

# UCAR

UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH

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Report for 1970

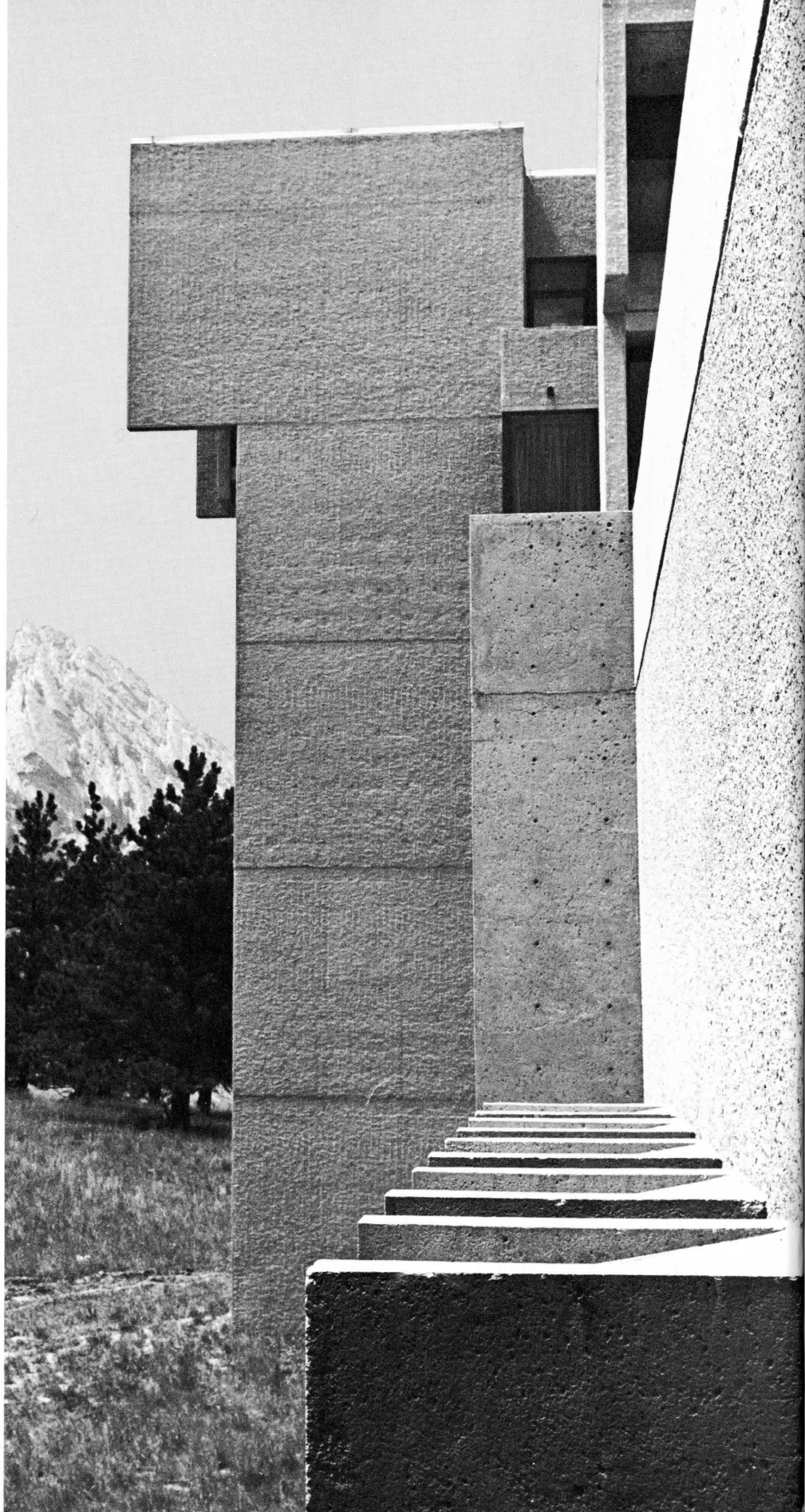


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# PRESIDENT'S REPORT

A decade has passed since a small group of representatives of the University Corporation for Atmospheric Research met with Alan T. Waterman, Director of the National Science Foundation, to sign the first contract for operation of the National Center for Atmospheric Research under UCAR management and NSF sponsorship. The Center's creation was one of several measures recommended by the scientific community to accelerate progress in the atmospheric sciences and to accord them a national priority commensurate with the contribution they could make to the solution of some of mankind's urgent problems. The founders and sponsor of NCAR believed that a powerful national atmospheric science laboratory would help stimulate and promote the kind of research the nation needed, reaching across the atmosphere from the surface of the earth to the surface of the sun — a broad, intellectually rigorous effort closely coupled to the universities, aimed at increasing man's knowledge of his atmospheric environment, his ability to predict its behavior, and his means of conserving its life-supporting qualities.

The founders' foresight has been verified. The Center and its governing corporation have exerted a strong influence toward strengthening the nation's effort in atmospheric research. Moreover, the nation and the world at large now strongly share their conviction that mankind's welfare depends greatly on his understanding of the atmosphere and his interactions with it, and on his ability to conserve this indispensable resource. The atmosphere now stands very properly at the center of the nation's concern for environmental protection. There is growing international concern as well. What happens to the air of one city, one state, one nation, matters significantly to every city, state, and nation.

