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PROSPECTUS

THE TRAVELERS RESEARCH CENTER, INCORPORATED,

A NON-PROFIT RESEARCH CORPORATION

The Travelers Weather Service and The Travelers Weather Research Center were established in 1955 by The Travelers Insurance Companies to provide more effective public weather services through improved means of public weather communication via WTIC radio and TV and by undertaking research on the development of weather forecasting techniques. Their success led to the establishment, in response to government inquiries, of the Weather System Division of the Research Department late in 1959 to undertake the important meteorological research and development activities in support of the government-sponsored National Weather System 433L. The staff of the Travelers Weather Research Center formed the nucleus of the newly created Weather System Division and the government supported research functions of the Center were transferred to the new Division. A greatly expanded staff of outstanding scientists in the fields of meteorology, mathematics, and statistics was assembled to undertake this research.

The capabilities and competence of this group of scientists has been recognized by governmental agencies and industrial companies and the group has been asked to undertake further research in the environmental sciences and to provide specialized weather services. These inquiries have been enthusiastically received by this team of scientists,

since their interests extend beyond the problems of Weather System 433L in the field of meteorological research, and beyond the provision of local public weather broadcasts in the field of applications and services.

These inquiries, as well as others, reflect a growing appreciation of the vital effects of natural and man-made environments on all types of human activities and industrial and governmental operations. They also demonstrate an increasing awareness of the potential of research and services in this field to develop and apply the knowledge necessary to counter the adverse and exploit the beneficial environmental effects. There is a clear need for the establishment of a vigorous, broadly based program in applied research in the environmental sciences which can attack, on a broad interdisciplinary basis, the critical problems in which environmental conditions play a key role. The Travelers Research Center, Inc., a non-profit corporation, building upon the nucleus of scientists of the Travelers Weather Research Center and the Travelers Weather Service has been formed in the hope that it will make a step toward filling these needs. The Center will continue research and development work in environmental and other sciences, and provide meteorological and other services to government and industry on an expanded basis.

SCOPE OF ACTIVITIES

The Travelers Research Center, Inc. will engage principally in applied research in the environmental sciences, develop applications of environmental information to industrial, governmental, and other

operations, and provide services and consultation to industry and government on problems arising from environmental conditions. The Corporation will undertake applied research and development, and provide services in other fields as deemed desirable and beneficial.

THE NEED

The environmental sciences represent a composite of scientific disciplines applied to man's natural environment. Many problems in the environmental sciences are of large scope and complexity. To undertake research and development in these sciences, and to make application of environmental information to governmental and industrial problems requires a group of scientists with exceptional capabilities and extensive facilities. The Travelers Research Center, Inc. hopes to meet needs of the public and scientific community for the establishment of such an organization.

Community

The Travelers Research Center will be an important asset to Connecticut. Although the Corporation is envisioned as a center for research on problems which may be national or international in scope, and for the provision of services on a national basis, it will offer Connecticut a focal point for applied research in state and regional environmental problems such as those involved in city planning, water resources, air pollution, nuclear hazards, agriculture, and severe weather and flood conditions.

The Scientist

The Corporation will provide the professional environment and associations, continuity of employment, and career growth opportunities for the scientists assembled at the Travelers to staff the Weather Service and conduct the research and development in support of the Weather System. The Corporation will be a center where other scientists with interests in applied environmental problems can undertake their work.

RELATIONSHIP TO THE NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

The recognition of the growing importance of the environmental sciences to the nation is manifest in the increasing support for and interest in environmental research on the part of the government and industry. The national need for increased basic research in these fields has been recognized by the National Academy of Sciences and the National Science Foundation. In cooperation with the University Corporation for Atmospheric Research, the National Science Foundation has established the National Center for Atmospheric Research. The National Center will concentrate on fundamental problems in atmospheric sciences and will not engage in applied environmental research which will be the key feature of the activities of the Travelers Research Center. The Travelers Research Center will undertake background studies as required for the support of its program of applied research where the relationship between the fundamental studies and the applied work is so close as to warrant their joint undertaking.

