

JULE GREGORY CHARNEY
MC 184 BOX 14, F. 456

RAND CORPORATION, 1956-1965

The **RAND** *Corporation*

1700 MAIN ST. • SANTA MONICA • CALIFORNIA 90406

RAND Corp.

3 December 1965

L-24104

Dr. Jule G. Charney
Meteorology Department
Massachusetts Institute of Technology
Cambridge, Massachusetts

Dear Jule:

Yale Mintz intended to discuss with you a small symposium we are planning on the Arctic Heat Budget and Atmospheric Circulation - but the subject got lost during his recent visit.

I am enclosing details about the symposium and we would be very glad if you could attend. Your insight into atmospheric behavior would add much to the discussion. If you would care to give a paper - so much the better. We do expect to have a stimulating give and take. Although names of Soviet participants are still uncertain, we do expect Soviet participation.

The meeting is one of the steps in preparation for a series of experiments we have proposed to gain insight into the meteorology of the ice ages. We will use the Mintz-Arakawa model with presence and absence of pack ice and continental glaciers. I believe you have already seen our proposal to use the NCAR computer for these experiments.

We do hope you can join us.

Sincerely yours,

Joseph O. Fletcher
Department of Geophysics and Astronomy

JOF:cs
Encls. (2) - As Above

Tentative Program as of 23 November 1965

Monday, January 31, 1966 - Relation of the Arctic Heat Budget to Global Climate

The first day will be devoted to a general discussion of possible relationships between the Arctic heat budget and climate, with the aim of stimulating discussion and establishing perspective for later sessions. Emphasis will be on stating crucial questions.

- (Soviet Participant) (USSR) The Polar Ice and Climate
- R. A. Bryson (US) Observed Climatic Changes and Ice Extent
- W. L. Donn (US) The Causes of the Ice Ages
- (Soviet Participant) (USSR) Atmospheric Circulation types and Anomalies in the Arctic Heat Budget
- J. O. Fletcher (US) The Arctic Heat Budget and Atmospheric Circulation
- W. Munk (US) The Formation of Bottom Water and its Climatic Implications

Tuesday, February 1, 1966 - The Climatic Experiments

The second day will be devoted to discussion of the design and use of numerical models of atmospheric and oceanic circulation, with emphasis on the formulation of specific climatic experiments and on ways of parameterizing diabatic heating.

- Y. Mintz (US) Numerical General Circulation Experiments
- G. Leith (US) Experiments with the Livermore Model
- A. Arakawa (US) Modeling the Surface Boundary Layer
- R. Popham (US) Satellite Observations in the Arctic
- (?) (S) Prospects for Modeling Oceanic Circulation
- J. Businger (US) Transfer of Momentum and Energy in the Planetary Boundary Layer

Wednesday, February 2, 1966 - Components of the Arctic Heat Budget

The third day will be devoted to a quantitative description of each component of the heat budget of the atmosphere in the Arctic, including seasonal and year-to-year variations.

- Soviet Participant (USSR) The Heat Budget of the Arctic Atmosphere
- Soviet Participant (USSR) Heat Exchange at the Surface in the Arctic
- N. Untersteiner (US) Thermal Regime of Pack Ice
- S. Orvig (Canada) McGill Studies of the Arctic Heat Budget
- F. Badgley (US) University of Washington Studies of the Arctic Heat Budget
- W. Wittman (US) Ice Budget
- M. R. Bloch (Israel) Volcanism and Albedo of Polar Areas

Thursday, February 3, 1966 - Ocean-Atmosphere Interaction

The fourth day will be devoted to a discussion of oceanic processes, including the heat and mass budget of floating ice, and their interaction with the atmosphere.