Because of the increasing pressure for knowledge about the atmosphere, and because a decade of history provides a useful vantage point from which to view the future, 1970 has been selected by the Corporation as an appropriate time to make a new and thoughtful evaluation of its past and a projection of its goals for the coming decade.

The planning effort, which will require more than 12 months, is being carried out by the staffs of the Corporation and the Center under the guidance of the Corporation's Evaluation and Goals



A meeting of the UCAR Evaluation and Goals Committee in the Sydney and Katharine Chapman Room at the Mesa Laboratory of NCAR in Boulder.

Clockwise from left: W. O. Roberts, UCAR; R. L. Chasson, University of Denver; E. L. Wolff, UCAR; T. F. Malone, University of Connecticut; A. W. Straiton, University of Texas at Austin; K. B. Mather, University of Alaska; E. S. Epstein, University of Michigan (back to camera).

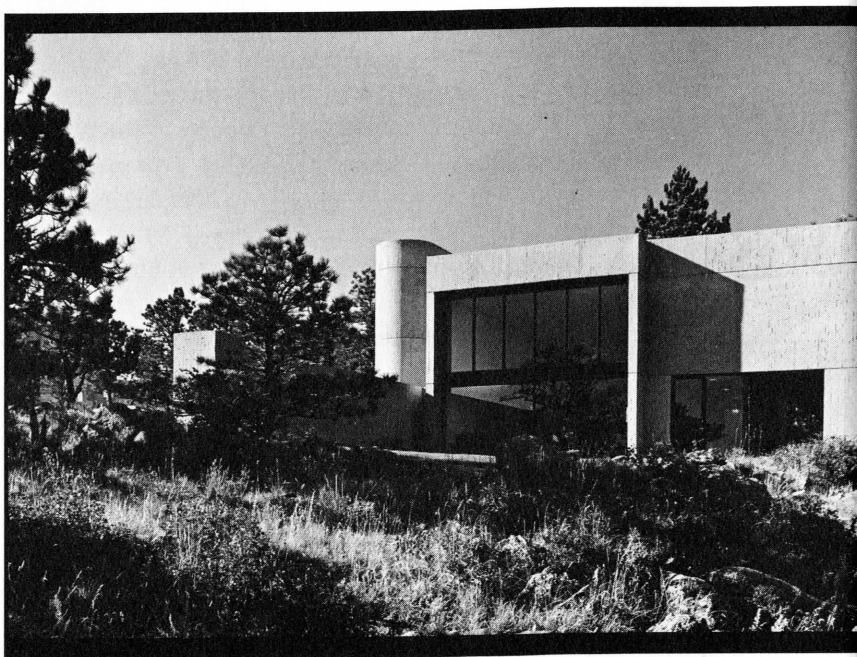


Committee, with review by the Members' Representatives and by the Board of Trustees. The resources for making such an evaluation are, of course, quite different from those available in the 1950s. The Corporation itself has grown from its original 14 member universities to its current membership of 27, and now represents a significant fraction of the atmospheric research effort within the academic community in the United States. The nation's atmospheric research effort, in the universities, in government, and elsewhere, is far stronger than it was a decade ago. Equally important, NCAR is a going concern with a staff of approximately 500 (of whom about 100 are at the Ph.D. level). The Center's current research program reflects the staff's judgments as to which atmospheric science problems deserve high priority in the coming decade; which problems are on the cutting edge of the science and can open up new and significant areas of research; and which problems promise, if they can be solved, information or techniques that will be most useful in attacking the world's economic or social problems.

Many important unanswered scientific questions will contend for priority attention by atmospheric scientists in the coming decade. Let me cite just a few examples. Are we headed for another ice age? Are the heat and pollution from man's enormous use of fossil fuels and other forms of energy changing the world's weather and climate? Will supersonic transport planes produce persistent ice clouds or photochemical hazes in the high atmosphere? How far in advance can long-range weather forecasts be extended before their accuracy unavoidably deteriorates? How do the sun's changing emanations influence the character of the earth's atmosphere in such a manner as to alter weather or climate? Is man-made atmospheric pollution progressing at such a rate that degradation of air quality is an inevitable consequence of material advancement of the peoples of the earth? What are the realistic prospects for attaining the economic and cultural growth the world's people so urgently demand without damaging the quality of the physical environment, and in particular, the air and weather? To what extent can we improve our ability to predict and modify extreme and dangerous weather events, such as hurricanes, hailstorms, blizzards, and heat waves?



A view of the Max C. Fleischmann Building from the east. The Fleischmann Building was constructed and furnished with private funds, contributed principally by the Max C. Fleischmann Foundation, the El Pomar Foundation, and by the Corporation itself. It is located at the north edge of the Mesa near the principal laboratory of the National Center for Atmospheric Research. The building houses a part of the activities of NCAR's Advanced Study Program and the offices of the Corporation president.



Not all of these questions — perhaps only a few of them — will be definitively answered by 1980. Nonetheless, there exist strong social imperatives for atmospheric scientists to make a maximum commitment to select and attack problems that are tractable and whose solutions offer the highest potential rewards. Those of us associated with the Corporation and the Center believe that the first decade has proven the value of the model they represent — an effective link between the research community and the national interest in atmospheric concerns. We sense a growing unity and uniqueness that derives from the strengths of the Corporation, with its close bonds with the academic community, joined to a national laboratory pursuing priority national research objectives. Bringing this union to its full potential is our most important motivation for the future.

