

**ENGINEERING RESEARCH INSTITUTE  
UNIVERSITY OF MICHIGAN  
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PROGRESS REPORT NO. 3

December 16, 1953 to March 15, 1954

DISPERSION AND PENETRATION OF  
POLLENS AND INDUSTRIAL CONTAMINANTS

By

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Submitted to the Geophysics Research Directorate,  
Air Force Cambridge Research Center, Cambridge,  
Massachusetts. The work reported herein is of a  
preliminary nature and the results are not necess-  
arily in final form.

Project 2160

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## ABSTRACT

Tests on the performance of the sampling equipment, cascade impactor, and millipore filter have been run and conclusions drawn on the basis of these runs. Fluorescent particles introduced into the atmosphere as tracers are being examined for use during seasons when there is no ragweed pollen in the air. Construction of the bridled-cup gust accelerometer has been completed and calibration runs in the wind tunnel have been made. A true linear relationship between wind speed and angular deflection of the bridled cup has been achieved. Plans have been drawn up and approved for a meteorological laboratory on the roof of the East Engineering Building. A 60-foot self-supporting steel tower will be erected beside the new laboratory and suitable instrumentation installed. This work has been undertaken by Mr. William H. Hansen, Research Associate, and Dr. E. Wendell Hewson, Project Director.

The aerodynamic analysis of impaction processes is proceeding. Previous analyses of the impaction of small particles on collector plates, such as the studies of Johnstone, Ranz, etc., of the University of Illinois, apply only to the case of uniform steady flow. Such analyses are not applicable to the turbulent flow of the atmosphere. In the new analysis, the wind velocity is made up of two components, one steady representing the mean wind and the other fluctuating and representing the turbulent component. The introduction of this rapidly fluctuating function requires the conversion of the dynamics of the particles (pollen, smoke, or water droplets) into a system appropriate to stochastic processes. Although the type of analysis is characteristic of those in "statistical physics", the particular characteristics of the fluctuating velocity give this particular stochastic process unique features of its own. Good progress has been made in this analytical approach by Dr. ~~W~~-Cheng Liu, Research Engineer.

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POLLENS AND INDUSTRIAL CONTAMINANTSINVESTIGATIONS BEING UNDERTAKEN

The respective merits of the millipore filter and the cascade impactor have been the subject of study during this report period. Our provisional conclusion is that the millipore filter is more suitable for use when particles of uniform size, such as ragweed pollens, are being studied. There was some evidence that not all the larger particles were caught by the appropriate stage of the cascade impactor. The great advantage of the millipore filter is that there is no possibility of such large particles getting through the filter. On the other hand, if particles having a substantial range of size are under investigation, then the ability of the cascade impactor to separate the particles in a spectrum of four size bands is valuable. Final tests of the millipore filter will not be made until the next quarter, but our present opinion is that because of its convenience and positive action, the millipore filter should be used whenever possible.

Preliminary studies of the particulate matter in the air of Ann Arbor, both indoors and outdoors, revealed a heterogeneous and nondescript assortment of particles both large and small. It is clear that a study of rates of penetration of such particles into buildings cannot be made without an elaborate program of particle identification. Under these circumstances, it is felt that during the seasons when there is no ragweed pollen in the air, it will be desirable to use readily identifiable tracer substances.

Samples of zinc cadmium sulfide and zinc sulfide, manufactured by the New Jersey Zinc Company have been obtained. The particles fluoresce under ultraviolet illumination, so that when collected by a filter they may readily be counted when properly illuminated. The techniques have been described by: R. R. Braham, B. K. Seely, and W. D. Crozier in "A Technique for Tagging and Tracing Air Parcels", Trans. Amer. Geophys. Union, 33, 825-833, (1952); W. A. Perkins, P. A. Leighton, S. W. Grinnell, and F. X. Webster

in "A Fluorescent Atmospheric Tracer Technique for Mesometeorological Research," Proc. Second Nat. Air Poll. Conf., 42,46 (1952); and L. L. Falk, C. B. Cave, W. R. Chalker, J. A. Greene and C. W. Thorngate in "Savannah River Plant Stack Gas Dispersion and Microclimate Survey"; E. I. duPont de Nemours and Company, Inc., Health and Safety, DP-19, January, 1953. It appears that rates of penetration may be determined conveniently and accurately by the use of such fluorescent particles. A suitable microscope for particle counting has been obtained on a loan basis.

Construction of the bridled-cup gust accelerometer as designed by G. C. Gill has been completed. The recording unit gives mean gust accelerations directly. Calibration in the wind tunnel shows excellent linearity of response.

An Instruments Corporation anemometer, wind vane, and recorder have been ordered. The recording unit of the Beckman and Whitley precision anemometer has been received and the remainder of the equipment will be arriving shortly.

The idea of fitting up laboratory space at the top of the Burton Tower has been abandoned in favor of building a penthouse laboratory of 900 sq ft on top of the East Engineering Building. Detailed plans have been drawn up and final approval of them is expected shortly. It is proposed to erect a 60-foot self-supporting steel tower on the top of the projecting elevator housing shaft. The Instruments Corporation anemometer and wind vane and probably the bridled-cup gust accelerometer will be mounted at the top of the steel tower, where they will be in a free flow of air and away from building influences.

The aerodynamic analysis of the impaction of particulate matter on surfaces is proceeding well. The equations have been set up and partly solved; the results obtained depend on the power spectrum that is used to characterize the turbulence of the atmospheric flow.

#### RESEARCH REPORTS, PUBLICATIONS, ETC.

The Project Director attended the National Meeting of the American Meteorological Society held near the end of January, 1954, in New York City.

He gave a paper entitled "The Dispersion of Pollen and Industrial Contaminants" before the Chicago Seminar of the American Meteorological Society on 11 March 1954.

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Tests on the performance of the sampling equipment, cascade impactor, and millipore filter have been run and conclusions drawn on the basis of these runs. Fluorescent particles introduced into the atmosphere as tracers are being examined for use during seasons when there is no ragweed pollen in the air. Construction of the bridled-cup gust accelerometer has been completed and calibration runs in the wind tunnel have been made. A true linear relationship between wind speed and angular deflection of the bridled cup has been achieved. Plans have been drawn up and approved for a meteorological laboratory on the roof of the East Engineering Building. A 60-foot self-supporting steel tower will be erected beside the new laboratory and suitable instrumentation installed. This work has been undertaken by Mr. William H. Hansen, Research Associate, and Dr. E. Wendell Hewson, Project Director.

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FISCAL INFORMATION

Actual expenditures up to the end of February, 1954, were approximately \$15,600, encumbrances were approximately \$2,800, with a total of \$18,400. The balance is therefore approximately \$11,600.

Future plans call for the purchase of a 60-foot self-supporting steel tower at approximately \$150. Erection of the tower might cost an additional \$150 or \$200.

The main item of property acquired is a Model AD440-3 Gast Air Pump built to A.E.C. specifications at a cost of \$129.