J. Bjerknes (US) Ocean-Atmosphere Interaction and Climate Change
S. Orvig (Canada) Possible Changes in the Radiation Budget
(Soviet Participant) (USSR) Interaction of Arctic Water Masses
J. Mitchell (US) Climatic Change and Long-Term Feedback of Oceanic Heat
L. K. Coachman (US) Water Masses of the Arctic
Erik Palmen (Finland) Meridional Heat Advection
Jack J. Schule (US) The Dynamics of the Arctic Ocean Circulation

Friday, February 4, 1966 - Needs and Plans for Future Research on the Arctic Heat Budget

The fifth day will consist of a summation of the findings of the symposium with regard to:

- a. Needed research on the Arctic heat budget.
- b. The formulation of crucial experiments on the interaction between Arctic heat processes and atmospheric circulation.
- c. Current plans for future research.

Soviet Participant (USSR) Arctic and Antarctic Scientific Research Institute
T. O. Jones (US) Head, Antarctic Programs, NSF
A. C. Crary (US) Chief Scientist, Antarctic Programs, NSF
T. Gjelsvik (Norway) Director, Norsk Polarinstitut
M. Rubin (US) ESSA
T. Harwood (Canada) Chief, Geophysics Div., Canadian Defense Research Board
J. C. Reed (US) Director, Arctic Institute of North America
H. W. Wells (US) National Academy of Sciences
W. Nordberg (US) National Aeronautics and Space Administration
L. Quam (US) Office of Naval Research
W. Lyon (US) Naval Electronics Laboratory

WORKING GROUPS

To make clear and explicit the consensus of the conference regarding needs for future investigations, a number of working groups will be formed. Each group will be asked to consider the present state of knowledge regarding a specific subject and to identify those investigations most urgently needed.

The groups will be designated on Monday and their conclusions reported to the symposium on Thursday and Friday. A tentative list of subject areas and possible participants might be as follows:

1. Summary of the main issues concerning climatic change and possible ways of resolving them. (The meteorological factors for various theories possible ways of modeling crucial conditions--crucial paleoclimatic evidence). Bjerknes, Budyko, Donn, Bryson, Arakwa, Leith, Mintz.
2. Atmospheric advection of heat and moisture. (Calculations for present conditions - crucial questions to examine by model experiments). Palmen, Rubin, Orvig, Mitchell.
3. Radiation climate and cloud conditions in the Arctic (Solar radiations; absorption in clouds, in atmosphere, at surface). (Long-wave radiation: surface temperature, cloud factors, emissivity of clouds and surface). Badgley, Nordberg, Dolgin, Popham, Wells.
4. Turbulent Heat exchange and evaporation (present uncertainties, needed measurements). Businger, Lyon, Harwood, Quam
5. Oceanic heat, water and ice exchange (heat and water exchange between oceans, density structure, dynamics). Mosby, Munk, Coachman, Schule, Gjelsvik, Jones
6. Heat and mass budget of the pack ice (water/ice ratios, ice export, ice production). Untersteiner, Wittman, Crary, Reed, Bloch.

Administrative Arrangements

10 October 1965

Symposium on the Arctic Heat Budget
And Atmospheric Circulation

Where: University of California Conference Center
Lake Arrowhead, California
(See attached folder, detailed provisions for
transportation to the site will be announced later)

When: January 30, 1966 to February 4, 1966

Purpose

The symposium is being organized to provide an opportunity for invited experts to exchange views on the interaction between the heat budget in the Arctic and circulation of the atmosphere. Recent progress in the dynamic theory of climate and in the development of numerical models of atmospheric circulation is opening up new possibilities for the experimental investigation of the influence of diabatic heating patterns on the planetary atmospheric circulation. Also, progress in understanding the Arctic heat budget now makes it possible to describe the annual changes in heat flow to and from the atmosphere in the Arctic.

Intended Scope

The emphasis will be on geophysical processes which influence the patterns of atmospheric heating and cooling in the Arctic during the year; their quantitative description and their interaction with atmospheric circulation.

The Program

The meetings will be informal and will resemble, as far as possible, a roundtable discussion. Attendance will be limited to those who can make significant contributions. Total attendance is expected to be between thirty and forty. Time has been provided for scheduling ad hoc sessions and working group activities, if needed.

Publication

To promote discussion, papers will be distributed to all participants in advance. The technical sessions will be devoted to discussions of each paper, following a presentation by the author. To allow time for preprinting, advance copies of papers are requested, if possible, by 1 January 1966. If this is not feasible, titles and tables of contents are requested for prior distribution.

