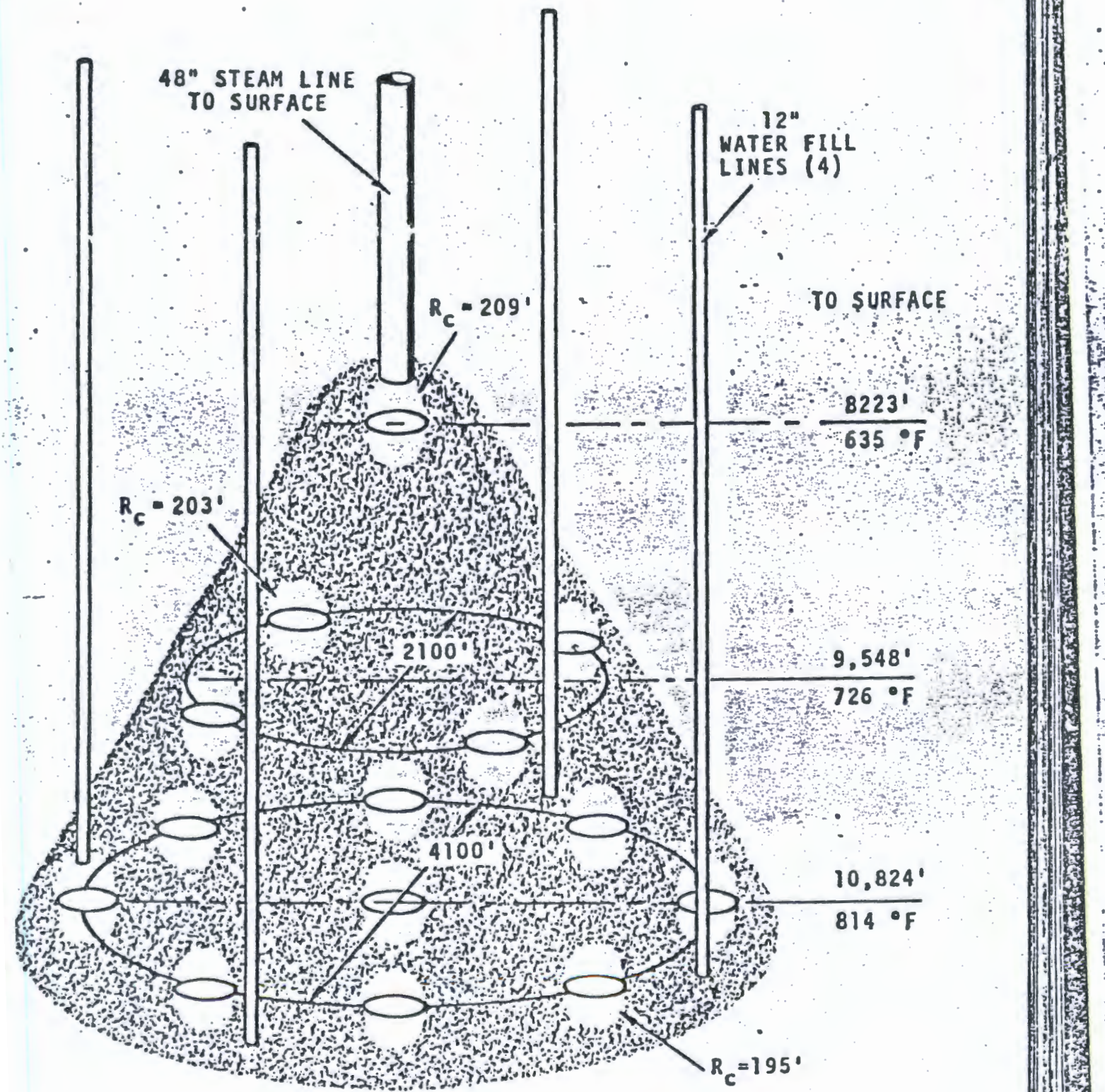


FIGURE 7.6. Close packed array for preshot concept, 1000 kt explosives.

CHAPTER 2

The Hydrogen Economy

COMPONENTS OF DOOM

THE WELL-KNOWN graphs of Meadows and his collaborators[1] clearly indicate the occurrence of a Doom Decade* somewhere between 2020 and 2070. Thus, by such a time, pollutional levels from fossil fuels will become unacceptable, even if massive research funds are deployed to reduce them. The growing CO_2 concentration in the atmosphere from fossil fuel combustion and/or aerosol concentrations from such combustions will have adverse climatic effects.[2] Pollutants, such as NO, CO and SO_2, will provide substantial health hazards.

Important resources, particularly some metals, will exhaust before 2000 (Table 2.1).[1] A fossil fuel economy, even if gasified coal is included, may not pass 2000, because of the exhaustion of economically minable coals[3] (see Chapter 3).†

Meadows' work has been criticised.[4,5] For example, a detailed examination of the computer programs used reveals an error in one so that a modification of the dates for doom are set. But Meadows' work seems to contain an essential (and indeed self-obvious) truth: sufficient growth of production would have a back reaction which would poison the surface on which it lived. Meadows *et al.*[1] have quantified this qualitatively obvious situation.

Progress from the present to the situation where there is independence from fossil fuels will be bumpy, because the period of plenty (and hence cheapness) in these fuels has gone, and political influence, amounting to a degree of control over some policies in their client states, will increasingly be executed by the possessors of the remaining bank of fuel. Correspondingly, an attempt to save the situation by a changeover to a Latter Day Fossil Fuel Age using coal to struggle through two or three decades after 2000, would give many problems (Chapter 3).

Meadows' work proves that *continuation of the present kind of fossil fuel-based and resource-consuming economy* will bring difficulties impossible to withstand in affluent countries before mid-century. However, Meadows' work implies that *sufficiently nimble* changes in technology

* Doom decade means a decade when a negative trend (for example, lessening food per capita) undergoes an average lowering of ten per cent or more per year over the decade.

† 'Exhaust' means here 'pass through the maximum on its amount of production-time curve'.

TABLE 2.1[a]
NATURAL RESOURCES WHICH WILL EXHAUST BEFORE 2000

Resource	Known Global Reserves[b]	Static Index (yrs)[c]	Projected Rate of Growth (% per year)[d] High	Av.	Low	Exponential Index (yrs)[e]	Exponential Index Calculated Using Five Times Known Reserves (yrs)	Countries or Areas with Highest Reserves (% of World Total)[b]	Prime Producers (% of World Total)[b]	Prime Consumers (% of World Total)[b]	US Consumption as % of World Total[b]
Aluminum	1.17×10^9 tons[f]	100	7.7	6.4	5.1	31	55	Australia(33) Guinea(20) Jamaica(10)	Jamaica(19) Surinam(12)	US (42) USSR (12)	42
Copper	308×10^6 tons	36	5.8	4.6	3.4	21	48	US (28) Chile(19)	US (20) USSR (15) Zambia(13)	US (33) USSR(13) Japan(11)	33
Gold	353×10^6 troy oz	11	4.8	4.1	3.4	9	29	Rep. of S.Africa(40)	Rep. of S.Africa(77) Canada(6)		26
Lead	91×10^6 tons	26	2.4	2.0	1.7	21	64	US(39)	USSR(13) Aust.(13) Canada(11)	US(25) USSR(13) W.Germany (11)	25
Mercury	3.34×10^6 flasks	13	3.1	2.6	2.2	13	41	Spain(30) Italy(21)	Spain(22) Italy(21) USSR(18)		24
Natural Gas	1.14×10^{13} cu.ft.	38	5.5	4.7	3.9	22	49	US(25) USSR(13)	US(58) USSR(18)		63
Petroleum	455×10^9 bbls	31	4.9	3.9	2.9	20	50	Saudi-Arabia(17) Kuwait(15)	US(23) USSR(16)	US(23) USSR(12) Japan(6)	33
Silver	5.5×10^9 troy oz	16	4.0	2.7	1.5	13	42	Communist Countries (36) US(24)	Canada(20) Mexico(17) Peru(16)	US(26) W.Germany (11)	26
Tin	4.3×10^6 lg tons	17	2.3	1.1	0	15	61	Thailand (33) Malaysia (14)	Malaysia (41) Bolivia(16) Thailand(13)	US(24) Japan(14)	24
Tungsten	2.9×10^9 lbs	40	2.9	2.5	2.1	28	72	China(73)	China(25) USSR(19) US(14)		22
Zinc	123×10^6 tons	23	3.3	2.9	2.5	18	50	US(27) Canada(20)	Canada(23) USSR(11) US(8)	US(26) Japan(13) USSR(11)	26

[a] Source: US Bureau of Mines, *Mineral Facts and Problems*, 1970, Government Printing Office, Washington, D.C., 1970.
[b] The number of years known global reserves will last at current global consumption. Calculated by dividing known reserves (column 2) by the current annual consumption (US Bureau of Mines, *Mineral Facts and Problems*, 1970).
[c] The number of years known global reserves will last with consumption growing exponentially at the average annual rate of growth. Calculated by the formula

THE GREENHOUSE EFFECT: A CLIMATE DISASTER?

DISCOVER

THE NEWSMAGAZINE OF SCIENCE

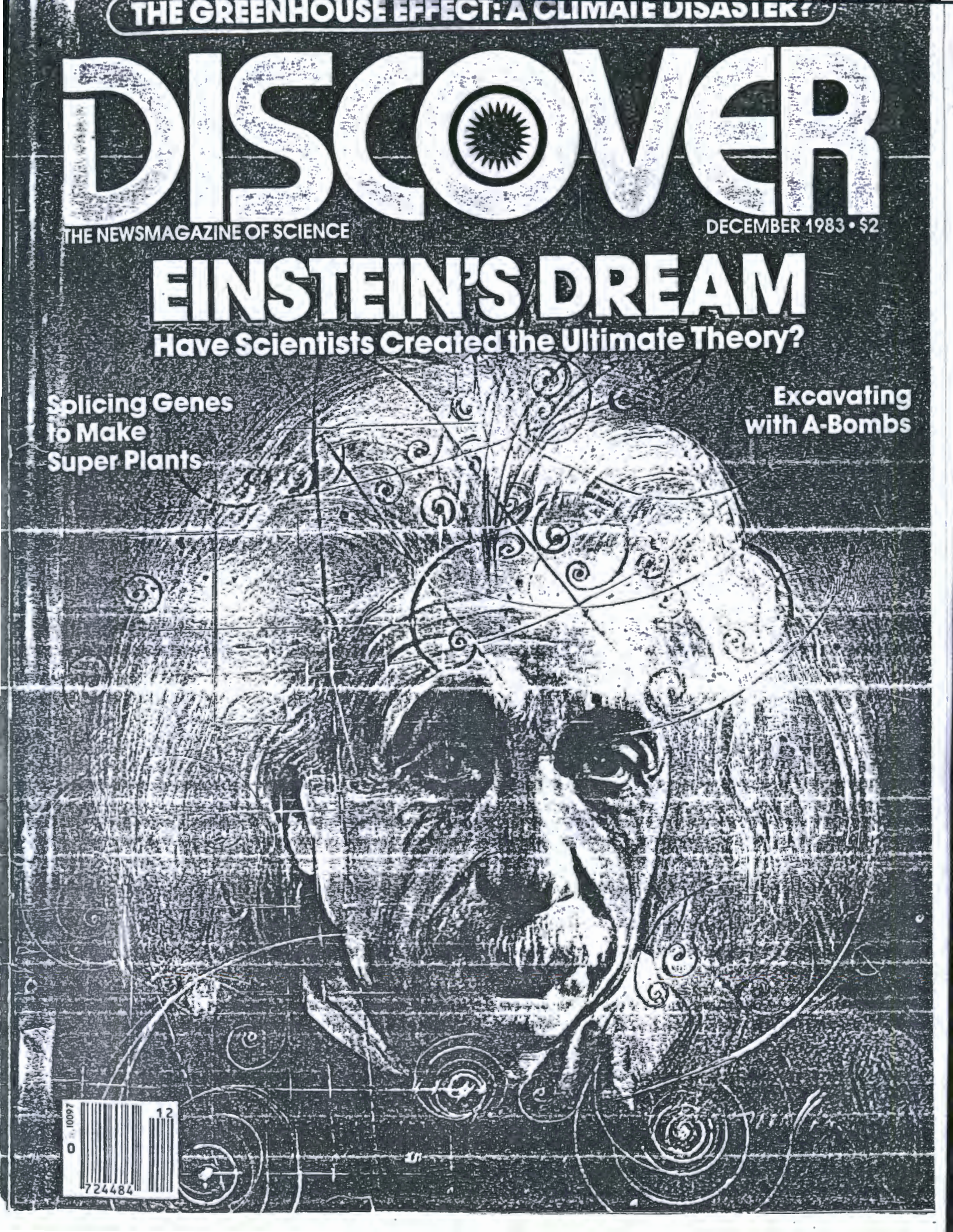
DECEMBER 1983 • $2

EINSTEIN'S DREAM

Have Scientists Created the Ultimate Theory?

