interactions. All three independent variables yielded statistically significant effects. The interaction between masking condition and number of target segments was also significant ($P < .01$); this interaction reflects the decreased detectability of the multisegmented targets and their decreased susceptibility to masking.

The reliability of the backward enhancement effect was assessed by simple *t*-tests, comparing the mean ratios of masking to nonmasking thresholds with the hypothetical ratio of 1.00 for the 16-segment target under both adapting-field conditions and for the 8-segment target under the light adapting-field condition only. Enhancement would be indicated where these ratios had values significantly less than 1.00. While the mean ratios associated with the 16-segment targets were both statistically significant ($P < .02$), the ratio associated with the 8-segment target was not ($P = .10$).

As a further test of the reliability of the enhancement effect for the 16-segment target, we combined data from the present study for the light adapting-field condition with that from the preceding one (*9*). Of the 12 subjects, 10 had ratios less than 1.00, a distribution which departs significantly from chance as assessed by a simple sign test ($P < .05$).

We are by now fairly confident in the reality of backward enhancement. How might it be interpreted? We favor at this point the following explanation. Any target generates both excitatory and inhibitory effects. Some targets, such as those with many internal contours, generate more inhibition than others, perhaps through the mechanism uncovered by Hubel and Weisel (*10*) in their electrophysiological investigations of retinal receptive fields. For such targets, the masking stimulus serves as a disinhibitor (analogous to the function of the second mask in the case of target recovery). That is, the mask acts primarily to reduce, or transform, the target-generated inhibition, leaving the excitatory component dominant and thereby yielding "backward enhancement." For simple targets, which generate little inhibition (relative to excitation), the mask serves primarily to reduce or transform target-generated excitation, thereby yielding the conventional backward masking effect.

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Buffer Systems and PAGE

The applicability of polyacrylamide gel electrophoresis (PAGE) to the entire *p*H range has recently been achieved. By use of the theory and computer program of Dr. T. M. Jovin we were able to generate 4269 multiphasic (discontinuous) buffer systems and give a complete physical description of these systems which operate at 0° and 25°C, in the cationic and anionic direction of migration. The systems are available in magnetic tape form from the National Technical Information Service (NTIS), Springfield, Va. (PB 196085–196089). The background and significance of this advance has been discussed and a portion of the output for a single, representative buffer system was shown [figure 7 in (*1*)].

A catalog of these multiphasic buffer systems (PB 196090) and instructions for its use (PB 196091) are also available from NTIS at a cost of $3. This catalog allows the user to determine the buffer system number of his choice.

The hardbound copy printout of all these buffer systems requires almost 15,000 pages of full-size computer output. Thus the distribution of these systems was, until recently, greatly hindered by cost, space requirements, and labor involved in printing and storage of the information available in magnetic tape form.

A retrieval program has now been formulated that makes it possible for the user of PAGE to obtain a copy of the system of his choice by entering the desired system number into the computer console (IBM 2741) or teletype machine stationed in the laboratory. Upon request, the desired tape is entered from the tape library into the active memory of a IBM 360 computer, the buffer system is typed out instantly in the user's laboratory, and the tape returns to the library until called again. This service is operative now at the National Institutes of Health only, but should become available over the various time-sharing companies when users will express an interest in the buffer system formulations. To the user of PAGE equipped with computing facilities the new retrieval program is available from NTIS (PB 203016).

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Aerosol Concentrations: Effect on Planetary Temperatures

Rasool and Schneider (*1*) have presented a model for planetary radiation balance which predicts that an increase in the atmospheric burden of aerosol would result in decreased planetary temperatures. We wish to point out that this conclusion is critically dependent upon the assumptions of their model, and that other reasonable assumptions can produce an opposite conclusion.

Specifically, they assume 50 percent cloud cover with aerosol effects operating only in the cloudless fraction; that is, the top of their aerosol layer is confined below the cloud tops. If, however, an aerosol is present above the cloud tops, as is indeed the case (2), then with other assumptions of their model (3) an increased aerosol burden would *decrease* the planetary albedo (4) and thereby would tend to increase the planetary temperature. This effect results from the circumstance that even a small (0.01) imaginary part of the aerosol's index of refraction can, with power-law size distribution, cause the aerosol's absorption to exceed its backscatter. The reverse occurs with water and ice clouds. Thus, even though an augmented upper-atmosphere aerosol would transfer solar energy deposition from the planetary and cloud-top surfaces into the upper atmosphere, it would also result in a net increase of the total, planetary heating rate.