Papers may be accepted from contributors who are unable to attend. They can be preprinted, distributed, and may form the basis of

discussion. Such papers may be included in the Proceedings of the Symposium.

English will be the official language of the symposium. It would be desirable to have uniform preprinting of papers and publication of proceedings in English, but it also seems desirable to retain some flexibility to accommodate the needs of individual participants.

Proceedings of the symposium will be published as promptly as possible. Inclusion of papers presented at the symposium will be at the option of the author. Those who desire publication will be allowed a specified time, probably one month, in which to revise or refine their papers. If revised papers are not submitted by publication time, the preprinted version will be used in making up the Proceedings. Insofar as feasible, the discussions will be included in the Proceedings.

Evening Activities

Several evenings will be available for informal discussion and fellowship. A short talk each evening will serve to bring the group together, but will leave ample time for the participants to dispose of as they wish.

Travel Arrangements (Specific)

Detailed information regarding travel arrangements for foreign participants is in the process of being confirmed. As soon as such information is available each participant will be notified. It is planned that participants arriving from outside the U.S. will be met at the airport. Please contact the information counter of the airline on which you arrive to meet your escort. Should there be difficulty in making contact, telephone the Conference Coordinator for instructions.

Conference Coordinator

Inquiries may be addressed to Miss Monta Klappert, 1700 Main Street, Santa Monica, California (Telephone - area 213 - 393-0411).

Sponsorship

The symposium is being organized by the Meteorology Department, University of California at Los Angeles and the RAND Corporation, with financial support by the National Science Foundation.

The Organizing Committee

Prof. Jacob Bjerknes (Chairman)
Mr. Joseph O. Fletcher
Prof. Yale Mintz
Prof. Norbert Untersteiner

The RAND Corporation

1700 MAIN ST. • SANTA MONICA • CALIFORNIA

22 May 1962

L-10731

Dr. Jule G. Charney
Department of Meteorology
Massachusetts Institute of Technology
Cambridge, Massachusetts

Dear Dr. Charney:

The purpose of this letter is to invite you to attend and participate in a symposium on the Application of Passive Microwave Technology to Satellite Meteorology to be held on 30 July - 1 August, 1962 in Santa Monica, California. The meeting will be hosted by The RAND Corporation under NASA sponsorship.

The desirability for convening a conference to discuss this subject at this time stems from recent conversations and correspondence with people in the NASA, the U.S. Weather Bureau, RAND's Planetary Sciences Department, and other segments of the meteorological community whose interests and research lie in the newly-developing National Meteorological Satellite Program. It has become apparent to all of us that the mounting interest in this subject now requires more than brief conversations and letter-writing.

The principal objective of this conference will be to provide a clearer understanding and a firmer grasp of the potentials afforded by utilization of the microwave portion of the electromagnetic spectrum in satellite meteorology for the sensing, measurement, and derivation of atmospheric constituents, parameters, conditions, and processes. For example, the present state of our physical knowledge, as well as the state-of-the-art in technological developments of sensory devices and their means of employment will be examined; areas where the application of microwave technology may provide useful information in specific fields of interest will be explored; limitations and problem areas will be delineated; and the needs for establishing research programs will be considered.

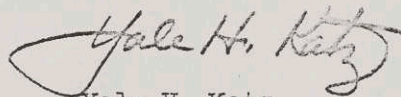
We strongly believe that the free interdisciplinary discussions that will be afforded at these meetings will not only prove to be mutually beneficial to those astronomers, meteorologists, and physicists attending, but will further provide powerful stimuli for the development of new ideas, new research, new knowledge, and better understanding in a scientific field where large strides forward are possible.

22 May 1962
L-10731

Enclosed you will find a preliminary agenda outline, and a list of invitees to the symposium. While time is not critical now, the quality of the symposium will, to a large degree, depend on the cooperation of our respondents. Therefore, may I urge you to reply to this invitation by 15 June 1962, and in so doing please indicate or summarize your areas of interest with respect to the symposium theme and agenda, so that final planning can proceed.

