results suggest that the effect of the 10- to 15-percent increase in the total amount of carbon dioxide in the atmosphere during the century has been to increase the temperature in the lower atmosphere—that is, the troposphere—by about 0.2° C and to decrease the temperature in the upper atmosphere—that is, the stratosphere—by about 2° C.

The significance of this work lies not so much in the preliminary results which have been obtained but in the existence of a scientific and technological development which will permit an assessment not only of the temperature changes over the balance of this century but also of the effect of these temperature changes on worldwide weather patterns. As an aside, it may be mentioned that the efficacy of countervailing measures that might appear to be feasible and required can also be assessed by the same method. The implication of this situation is related to the volume of water contained in the masses of ice in polar regions. If the earth is warmed, the ice melts and the sea level would be raised so high that, were it to happen, we would probably have to swim home from this building this morning. I would emphasize that this is not an immediate danger. We do not have a crisis. The problem is not one for this year or next year, but neither is it one that can be left unattended for 100 years. The degree of danger which exists from the warming of the earth is something we must resolve in a matter of decades. The situation could become serious by the end of the century. We do have the tools now to ascertain the effects of increasing the carbon dioxide in the atmosphere and we should have these tools in pretty good working order by about 1975. If we haven't sharpened these tools by that time, we will have been derelict. Incidentally, I am a little more optimistic than your panel about the possibility of countervailing measures. I don't know yet what they will be, but I return to the point that we now have a means of assessing the efficiency of any countervailing measures that may be proposed to counterbalance the effects of increasing CO_2.

Mr. DADDARIO. Dr. Malone, you talk about our looking ahead to 1975 or to the end of the century and you point out that if we don't take certain steps now, we will be derelict in our duties. Should we even look beyond that? We do have available to us techniques that we can use to determine causes and effects over a long period of time. If you take these figures and extrapopolate them over this period, instead of having a 2° change, it could conceivably be 8° or 10°. What would that mean?

Dr. MALONE. Yes, sir, I agree with you completely that we should. Mankind in its present form has been around for about 40,000 years. We have a little responsibility even now to worry that far ahead, so you are absolutely right. The reason I picked the end of the century because it is rather difficult, and this is something a computer will not do for us, rather difficult for us to anticipate the changes that may result. We may be using entirely different forms of energy after the turn of the century so that the initial conditions of our problems may be changed rather markedly. In broader terms in the sense which you raise the question, yes, we can plug in different conditions and generate the consequences a thousand years down in the future.

It would probably take a computer quite a bit larger than we presently have but not so far beyond the state of technological capability