In the following pages I am pleased to present Director John W. Firor's brief summary of the Center's research highlights for the past year, and also to present a corporate financial summary and audit report for the fiscal year ended 30 June 1970.

Walter Orr Roberts  
President  
University Corporation for  
Atmospheric Research



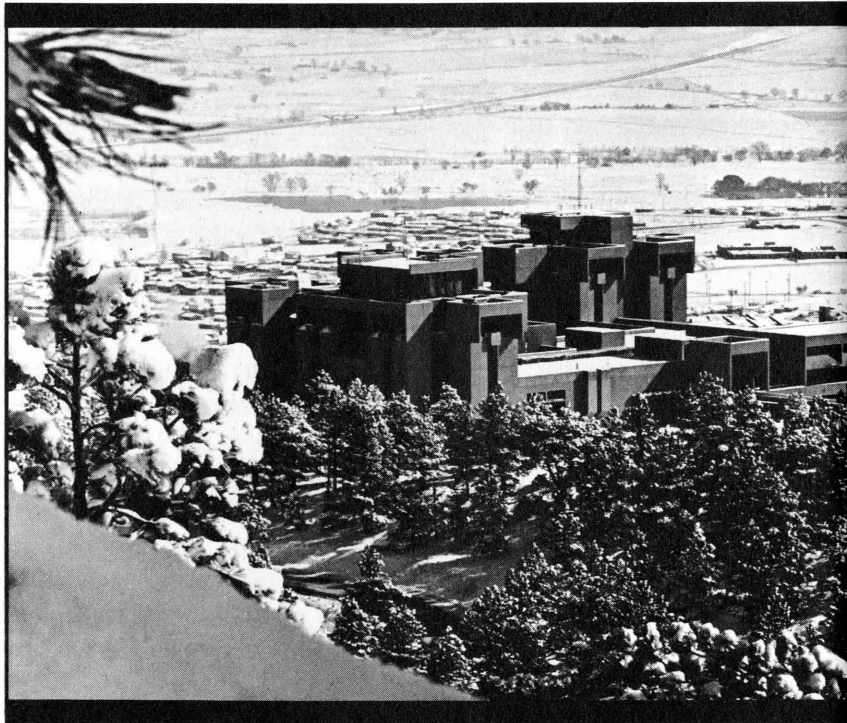
THE NATIONAL CENTER  
FOR  
ATMOSPHERIC RESEARCH

In pursuit of the goals described by Dr. Roberts in the preceding section, NCAR is continuing to strengthen its broad range of research programs on the atmospheres of the earth and the sun, to develop new observational techniques, and to maintain close cooperation and communication with university and government scientists. During the past year NCAR research scientists conducted investigations encompassing virtually the whole range of the atmospheric sciences, and the Facilities Laboratory continued to provide aircraft, ballooning, computing, and field support services to the scientific community.

The breadth of NCAR's research activities allows the combining of diverse talents in attacks on complex atmospheric problems. During the past year much effort was devoted to field research and to the development of measuring systems capable of dealing with the atmosphere through the full scale of dimensions on which its processes occur. A growing ability to carry out operations involving complex measurements over large areas will enable NCAR to strengthen this trend in atmospheric science and to apply some of its disciplines to the critical environmental problems now facing society.

In October 1969 approximately 300 scientists gathered in Boulder to discuss proposed United States participation in the Global Atmospheric Research Program (GARP). GARP was proposed in 1967 by the International Council of Scientific Unions and the World Meteorological Organization to attain "economically-useful long-range weather prediction" as the "next step in man's effort to predict the weather and eventually modify it for his own uses." During the middle and late 1970s large field programs uniting the research contributions of many nations will be carried out to acquire sufficient global data to test the adequacy and utility of numerical weather prediction methods.

NCAR has been closely involved in GARP preparations since the program was conceived, and has hosted several planning meetings. Individual members of the NCAR staff have worked on the proposed U.S. plan for participation and served on national committees for reviewing the plan. NCAR programs directed to the development of specific measurement techniques to make global observations possible, and of numerical models to make such measurements useful, are a vital part both of NCAR's long-range research objectives and of its contribution to GARP.



The October meeting was the final U.S. step toward an international conference on GARP in Brussels in March 1970. Delegates to that meeting agreed that the time had come to work cooperatively for a major global experiment on the general circulation of the atmosphere. The questions of whether such an effort would be possible, timely, and justified were decisively resolved; the international scientific community was ready to push ahead.

The Boulder and Brussels meetings were milestones in the overall GARP effort. They were also important to NCAR: they indicated how NCAR could provide a link between individual scientific efforts in the university community and those of government and nongovernment groups throughout the world. While continuing its strong efforts in technique development, numerical modeling, and investigations of tropical processes, NCAR will explore new means to assist individual scientists in working effectively in the framework of a complex international enterprise, and in undertaking field work in remote locations.

The following passages describe briefly some highlights of NCAR's work during the past year. Scientific activities are reported more fully in the **Annual Report, NCAR Research and Facilities Programs**, issued in May 1970.