TECHNICAL PROGRAM

The technical program of the Travelers Research Center will represent a balance of services and applied research and development. Initially, the Corporation will provide services and engage in those aspects of the environmental sciences in which its staff of key scientists is qualified. As conditions warrant, the Center will extend its staff and efforts into other environmental sciences in which it can make important contributions. It is expected that the scope of the Center's efforts will include studies of the water, air, and space environments, and the provision of services relating to these scientific fields. Initially, however, the Center will concentrate on problems of the air environment and the application of mathematical and statistical techniques developed for weather problems to other fields, such as medicine and economics. The new Corporation will assume responsibility for all research and services of the Weather System Division and the Travelers Weather Service.

The areas of applied research to be considered initially are:

1. Meteorological Research - This research will lead to improvements in the description, understanding, prediction or control of the atmosphere. The studies will provide the meteorological knowledge necessary for applications to a wide variety of environmental problems. The meteorological research activities will consist of:

Observational and experimental studies, including the design

of instrumental or experimental devices and techniques for probing or simulating atmospheric conditions.

Environmental data analysis for the development of analysis techniques and for obtaining a better description and understanding of atmospheric phenomena.

Weather prediction studies for the development of improved weather forecasting techniques and procedures directed toward increasing the effectiveness of weather information for use by the government, industry, and the public.

Weather and climate control studies of the feasibility of modifying or controlling weather phenomena on a local, regional or global basis.

2. Environmental Research - This research will lead to improved understanding of the physical interactions between human activities or resources and the environments within which they take place or are located. Problem areas selected for initial emphasis are:

Atmospheric Pollution - Studies of the processes by which air pollutants are transported and dispersed by the atmosphere are fundamental to the establishment of safe pollution limits in the vicinity of urban areas and large industrial and nuclear facilities. These considerations enter in long-range urban planning, design and cost of air cleaning equipment, and the assessment of potential environmental losses in case of a major malfunction of nuclear and other industrial facilities. Military and civil defense procedures enter importantly in this problem area also. Satisfactory solutions

require the integrated efforts of source and receptor specialists as well as meteorological competence, an integration which should be achieved within the Travelers Research Center.

Water Resources - Water resources are one of the ultimate limitations on the suitability of any area for human habitation or industrial operations. The mechanics of the exchange of water between the atmosphere and the earth, and the transfer of water substance through the atmosphere, is a key factor in considerations of water resource problems.

Agriculture - Plant growth and plant yield are largely controlled by atmospheric conditions. Insufficient attention has been given in this country to the close relationships between these factors and meteorological conditions. Extensive work is required to establish agricultural practices which make maximum use of environmental information.

3. Meteorological Applications - Research on problems in which application of environmental information is of significant importance in increasing the efficiency of industrial or governmental operations or services. Problems in this category may involve the application of environmental information to industrial distribution, marketing or production problems, or to the design of structures, vehicles or equipment.

4. Mathematical and Statistical Research - Development of the mathematical and statistical theories and techniques applicable to such non-environmental fields as medicine, economics, communications,

data processing, and management decisions. Many of these can be effectively treated by the mathematical and statistical procedures developed in the course of the Corporation's technical program. The areas of expansion in weather services to be considered initially are:

1. Public Weather Services - To test and experiment with improved methods of public weather communication via radio and TV.
2. Industrial Weather Services - To study and test techniques for the provision of specialized weather and climatological services capable of satisfying the expanding needs of industry and government for weather information through the exploitation of modern computational technology and communications facilities.

PERSONNEL AND FACILITIES

The Travelers Research Center presently will have an initial staff of approximately 50 people, nine of whom possess their doctorate, and 5 of whom possess their masters degrees. Biographical resumes of some of the individuals who will be key scientists of the new corporation are attached.

The proposed organizational structure of the new Corporation is shown in the accompanying diagram.

The Corporation will occupy offices at 650 Main Street, Hartford.

Robert M. White, Sc.D.