Splicing Genes to Make Super Plants

Excavating with A-Bombs



27001 0 12 724484

File - Nucl. Winter

FYI

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

July 26, 1984

Dear Edward:

John Maddox took me to lunch and made me aware of your interest in the "nuclear winter" business. He tells me that my letter which critiques the TTAPS and CST studies will appear in the same August issue as your paper.

I only became aware of Sagan's activities last winter and wrote articles/letters to the Wall Street Journal and Science, and later to Nature and Foreign Affairs.

Science has dragged its feet and seems to be unwilling to publish any critical letters on TTAPS. They have even claimed that my WSJ article may constitute prior publication!

Foreign Affairs seems to be unenthusiastic about publishing my reply to Sagan's recent article. I make the following new points:

1) A nuclear winter scenario would be worse for the USSR than for the US -- in a number of different ways;

2) A nuclear winter scenario would tend to further decouple the tactical use of nuclear weapons from a large-scale strategic nuclear war.

I would really be pleased to have your comments on any of these points -- even though I don't plan to do much more work on the nuclear winter phenomenon.

I'm consulting for Jay Keyworth here. I am mainly concerned with acid rain and with the problems of commercial nuclear power. I'll have to let him know about my space interests so that I can get involved with him in anti-satellite matters and SDI ("Star Wars").

Best wishes,

S. Fred Singer

P.S. Effective September 1, I will be at George Mason University (Fairfax, VA 22030), on leave from the University of Virginia.

Dr. Edward Teller
Lawrence Livermore Laboratory
University of California
P. O. Box 808
Livermore, California 94550

cc: Dr. G. A. Keyworth

CHET ORLOFF
3315 Northwest Savier Street
Portland, Oregon 97210

File: ~~"A Father~~
~~Send Nucl. Winter~~

June 4, 1984

Dr. George A. Keyworth
The White House
Washington D. C.

Dear Dr. Keyworth:

On behalf of our fellow Americans as well as others throughout the world, I want to extend personal gratitude to you for approving the study of the so-called "nuclear winter." It was a politically bold and scientifically wise decision; from a humanitarian point of view, it was desperately needed.

Your approval of the study was the first step. I hope you will encourage the President to invite, with vigor and all sincerity, every other nuclear nation to join us in this analysis. I respectfully submit a persuasive argument from The Oregonian of May 31 which, I believe, reviews the logic behind such a move. As a scientist, you are in the best position to make the case for this multi-national effort.

Thank you for your effective efforts so far. I wish you well on this project and trust you will do your utmost to provide the world with a valid, non-partisan study.

Sincerely,

Chet Orloff
Historian

The Oregonian

Founded Dec. 4, 1850. Established as a daily Feb. 4, 1861. The Sunday Oregonian established Dec. 4, 1881. Published daily and Sunday by the Oregonian Publishing Co., 1320 S.W. Broadway, Portland, Oregon 97201.

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THURSDAY, MAY 31, 1984

'Nuke winter' chills all

Who will believe the results of the U.S. government's study to determine whether a nuclear war will produce a world climate disaster, a so-called "nuclear winter?" If the study, already approved by President Reagan's science adviser, George A. Keyworth, is to have maxiumum value in deterring a nuclear war, other nuclear nations, including the Soviet Union and China, must participate so they can verify the results for their own governments.

The study would be greatly enhanced if the world's best scientific minds worked on the project, regardless of their national origins. This kind of cooperation in itself could prove beneficial to peace efforts.

It is everyone's world, and efforts to develop a sound scientific impact statement on the results of a nuclear war should be the business of all nations, of all peoples and of scientists everywhere.

But, it must be asked, what if the study shows that nuclear war will not devastate the climate or make it impossible to grow crops because of heavy clouds of nuclear materials blocking out the sunlight? Recent studies to the contrary, like all scientific work, are subject to further testing or refinements. Previous work indicates that the argument would be only on the degree of environmental harm or the magnitude of a nuclear disaster on all life forms.

If the initial work is modified or shown to be unduly pessimistic, there is no risk that the findings would fail to show plant and animal life crippled from fallout and dust clouds that would block sunlight and change the climate to varying degrees.

If the Soviets and other nuclear-armed nations participate in the study, there would be a tremendous opportunity to prove that nuclear wars are unwinnable and that making a first strike would be counterproductive.

Reagan can scotch suspicions that the study is really aimed at finding that nuclear war is less damaging than thought, and thus is thinkable, by inviting a broad spectrum of world scientists to take part in the project, under American leadership.

The U.S. Oceanic and Atmospheric Administration, which will lead the proposed study involving several federal teams from other agencies, including those from the Livermore National Laboratory, might well take the initiative by inviting other nations to observe the work or participate in gathering facts from various parts of the world.

It is sensible to use America's great computer capability to make the massive calculations, but much of the data could be gathered by foreign specialists. In fact, better information would be available for the computers if it were collected from many parts of the world where nuclear blast effects could be expected to damage the environment.

Such a study, if coordinated over the next three years, might prove a major deterrent to war by producing the ultimate environmental impact statement.

Dr. George A. Keyworth
THE WHITE HOUSE
1600 Pennsylvania Avenue
Washington, D. C.

Nucl. Winter

THE WHITE HOUSE

WASHINGTON

December 20, 1984

MEMORANDUM FOR MAJOR GENERAL WILLIAM W. HOOVER
Assistant Secretary for
Defense Programs, Department of
Energy

SUBJECT: Funding for the National "Nuclear Winter" Research Program

There is an initiative within the Administration to establish a formal "Nuclear Winter" research program which I support. I want to state my view that the appropriate source of the additional funding needed for this program effort is Defense Programs (DP). The research program addresses a sensitive national issue and is a necessary adjunct to the nuclear weapons work for which you have responsibility.

I had asked Ralph DeVries to discuss the funding issue with you and he informs me that you have requested further information on the research program. Therefore, I have instructed my staff to brief you in early January.

Your support is needed in this national effort to insure that the appropriate scientific research is carried out in this key area. You should also be aware that there is an initiative in the NSC and OMB that calls for DOE funding for this effort.

Jay Keyworth

G. A. Keyworth
Science Advisor to the President

Nucl. Winter

THE WHITE HOUSE

WASHINGTON

December 20, 1984

MEMORANDUM FOR MR. ERICH BLOCH
Director, National Science Foundation

SUBJECT: Management of the National Nuclear Winter Research Program

"Nuclear Winter" has become a sensitive national issue. The recent report from the National Academy of Sciences adds fuel to the fire surrounding the controversy of the nuclear winter phenomenon. I believe you are aware of the National Climate Project Office's (NCPO) report which proposes a comprehensive National research program. This National Program will give us the necessary answers to deal with the nuclear winter issue intelligently.

The management of the National Program is crucial to its success. The administrative requirements are important but attention must also be paid to perceptions of the scientific community. The conduct of the research and the relationships with DoD, DOE and the Administration will be carefully scrutinized. Because of the delicate nature of this managerial challenge, NSF is the appropriate organization to make the National Program a success. I would like to see NSF take overall responsibility for the conduct of the program and establish an interagency (DoD and DOE) program office with NCAR (Bill Hess) as the science manager.

NSF would be responsible for coordinating the research recommended by the NCPO report with the ongoing programs of DoD and DOE to form these efforts into a cohesive National Program. With your agreement, we can establish a charter as I have discussed above, and start the ball rolling in early January 1985. The funding issue should be settled shortly.

Please call me or Dr. Maurice Roesch, my Assistant Director for Defense Programs to discuss the details of what we have to do. Thank you for your support.

Jay

G. A. Keyworth
Science Advisor to the President

EXECUTIVE OFFICE OF THE PRESIDENT

OFFICE OF SCIENCE AND TECHNOLOGY POLICY

FROM:	DATED:
Carl Sagan	November 6, 1984

SUBJECT:

Nuclear Winter, Biological study and the Ecological society are the topics discussed in the letter.

RECEIVED:	ACTION BY:
NOV 20 RECD November 19, 1984	Executive Director/dlw

ACTION COPY TO:

Roesch

INFORMATION COPIES TO:

-Lynch

RESPENSE DATE:
December 10, 1984

REMARKS: FOR APPROPRIATE ACTION

Please indicate action taken below and include date of action.
If written correspondence was sent, please attach a copy.

( ) Written correspondence.

( ) Telecon.

( ) Action transferred to _____.

( ) No action necessary.

( ) Other

File Nucl. Winter

THE WHITE HOUSE

WASHINGTON

December 20, 1984

Dear Dr. Sagan:

Thank you for your letter concerning the conduct of parallel nuclear winter studies and the management scheme for an associated biological study. As you well know, there are many policy and science implications that must be dealt with on the nuclear winter issue. The initial thrust of our effort must be to answer the basic science questions in order to reduce the uncertainties in our knowledge of how the climatic mechanisms work. These answers will give us the tools to analyze the potential biological, chemical and toxicological aspects of nuclear winter. As much as I would like to do the studies in parallel because of the time urgency, it is much more prudent to ensure that the base step, the climatic research, is done properly. It becomes the foundation for all that follows. Using your example of electrical current, a parallel course may yield a shorter time, but it splits your resources and each part may not receive adequate attention. The proposed research program calls for a periodic review of the results so that appropriate action may be taken. I think you will agree that it is absolutely necessary to finally put to rest the wide ranging estimates that abound in the nuclear winter literature.

The National Academy of Sciences has just published the results of their study on The Effects on the Atmosphere of a Major Nuclear Exchange. Their recommendations underscores the need for reducing the uncertainties in the basic understanding of the underlying climate mechanisms so that meaningful analyses can be done. Let me assure you that I feel that the policy and biological issues are important, but the basic atmospheric science has to be done first. Thank you again for your comments and recommendations. I am always interested in your observations and suggestions.

In regard to your comment on a joint US/Soviet Mars mission, I am willing to discuss that subject with you at some future time.