A frame from a motion picture presentation of the 6-layer NCAR General Circulation Model shows sea-level pressure distribution (in 5-millibar intervals) and large areas of cloudiness. The bright zone south of the Equator is a region of intense convection which extends from South America to Africa; this zone is referred to as the Intertropical Convergence Zone. The cloud patterns on the eastern side of low pressure regions in middle latitudes are associated with warm front precipitation zones.



## GLOBAL MODELING

Mathematical expression of the laws governing weather, which allows numerical modeling of weather processes on high speed computers, is one of the important achievements of twentieth century meteorology. Development of a General Circulation Model (GCM) of the atmosphere has progressed steadily for several years at NCAR and has resulted in increasing realism in the portrayal of weather processes. In recent work a new method has been formulated for treating the effects of mountain ranges on large-scale flow patterns and has improved the diagnosis of high and low pressure areas. Expansion of the GCM to include six vertical atmospheric layers has allowed closer study of motions in the lower stratosphere, and has improved the simulation of motions in the troposphere by depicting, for example, the separation of the westerly and polar jet streams. The model is used with observational data for studying short-term weather processes, and for exploring special problems such as the influence of southern hemisphere meteorological data on weather predictability in the northern hemisphere.

NCAR scientists are also modeling oceanic circulation patterns in preparation for developing a combined atmosphere-ocean model applicable to studies of climate change. Such a model is necessary, since the air and oceans function as an integrated system despite large differences in their motions and time scales. NCAR ocean models now include the main features of the North and South Pacific ocean flow, the Antarctic circum-polar current, and the effects of ocean bottom topography.

Simulations of summer and winter climate have revealed that mean climatological data provide insufficient detail about ocean surface temperatures. Consequently, analysis of wider data sources for all months of the year has been started as a means of improving the simulation of seasonal changes.

Rising air motions in the tropics generate convective cloud systems that are often organized into long squall systems through the influence of larger scale processes. The large cloud clusters seen in the center and lower right areas of this satellite view of the Caribbean Sea are associated with the Intertropical Convergence Zone, where tropical trade winds from the northern and southern hemispheres meet.



## TROPICAL CONVECTION

Convection, the vertical rising of air currents, is a particularly important element of tropical weather because it both influences and is influenced by processes with larger dimensions. Squall systems, often extending in lines several hundred kilometers long, are familiar evidence of this mutual influence. The tropics often develop massive downdraft systems which bring cool, dry air to lower levels and cause sharp contrasts in temperature and dew point. Warm updrafts in turn increase the rate at which heat and water vapor are transferred from the sea to the air. NCAR studies of tropical disturbances, using data from satellite and conventional measuring networks, have shown that the water and energy budgets of updraft and downdraft cycles closely resemble those of a Midwest squall line about 300 kilometers in length. Investigation of this similarity will reveal important details about the transfer of energy through deep layers of the tropical atmosphere. Processes in the tropics are a key to much of the global weather but have not been adequately studied since most of the tropics lie in remote ocean regions. Midwest squall systems are more accessible for study, and have long been a subject of close meteorological scrutiny.



A new airborne turbulence measuring system is mounted on a nose boom installed on NCAR's Buffalo aircraft. The base of the boom contains an inertially stabilized reference platform which precisely determines motions of the aircraft from the moment of takeoff. The system is the most accurate of its kind and will be an asset to a variety of studies on the motions and transfers of energy in the atmosphere.

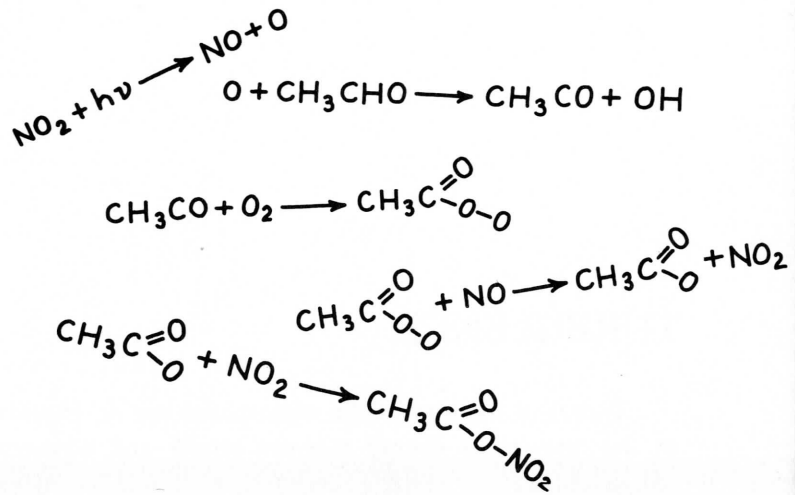


## TURBULENCE

Turbulent motions in the atmosphere are an important link in the transfer of energy between small- and large-scale processes, but remain poorly understood and inadequately observed. Accurate measurement of turbulent motions whose wavelengths are larger than 1 or 2 kilometers was first made possible by an airborne system developed jointly by NCAR and the University of Nevada Desert Research Institute. Installed on NCAR's Buffalo aircraft, the system is designed to measure air velocity to an accuracy of 10 centimeters per second. External sensors, mounted on a long nose boom, measure angles between the airstream and the aircraft as well as true airspeed and temperature; coupled to the sensors is an inertially stabilized reference platform which continuously measures the velocity and orientation of the aircraft. This unique combination of instruments will serve as a prototype of aircraft instrumentation to be used in GARP studies of clear air turbulence and of the organization of tropical disturbances. The system has already been used in two NCAR research programs.