Professional Experience

Dr. White is Associate Director of the Research Department. He came to The Travelers in July of 1959 to establish a division for sponsored research in The Travelers Weather Research Center and to direct the meteorology research and development program in support of the Government-Sponsored National Weather System 433L. Prior to this he served as a Research Associate at the Massachusetts Institute of Technology, studying problems of the general circulation. In 1958 he was chief of the Meteorological Development Laboratory, Geophysics Research Directorate, Air Force Cambridge Research Center. In this position Dr. White was responsible for the technical direction of an extensive research program in weather prediction, atmospheric dynamics, applied climatology, and meteorological equipment. From 1952 to 1958 he was chief of the large scale processes branch of the Atmospheric Analysis Laboratory at the Cambridge Research Center. In this position he directed a program of studies of the dynamics of the general circulation of the atmosphere, long-range forecasting, and statistical weather prediction. During World War II, Dr. White served as a Captain in the U. S. Air Force with duties both in forecasting and instructing. Dr. White is recognized as an authority on the general circulation, and statistical weather prediction and his wide experience in management of research activities makes him excellently qualified for the work of his present position.

Educational Background

Meteorology, B.A. ('44), Harvard University
 Meteorology, M.S. ('49), Massachusetts Institute of Technology
 Meteorology, Sc.D. ('50), Massachusetts Institute of Technology

Professional Affiliations

American Meteorological Society, Chairman, Committee on Weather Forecasting
 Panel on Meteorology, U.S. National Committee, International
 Geophysical Year
 American Geophysical Union
 Royal Meteorological Society
 Sigma Xi
 Research Society of America

Technical Publications

"The Role of Mountains in the Angular Momentum Balance of the Atmosphere,"
J. Meteor., 1949.
 "A Mechanism for the Vertical Transport of Angular Momentum in the Atmosphere,"
J. Meteor., 1950.
 "The Meridional Eddy Flux of Energy," Quart. J. Roy. Meteor. Soc., 1951
 "A Hemispherical Study of the Atmospheric Angular Momentum Balance," Quart.
J. Roy. Meteor. Soc., 1951.
 "The Meridional Flux of Heat Over the Northern Hemisphere," Tellus, 1951.

- "On the Energy Balance of the Atmosphere," Trans. Amer. Geophys. Union, 1951
- "Large-Scale Atmospheric Exchange Processes as Diffusion Phenomena," J. Meteor., 1951.
- "Note on the Seasonal Variation of the Meridional Flux of Angular Momentum," Quart. J. Roy. Meteor. Soc., 1952.
- "Meridional Flux of Angular Momentum in the Tropics," Tellus, 1952.
- "Schemes for the Study of Hemispheric Exchange Processes," Quart. J. Roy. Meteor. Soc., 1952.
- "The Large-Scale Vertical Eddy Stress in the Free Atmosphere," Trans. Amer. Geophys. Union, 1952
- "The Construction and Application of Contingency Tables in Weather Forecasting," A.F. Surv. in Geophys., No. 19, 1952.
- "Two Years of Momentum Flux Data for 31°N," Tellus, 1952.
- "Contributions to the Study of Planetary Atmospheric Circulations," AFCRC Geophys. Res. Paper No. 24, 1953.
- "Two Years of Momentum Flux Data for 13°N," Tellus, 1954.
- "The Counter Gradient Flux of Sensible Heat in the Lower Atmosphere," Tellus, 1954.
- "Balance Requirements of the General Circulation," AFCRC Geophys. Res. Paper No. 35, 1954
- "The Preparation of Extended Forecasts in the Pressure Height Distribution in the Free Atmosphere over North America by the Use of Empirical Influence Functions," A.F. Surv. in Geophys., No. 69, 1954.
- "Direct Measurement of the Hemispheric Poleward Flux of Water Vapor," J. Mar. Res., 1955.
- "On the Forecasting Possibilities of Empirical Influence Functions," J. Meteor., 1955.
- "A Comparison of the Accuracy of Certain Statistical and Synoptic Forecasts," Bull, Amer. Meteor. Soc., 1956.
- "Pressure Height Predictability as a Function of the Amount and Type of Initial Data," J. Meteor., 1956.
- "The Spectrum of the Kinetic Energy of Meridional Motions in the Mid-Troposphere," J. Meteor., 1956.
- "Hemispherical Prediction by Statistical Techniques," J. Meteor., 1957.
- "The Development of Efficient Linear Statistical Operators for the Prediction of Sea Level Pressure," J. Meteor., 1958.
- "A Preliminary Study of the Potential to Kinetic Energy Conversion Process in the Atmosphere," Tellus, 1960.
- "Statistical Methods," Triennial Report to IUGG, 1960.