Sincerely,

G. A. Keyworth

G. A. Keyworth
Science Advisor to the President

Professor Carl Sagan
Cornell University
Ithaca, New York 14853-0355

CORNELL UNIVERSITY
Center for Radiophysics and Space Research
SPACE SCIENCES BUILDING
Ithaca, New York 14853 - 0355

Telephone (607) 256-4971

6 November 1984

Laboratory for Planetary Studies

Dr. George A. Keyworth
Science Advisor to the President
The White House
Washington, DC

Dear Dr. Keyworth:

Thank you for your letter of October 9th. Studies of the policy implications of [redacted] could be parameterized in the same way that the physical and biological studies are parameterized: Let the uncertainties vary over their plausible range, and see what policy implications emerge for the various parameter choices. This is already the procedure being pursued by Department of Defense studies, and does not involve prejudging anything. The advantage of carrying out the climatological, the biological, and the policy implications in parallel, with uncertain values parameterized, rather than in series is the time-urgency of some of the possible implications for policy and doctrine. (As in electrical circuitry, the net resistance is larger when the resistors are in series than in parallel.) We agree that a study of the biological consequences of various Nuclear Winter outcomes could be important for biology even apart from the "practical" nuclear war implications. I suggest that something similar is true of a parameterized study on Nuclear Winter implications for policy and doctrine.

On the question of how to proceed with a parallel biological study, I would urge that a scientific drafting group be organized for the biological investigations somewhat similarly to the NOAA-led interagency drafting group for the climatological effects. There is, however, the difficult question of what is the appropriate organizing entity. The Department of Agriculture surely should be involved, but probably does not have the needed breadth of

expertise. This is probably also true for the National Institutes of Health, say, or the National Institute of Medicine. The American Institute of Biological Sciences and the Ecological Society of America bring very important skills, but are not even quasi-governmental organizations. The only organization that seems to me appropriate for such a study to be a [redacted] of the National Academy of Sciences and the National Institute of Medicine.

Cordially,

[redacted]

P.S. I hope to have a chance sometime to chat with you on a totally different matter -- a joint U.S./Soviet mission to Mars with a human crew as a major national objective, for some future time when the United States and the Soviet Union wish to demonstrate their ability to work together on behalf of the human species.

C.S.

CS/np

THE WHITE HOUSE

WASHINGTON

October 9, 1984

Dear Dr. Sagan:

Thank you for your letter concerning both the public reactions to the study of nuclear winter phenomena (i.e., Turner's editorial), and for the need to better articulate such a study's purpose and direction. I'm afraid that I too must admit a certain level of frustration with head-in-the-sand philosophies such as that recommended by Reverend Turner. Too many people fail to realize that decisionmakers have necessarily become inured, and therefore tend to move very cautiously, on recommendations based upon doomsday predictions, regardless of how well initially documented.

As a result, I always find a "we don't need to know anymore" attitude to be counter productive. If decisionmakers are to act, they need broadly based expert consensus which has fully explored the problem, time to internalize the results, and at least some semblance of practical alternatives from which to choose.

Because of the central role of climatology in any nuclear winter discussion, NOAA has offered to begin an independent preliminary assessment of the issues. They intend to report their initial findings and recommend the context and content of any follow-on national program in time for a well planned start subsequent to the 1985 fiscal year. To this extent I believe it would therefore be drastically premature to preface such a recommendation with discussion of its implications on doctrine and policy. Right or wrong, such discussions would have to be the result of the actual findings of any meaningful research effort. To do so earlier would not only be tilting at windmills, but might actually have an adverse

effect by appearing to prejudge study findings much like the Reverend Turner has done. I think you and I would agree that any such perception could have a very deleterious effect on what could otherwise be an extremely important piece of work. Your recommendation that a parallel study concerning the ecological effects of macro-changes in weather patterns might, however, have much broader utility than just the implications of global winter. I would accordingly lean toward experimental/analytical parameters which include, but are not necessarily limited by, preliminary nuclear winter boundary conditions. Such a broader effort could, as you suggest, be carried out independently of what could otherwise become a very controversial climatological study and be of benefit regardless of the results of that study. I would therefore be very much interested in hearing your suggestions along this line.

Sincerely,

G. A. Keyworth

G. A. Keyworth
Science Advisor to the President

Professor Carl Sagan
Cornell University
Ithaca, New York 14853-0355

Nuclear Winter

The Effects on the Atmosphere of a Major Nuclear Exchange

Committee on the Atmospheric Effects
of Nuclear Explosions

Commission on Physical Sciences, Mathematics,
and Resources

National Research Council

NATIONAL ACADEMY PRESS
Washington, D.C. 1985

BASELINE TARGETING

HARDENED TARGETS (GROUND BURSTS)	1500 MT
TARGETS IN OR NEAR MAJOR CITIES	1500 MT
OTHER	3500 MT

BASELINE LOADINGS

		RANGE
NO_x ENTERING STRATOSPHERE	20TG	(8-30TG)
DUST ENTERING STRATOSPHERE	15TG	(10-24TG)
SUBMICRON SMOKE	180TG	(20-650TG)

ILLUSTRATIVE UNCERTAINTIES

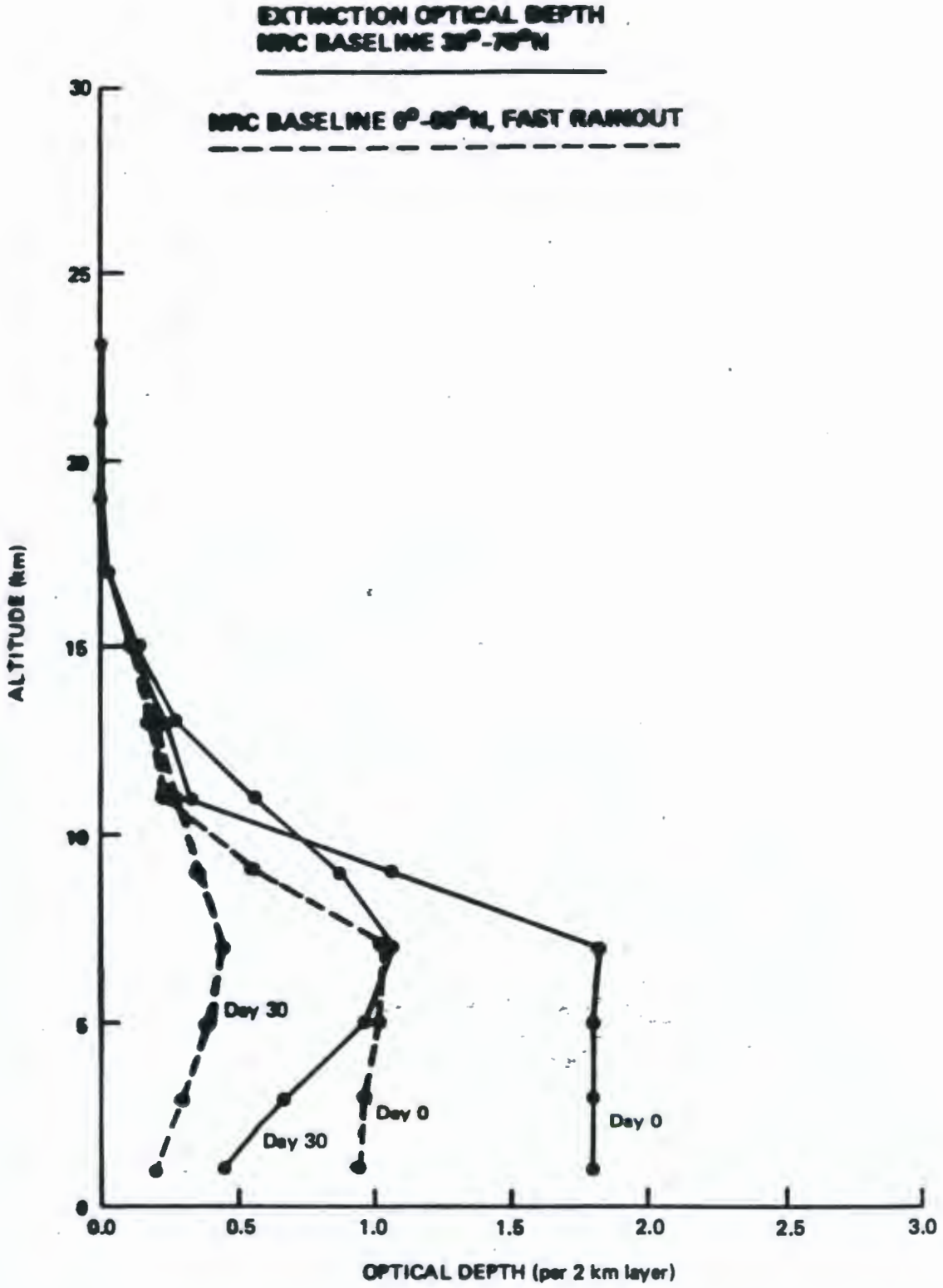
FUEL IMPACTED (20 CAL/CM^2) (URBAN FUEL PER UNIT AREA X AREA IMPACTED)	FACTOR OF 2
COMPLETENESS OF COMBUSTION	FACTOR OF 2
SMOKE GENERATION	FACTOR OF 3
SMOKE SURVIVING PLUME SCAVENGING (DRY COAGULATION AND MOISTURE CONDENSATION)	FACTOR OF 3

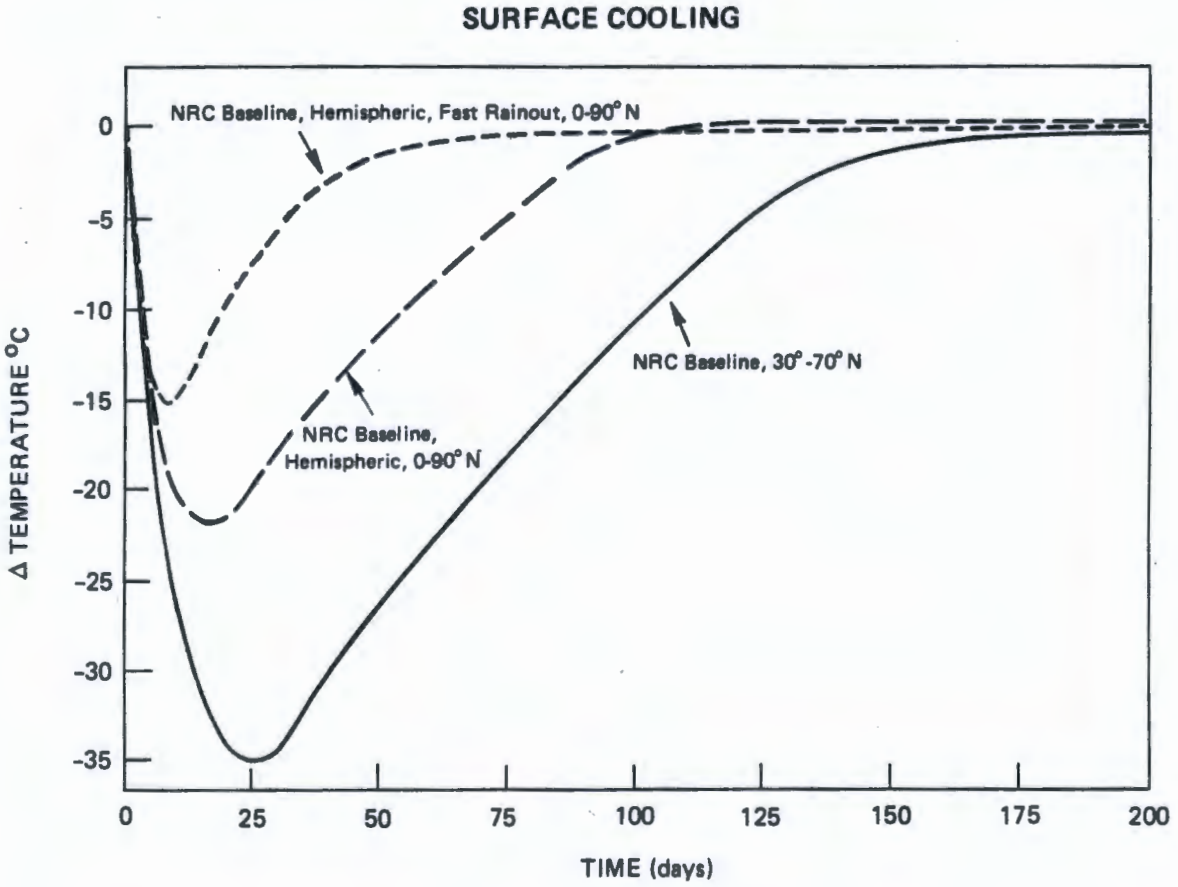
SMOKE DESERVES MAJOR ATTENTION

MORE OF IT THAN DUST.