It is expected that the bulk of the discussions will be unclassified. However, there will be opportunity for the presentation of classified subject matter through SECRET. To this end, please forward papers confirming your highest security clearance to Security Officer, The RAND Corporation, 1700 Main Street, Santa Monica, California.

Sincerely yours,



Yale H. Katz
Planetary Sciences Department

YHK:bg
Enclosures

The following items summarize the present plans for a symposium on the Application of Passive Microwave Technology to Satellite Meteorology.

DATE: 30 July - 1 August 1962

PLACE: The RAND Corporation, 1700 Main Street, Santa Monica, California

INVITEES: This list is not meant to be all-inclusive, or comprehensive. We would welcome additional suggestions for invitations to others who are active in the field and could make a worthwhile contribution to the symposium.

A. H. Barrett - MIT	A. E. Lilley - Harvard
W. S. Benedict - Johns Hopkins	T. H. Maiman - Quantatron
R. M. Chapman - Geophysics Corp. of America	C. H. Mayer - NRL
J. G. Charney - MIT	M. L. Meeks - Lincoln Lab.
F. D. Drake - National Radio Astronomy Observ.	W. Nordberg - NASA
P. Falco - Space-General Corp.	J. M. Richardson - NBS
J. W. Ford - Cornell Aero. Lab.	C. Sagan - Univ. of California
W. Gordy - Duke	A. L. Schawlow - Stanford
R. M. Goody - Harvard	J. H. Shaw - Ohio State
R. A. Hanel - NASA	S. F. Singer - USWB
D. Hilliary - USWB	R. A. Smith - GE/TEMPO
J. N. Howard - AFCRL	V. E. Suomi - Univ. of Wisconsin
D. S. Johnson - USWB	H. J. Stewart - JPL
D. E. Jones - JPL	M. Tepper - NASA
W. Liller - Harvard	C. H. Townes - MIT
	W. E. Vivian - Conductron
	D. Q. Wark - USWB
	H. Wexler - USWB

AGENDA TOPICS:

1. Summary of contemporary meteorological and atmospheric problems and survey of research in progress.
2. Present state of physical knowledge, e.g.,
 - a. Absorption and emission characteristics of various atmospheric constituents and clouds,
 - b. Microwave lines of interest in satellite meteorology.
3. State of the art in technological development of microwave sensory devices; future problem areas.
4. Experimental data and programs providing land and water surface temperature measurements.
5. Measurement and interpretation of radiation data.
6. Needs for research.

SECURITY: Security clearance through level SECRET will be required. Clearances should be sent so as to arrive at least 2 weeks prior to the symposium. Send to SECURITY OFFICER, The RAND Corporation, 1700 Main Street, Santa Monica, California

The **RAND** Corporation

1700 MAIN ST. • SANTA MONICA • CALIFORNIA

16 August 1960

L-16249

Dr. Jule G. Charney
Massachusetts Institute of Technology
Department of Meteorology
Cambridge 39, Massachusetts

Dear Dr. Charney:

Thank you for the copy of your paper, "Propagation of Planetary-Scale Disturbances from the Lower to the Upper Atmosphere." As we have not completely digested its contents, we have no comments to offer. The discrepancy between the balloon and rocket data which you have noted should be corrected in the future.

Enclosed you will find a copy of "Wind Systems in the Mesosphere and Lower Ionosphere," which I hope will be of interest to you.

Sincerely,



E. S. Batten
Planetary Sciences

ESB:cs

Encl. (1) As Above.

The **RAND** Corporation

1700 MAIN ST. • SANTA MONICA • CALIFORNIA

3 April 1956

L-5503

Dr. Jule G. Charney
Director, Meteorology Project
School of Mathematics
The Institute for Advanced Study
Princeton, New Jersey

Dear Dr. Charney:

As Mr. Armer told you, an analysis of our program indicates that RAND will be in a position to sell 704 computer time to you for use in your study of numerical weather prediction under your ONR-Air Force contract. As you know, RAND is not normally in the business of selling computer time, but inasmuch as such services are not available elsewhere in this area, we are willing to sell such time as we are not using ourselves in the performance of our government contracts. To government contractors, the cost is a pro-rata share of the rental (estimated to be in the range of \$150 to \$200 per hour) plus a fixed charge per hour for the use of the premises and the services of an operator. We understand your needs to be some 250-350 hours of 704 time spread over a year beginning in October or November of this year. We feel that there should be no difficulty in providing you with such amounts of time.

