Theoretical Models - White

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Mr. T. S. Church
Sandia Corporation
Post Office Box 5800
Sandia Base
Albuquerque, New Mexico

Dear Mr. Church:

Enclosed is the description of a method of computing fall-out that we discussed 20 July. I have delayed sending it in order to satisfy myself that it can easily be modified in such a way as to include the same approximation to aerodynamic fall theory as is planned for the Weather Bureau - Bureau of Standards computer.

I apologize for sending you a part manuscript copy, but I do not want to make any further delay. The confusion on Fig. 4 arises in part from some irregularities that come out of our machine calculation on account of too coarse an integration system, and on account of a discontinuity in the cloud model used in the machine calculation. Toward the end of TEAPOT we came to feel that our hand calculation, which presents the distribution on any arc as a single gaussian, was more reliable than the machine results. We are currently trying to improve the machine code.

If one could count on the single gaussian always to do as well as in this particular case, there would be no need to build an analog machine for operational forecasting of distant fallout. The single gaussian method will give a pattern in 20 to 30 minutes of hand calculation. However, I am afraid that it may fall down rather badly for some Nevada and many Pacific patterns.

It seems to me that one should be able to obtain a satisfactory operational system with a minimum of design and construction effort by a combination of hand with analog computation. The computation of the functions QE_1/r and E_2 for any given point on an arc can be done quite quickly and easily by graphical methods. The real bottle-neck is in the integration of the products of the functions. I think that either function can be represented adequately by linear interpolation between not more than ten points. The first function remains unchanged so long as one is working on the same arc, and, with sufficient experience, one should be able to choose on each arc

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three points, on each side of the main fall-out axis, so that the results at these points would define the limits of the pattern adequately at this distance. This still means a lot of hand work; perhaps 5 arcs with 70 settings of interpolation values per arc, but I think that it could be done fast enough for operational purposes if the interpolation values can be entered as easily as by setting potentiometers.

It would speed up the computation considerably if one could make the machine compute E_2. As I see it, the main difficulty arises because, although E_2 is fundamentally a very simple function, the quantity that has to be put into it is the difference between the arbitrary angle ϕ and another angle that is specified by the height by way of the composite wind diagram, as in Fig. 2. As a result, the E_2 that must be used in the calculation is a different function for each value of ϕ, as in Fig. 3A.

It would be very nice to have a machine that would plot the dose, or dose-rate, as a function of ϕ, but I would not favor risking such an effort if it would interfere with getting a workable machine in time. If you think that there is time to include this feature, the merits of another co-ordinate system should be considered. Nevada experience, and a little Pacific experience, indicate that the actual width of a distant fall-out pattern is more constant than the angular width. From the viewpoint of resolving power it would thus seem preferable to handle E_2 as a function of $r(\theta-\phi)$ rather than as a function of $(\theta-\phi)$. The disadvantage is that one then has to feed in $r\theta$ vs h for each arc distance r, instead of the single curve of Fig. 2. However, since this is a simple multiplicative correction perhaps the machine could do this too.

I hope that you will not hesitate to call me if there is anything obscure in this description of the problem.

To the best of my knowledge, the only classified information in this material is that which reveals the cloud model which we are using.

Very sincerely yours,

ORIGINAL SIGNED BY THOMAS N. WHITE

Thomas N. White, Leader
Radiological Physics Group
HEALTH DIVISION

TNW:bg

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cc: Gaelen Felt w/o enc.
Vay Shelton w/o enc.

25