LARGER ABSORPTION COEFFICIENT FOR SOLAR RADIATION BUT NOT FOR INFRARED.

GREATEST UNCERTAINTIES IN AMOUNT.


EXTINCTION OPTICAL DEPTH
NRC BASELINE 39°-79°N
NRC BASELINE 6°-69°N, FAST RAINOUT
ALTITUDE (km)
30
25
20
15
10
5
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
OPTICAL DEPTH (per 2 km layer)
Day 30
Day 0
Day 30
Day 0


SURFACE COOLING
NRC Baseline, Hemispheric, Fast Rainout, 0-90° N
NRC Baseline, 30°-70° N
NRC Baseline, Hemispheric, 0-90° N
Δ TEMPERATURE °C
0
-5
-10
-15
-20
-25
-30
-35
0
25
50
75
100
125
150
175
200
TIME (days)

SURFACE AVERAGE TEMPERATURE DECREASES

MODEL	SEASON	REGION	ΔT	$t_{1/2}$
1-D	Yr. Av.	30°-70°	31	76
1-D	Yr. Av.	0-90°	21	51
1-D (Fast Rain)	Yr. Av.	0-90°	15	26
GCM: 3-D	Summer	30°-60°	26	—
GCM: 3-D	Spring	30°-60°	17	—

CONCLUSIONS

(1) THE UNCERTAINTIES THAT PERVADE THE QUANTITATIVE ASSESSMENT OF THE ATMOSPHERIC EFFECTS OF A NUCLEAR EXCHANGE ARE SO NUMEROUS AND SO LARGE THAT NO DEFINITIVE DESCRIPTION OF THOSE EFFECTS IS POSSIBLE AT THIS TIME. NEVERTHELESS:

(2) THE MODEL CALCULATIONS THAT CAN BE MADE SUGGEST TEMPERATURE CHANGES OF A SIZE THAT COULD HAVE DEVASTATING CONSEQUENCES. THIS POSSIBILITY CANNOT AND MUST NOT BE IGNORED. THEREFORE:

(3) IT IS INCUMBENT ON AGENCIES HAVING RESOURCES THAT CAN BE ALLOCATED TO SUCH MATTERS AND ON APPROPRIATE MEMBERS OF THE SCIENTIFIC AND TECHNOLOGICAL COMMUNITY TO SUPPORT AND CONDUCT INVESTIGATIONS THAT CAN NARROW MANY OF THE UNCERTAINTIES. ONLY IN THIS WAY CAN WE APPROACH A POSTURE FROM WHICH A MORE DEFINITIVE ASSESSMENT CAN BE MADE.

November 29, 1984

Nuclear Winter Research Program
Management Options

A national research program for assessing the climatic effects of nuclear war has been moving toward completion.

- Development of the program has primarily involved representatives from OSTP, OMB, and the National Climate Program Office (NCPO), which is part of NOAA.

- Current plans call for public announcement of a government program during the week of January 14, 1985.

The major thrust of this effort is to apply available scientific data and expertise toward improving our understanding of the environmental consequences of nuclear war. The "nuclear winter" hypothesis -- which has attracted considerable public attention -- advances the view that widespread layers of smoke and dust in the atmosphere, following a series of nuclear explosions, would alter our climate and produce a prolonged period of colder than normal temperatures.

- Scientific evidence does not exist to either support or reject this hypothesis.

- Anti-nuclear groups have, however, embraced the concept and the Soviet Union has used it for propaganda purposes.

The implications of this issue for the development of our defense and foreign policy positions argue for undertaking a concentrated scientific effort to reduce the level of speculation associated with this issue. There is a general consensus within the planning group as to the type of research work which needs to be done. There is also supposedly OMB concurrence on funding of about $4.0 million, to be handled through the DOD appropriation. However, there has not been a high level policy or political decision made as to whether or not to implement this program.

If a decision is made to proceed, it is critical, given the nature of the issue, that the program be conducted by a scientfically reputable organization -- free as much as possible from government involvent and influence. The current draft plan implies that the program would be implemented by DoD and DOE, but, in fact the management structure for coordinating the program has <u>not</u> been defined.

The National Science Foundation (NSF) meets this criteria and could provide the civilian agency leadership necessary for an effort of this complexity. The NSF, established in 1950, has a broad charter directed at increasing scientific knowledge and supporting national science policy planning. The National Science Foundation is authorized to:

> "initiate and support basic scientific research and programs to strengthen scientific research potential ...in the mathematical, physical, medical, biological, engineering, social and other sciences;
>
> ...to initiate and support specific activities in connection with matters relating to international cooperation, national security, and the effects of scientific applications upon society...; and
>
> When so directed by the President,...to support,...applied scientific research relevant to national problems involving the public interest". 1/

The nuclear issue clearly fits within the Foundation's mandate. Moreover, NSF has at its disposal the resources and mechanisms already in place for processing the various research proposals that will make up the program.

- NSF has strong, well established contacts with the scientific community and is a nationally and internationally recognized institution.
- In FY 1985, NSF has a budget of $97 million for atmospheric sciences R&D. It also has a funding base in the biological sciences, which the planning group has identified as an area of research that will ultimately need to be incorporated in the program. NSF also supports a strong program in physical sciences (e.g. high energy physics).

One of NSF's research centers, the National Center for Atmospheric Research (NCAR), has as part of its mandate understanding climatic change and initiating, and carrying out "...atmospheric research that requires long-term, cooperative efforts among scientists at NCAR and at universities and government laboratories." 2/

1/ 42 USCA 1862, National Science Foundation Act of 1950, as amended.

2/ National Atmospheric Sciences Program, FY 1978-1981; FCCSET Report, July 1982.

- NCAR has an FY 1985 operating budget of $45 million and a staff of scientists capable of conducting long-term atmospheric research.

- NCAR has been involved in the development of general circulation models of the earth, which are the key to understanding climate sensitivity to changes in external energy input or chemical composition (e.g. increases in hydrocarbons).

- In FY'85, NCAR will be acquiring an advanced Class VII vector computer to assist atmospheric researchers.

Because the credibility of this research effort is so critical, OSTP and the planning group have tended to, understandably, shy away from placing DoD/DOE in a direct role dealing with the public and scientific community.

NCPO has suggested that it serve in this role, administering -- through a proposed scientific projects office -- the coordination of the program. OSTP staff have been supportive of NCPO and have encouraged their involvement in managing the research program.

Since its establishment, in 1978, NCPO has primarily served in a coordinating role pulling together the national climate activities and representing the U.S. in international meetings on world-wide climate research efforts. NCPO has also been responsible for preparing a five year plan (updated bi-annually) and required annual reports to the Congress. The Office has a relatively small budget ($1.1 million and 9 positions), about half of which goes toward grants to support university research.

While NCPO has been instrumental in developing the draft nuclear research plan, it does not necessarily follow that this office should be placed in the role of managing a major research effort.

- NCPO does not have the staff or the experience to manage a program of this size and complexity. NCPO does not have operational program responsibilities.

- NCPO involvement in this effort would seriously detract from its ability to coordinate objectively other ongoing Federal climate research activities. It is important that NCPO's neutral position be maintained if it is to continue to be an effective coordinator on the national level and perceived as an unbiased spokesperson in international circles.

- While NCPO is recognized by the scientific community, it does not have any established public credibility, which ultimately will be critical in the acceptance of research findings.

Further, an NCPO lead for this effort would inappropriately draw NOAA and the Department of Commerce into the nuclear issue, which could not only impact the agency's programs, but would directly involve this Department in an area where it has no particular scientific expertise or public crediability.

Understanding the nuclear winter problem, according to the draft plan, "is embedded in more general problems of understanding fire phenomenology, atmospheric chemistry, mesoscale and global circulation, and cloud dynamics". NSF and NCAR have been deeply involved in the support and conduct of research in all of these areas, and as such should assume the lead in this program.

* * *

A briefing is scheduled for Friday, November 30, 1984, with Dr. Keyworth, OSTP, to review the draft plan and to discuss the management issue. As the plan currently stands it does not provide a clear statement of how the proposed funds would be utilized or managed. There are also serious concerns regarding NCPO's involvement in the program, which would shift its traditional role from one of coordination to operational program management. Further, the drafting committee, despite recognition that OMB will probably only go along with a $4 million program, still feels that an appropriate level of effort would be a the $15 million level.

Before any program is finalized and announced by OSTP, there should be proper consulation with the involved Departments at a policy level to first determine if the Administration wants to proceed with a program of this type. Those discussions should also result in a clearer delineation of program management responsibilities and funding levels.

CD FORM 69-1 (11-82)

TABLE OF ORGANIZATION

U.S. DEPARTMENT OF COMMERCE

1 AGENCY	2 ORGANIZATION CODE	3 ORGANIZATION	4 DATE
CM87	AA8000	NOAA HDQTRS,OFFICE OF ADMINISTRATOR, NOAA NATIONAL CLIMATE PROGRAM OFFICE	10-31-84

A

AUTHORIZED POSITIONS / EMPLOYMENT DATA

5 POSITION CONTROL NUMBER	6 FUNCTION CODE	7 POSITION TYPE	8 9 PAY PLAN, GRADE	10 ORGANIZATION TITLE OF POSITION	11 STATE CODE	12 TITLE	13 APPOINT CODE	14 TOUR DUTY	15 16 PAY PLAN GRADE	17 NAME OF INCUMBENT	18 CSC SERIES CODE	19 POSITION DESCRIPTION NUMBER
001	AM2890	PTP	ES-00	DIRECTOR, NATIONAL CLIMATE PROGRAM OFFICE	MD		A	FT	ES-00	HECHT, ALAN D	01301	ES1275
002	AM2890	PTP	GM-15	GENERAL PHYSICAL SCIENTIST (61 SPI)	MD		1	FT	GM-15	SPRIGG, WILLIAM	01301	ES7926
003	AM2890	PTP	GM-13	GENERAL ENGINEER	MD		1	FT	GM-14	ETKINS, ROBERT	00801	H83182XX
004	AM2890	PTP	GM-13	ECONOMIST	MD		1	FT	GM-15	CHARAK, MASON THOM	01340	ES9051XX
005	AM2890	PTP	GS-08	SECRETARY	MD		1	FT	GS-08	SHAW, BRENDA J.	00318	ES7327XX
006	AM2890	PTP	GS-08	SECRETARY/STENOGRAPHER	MD		1	FT	GS-09	GRAHAM, WENDY MC G	00318	H84381XX•
007	AM2890	PTT	GM-13	GENERAL PHYSICAL SCIENTIST (61 SPI)	MD		1	FT	GM-14	YERG, MARTIN CHARL	01301	ES9057
008	AM2890	INT	EP-00	CONSULTANT	MD				-	(VACANT) 01-83		
				888			2	FT	GS-06	•DIGGS, DONNA A		H83025XX