Theoretical studies of turbulence have shown that in some important respects the large-scale atmosphere behaves like a two-dimensional rather than a three-dimensional fluid. Two-dimensional turbulence theory therefore allows simpler but no less rigorous exploration of many of the atmosphere's characteristics. One of its important applications has been the investigation of how errors grow in predictions of the flow field, a topic crucial to assessing the general limits on long-term atmospheric predictability.

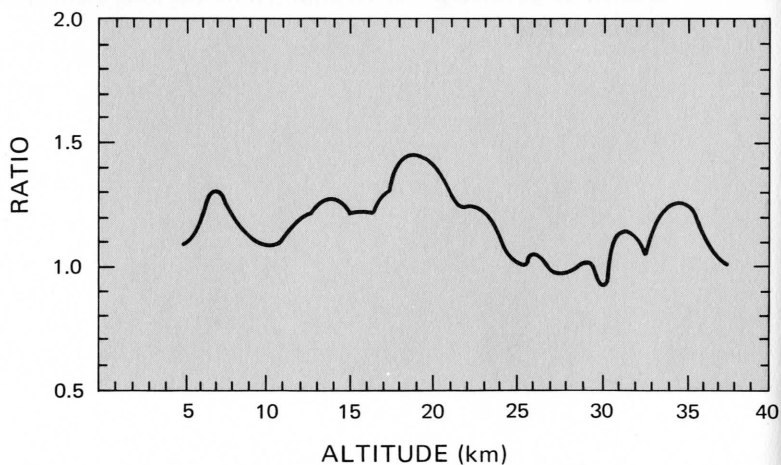
NCAR chemists are presently studying the formation of peroxyacetyl nitrate (PAN), a product of photochemical smog generation that is highly toxic to plants and animals and is probably the most potent of all pollutants. This sequence of reactions may represent the most direct formation of PAN, and has been successfully reproduced in the NCAR laboratories.



The NCAR lidar, or optical radar, detects atmospheric particle layers by transmitting intense pulses of laser light vertically upward and collecting the small portion of backscattered light in an optical receiver. In a cooperative study with the Sandia Corporation and the Douglas Advanced Research Laboratory, carried out at Sandia, the NCAR and Sandia lidars were positioned to receive returned signals from the same laser pulse transmissions; structures observed by one lidar system were verified by the other system.



A plot of the ratio of the backscattered laser intensity to the theoretical intensity received from a purely molecular atmosphere shows peaks corresponding to atmospheric particle layers. Measurements made in the summer of 1969 showed that the sulfate layer at about 20 kilometers varies slightly in altitude, thickness, and concentration. Later measurements have shown a reduction in the layer's scattering intensity, indicating that its concentration has recently decreased. The layer indicated by a peak at about 36 kilometers has been postulated to be responsible for the blue and white bands photographed by astronauts. Its intensity has also decreased within the last year.



## ATMOSPHERIC CHEMISTRY

Much of NCAR's research in atmospheric chemistry centers on the study of natural trace constituents and man-made contaminants and on their direct or indirect relation to problems of pollution, from the local to the global scale. Laboratory investigations were carried out to learn how chemical reactions among atomic oxygen, sulfur dioxide, carbon dioxide, the oxides of nitrogen, and organic vapors contribute to the development of photochemical smog. Aldehydes, one class of organic vapors, are known to initiate smog-forming reactions. However, the probability that the process begins through reaction with atomic oxygen was found to be unlikely because the reaction proceeds too slowly. Laboratory tests showed that electronic excitation of aldehydes by sunlight may be of greater importance. If this is the case, reduction of nitrogen oxide emissions, from which atomic oxygen is produced, will probably not suppress the smog-forming action of aldehydes. Instead, aldehyde emissions must themselves be controlled.

In addition to collecting and analyzing air samples over several continental and maritime regions, NCAR chemists completed a detailed study of the chemistry of trace constituents in moist tropical air. A primary objective of the study, carried out in Panama, was to determine the amounts and variability of constituents in the atmospheric nitrogen and sulfur cycles, and their correlation with meteorological conditions. Cooperation with the Brazilian government led to a new study in which the Panamanian findings are being checked at a tropical site farther inland.