Glenn R. Hilst, Ph.D.

Professional Experience

Dr. Hilst is the Assistant Director of the Weather System Division and Supervisor of the Environmental Meteorology Section. As Assistant Director, he assists in the management and coordination of the activities of the Division with particular responsibility for program planning and evaluation. As Supervisor of the Environmental Meteorology Section, he directs research in meso- and micro-scale meteorological problems and radar utilization. Dr. Hilst has had extensive experience in the management and direction of Research activities and has performed both basic and applied research in turbulence and diffusion. From 1954 to early 1960 he was manager of the Atmospheric Physics group at the Hanford Atomic Products Operation of the General Electric Company. In this position he was responsible for the operation of an industrial weather service and the direction of a substantial research and development program in Atmospheric Pollution studies. During the years 1952 through 1954 he was associated with the Argonne National Laboratory of the Atomic Energy Commission doing research on problems in micro-meteorology and micro-climatology. Prior to this work for the AEC, Dr. Hilst had worked for a period of nearly four years with the General Electric Company, organizing a research program for the Hanford Works and conducting studies of atmospheric dispersion of radioactive wastes. During 1948 and 1949 Dr. Hilst participated in weather radar research at the Massachusetts Institute of Technology, and during World War II he was an Air Weather Service Officer, serving both as field forecaster and instructor in Meteorology.

Educational Background

Meteorology, S.B. ('48), Massachusetts Institute of Technology
 Meteorology, S.M. ('49), Massachusetts Institute of Technology
 Meteorology, Ph.D ('57) University of Chicago

Professional Affiliations

Americal Meteorology Society, Chairman of the Committee on Air Pollution
 Royal Meteorological Society
 Sigma Xi

Technical Publications

- "Radar Signal Spectroscopy," masters thesis published as Weather Radar Project Tech. Rpt. 9A, MIT, 1949.
- "Growth of Precipitation Cells," with MacDowell, Bull. Amer. Meteor. Soc., 1950.
- "Climatological Study of Hanford Area," with Jenne, Hanford - G. E. Rpt., 1950.
- "Modification of Sutton's Parameters," with Barad, Hanford - G. E. Rpt., 1951.
- "400-Mile Trajectory Studies," Hanford - G. E. Rpts. (3), 1951-1952.
- "The Argonne Experimental Meteorology Stack," with Moses, Bull. Amer. Meteor. Soc., 1955.
- "Wind Erosion of Small Particles," Hanford - G. E. Rpt., 1955.

- "Observations of the Dispersion of Stack gases in Stably Stratified Atmosphere," Ph.D. dissertation for Dept. of Meteor., Univ. of Chicago, 1957.
- "Dispersion of Stack Gases in Stable Atmospheres," J. Air Poll. Cont. Assoc., 1957.
- "Meteorology in the Nuclear Energy Industry," Weatherwise, 1957.
- "Vertical Dispersion Rates in Stable Atmospheres," with Simpson, J. Meteor., 1958.
- "On the Wind Erosion of Small Particles," with Nickola, Bull. Amer. Meteor. Soc., 1959.
- "Proceedings of Hearings of JCAE on Waste Disposal," Sub-Committee on Radiation Protection, Congressional Record, 1959.

Eugene J. Aubert, Ph.D.

Professional Experience

Dr. Aubert is Supervisor of the Atmospheric Dynamics Section in the Weather System Division of The Travelers Weather Research Center. He directs research in both dynamic and statistical weather forecasting techniques and in the development of techniques for objective analysis of weather information. Dr. Aubert has conducted extensive research in numerical methods of forecasting and has participated in important studies of the application of statistical methods to weather prediction. From 1951 to early 1960 he was chief of the Technique Applications Branch, Meteorological Development Laboratory, Geophysics Research Directorate, Cambridge, Massachusetts. In that position he directed a program of research in objective analysis and prediction techniques using both dynamic and statistical methods. Prior to his association with GRD Dr. Aubert had served as a Research Meteorologist with the extended forecast section of the U. S. Weather Bureau in Washington, D. C. During World War II he served as an Aerological Officer in the U. S. Navy.