• DENOTES CHANGE IN DATA SINCE LAST UPDATE

SOURCE: NOAA Table of Organization - Form 9

B

ACCUMULATIONS	OPNS	TOTAL
FULL TIME PERMANENT	6	6
OTHER	2	2
TOTAL	8	8

R&D budget authority for general science
[Dollars in millions]

	1983 actual	1984 estimate	1985 estimate
Total	$1,502	$1,717	$1,942
National Science Foundation	1,056	1,238	1,414
Mathematical and physical sciences	308	365	423
Astronomical, atmospheric, earth and ocean sciences	289	337	377
Biological, behavioral, and social sciences	200	231	260
Engineering	106	125	152
U.S. Antarctic program	81	94	107
Science and engineering education	1	7	8
Scientific, technological, and international affairs	43	46	52
Special foreign currency	3	3	3
Program development and management	32	31	33
Adjustment for carryovers	-5	-	-
Department of Energy	446	479	528
High energy physics	326	343	382
Nuclear physics	119	134	145
General science program direction	1	2	2

SOURCE: Federal R&D Funding by Budget Function
Fiscal Years 1983-85
Division of Science Resources Studies
National Science Foundation
March 1984
NSF 84-316

The astronomical, atmospheric, earth and ocean sciences (AAEO) activity is proposed for an increase of 12 percent--$40 million higher than in 1984. Support for astronomical sciences, up 17 percent or $13 million, provides funds for university research project support grants and for five National Astronomy Centers. Astronomy project support in the 1985 budget emphasizes astronomical instrumentation and detectors, theory and data analysis, digital detectors for telescopes, and computational facilities. Funds are also provided for studies of Comet Halley, laboratory astrophysics, infrared astronomy and support of ground-based observatories at universities. Support for the development of a unique submillimeter-wave radio facility, initiated in 1984, will continue in 1985. The five National Astronomy Centers provide a variety of optical, infrared, radio and other specialized instrumentation, on a competitive basis, to scientists throughout the nation and abroad. Additional funds proposed for the National Radio Astronomy Observatory reflect initiation of development of the Very Long Baseline Array radio astronomy facility.

Atmospheric sciences are scheduled to grow 9 percent in 1985--an $8 million increase. The four areas designated to significant growth in 1984 continues to be emphasized in 1985. These areas are instrument and research equipment acquisition, mid-latitude storm research, global tropospheric chemistry, and climate studies emphasizing the interaction between the atmosphere and the oceans. The other major component of the atmospheric sciences activity, the National Center for Atmospheric Research (NCAR), emphasizes the development of an Advanced Vector Computer (AVC) system. This computer is expected to have greatly increased central memory and speed compared to the current NCAR mainframe computers. The AVC system strengthens current research efforts requiring large-scale computing in atmospheric and ocean sciences.

The earth sciences program grows 17 percent, or $7 million, in the 1985 budget. In addition to proposing increases in areas where instrumentation needs are critical, research areas to be emphasized include planning, site selection, and preliminary studies for a possible program of scientific drilling on the continents as well as projects in lithospheric seismology, a global digital seismograph array, and laboratory studies of geological materials. Also, support is proposed for research on ancient asteroid impacts and their possible influence on the mass extinctions of life forms as seen in the fossil record, the tectronic and thermal history of sedimentary basins, the structures and properties of rocks and minerals at the pressures and temperatures of earth's interior, and volcanoes and their historical patterns of eruption.

Ocean sciences are scheduled for growth of 10 percent, or $11 million in 1985. In the area of ocean sciences research support considerable attention is given to instrumentation improvements in all areas supported. In addition, increases in submarine geology and geophysics will support submersible research on the evolution of the oceanic crust, the chemistry at hydrothermal events, and the microbiology of vent organisms.

SOURCE: Federal R&D Funding by Budget Function
Fiscal Years 1983-85
Division of Science Resources Studies
National Science Foundation
March 1984
NSF 84-316

R&D budget authority for astronomical, atmospheric, earth, and ocean sciences
[Dollars in millions]

	1983 actual	1984 estimate	1985 estimate
Total	$289	$337	$377
Astronomical sciences	63	78	91
Astronomy project support	22	28	29
National Astronomy and Ionosphere Center	5	6	6
Kitt Peak National Observatory Cerro Tololo Inter-American Observatory National Solar Observatory	20	24	25
National Radio Astronomy Observatory	16	21	31
Atmospheric sciences	75	89	97
Atmospheric sciences project support	40	46	49
National Center for Atmospheric Research	32	40	45
Upper Atmospheric Research Facilities	3	3	4
Earth sciences	35	42	49
Ocean sciences	102	114	125
Ocean sciences research support	50	55	61
Oceanographic facilities and support	31	33	36
Ocean drilling program	21	26	28
Arctic research	6	7	8
Program development and management	8	8	8

SOURCE: Federal R&D Funding by Budget Function
Fiscal Years 1983-85
Division of Science Resources Studies
National Science Foundation
March 1984
NSF 84-316

The National Science Foundation (NSF) promotes the progress of science and engineering through the support of research and education programs. Its major emphasis is on high quality, science-driven research, the search for improved understanding of the fundamental laws of nature upon which our future well-being as a nation depends. The National Science Foundation also supports applied research in several areas. Its educational programs are aimed at ensuring increasing understanding of science at all educational levels and an adequate supply of scientists and engineers to meet our country's needs.

The purposes of the National Science Foundation are: to increase the Nation's base of scientific knowledge and strengthen its ability to conduct research in all areas of science and engineering; to develop and help implement science education programs that can better prepare the Nation for meeting the challenges of the decades ahead; and to promote international cooperation through science. In its role as a leading Federal supporter of science, NSF also has an important role in national science policy planning.

The National Science Foundation was established by the National Science Foundation Act of 1950 (64 Stat. 149; 42 U.S.C. 1861–1875), as amended, and was given additional authority by the National Defense Education Act of 1958 (72 Stat. 1601; 42 U.S.C. 1876–1879) and the Science and Technology Equal Opportunities Act (94 Stat. 3010; 42 U.S.C. 1885–1885d). Reorganization Plan No. 1 of 1977 transferred to the Foundation certain reporting functions of the Office of Science and Technology Policy under the National Science and Technology Policy, Organization, and Priorities Act of 1976 (90 Stat. 459; 42 U.S.C. 6601).

The Foundation consists of the National Science Board, which is composed of 24 part-time members and the Director *ex officio*. Members are appointed by the President, with the advice and consent of the U.S. Senate, for 6-year terms. They are selected because of their distinguished service in science, medicine, engineering, agriculture, education, public affairs, research management, or industry. They are chosen in such a way as to be representative of the scientific leadership in all areas of the Nation.

The NSF Act assigns policymaking functions to the National Science Board and the administration of the Foundation to the Director. The policies of the Board on support of science and development of scientific personnel are generally implemented throughout the various programs of the Foundation. The act also provides for the appointment of a Deputy Director and four Assistant Directors, subject to Senate confirmation.

Activities

The National Science Foundation initiates and supports fundamental, long-term, science-driven research in all the scientific and engineering disciplines. This support is made through grants, contracts, and other agreements awarded to universities, university consortia, nonprofit, and other research organizations. Most of this research is directed to the resolution of scientific questions concerning fundamental life processes, natural laws and phenomena, fundamental processes influencing the human environment and the forces impacting on people as members of society as well as on the behavior of society.

The NSF encourages cooperative efforts by universities, industries, and government, and promotes the application of research and development for better products and services that improve the quality of life, create employment opportunities, stimulate economic growth, and increase productivity and foreign trade.

The Foundation supports major national and international science programs, including the U.S. Antarctic Program, Ocean Drilling Programs, and others.

Support is given, through contracts, to national centers where large facilities are made available for the use of qualified scientists. Among the centers supported by the Foundation are the National Center for Atmospheric Research, the Kitt Peak National Observatory, the Cerro Tololo Inter-American Observatory, Sacramento Peak Observatory, the National Astronomy and Ionosphere Center, the National Radio Astronomy Observatory, and the Very Large Array (VLA) Radio Astronomy Observatory, the largest facility of its kind.

The Foundation's science and engineering education activities includes the graduate fellowships program, the minority graduate fellowships program, the NATO postdoctoral fellowships program, and travel grants to NATO advanced study institutes.

The Foundation also supports research aimed at formulating science policy through analysis of existing and emerging national issues that have significant scientific and technological content. It defines options and supplies analysis directed toward enhancing the contribution of science and technology to national goals.

The NSF develops and disseminates information relating to the Nation's available human and financial resources for scientific and technological activities. Programs in information science and technology support basic and applied research leading to timely and resourceful use of information, especially by the scientific and technological enterprise.

International programs, including cooperative scientific research activities, support the exchange of American and foreign scientists and engineers, the execution of jointly designed research projects, participation in the activities of international science organizations, and travel to international conferences. Support is also provided for the translation of foreign scientific and technical literature.

The National Science Board presents annually the Alan T. Waterman Award to an outstanding young scientist for support of research and study. This award [illegible] up to $150,000 for 3 years of research and study at the institution of the awardee's choice. From time to time, the Board also makes the honorary Vannevar Bush Award to a person who, through public service activities in science and technology, has made an outstanding contribution toward the welfare of mankind and the Nation. The two awards together are designed to encourage individuals to seek to achieve the Nation's objectives in scientific and engineering research and education.

The NSF also provides support for the President's Committee on the National Medal of Science.

Sources of Information

Grants Individuals or organizations who plan to submit grant proposals should refer to the *NSF Guide to Programs* and appropriate program brochures and announcements which may be obtained as indicated in the reference to publications, below.

Beginning graduate and minority graduate students wishing to apply for fellowships should contact the Office of Scientific and Engineering Personnel and Education. Phone, 202–357–7536.

Contracts The Foundation publicizes contracting and subcontracting opportunities in the *Commerce Business Daily* and other appropriate publications.

Organizations seeking to undertake contract work for the Foundation may contact the Division of Grants and Contracts. Phone, 202–357–7880.

Small Business The Office of Small Business Research and Development in the Foundation provides information on opportunities for NSF support to small businesses with strong research capabilities in science and technology. Phone, 202–357–7464.

The Office of Small and Disadvantaged Business Utilization oversees NSF compliance with the provisions of the Small Business Act and Small Business Investment Act of 1958, as amended (92 Stat. 1757; 15 U.S.C. 683).

Publications The National Science Board assesses the status and health of science and its various disciplines,

SOURCE: The United States Government Manual 1983/84

GENERAL SCIENCE, SPACE, AND TECHNOLOGY

Federal investments in general science and space programs are needed to ensure the future technological strength of the Nation.

The continued growth of scientific knowledge through basic research, the development of new technology, and the training of scientists and engineers are vital to sustained economic growth, to enhanced national security, and to continued improvement in the quality of life.

Most of the Federal investment in science and technology is reflected in research and development programs included in other budget functions that serve specific agency missions, such as health, defense, energy, and agriculture. The programs in this function have the goal of generally helping to ensure U.S. strength and leadership in science and space technology in the broad national interest. Included are all the programs of the National Science Foundation, the space programs of the National Aeronautics and Space Administration, and the general science programs of the Department of Energy. Proposed budget authority for the programs in this function is $9.1 billion in 1985, an increase of 5.9% over 1984.