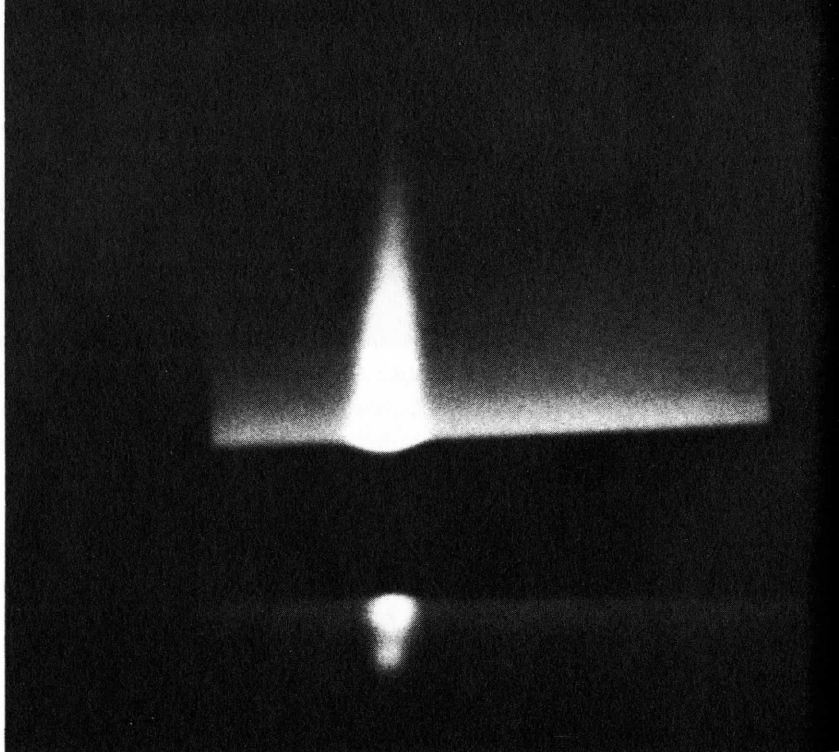
Ground-based laser equipment and aircraft sampling devices were used to study a layer of particles, thought to consist of sulfate compounds, which lies above most of the earth at about 18 kilometers. Airborne sampling verified that most particles do consist of sulfate; it also showed that most of the solid and liquid particles are formed in the stratosphere by oxidation of sulfur dioxide gas. Fallout of extraterrestrial particles and elevation of volcanic ash were shown to be unlikely sources; however, the association of volcanic activity with the sulfate layer remains a likely possibility, since volcanoes emit large quantities of sulfur dioxide gas.



The High Altitude Observatory's eclipse site was located about 90 miles south of Oaxaca, Mexico, at an altitude of 8,800 feet. The expedition spent several weeks at the site making final adjustments to the instruments and rehearsing eclipse procedures. Over a dozen international teams of scientists journeyed to Mexico to observe the eclipse, which provided one of the best observing opportunities in recent years.



One of the eclipse experiments recorded the light emitted by two highly ionized forms of iron in the solar corona to determine the distribution of temperature in vertical profiles at various positions around the sun. The widths of these lines of red light (below) and green light (above) were measured to derive the temperature data: the wider the line, the hotter the corona. The photographs were overexposed near the solar limb to bring out detail far from the limb where the corona declines steeply in brightness.



## SOLAR ECLIPSE

A cloudless and unusually dark sky enabled five teams of High Altitude Observatory investigators to obtain excellent observations of the 7 March 1970 total eclipse from a mountain field site in southern Mexico. Although fixed observatories can observe many of the sun's processes throughout the year, eclipses remain vital to progress in solar research. HAO engineers spent over a year preparing the special instruments for experiments which examined the fine structure of prominences and spicules and the mechanisms by which they condense from the solar corona; the magnitude and direction of coronal magnetic fields and their role in determining coronal structure; temperature distributions, transient wave phenomena, polarization of major emission lines, and excitation of ions in the corona; and the infrared spectrum of the thermal corona, composed of small particles of interplanetary dust. Most of these topics can be studied only during an eclipse when the bright glare of the solar disk is masked and the earth's atmosphere is darkened by the moon's shadow.

MECHANICAL ENERGY PROPAGATION  
IN THE SUN

One of the central mysteries in solar research is how the sun's atmosphere, or corona, is heated to temperatures of nearly two million degrees Kelvin, while the sun's surface does not exceed about 6,000 degrees. One explanation for coronal heating is that mechanical energy flows outward from the sun's surface and is converted to heat energy. Apparent evidence of the propagation of mechanical energy through the lower layers of the sun's atmosphere has been observed in the form of oscillating cells. Much research has been directed to determining the exact nature of such cells, or moving waves, by studying their velocities and structural features. However, density variations in the layers through which the waves move seriously complicate measurement and interpretation of the velocities. Theoretical studies at HAO have shown that the actual velocities could be either much larger or smaller than the purported "measured" velocities. Standard measurements can, in fact, be so ambiguous that effects attributed to upward moving matter could just as well be attributed to downward moving matter. Defining the limitations of present techniques for measuring large-scale motions in the solar atmosphere will enable HAO investigators to specify new directions for acquiring reliable data.



## FACILITIES OPERATIONS

The Research Aviation Facility provided over 600 hours of research flight support to NCAR and university programs throughout North America and over surrounding ocean areas. In September 1969 NCAR's twin-jet Sabreliner aircraft provided major support to Colorado State University's Venezuela International Meteorological and Hydrological Experiment (VIMHEX) and demonstrated its utility for programs outside the continental U.S. The facility continued to improve its aircraft for research use, installed and tested turbulence sensors and an inertial reference system on the Buffalo aircraft, and conducted training programs to acquaint students with airborne research techniques.

The Scientific Balloon Facility continued to provide balloon flights for the scientific community and to improve its facilities at the Palestine, Texas, launch site. A total of 80 flights was launched, and theoretical and experimental studies of balloon design, flight dynamics, and inflation and deployment systems were continued.