Enclosed is a copy of a proposed "Computer Use Agreement" which covers the details of such an arrangement. Similar agreements will soon be in effect between RAND and several government contractors in this area. If you have any questions concerning the agreement, they should be taken up with Mr. Armer.

We at RAND were pleased to learn that you are considering moving your group to UCLA and hope that you decide to join the growing scientific community of Southern California.

Sincerely,



F. R. Collbohm

cc: Dean Paul Dodd

COMPUTER USE AGREEMENT

THIS AGREEMENT, entered into as of the _____ day of _____, 19____, at _____, California, between _____

_____ a corporation organized and existing under the laws of the State of _____, whose address is _____

_____ (hereinafter referred to as "_____"), and THE RAND CORPORATION, A California non-profit corporation, whose address is 1700 Main Street, Santa Monica, California, (hereinafter referred to as "RAND"),

WITNESSETH:

WHEREAS, RAND has available upon its premises at Santa Monica an International Business Machine, Type 704 Computer consisting of IBM components designated as 704, 737 Model I, 737 Model II, 711 Model II, 716, 721, 727 (6 units), 753, and 733 (hereinafter sometimes called "the computer"), title to which is in the International Business Machine Corporation (hereinafter sometimes called "I.B.M."); and

WHEREAS, _____ desires to use the computer on RAND premises; and

WHEREAS, _____ agrees that its use of the Computer under this Agreement will be limited to work required in the performance of its Government Contracts; and

WHEREAS, RAND is willing to permit _____ to use the Computer upon certain specified conditions; and

WHEREAS, the International Business Machine Corporation has approved the use of the computer by _____;

NOW, THEREFORE, in consideration of the mutual promises herein contained, the parties hereto agree as follows:

1. RAND hereby grants to _____ permission (which permission shall be limited to not more than five (5) of its employees at any one time) to enter upon and use, at times mutually agreeable, such portion of RAND's Main Street premises (which premises shall be limited to the enclosure housing the computer and the connecting halls to the South Lobby) as is reasonably necessary for purposes of this contract, which use shall include use of the computer. RAND may at any time deny _____ the use of the computer by notifying _____, not later than six (6) hours before the agreed upon beginning time, on each and any day,

that RAND wishes to deny such use.

2. The term of this Agreement shall commence on the date of signing by both parties hereto and shall extend for a period of six (6) months unless sooner terminated as hereinafter provided.
3. RAND shall provide the necessary repair, maintenance, power, heat and light. _____ use of the computer may be interrupted or postponed for maintenance or repair work or by reason of any event. _____ assumes the risk of such interruptions.
4. _____ shall provide all supplies and materials (such as cards, paper, plugboards, and magnetic tapes) and all manpower except the RAND operator, which may be required for _____ use of the computer hereunder.
5. _____ shall pay to RAND the following sums until this agreement is properly terminated:
 - (a) \$10.00 per hour of actual use of the computer by _____; and
 - (b) \$7.50 per hour of actual use of the computer as a charge for the RAND operator, whether or not he is actually operating the computer. RAND may waive this charge at its discretion; and
 - (c) an amount per calendar month equal to the number of hours per calendar month of actual use of the computer by _____ divided by the total number of hours per calendar month of actual computer use multiplied times the total charge, for such use, made by I.B.M. However, in no event shall the amount to be paid under the terms of this paragraph [5(c)], exceed \$300 times the number of hours of use of the computer by _____. Use time shall be determined in the same manner that it is determined under the RAND-IBM contract covering the computer with the following addition: Computer time, scheduled by mutual agreement of the parties hereto, will be considered to be use time for

purposes of invoicing _____, if _____ fails to actually use such scheduled time and if RAND is unable to otherwise use the computer. _____ must report time lost due to computer failures, occurring during their use of the computer, to RAND within 48 hours of occurrence and, if accepted by RAND such time will not be used in the computation of actual use time for purposes of invoicing _____.