Common to the programs in this function is the support of basic research, accounting for more than one-third of the overall Federal funding for such research. Departments and agencies in other functions, chiefly the Department of Agriculture and the National Institutes of Health, provide the major share of support of basic research in the agricultural and life sciences. But the programs in this function are the primary source of funding for the physical and engineering sciences and account for some 80% of the total Federal support for these disciplines. The balance is provided mainly through programs of the Department of Defense.

In 1985, the Federal investment in basic research through programs in this function is projected to grow by about 16%. This increase, together with those in other functions, reflects the high priority that this administration continues to give to the support of basic research. It gives further recognition to the understanding that the private sector lacks sufficient incentives to make adequate investments in such research to serve the broad national interest.

General science and basic research.—This part of the function covers all the programs of the National Science Foundation and the general science programs of the Department of Energy in high energy and nuclear physics. Budget authority of $2.3 billion is proposed for these programs in 1985, a 15% increase over 1984.

NATIONAL NEED: INCREASING BASIC SCIENTIFIC KNOWLEDGE AND USE OF SPACE

(Functional code 250; in millions of dollars)

Major missions and programs	1983 actual	1984 estimate	1985 estimate	1986 estimate	1987 estimate
BUDGET AUTHORITY					
General science and basic research:					
National Science Foundation programs	1,104	1,326	1,507	1,570	1,636
Department of Energy general science programs	534	638	746	755	800
Subtotal, general science and basic research	1,638	1,965	2,253	2,326	2,437
Space research and technology:					
Space flight	4,085	4,048	3,821	4,001	4,323
Space science, applications, and technology	1,596	1,735	2,019	2,242	2,330
Supporting space activities	647	808	964	934	930
Subtotal, space research and technology	6,328	6,591	6,804	7,177	7,583
Total, budget authority	**7,966**	**8,555**	**9,057**	**9,503**	**10,020**
OUTLAYS					
General science and basic research:					
National Science Foundation programs	1,055	1,242	1,457	1,525	1,588
Department of Energy general science programs	589	621	684	761	794
Subtotal, general science and basic research	1,644	1,864	2,141	2,286	2,383
Space research and technology:					
Space flight	4,053	4,091	3,884	3,998	4,190
Space science, applications, and technology	1,486	1,590	1,899	2,127	2,279
Supporting space activities	562	746	894	939	938
Subtotal, space research and technology	6,101	6,427	6,677	7,064	7,407
Total, outlays	**7,745**	**8,291**	**8,818**	**9,350**	**9,790**
ADDENDUM					
Off-budget Federal entity:					
Federal Financing Bank:					
Supporting space activities:					
Budget authority	189	1,079			
Outlays	189	131		−7	−86

search in all fields of science and engineering. The NSF's broad-based research programs complement the more specialized support of basic research by agencies in other functions, such as the Department of Defense and the National Institutes of Health, and helps to ensure balanced Federal support across the major scientific disciplines.

The 1985 budget includes $1.5 billion in proposed budget authority for NSF, $181 million or 14% above 1984. Within this amount, the support of basic research will increase by 13%.

The principal increase, $112 million in 1985, will be for additional support of basic research at academic institutions through project grants. Within this increase, further emphasis will be given

to strengthening support for the physical and engineering sciences and to the improvement of university research instrumentation across all disciplines.

The proposed budget for NSF places special emphasis on increasing the access of academic scientists in all scientific fields to the most advanced computers as research tools. As part of this effort, the Foundation plans to extend and expand in 1985 its effort begun in 1984 to provide blocks of time on supercomputers located at existing centers and to increase funding for networks and local user support. A related but separate proposal is to provide for an advanced vector computer at the National Center for Atmospheric Research to serve the special needs of researchers in the atmospheric and ocean sciences. In addition to increased support for engineering research through traditional project grants, the 1985 budget includes $10 million in budget authority to initiate a program of support for centers for cross-disciplinary research in engineering at universities. This program will support specialized instrumentation and experiments by groups of researchers and students across the engineering disciplines.

The budget also provides for the construction of a sophisticated instrument to further advance radio astronomy, the very long baseline array radiotelescope.

In addition, an increase is provided for the U.S. Antarctic program, managed by NSF, to assure the necessary logistical support for Antartic research programs and thus maintain an active and influential U.S. scientific presence in that region.

The budget also includes $76 million in budget authority to continue to develop innovative teaching materials and to improve the instructional capabilities of the Nation's science and mathematics teachers. These funds are intended to complement the efforts of State and local governments and the private sector. Additional Federal assistance to help alleviate the shortage of qualified mathematics and science teachers is included in the education, training, employment, and social services function under the Department of Education.

Department of Energy general science programs.—The general science programs of the Department of Energy (DOE) continue to support basic research in nuclear and high energy physics initiated under the Atomic Energy Commission. The goal of this research is to achieve a comprehensive understanding of the basic constituents of matter and energy and the forces that govern their interaction. Budget authority of $746 million is requested for support of these programs in 1985, $108 million above 1984.

This increase includes an additional $48 million for the operation of particle physics accelerator facilities supported by DOE. This amount will largely cover cost increases over 1984.

The increase also provides an additional $40 million in 1985 for several on-going or new research facilities. Included in high energy physics are funds to continue construction of the Stanford linear collider. In nuclear physics, additional support is planned to complete the upgrading of accelerator facilities at the University of Washington and at Yale University, and to undertake an upgrading of existing accelerators at the Brookhaven National Laboratory. The budget also includes an increase to finance planning for the construction of an advanced nuclear physics electron facility sponsored by the Southeastern University Research Association at Newport News, Virginia.

Funds to complete the construction of the Tevatron II upgrade at the Fermilab accelerator, and funds to continue the Tevatron I modifications at Fermilab are also provided for at about the 1984 level.

The budget proposes $20 million in budget authority to continue funding preliminary research and development activities for the design of a possible next generation of high-energy particle accelerators.

Space research and technology.—This part of the function covers the space-related activities of the National Aeronautics and Space Administration (NASA). For 1985, the administration is proposing to continue a vigorous program of space science, applications, and technology development. It is also committed to providing the resources necessary to continue progress towards making the space shuttle fully operational and cost-effective in providing routine access to space. Budget authority of $6.8 billion is proposed for these programs in 1985, an increase of $213 million over 1984. New activities for 1985 include the definition and design of a space station.

The budget levels proposed for 1985 and later years reflect economies from management reform efforts now under way or planned. In NASA, efficiency improvements in administrative support services will reduce budget authority and outlays over $7 million in 1985.

Space flight.—The space flight programs of NASA help sustain and improve the Nation's ability to supply space transportation services. These programs include the development, production, and operation of the four-orbiter space shuttle fleet; research activities using the shuttle-borne Spacelab; development and procurement of the upper stage vehicles to carry shuttle-launched payloads into high-Earth orbit; and cooperative projects with other nations.

Budget authority of $3.8 billion is proposed for the space flight program. This includes $150 million in budget authority for a program to define and design a space station. Planned for launch

SACRAMENTO PEAK OBSERVATORY

The Sacramento Peak Observatory (SPO), sponsored by the National Science Foundation, is operated and managed under contract by the Association of Universities for Research in Astronomy, Inc. (AURA). The observatory provides solar astronomers in the United States and abroad with telescopes and auxiliary equipment of the highest quality for solar research. In addition the observatory staff undertakes research, in collaboration with colleagues at universities, on a number of large-scale problems that have an astrophysical or geophysical context.

The observatory is situated in the Sacramento Mountains of south-central New Mexico at an elevation of 9,200 feet. Because of the excellent daytime and nighttime seeing and specialized equipment such as the Solar Vacuum Tower Telescope, the observatory is well-suited for studies that demand the highest obtainable spatial resolution on the sun. In addition, the observatory is one of two within the United States that are able to observe the solar corona, with specialized equipment, outside of a total eclipse.

The SPO supports research on several fundamental solar processes that influence the interplanetary medium, the magnetosphere, the ionosphere, and possibly, the troposphere of the earth. In addition, the observatory provides the scientific community with synoptic data and specialized solar data that are needed for studies of the terrestrial atmosphere.

Coronal holes are monitored continuously at SPO with a differential photo-electric photometer at the coude focus of the 16-inch coronagraph. The technique used at SPO detects coronal holes at their eastern limb passage and so gives forecasters a seven-day warning of possible geomagnetic storms. Daily observations of active regions, sunspots, and flares are also supplied to various geophysical data centers and, through them, to a wide circle of users in the atmospheric sciences community.

A special solar atlas was prepared recently at SPO for the benefit of the aeronomy community. The atlas gives the spectrum of integrated sunlight on a well-calibrated intensity scale and with high spectral resolution. Such information is essential for studies of the chemistry of the upper atmosphere.

POLAR RESEARCH

The National Science Foundation's Atmospheric Sciences Program in the polar regions is supported by the Division of Polar Programs. Basic support for projects in both the Antarctic and the Arctic is provided by DPP through grant programs in Meteorology, Upper Atmospheric Physics, Glaciology, and Ocean Sciences. The program is directed toward understanding meteorological processes in the polar regions, the climatic history of glaciers, the role of the Arctic sea ice in global weather and climate, and solar terrestrial relationships.

Upper Atmospheric Physics

The Upper Atmospheric Physics Program supports a variety of studies aimed at improving our understanding of the Earth's upper atmosphere, its near- and farspace environment, and how the sun affects these regions. These studies include measurements of aurora, cosmic radiation, geomagnetic activity, very low frequency wave phenomena, electric fields, solar particle precipitation, changes in the ionosphere, and atmosphere-ionosphere-magnetosphere coupling.

Most of the Upper Atmospheric Physics projects are conducted at Siple Station, Antarctica (76°S, 84°W) which is ideally located for studies of the plasmapause region of the magnetosphere. A unique VLF facility located at Siple is used to conduct active and investigations of the plasmapause. A VLF transmitter with a 21 km long dipole antenna at Siple is used in a variety of transmission modes to inject VLF waves of known characteristics into the magnetosphere. Observations of the Siple transmission are made at Roberval, Canada, the magnetic conjugate point of Siple. In the 1980-81 season such observations were also made with rocket and balloon-borne instruments launched from Siple. These studies contribute to the objectives of the International Magnetospheric Study (IMS).

Meteorology

South Pole Station, located on the relatively flat, featureless Antarctic Plateau, is an excellent facility for studying the role of the antarctic ice sheet in the global atmospheric circulation. Projects at the South Pole include comprehensive studies of the structure of the boundary layer, the tropospheric circulation, and the ice crystal precipitaion process. Background levels of natural and artificial atmospheric constituents are measured as part of the Global Monitoring for Climatic Change (GMCC) program. Specific activities at the South Pole include studies of the thermal radiation budget, the energy balance at the air/ice interface, trace metals and halogens in the troposphere, submicron particulate matter in the stratosphere, and the origin of ice crystals. The development of katabatic winds is being studied along a chain of automated weather stations inland from the French coastal station.

An instrumented, ski-equipped, four engine turboprop LC-130R aircraft became available for use by geophysical and atmospheric researchers in 1978. The aircraft is fitted with systems for direct and remote atmospheric sensing and is capable of making radio echo soundings in ice. Overhead apertures allow the installation of air samplers, radiometers or cameras. Fifty data channels can be recorded continuously for periods up to eight hours. The aircraft has been used for trans-Pacific air sampling profiles, aerosol trajectory studies, and remote sensing missions.