Educational Background

Meteorology, B.S. ('46), New York University
 Meteorology, M.S. ('47), New York University
 Meteorology, Ph.D ('57), Massachusetts Institute of Technology

Professional Affiliations

American Meteorological Society

Technical Publications

- "Isentropic Eddy Diffusion of Moisture," masters thesis for Meteorology Dept., New York Univ., 1947.
- "Progress Report on a Study of Atmospheric Heat Sources in the Northern Hemisphere," with J. Winston, Ext. Fcst. Sec., USWB, 1948.
- "An Attempt to Improve the Monthly 700 mb Regression Height," Ext. Fcst. Sec. Report, USWB, 1948.
- "Solar Weather Relationships," Ext. Fcst. Sec. Report, USWB, 1949.
- "The Weather and Circulation of May 1950," Monthly Weather Review, 1950.
- "The Weather and Circulation of June 1950," Monthly Weather Review, 1950.
- "A Study of Atmospheric Heat Processes in the Northern Hemisphere," with J. Winston, J. Meteor., 1950.
- "Comparison of Monthly Geostrophic and Gradient Winds," with J. Winston, J. Meteor., 1950.
- "A Test of Monthly Precipitation Forecasting in the Hawaiian Islands," Ext. Fcst. Sec. Report, USWB, 1950.
- "Progress Report on Application of One-Dimensional Numerical Methods to Extended Forecasting," Ext. Fcst. Sec. Report, USWB, 1950.
- "The Weather and Circulation of November 1950," Monthly Weather Review, 1951.
- "The Weather and Circulation December 1950," Monthly Weather Review, 1951.
- "The Application of One-Dimensional Numerical Methods to Extended Forecasting," Ext. Fcst. Sec. Report, USWB, 1951.
- "Final Report: Research in Cyclogenesis Processes," GRD, AFCRC, 1954.

Eugene J. Aubert, (cont'd)

- "A Survey of the Problems of Forecasting Tornadoes and Associated Phenomena," GRD, AFCRC, 1954.
- "A Survey of the Short Time-Period Ceiling Fluctuations," GRD, AFCRC, 1955.
- "A Multi-Level Baroclinic Model Applicable to Numerical Prediction," GRD, AFCRC, 1956.
- "The Release of Latent Heat as a Factor in Atmospheric Motions," Ph.D. thesis at MIT, 1957.
- "The Release of Latent Heat as a Factor in Large Scale Atmospheric Motions," J. Meteor., 1957.
- "Hemispheric Prognosis of the 500 mb Surface for Silent Area Initial Condition," GRD, AFCRC, TM 57-12, 1957.
- "Objective Map Analysis Utilizing the Concept of Circulation and Vorticity," J. Meteor., 1959.
- "Some Objective 6-Hour Predictions Prepared by Statistical Methods," with I. Lund and A. Thomasell, J. Meteor., 1959.
- "Analysis and Prediction of 500 mb Surface in a Silent Area," AF Surv. in Geophys., No. 122, 1960.

Joseph G. Bryan, Ed.D.

Professional Experience

Dr. Bryan is Chief Statistician for The Travelers Weather Research Center. He provides consultation on statistical problems arising in connection with the research program of the Center. Dr. Bryan has made many original and outstanding contributions in both basic and applied mathematics and in statistics. He has made substantial contributions to the development of statistical techniques for use in weather analysis and prediction. His joint work with Professor Wadsworth of the Massachusetts Institute of Technology laid the foundations on which statistical weather forecasting has been developed in recent years.

Prior to joining the staff of the Travelers Weather Research Center, Dr. Bryan was an Operations Research Analyst with the Central Research Laboratory of the American Machine and Foundry Company. During this period he completed a great many studies in Operations Research and Applied Statistics and wrote a major portion of his textbook, Probability and Random Variables.