6. The computer use charges paid by RAND to I.B.M. are approximately \$34,000 per month for one-shift use and, for use on an additional shift, 50% of that amount multiplied by a factor representing the per cent that the actual use bears to the available use time on each such additional shift.
7. _____ agrees to and does hereby expressly release and agree to indemnify and save harmless THE RAND CORPORATION, its officers, agents, employees, successors and assigns, and any of them, from and against any and all liabilities, loss, cost, expense, claims, damage, or demands, including costs and attorneys' fees, except any such as may be caused by the negligence of RAND or its employees, arising directly from acts or omissions undertaken by _____ in connection with this agreement. _____ hereby agrees to pay and discharge forthwith on demand of RAND each and every such liability, loss, cost, expense, claim, damage or demand.
8. In the exercise of its rights under this Agreement _____ and each of its employees shall comply with all security regulations and security requirements of RAND and the United States Government where applicable.
9. No alteration in, or attachments to, the computer are to be made or modified by _____ without first obtaining the written consent of RAND. _____ will not use the machine for any purpose not previously disclosed to RAND.
10. _____ shall pay to RAND the respective amounts called for by this contract upon presentation of invoices therefor approved by the cognizant government auditor for RAND, which invoices may be submitted each month or at such other intervals as RAND may determine to be practicable, and are payable within ten days from date of presentation of invoice.

11. Any notices required or contemplated by this Agreement shall be deemed to have been delivered if deposited in the United States mail addressed to the party concerned at its respective address set forth above, or if otherwise actually delivered to the other party.
12. This Agreement shall be subject to sections titled: Term of Agreement, Monthly Charges, Cards and Tape, Maintenance, and Alterations and Attachments of that Agreement between I.B.M. and RAND dated _____ as amended, for Machine Service. (I.B.M. Form 12-6399-0-25M-11-54-M&E).
13. This Agreement shall be terminable by RAND, in whole or in part, without any obligation whatsoever, at any time by written notice to _____. This Agreement shall be terminable by _____ at any time by written notice to RAND. Such termination shall become effective to the extent stated in any such notice fourteen (14) days after said notice has been delivered to the other party.
14. Neither this Agreement nor any rights hereunder shall be assignable or otherwise transferable by _____ without the prior written consent of RAND.

March 19, 1956

Mr. Colbaum
President, Rand Corporation
Santa Monica, California

Dear Mr. Colbaum:

You may recall from a telephone conversation with Dean Paul Dodd on February 24th last that I have been considering an appointment to UCLA and the transfer to UCLA of the group working with me at the Institute for Advanced Study on numerical weather prediction. Dean Dodd perhaps told you that a prerequisite to the continuation of our work is ready access to an electronic digital computer of at least IBM 701 caliber. Since UCLA does not have such a machine at this time, although it hopes to have one in the future, the best possibility for the present appears to be to use one of the existing machines in the Los Angeles area. It was therefore very encouraging to learn from Mr. Paul Armer, with whom I discussed the matter the afternoon of the 24th, that Rand Corporation would be willing to supply the necessary machine time at cost. I am writing this letter to tell you explicitly of our needs and to enquire formally whether the required time would be available at Rand, and, if so, under what conditions and at what unit and total cost.

For the first year, beginning next October or November, we would need approximately 1000 hours of 701 time (or an equivalent amount of 704 time) and could pay for it under an ONR-Air Force contract. The time would not have to be consecutive nor on a particular shift but should be available rather regularly, say in equal weekly amounts. Our needs can be expected to continue beyond the year at a steadily increasing rate until such time as UCLA acquires a large machine of its own.

A reply to this letter at your earliest convenience would be very greatly appreciated, since my decision to accept the UCLA offer must necessarily depend on the existence of facilities which would enable me to continue my work.

Very sincerely yours,

Jule G. Charney
Director, Meteorology Project

JGCesg
CC Dean Paul Dodd