Research projects in arctic meteorology include studies of the radiational and physical characteristics of the quasi-permanent stratus cloud cover, tundra aerosols, and the structure of the planetary boundary layer.

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

NCAR's mandate is to serve as a focal point for understanding the interlocking chemical, physical, and dynamical processes of the atmosphere, particularly where commitments of scientists and technical resources over extended periods of time are required. Within this mandate, NCAR has two missions:

- To initiate, coordinate, and carry out atmospheric research that requires long-term, cooperative efforts among scientists at NCAR and at universities and government laboratories.
- To provide and develop facilities and related services for the atmospheric research community.

Research at NCAR is directed toward the following long-range objectives:

- To extend the range and quality of weather prediction from the present limits of two days to about one week;
- to improve understanding of climatic trends and their causes;
- to increase knowledge of those aspects of severe storms that will improve prediction and warning capability and evaluations of possibilities for modifications;

SAR I-FY 78-81 July 1982
SOURCE: National Atmospheric Sciences Program
Fiscal Year 1978-1981
Subcommittee on Atmospheric Research
Committee on Atmosphere and Ocean
Federal Coordinating Council
for Science, Engineering and
Technology
Executive Office of the President

- to better understand solar processes and their influences on the interplanetary medium and the earth's atmosphere;
- to determine trends and influences on air quality.

Range and Quality of Prediction

The use of computer models of the atmosphere has brought the goal of achieving accurate short-to-medium-range weather forecasts much closer. Such numerical models are based on the laws governing atmospheric motions. Predictions are carried out by solving a set of time dependent mathematical equations. The results of such calculations, in addition to observed data from the atmosphere, are used to study the atmosphere and its predictability.

Until a few years ago, considerable attention and effort was devoted to the development of numerical techniques—i.e., to improving the accuracy of approximate numerical methods and to increasing their effective spatial resolution. More recently, it has been found that models based on entirely different numerical methods (and with similar, but not identical, formulations of the physics) suffered from the same characteristic types of error—notably, an inability to predict correctly the very large scales of motion. Suspecting that there may be some defect in the basic formulation of all current physical models, NCAR scientists concentrated more effort on understanding basic physical mechanisms and on making finer distinctions between various characteristic types of motion and the way in which they interact.

A direct outgrowth of this change in emphasis has been the development and application of the so-called nonlinear normal-mode initialization (NLNMI), a procedure for extracting the meteorologically important components of motion from a complete set of initial data and for excluding the nonmeteorological "noise." This method immediately established a previously missing connection between the dynamics of the prediction model and the problem of prescribing the correct initial conditions for the prediction model. As important by-products, the application of the NLNMI has also provided a powerful means of diagnosing the behavior of the models, as well as a sound basis for the theory of meteorological observing systems.

Climate

Much of the climate research has focused on the development of a more realistic and less costly general circulation model to be used for studies of the climate's sensitivity to changes in external energy input or chemical composition. The third in a series of increasingly detailed models incorporates improved treatments of cloud-radiation feedback, surface physics, hydrologic cycle, sea ice, ocean circulation, and air-sea interactions. Using less detailed interim models of the energy-balance type, NCAR has investigated long-term average temperature changes that might result from the CO_2 released as a by-product of increased burning of fossil fuels. It has been found that the time required for the oceans (one of the main reservoirs for CO_2) to reach diffusive equilibrium is about 20 years, so there is a correspondingly long lag time between equilibrium response and an impulsive increase of CO_2 content. This, in turn, drastically affects our estimates of short-term response.

A crucial factor for determining climate and climate change is the state of the oceans—their temperature, circulation, and ice cover. Accordingly, separate but related studies of the oceanic factors in climate have been undertaken, concentrating on the role of mesoscale eddies and other features of the ocean circulation that affect heat and salinity transport. The mesoscale eddies, vortices some tens of kilometers in diameter that are apparently shed from meanders in the unstable northern reaches of the Gulf Stream, are being investigated by a combination of theoretical studies, numerical modeling, and field observation. Although these features are small, they contain an unexpectedly large amount of kinetic energy and may have an important effect on oceanic transport.

Severe Storms

The "whole cloud" approach to convective storms and precipitation is being utilized to study the most important of the many cloud microphysical and dynamical interactions. Field studies employing multiple in situ and remote probes including Doppler radar and aircraft may be expected to contribute to the ability to predict the nature and amount of precipitation from convective clouds, evaluate the possibilities of intentional modification, and estimate the magnitude of man's impact on weather and climate through inadvertent cloud modification.

During FY 1978-80, analysis of data collected during the National Hail Research Experiment field seasons was completed. Plans for a new field program to address major problems of precipitation physics in FY 1981, the "Cooperative Convective Precipitation Experiment" (CCOPE), have been prepared in cooperation with the Water and Power Resources Service, Department of Interior.

Studies of the dynamics of large convective storms have been extended through the Severe Environmental Storms and Mesoscale Experiment (Project SESAME), a multi-agency observational program that has provided a wealth of special observations and Doppler radar data during periods of intense thunderstorm activity over the southern and southwestern United States. Parallel experiments with numerical models of idealized storms have been successful in predicting the "splitting" of large storms into a dipole structure.

A major change of emphasis has been the gradual phasing out of efforts in subsynoptic-scale data analysis and modeling, and the strengthening of planetary boundary-layer studies. An understanding of the structure of boundary layers is essential in simulating the effects of vertical heat, moisture, and momentum exchange in numerical models of the large-scale circulation of the atmosphere.

Solar Processes/Influence on the Interplanetary Medium

Research in this area consists of three major components:

- The investigation of the sources of non-radiative energy responsible for heating the outer solar atmosphere and the role magnetic fields play in determining solar atmospheric structure and the flow of energy. This effort is coupled with interpretive analyses of observations in order to understand the steady energy and mass balances of the solar atmosphere. Work in this area involves the development and use of new observational techniques, including satellite-borne instruments, and research in radiative transfer, magnetohydrodynamics and fluid dynamics.
- The development of a realistic understanding of the processes responsible for the corona and solar wind, their structure, and evolution. Activity in this area is pursued on a variety of levels including the theory of basic processes responsible for the flow of the solar wind and its interaction with the magnetic field, and observations with both ground-based and satellite-borne sophisticated instruments.
- A new coordinated program to understand further areas of solar variability on time scales of months to 10^4 years, including variations in solar radiation, magnetic fields and particles.

SOURCE: SAR 1-FY 78-81 July 1982
National Atmospheric Sciences Program
Fiscal Year 1978-81
Federal Coordinating Council
for Science, Engineering and
Technology

Astronomical, Atmospheric, Earth, and Ocean Sciences:

$373.5 million +13.1 percent

The programs of the AAEO Directorate also are slated for increases designed to provide for growth above inflation. The AAEO budget is up overall by 13.1 percent, with increases from 8.1 percent for the Arctic Research Program to 19.4 percent for the Astronomical Sciences. During the past five years the AAEO budget has increased in constant dollars by 24.2 percent, with both the Earth and Ocean Sciences receiving real increases of 36 percent over the period.

Biological, Behavioral, and Social Sciences:

$253.1 million +12.6 percent

All of the programs of the BBS Directorate receive increases greater than an inflationary adjustment. These increases are in a range from 8.2 percent for Information Science and Technology to 14.0 percent for Physiology, Cellular and Molecular Biology.

When examined in constant dollars for the past five years, quite another picture emerges. The Biology, Biotic Systems and Resources programs have grown by more than 17 percent since FY 1980.

Despite recent increases, however, the Social and Economic Sciences remain at a level nearly 50 percent below the FY 1980 level, measured in constant dollars. Clearly these programs have not recovered from the severe cuts imposed by the administration's first budget. This undoubtedly will generate continuing pressure from these fields for restorations to former levels either by add-ons or by congressionally mandated reallocations from the more favored disciplines. The Behavioral and Neural Sciences also remain almost 3 percent below the FY 1980 level in real terms, and the Information Science and Technology program is more than 14 percent below the FY 1980 level.

U.S. Antarctic Program:

$115.1 million +12.4 percent

A total increase of $12.6 million is requested. Of this

SOURCE: AAAS Report IX:
Research & Development
FY 1985
Intersociety Working Group

be carried out in such manner as he shall direct and by such agencies as he shall designate.

Sec. 32. Interim officers. (a) The President may authorize any person who immediately prior to the effective date of Part I of this reorganization plan holds a position in the Executive Office of the President to act as Director of the Office of Science and Technology until the office of Director is for the first time filled pursuant to the provisions of this reorganization plan or by recess appointment, as the case may be.

(b) The President may authorize any person who immediately prior to the effective date of section 22 of this reorganization plan holds any office existing under the provisions of the National Science Foundation Act of 1950 [this chapter] to act as Director of the National Science Foundation until the office of Director is for the first time filled pursuant to the provisions of this reorganization plan or by recess appointment, as the case may be.

(c) The President may authorize any person who serves in an acting capacity under the foregoing provisions of this section to receive the compensation attached to the office in respect of which he so serves. Such compensation, if authorized, shall be in lieu of, but not in addition to, other compensation from the United States to which such person may be entitled.

Library References

United States ⇨33 et seq. C.J.S. United States § 33.

§ 1862. Functions

Initiation and support of studies and programs; scholarships; current register of scientific and technical personnel

(a) The Foundation is authorized and directed--

(1) to initiate and support basic scientific research and programs to strengthen scientific research potential and science education programs at all levels in the mathematical, physical, medical, biological, engineering, social, and other sciences, by making contracts or other arrangements (including grants, loans, and other forms of assistance) to support such scientific and educational activities and to appraise the impact of research upon industrial development and upon the general welfare;

(2) to award, as provided in section 1869 of this title, scholarships and graduate fellowships in the mathematical, physical, medical, biological, engineering, social, and other sciences;

(3) to foster the interchange of scientific information among scientists in the United States and foreign countries;

(4) to foster and support the development and use of computer and other scientific methods and technologies, primarily for research and education in the sciences;

(5) to evaluate the status and needs of the various sciences as evidenced by programs, projects, and studies undertaken by agencies of the Federal Government, by individuals, and by public and private research groups, employing by grant or contract such consulting services as it may deem necessary for the purpose of such evaluations; and to take into consideration the results of such evaluations in correlating the research and educational programs undertaken or supported by the Foundation with programs, proj-

ects, and studies undertaken by agencies of the Federal G ment, by individuals, and by public and private research g

(6) to maintain a current register of scientific and t personnel, and in other ways to provide a central clearin for the collection, interpretation, and analysis of data availability of, and the current and projected need for, sc and technical resources in the United States, and to pro source of information for policy formulation by other agen the Federal Government; and

(7) to initiate and maintain a program for the determi of the total amount of money for scientific research, incl money allocated for the construction of the facilities wherein research is conducted, received by each educational institution appropriate nonprofit organization in the United States, by gr contract, or other arrangement from agencies of the Federal G ernment, and to report annually thereon to the President and Congress.

Contracts, grants, loans, etc., for scientific activities; financing of progra

(b) The Foundation is authorized to initiate and support spe scientific activities in connection with matters relating to internat al cooperation, national security, and the effects of scientific appl tions upon society by making contracts or other arrangements (incl ing grants, loans, and other forms of assistance) for the conduct such activities. When initiated or supported pursuant to reque made by any other Federal department or agency, including the Off of Technology Assessment, such activities shall be financed wh ever feasible from funds transferred to the Foundation by the re questing official as provided in section 1873(g) of this title, and s such activities shall be unclassified and shall be identified by t Foundation as being undertaken at the request of the appropriate offi cial.