The Computing Facility completed its fourth year using the Control Data 6600 computer, and processed an average of 11,000 jobs monthly. The facility published the first of four atlas volumes on the climatology of the southern hemisphere, and added to its computer-assembled set of microfilm analyses and grids. A 26-minute, computer-generated film derived from the atlas was made available for purchase or loan. Liaison continued with the University of Illinois, where the ILLIAC IV computer, whose potential is 20 times greater than that of any existing computer, is being developed. Facility staff completed the expansion of the ILLIAC IV benchmark code, achieving a saving of 50 percent in storage requirements and 40 percent in execution time. When ready for service, the ILLIAC IV will greatly increase the versatility of the NCAR General Circulation Model.

The Field Observing Facility supported numerous field programs during the year; the largest of these were HAO's eclipse expedition to Mexico in March 1970, and Colorado State University's VIMHEX field operation in Venezuela from May to



The Scientific Balloon Facility has developed an in-flight deployment system to permit launching of large delicate balloons in a small area with minimal risk of damage through handling and gustiness of surface winds. A tow balloon (seen in the photograph) is inflated with enough gas to lift the main balloon and its payload. Once the system is airborne and drifting with the wind, the main balloon is pulled from its protective cradle, then filled with helium gas forced from the tow balloon by its expansion at increasing altitudes. The cradle (seen below the tow balloon in the photograph) is then jettisoned.

October 1969. Both involved diplomatic assistance, logistics support, and field management. The facility continued to expand its ability to support large field expeditions in anticipation of the importance of this function in the international programs of GARP.

The staff of the Global Atmospheric Measurements Program (GAMP) continued testing constant-level balloons at its Christchurch, New Zealand, flight station. These balloons are equipped with lightweight instruments and radio transmitters, and are designed to drift with the wind at fixed altitudes in order to trace southern hemisphere circulation patterns. The 1969 tests showed that constant-level balloons are capable of flying for longer than 6 months in the stratosphere above 100 millibars (53,000 feet). At 200 millibars (40,000 feet) balloons survive for an average period of 5 months in temperate latitudes but for shorter periods over the tropics. At lower levels the problems of ice and frost accumulation cannot be solved without the addition of complex mechanisms that might endanger aircraft. At Ascension Island in the equatorial Atlantic nine constant-level balloons were flown in preparation for testing a satellite interrogation system designed to determine the locations of drifting balloons. These flights revealed that ultraviolet radiation can degrade the balloon film or sealing tapes, and thus limit flight durations. In recent work the GAMP staff has also developed several new balloon-borne sensors and radio transmitting devices.

## EDUCATIONAL ACTIVITIES

NCAR continues its efforts to attract students into graduate study in atmospheric science and to involve visiting scientists in its research activities. Predoctoral and postdoctoral fellowships are offered to scientists from the U.S. and abroad, and several NCAR scientists serve as affiliate or adjoint professors in university research and teaching. The Research Aviation and Computing Facilities hold work-study programs to teach students practical research skills. Each summer the Advanced Study Program sponsors a colloquium to explore a topic identified as crucial to the advancement of the atmospheric sciences. The topic for 1970 is microphysics and dynamics of convective clouds. Frequent lectures, seminars, and informal discussions throughout the year attract invited participants, graduate students, resident scientists, and visitors.

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# NCAR Senior Management Staff

John W. Firor  
Director

William W. Kellogg  
Associate Director and  
Director, Laboratory of Atmospheric Science

Gordon A. Newkirk, Jr.  
Associate Director and  
Director, High Altitude Observatory

Daniel F. Rex  
Associate Director and  
Director, Facilities Laboratory

Philip D. Thompson  
Associate Director and  
Director, Advanced Study Program

Fred W. Roecker  
Assistant Director for Administration

# Corporate Financial Summary

## Fiscal Year 1970

UCAR contracts for Fiscal Year 1970 totaled approximately \$16 million. This amount included a \$140,000 corporate management fee from the National Science Foundation for services rendered by UCAR in management of NCAR. Funding from NSF through Contract NSF-C460 for maintenance and operation of NCAR totaled approximately \$12.6 million.

Additional funds totaling \$3,326,000 were received in Fiscal Year 1970 from contracts with NASA, the Air Force, the Army, the Navy, and Colorado State University. The High Altitude Observatory received approximately \$2,560,000 from NASA to continue design and construction of a white light coronagraph to be flown aboard an Apollo spacecraft in 1972. The Scientific Balloon Facility received approximately \$160,000 from NASA to support NASA-sponsored balloon flights, primarily from NCAR's Balloon Flight Station at Palestine, Texas. Additional funds totaling \$606,000 were received from NASA, the Army, the Air Force, the Navy, and Colorado State University, for specific research projects with definite termination dates, in the Laboratory of Atmospheric Science, the High Altitude Observatory, and the Facilities Laboratory.

At 30 June 1970, UCAR had unfilled purchase order and contract commitments of approximately \$1,964,000 and annual lease commitments on various facilities for the year ending 30 June 1971, of approximately \$97,000. On 30 June 1970, the Corporation entered into an agreement with a major computer manufacturer for scientific computer services. The agreement provides for annual payments of approximately \$3,286,000 to the manufacturer. All such payments are to be funded under the prime contract with the National Science Foundation (NSF-C460).