From 1942 to 1957 Dr. Bryan was a Research Mathematician at the Massachusetts Institute of Technology and from 1945 through 1954 was Deputy Director of the Statistical Laboratory in the Division of Industrial Cooperation. While at MIT Dr. Bryan served as a statistical consultant to industry and participated in the early studies on statistical weather forecasting.

Educational Background

Science, B.S. ('38), Massachusetts Institute of Technology
Education, Ed.M. ('42), Harvard University
Education, Ed.D. ('50), Harvard University

Professional Affiliations

American Meteorological Society
American Geophysical Union
Operations Research Society of America
The Institute of Mathematical Statistics
The American Statistical Association
Biometric Society
Psychometric Society
American Association for Advancement of Science
Phi Delta Kappa
Sigma Xi

Technical Publications

"The Multiple Discriminant Function," Harvard Ed. Rev., 1950.
"Time Series Analysis," Geophys., 1953.
"Inventory Analysis," Nav. Res. Logistics Quart., 1955.
"Analysis of Economic Feasibility of Defense Contracting," for Central Research Lab. of American Machine and Foundry Company, 1957.

"Design of an Experiment for Statistical Testing of Plastic Coatings for Bowling Pins," for Central Research Lab. of AMF, 1958.

"Probability Distribution of Resultant Eccentricity of an Assembly of Individually-Eccentric, Component Parts Rotating About a Common Axis," for Central Research Lab. of AMF, 1958.

"Statistical Analysis of Feasibility of Mechanical Color Sorting of Cigars," for Central Research Lab. of AMF, 1958.

Probability and Random Variables, McGraw-Hill Book Co.

Various reports at MIT on statistical forecasting and industrial consulting.

Robert G. Miller, M. S.

Professional Experience

Mr. Miller is Supervisor of the Statistical Prediction Section of The Travelers Weather Research Center. He directs both the research and engineering phases of applying advanced statistical techniques to numerous weather prediction problems. His recent work has been devoted to development of procedures for using multiple discriminant analysis to derive predictors for specific weather parameters. Multiple discriminant analysis is particularly applicable where antecedent and consequent conditions have a non-linear character. Between 1955 and 1959, while a Research Associate in The Travelers Research Department, Mr. Miller made several major contributions to the field of statistical prediction and the use of high-speed computers in meteorology. His adaptation to weather prediction of a screening procedure in multiple regression analysis received wide acceptance; its application to hurricane prediction has been especially successful. From 1952 to 1955 Mr. Miller was a staff member in the Division of Sponsored Research at the Massachusetts Institute of Technology, where he collaborated with Dr. T. F. Malone in pioneering an extension of the use of orthogonal polynomials, begun by Wadsworth and Bryan, to the prediction of surface pressure patterns over the United States.

Educational Background

Mathematics, B.A. ('51), Rutgers University
 Meteorology, M.S. ('52), New York University

Professional Affiliations

American Meteorological Society
 American Statistical Association
 The Institute of Mathematical Statistics
 Sigma Xi

Technical Publications

Studies in Synoptic Climatology, edited by W. D. Sellers, Dept. Meteorology, Mass. Inst. of Technology, Final Report, Synoptic Climatology Project, No. N5ori-07883, Sponsored by the Office of Naval Research, 1956. (Co-author of 4 chapters)

Studies in Statistical Weather Prediction, AFCRC-TR-58-272, edited by Bernard Shorr, Travelers Weather Research Center, The Travelers Insurance Company, Final Report, Contract No. AF19(604)-1590, prepared for Geophysics Research Directorate, Air Force Cambridge Research Center, Air Research and Development Command, 1958 (Author and Co-author of 6 of the 7 chapters)

Probabilistic Prediction of Hurricane Movements by Synoptic Climatology, with Veigas and Howe, The Travelers Weather Research Center, The Travelers Insurance Companies, Occasional Papers in Meteorology, No. 2, 1959.

Miller, Robert G. (continued)

Selecting Variates for Multiple Discriminant Analysis with an application to short period forecasting of airfield ceiling conditions, The Travelers Weather Research Center, The Travelers Insurance Companies, Final Report, Contract No. Af19(604)-3878, sponsored by Geophysics Research Directorate, Air Force Cambridge Research Laboratories, Air Force Research Division, 1960.