Scientific research programs at academic and other nonprofit institutions; applied scientific research programs by Presidential directive; employment of consulting services; coordination of activities

(c) In addition to the authority contained in subsections (a) an (b) of this section, the Foundation is authorized to initiate and sup port scientific research, including applied research, at academic an other nonprofit institutions. When so directed by the President, th Foundation is further authorized to support, through other appropri ate organizations, applied scientific research relevant to national pro lems involving the public interest. In exercising the authority con tained in this subsection, the Foundation may employ by grant or con tract such consulting services as it deems necessary, and shall coordi nate and correlate its activities with respect to any such problem with other agencies of the Federal Government undertaking similar pro grams in that field.

Promotion of basic research and education in sciences

(d) The Board and the Director shall recommend and encourage the pursuit of national policies for the promotion of basic research and education in the sciences.

Balancing of research and educational activities in sciences

(e) In exercising the authority and discharging the functions referred to in the foregoing subsections, it shall be an objective of the Foundation to strengthen research and education in the sciences, including independent research by individuals, throughout the United States, and to avoid undue concentration of such research and education.

Annual report to President and Congress

(f) The Foundation shall render an annual report to the President for submission on or before the 15th day of April of each year to the Congress, summarizing the activities of the Foundation and making such recommendations as it may deem appropriate. Such report shall include information as to the acquisition and disposition by the Foundation of any patents and patent rights.

May 10, 1950, c. 171, § 3, 64 Stat. 149; July 11, 1958, Pub.L. 85–510, § 1, 72 Stat. 353; Sept. 8, 1959, Pub.L. 86–232, § 1, 73 Stat. 467; July 18, 1968, Pub.L. 90–407, § 1, 82 Stat. 360; Aug. 10, 1972, Pub.L. 92–372, § 8, 86 Stat. 528; Oct. 13, 1972, Pub.L. 92–484, § 10(b), 86 Stat. 802; Apr. 21, 1976, Pub.L. 94–273, § 11(3), 90 Stat. 378; Aug. 15, 1977, Pub.L. 95–99, § 14(a), 91 Stat. 835.

Historical Note

1977 Amendment. Subsec. (e). Pub.L. 95–99 substituted "an objective" for "one of the objectives".

1976 Amendment. Subsec. (f). Pub.L. 94–273 substituted "April" for "January".

1972 Amendments. Subsec. (a)(1). Pub.L. 92–372 added the support of science education programs at all levels to the functions of the Foundation and substituted "scientific and educational activities" for "scientific activities".

Subsec. (b). Pub.L. 92–484 added provisions authorizing the Foundation to initiate and support specific scientific activities in connection with matters relating to the effects of scientific applications upon society, and substituted provisions relating to the initiation or support pursuant to requests of activities by any other Federal department or agency, including the Office of Technology Assessment, for provisions relating to the initiation or support pursuant to requests of activities by the Secretary of State or Secretary of Defense.

1968 Amendment. Subsec. (a)(1). Pub.L. 90–407 redesignated former subsec. (a)(2) as (a)(1), and added social sciences to the enumerated list of sciences. Former subsec. (a)(1) redesignated (d).

Subsec. (a)(2). Pub.L. 90–407 redesignated former subsec. (a)(4) as (a)(2), and added social sciences to the enumerated list of sciences. Former subsec. (a)(2) redesignated (a)(1).

Subsec. (a)(3). Pub.L. 90–407 redesignated former subsec. (a)(5) as (a)(3). Former subsec. (a)(3) redesignated (b).

Subsec. (a)(4). Pub.L. 90–407 added subsec. (a)(4). Former subsec. (a)(4) redesignated (a)(2).

Subsec. (a)(5). Pub.L. 90–407 redesignated former subsec. (a)(6) as (a)(5), and provided for the employment of consulting services, by grant or contract, to assist in the evaluation of the status and needs of the various sciences as evidenced by the programs and studies undertaken by agencies of the government, by individuals, and by public and private re-

science Foundation as provided by such Act [this chapter], part II of Reorganization Plan Number 2 of 1962, and Reorganization Plan Numbered 5 of 1965 [set out in Appendix to Title 5]. From and after the date of the enactment of this Act [July 18, 1968], part II of Reorganization Plan Numbered 2 of 1962, and Reorganization Plan Numbered 5 of 1965, shall be of no force or effect; but nothing in this Act shall alter or affect any transfers of functions made by part I of such Reorganization Plan Numbered 2 of 1962."

Emergency Preparedness Functions. For assignment of certain emergency preparedness functions to the Director of the National Science Foundation, see Parts 1, 23, and 30 of Ex.Ord. No. 11490, Oct. 28, 1969, 34 F.R. 17567, set out as a note under section 2292 of the Appendix to Title 50, War and National Defense.

Investigation of Need for Geophysical Institute in Territory of Hawaii. Act Aug. 1, 1956, c. 865, 70 Stat. 922, directed the National Science Foundation to conduct an investigation into the need for and the feasibility and usefulness of a geophysical institute located in the Territory of Hawaii, and to report the results of its investigations, together with its recommendations based thereon, to the Congress not later than nine months after Aug. 1, 1956.

Legislative History. For legislative history and purpose of Act May 10, 1950, see 1950 U.S.Code Cong. Service, p. 2269. See, also, Pub.L. 85–510, 1958 U.S.Code Cong. and Adm.News, p. 3012; Pub.L. 86–232, 1959 U.S.Code Cong. and Adm. News, p. 2241; Pub.L. 90–407, 1968 U.S. Code Cong. and Adm.News, p. 2644; Pub.L. 92–484, 1972 U.S.Code Cong. and Adm.News, p. 3568; Pub.L. 94–273, 1976 U.S.Code Cong. and Adm.News, p. 690; Pub.L. 95–99, 1977 U.S.Code Cong. and Adm.News, p. 1580.

EXECUTIVE ORDER NO. 10521

Mar. 17, 1954, 19 F.R. 1499, as amended by Ex.Ord.No.10807, § 6(b), Mar. 13, 1959, 24 F.R. 1899

ADMINISTRATION OF SCIENTIFIC RESEARCH

Section 1. The National Science Foundation (hereinafter referred to as the "Foundation") shall from time to time recommend to the President policies for the promotion and support of basic research and education in the sciences, including policies with respect to furnishing guidance toward defining the responsibilities of the Federal Government in the conduct and support of basic scientific research.

Sec. 2. The Foundation shall continue to make comprehensive studies and recommendations regarding the Nation's scientific research effort and its resources for scientific activities, including facilities and scientific personnel, and its foreseeable scientific needs, with particular attention to the extent of the Federal Government's activities and the resulting effects upon trained scientific personnel. In making such studies, the Foundation shall make full use of existing sources of information and research facilities within the Federal Government.

Sec. 3. The Foundation, in concert with each Federal agency concerned, shall review the basic scientific research programs and activities of the Federal Government in order, among other purposes, to formulate methods for strengthening the administration of such programs and activities by the responsible agencies, and to study areas of basic research where gaps or undesirable overlapping of support may exist, and shall recommend to the heads of agencies concerning the support given to basic research.

Sec. 4. As now or hereafter authorized or permitted by law, the Foundation shall be increasingly responsible for providing support by the Federal Government for general-purpose basic research through contracts and grants. The conduct and support by other Federal agencies of basic research in areas which are closely related to their missions is recognized as important and desirable, especially in response to current national needs, and shall continue.

Sec. 5. The Foundation, in consultation with educational institutions, the heads of Federal agencies, and the Commissioner of Education of the Department of Health, Education, and Welfare, shall study the effects upon educational institutions of Federal policies and administration of contracts and grants for scientific research and development, and shall recommend policies and procedures which will promote the attainment of general national research objectives and realization of the research needs of Federal agencies while safeguarding the strength and independence of the Nation's institutions of learning.

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SOURCE: U.S. Code

Sec. 6. The head of each Federal agency engaged in scientific research shall make certain that effective executive, organizational, and fiscal practices exist to ensure (a) that the Foundation is consulted on policies concerning the support of basic research, (b) that approved scientific research programs conducted by the agency are reviewed continuously in order to preserve priorities in research efforts and to adjust programs to meet changing conditions without imposing unnecessary added burdens on budgetary and other resources, (c) that applied research and development shall be undertaken with sufficient consideration of the underlying basic research and such other factors as relative urgency, project costs, and availability of manpower and facilities, and (d) that, subject to considerations of security and applicable law, adequate dissemination shall be made within the Federal Government of reports on the nature and progress of research projects as an aid to the efficiency and economy of the overall Federal scientific research program.

Sec. 7. Federal agencies supporting or engaging in scientific research shall, with the assistance of the Foundation, cooperate in an effort to improve the methods of classification and reporting of scientific research projects and activities, subject to the requirements of security of information.

Sec. 8. To facilitate the efficient use of scientific research equipment and facilities held by Federal agencies:

(a) the head of each such agency engaged in scientific research shall, to the extent practicable, encourage and facilitate the sharing with other Federal agencies of major equipment and facilities; and

(b) a Federal agency shall procure new major equipment or facilities for scientific research purposes only after taking suitable steps to ascertain that the need cannot be met adequately from existing inventories or facilities of its own or of other agencies.

(c) the Interdepartmental Committee on Scientific Research and Development shall take necessary steps to ensure that each Federal agency engaged directly in scientific research is kept informed of selected major equipment and facilities which could serve the needs of more than one agency. Each Federal agency possessing such equipment and facilities shall maintain appropriate records to assist other agencies in arranging for their joint use or exchange.

Sec. 9. The heads of the respective Federal agencies shall make such reports concerning activities within the purview of this order as may be required by the President.

Sec. 10. The National Science Foundation shall provide leadership in the effective coordination of the scientific information activities of the Federal Government with a view to improving the availability and dissemination of scientific information. Federal agencies shall cooperate with and assist the National Science Foundation in the performance of this function, to the extent permitted by law.

EXECUTIVE ORDER NO. 10807

Ex.Ord.No.10807, Mar. 13, 1959, 24 F.R. 1897, as amended Ex.Ord.No.11381, Nov. 8, 1967, 32 F.R. 15629, which established the Federal Council for Science and Technology, provided for a chairman and membership, specified the functions of the Council, provided for assistance from other federal agencies and the establishment of standing committees and panels, revoked Ex.Ord.No.9912 of Dec. 24, 1947, entitled "Establishing the Interdepartmental Committee on Scientific Research and Development", and amended Ex.Ord.No.10521, set out as a note under this section, was omitted from the Code in view of Pub.L. 94-282, Title IV, § 402, May 11, 1976, 90 Stat. 472, set out as a note below, which abolished the Federal Council for Science and Technology.

Abolition of Federal Council for Science and Technology. Pub.L. 94-282, Title IV, § 402, May 11, 1976, 90 Stat. 472, provided that: "The Federal Council for Science and Technology established pursuant to Executive Order No. 10807, Mar. 13, 1959, 24 F.R. 1897, as amended by Executive Order No. 11381, Nov. 8, 1967, 32 F.R. 15629, is hereby abolished."

Functions as Not Limited. Section 6(c) of Ex.Ord.No.10807, formerly set out as a note under this section, provided that Ex.Ord.No.10521 should not limit functions of Federal Council for Science and Technology under Ex.Ord.No.10807, and that Ex.Ord.No.10807 should not limit functions of any agency or officer under Ex.Ord.No.10521.

Library References

United States ⇐41.

C.J.S. United States § 41.