NCAR has a contingent liability not reflected in the foregoing financial statements of approximately \$631,000 at 30 June 1970, for employee vacations earned but not taken which would be satisfied in event of termination of the NSF contract for the

convenience of the Government. At 30 June 1970, \$36,000 of the Corporation's fund balance has been restricted for a contingent liability pursuant to a deferred compensation contract with a corporate officer.

Property is recorded at cost except for property acquired from United States Government excess, donations, and grants, which is recorded at an appraised value of \$4,746,622 on 30 June 1970. Title to \$23,067,602 of UCAR property is vested in the NSF and other government agencies, with the balance owned outright by the Corporation. In accordance with practices generally followed by organizations similar to UCAR, no provision has been made for depreciation of property.

As of 30 June 1970, the number of regular staff members employed by UCAR in the operation of NCAR was 522. Of this number 228 were scientists, engineers, and professional staff; 180 technical and maintenance staff; and 114 administrative, secretarial, and clerical staff.

During 1970 the Corporation developed an Affirmative Action Plan to analyze employment opportunities at NCAR for members of minority groups. The analysis has resulted in a plan for improving the flow of applicants and for initiating specific programs for the upgrading of present employees.

UCAR's balance sheet as of 30 June 1970, and a statement of revenues and expenditures for fiscal 1970, are included at the end of this section.



# University Corporation for Atmospheric Research

Balance Sheet  
30 June 1970 and 1969

	<b>ASSETS</b>	
	<b>1970</b>	<b>1969</b>
<b>Current Fund</b>		
Cash (includes \$15,202 in 1970 and \$131,056 in 1969 in interest-bearing deposits) .....	\$ 90,097	\$ 183,620
U.S. Government securities .....	244,615	210,310
Receivables .....	2,559,055	2,263,651
Prepaid expenses .....	214,554	217,687
Total Current Fund ....	3,108,321	2,875,268
<b>Plant Fund — Property, Plant, and Equipment</b>		
Plant .....	8,747,085	8,454,660
Equipment .....	15,283,906	14,370,355
Construction in progress .....	93,423	345,382
Total Plant Fund .....	24,124,414	23,170,397
TOTAL .....	\$27,232,735	\$26,045,665

## LIABILITIES AND FUND BALANCES

<b>Current Fund</b>		
Accounts payable and accrued expenses .....	\$ 507,076	\$ 602,282
<b>Balance</b>		
National Science Foundation other government contracts and grants (restricted) .....	2,311,128	1,927,011
Corporate (1970, \$36,000 restricted) .....	290,117	345,975
Total balance .....	2,601,245	2,272,986
Total Current Fund ....	3,108,321	2,875,268
<b>Plant Fund Balance</b> .....	24,124,414	23,170,397
TOTAL .....	\$27,232,735	\$26,045,665

# University Corporation for Atmospheric Research

Revenues and Expenditures  
and Changes in Current Fund Balance  
for the Years Ended 30 June 1970 and 1969

	<u>1970</u>	<u>1969</u>
<b>Revenues from Contracts, Grants and Gifts</b> .....	\$15,997,910	\$15,400,465
<b>Expenditures</b>		
Operating		
Salaries and wages.....	6,504,099	6,187,715
Employee benefits .....	793,637	727,264
Materials and supplies .....	1,756,248	1,740,288
Services .....	4,548,303	4,417,149
Travel .....	409,668	400,772
Other .....	245,028	179,341
TOTAL .....	<u>14,256,983</u>	<u>13,652,529</u>
Property .....	1,412,668	2,287,838
TOTAL .....	<u>15,669,651</u>	<u>15,940,367</u>
Revenues over (under) expenditures .....	328,259	(539,902)
<b>Current Fund Balance, Beginning of Year</b> .....	2,272,986	2,812,888
<b>Current Fund Balance, End of Year</b> .....	<u>\$ 2,601,245</u>	<u>\$ 2,272,986</u>

Changes in Plant Fund Balance  
for the Years Ended 30 June 1970 and 1969

	<u>1970</u>	<u>1969</u>
<b>Fund Balance, Beginning of Year</b> .....	\$23,170,397	\$21,069,207
<b>Acquisitions</b> .....	1,558,008	2,882,225
<b>Disposals</b> .....	(603,991)	(781,035)
<b>Fund Balance, End of Year</b> .....	<u>\$24,124,414</u>	<u>\$23,170,397</u>

**HASKINS & SELLS**

CERTIFIED PUBLIC ACCOUNTANTS

621 SEVENTEENTH STREET  
DENVER 80202

**ACCOUNTANTS' OPINION**

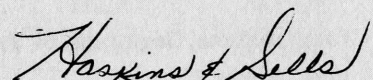
Board of Trustees,  
University Corporation for Atmospheric Research:

We have examined the balance sheet of the University Corporation for Atmospheric Research as of June 30, 1970, the related statements of revenues, expenditures, and changes in current fund balance, and of changes in plant fund balance for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying financial statements present fairly the financial position of the University Corporation for Atmospheric Research at June 30, 1970 and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

August 14, 1970

Yours truly,

A handwritten signature in cursive script that reads "Haskins & Sells".