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REFER:

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March 31, 1953

Dr. Walter D. Claus
Chief, Biophysics Branch
Division of Biology and Medicine
U. S. Atomic Energy Commission
Washington, D.C.

Dear Dr. Claus:

In accordance with our recent telephone conversation, I shall attempt to outline our meteorological program in sufficient detail so that a personal visit will be unnecessary at this time. If certain portions of the plans seem to require clarification, perhaps we can arrange a visit at a time more convenient to you.

Our earlier work has consisted of the development and operation of a meteorological control program for the Brookhaven reactor. It has included such applied research as was necessary to achieve a practical solution to the problem. Since relatively little was known of atmospheric dispersion processes, our investigation had to be rather thorough, but some of the more promising avenues of research were left relatively untouched owing to practical considerations.

Although a number of meteorologists have done intensive work on the turbulence and dispersion problem during the past ten years, our understanding of the physical processes involved has progressed slowly. I think it is fair to say that we now know enough to criticize many of the assumptions and numerical values used by earlier researchers, but no really acceptable treatment has yet been derived. Our intention is to continue our investigations of the physical, theoretical and practical aspects of the problem in such a manner as to make the best possible use of the Brookhaven facility and the combined experience of the personnel we now have. The specific program is outlined below:

Meteorological Research Group Program

1. Diffusion Experiments. Most atmospheric diffusion experiments have been imperfect in the sense that they have not permitted evaluation of all parameters from the experiments themselves. It has almost always been necessary to make some assumptions in order to relate theory and experiment. It is our intention to conduct future field experiments so that it will not be necessary to assume relationships between diffusion parameters and

meteorological variables. This will allow us to determine the relationships empirically. The objective can be accomplished by a sampling technique that will give an accurate measurement of the crosswind distribution of the test effluent for at least three different distances downwind of the source. We plan to use one or more of the following:

a. Photometric Densitometers and Oil-Fog. The techniques developed by the Meteorology Group over the past several years fulfil the requirements, and we already have a small amount of valuable data of this type. We have the advantage of being fully familiar with the peculiarities of our three detection instruments and the system, but it must be admitted that the method is costly in man-hours and frequently gives disappointing results because of instrument failure or minor changes in meteorological conditions. The system probably will be used to obtain at least a part of the desired data.

b. Fluorescence. The ideal of a larger number of simple, inexpensive samplers may be approached by a fluorometric technique in which either the fluorescence of the oil fog or that of an additive such as zinc cadmium sulphide powder would be measured. It is probable that the latter, collected on molecular filters, can be used in conjunction with a modified version of our present fluorometer. Either method would be a distinct improvement over the densitometer technique, if the required accuracy can be achieved, and the latter should be applicable to future research in particulate deposition and "wash-out".

c. Radioactivity. A relatively short-lived beta-emitter, also collected on molecular filters, could be used for the same purpose. However, the problems of allowable operating levels, public relations and confusion with other sources on the site may make this impractical.

2. Theoretical Implications. The completion of 20 to 30 successful diffusion experiments, each of 1 to 3 hours duration, should enable us to:

a. Calculate an excellent set of parameters for the diffusion equations, covering a wide range of meteorological conditions.

b. Determine correlations between the diffusion parameters and the meteorological variables of wind and thermal stability, which should in turn improve our understanding and treatment of the physical processes involved.

3. Standard Meteorological Measurements. The tower installation is very well equipped to provide almost all of the wind and temperature data considered important. However we foresee the need of measuring vertical wind fluctuations at more than one level on the tower, and we plan to supplement our recording bi-directional wind vane with two others of an improved design. We also hope to develop an instrument to measure wind speed and gustiness from a tethered balloon or Kytoon to be used in locations where elevated structures are not available.

Other improvements can be made in altering equipment so that records are either automatically processed, or are in better form for processing.

4. The Use of Radioactivity in Meteorological Measurements. Very little effort has been made to utilize radioactivity in the measurement of meteorological variables. We plan to give consideration to the problem. The most fruitful possibilities appear to lie in the measurement of humidity and liquid water.

It is our plan to utilize the time remaining in the current fiscal year to reorient the Group and prepare for the tests outlined above. We expect to determine whether fluorescence or radioactivity will make a more practical supplement to the standard oil fog tests, and we hope to be ready to make use of one of the techniques by July. The new bivanes will also be constructed during this period.

The personnel and financial requirements of the program have been covered in the budget requests already submitted through normal channels.

It might be well to review at this time our existing cooperative arrangements as well as our plans for the future.

Current Cooperative Arrangements

1. DAF-Meteorology Study. The Department of the Air Force has provided $30,000 to the Commission to have hourly mean values of most of our data transferred to machine punch cards. We have completed approximately the first third of the work, and expect to have it finished in the spring of 1954. Three persons are employed on this project. The resulting data should be of considerable value not only to the Air Force but to the Laboratory and the Commission.

2. N.Y.U. Wind Tunnel Project. New York University is converting a low-speed wind tunnel, which it is hoped will simulate atmospheric turbulence. Our Group provides data and lapse time movies of our smoke tests to be used in the comparison between field and tunnel tests. No funds are exchanged.

3. Pennsylvania State College. The Meteorology Department at Penn State makes use of Brookhaven data in specialized meteorological work. Some of the material is obtained by special "runs", and the rest from routine records. There has been no necessity for financial support to date.

Future Cooperative Arrangements

As you know, we intend to cooperate with outside agencies to a much larger extent than has been the case in the past. At the present time, one major project is contemplated:

1. The Rise of Heated Stack Effluent in a Crosswind. This problem is of considerable practical importance, since it is often a critical factor in the analysis of industrial pollution problems. It seems certain that the wind speed, thermal stability, effluent density, speed of emission and volume are the important factors, but no previous work has clarified the relationships to a satisfactory degree. We are currently considering the cost of alterations to our facility for further discussion with New York University.

I hope that the above will provide a fairly clear picture of our program. We will welcome any suggestions and criticisms you may care to make.

Sincerely yours,

Maynard E. Smith

Maynard E. Smith
Leader, Meteorology Group

MES:lr

cc: E. L. Van Horn
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