Moreover, many other plausible effects of increased concentrations of aerosols can be suggested which complicate predictions of even the sign of planetary or surface temperature perturbations. For instance, light absorption due to aerosol bands distributed systematically downwind from heavily industrialized regions, such as Europe and the eastern United States, might systematically affect fluid mechanical processes. The increased vertical stability of the atmosphere resulting from increased aerosol heating in the upper atmosphere might influence cloudiness, as also might aerosol nucleation effects.

For all these reasons, we conclude that a prediction of an aerosol-induced ice age is not justified. Just the opposite is possible, but convincing evidence or argument in support of either conclusion is lacking.

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1. S. I. Rasool and S. H. Schneider, *Science* **173**, 138 (1971).
2. R. D. Cadle, *Particles in the Atmosphere and Space* (Reinhold, New York, 1966).
3. Aerosol size distribution varies as r^{-4} (where r is the radius) with 0.01 $\mu m \leq r \leq 10$ μm; index of refraction = $1.5 - 0.01i$; cloud albedo = 0.52 [see (1) and (4) for explicit details].
4. D. S. Ensor, W. M. Porch, M. J. Pilat, R. J. Charlson, *J. Appl. Meteorol.*, in press.

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As with all models, it is clear that the conclusions drawn from the model of Rasool and Schneider (1) are critically dependent upon the assumptions in the model. The problem, therefore, is how closely the model represents the reality.

One of the basic assumptions in our model questioned by Charlson *et al.* (2) is that the aerosol layer is concentrated primarily below the average cloud level (3), and that, therefore, its presence affects only the albedo of the cloudless part of the earth. This effect, as calculated according to our model, is that an increase of a factor of 4 in the optical thickness of aerosols increases the albedo of the cloudless earth from 10 to 15 percent, resulting in a global albedo increase from 31 to 33.5 percent. Because, in the model, the scale height of the aerosol density is ~ 1 km, the aerosol concentration above the clouds is less than that at the surface by a factor of ~ 100. The effect of aerosols on the cloudy part of the earth has therefore been neglected. Charlson *et al.* will be making a valid point if they can show quantitatively that the small amount of aerosol *above* the cloudy part of the atmosphere could *decrease* the albedo of the cloudy half of the earth so as to offset the increase in the albedo of the cloudless half. In the absence of such a quantitative estimate of this effect, no comments can be made on their criticism of our assumptions.

It should be pointed out that the major weakness of our model lies not so much in the adopted values for various parameters, but rather in the fact that it is a "static" model of a "dynamic" atmosphere. We commented upon this difficulty in our report (1) (for example, in reference 14), and it applies to all global-average models. It has also been alluded to by Charlson *et al.*, who mentioned some specific cases of possible interactions between the changes in the radiation field resulting from an increase in the concentration of aerosols and possible dynamic responses of the atmosphere, such as a change in static stability. The answers to these questions can only be obtained by coupling the radiative effect of aerosols or CO_2 to a realistic global dynamic model of the atmosphere, which should also include any effects of aerosol particles on the microphysics of clouds (4). Only then will we be able to predict the ultimate effects of changes in aerosol and CO_2 concentrations on the global climate. Meanwhile, we still believe that multiple scattering computations, even on a global-average basis, are instructive and a necessary first step in the modeling of this problem.

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3. This assumption is based on figure 2 from L. Elterman [*Appl. Opt.* **3**, 745 (1964)], in which an exponential scale height of 1.2 km is given for the variation in the number of aerosol particles with altitude in the troposphere. For this reason, and also because most man-made sources of particles are located near the earth's surface, we felt that it was necessary to assume that atmospheric aerosols (and especially, increases in aerosol concentration related to man's activities) were primarily concentrated below the average cloud-top levels.
4. More detailed discussions of the difficulties in modeling the effects of aerosols or CO_2 on climate are given in chapters 6 and 8 of the Study of Man's Impact on Climate (SMIC), *Inadvertent Climate Modification* (M.I.T. Press, Cambridge, Mass., 1971).
5. One of us (S.H.S.) is supported by a National Academy of Sciences–National Research Council resident research associateship at the Institute for Space Studies, Goddard Space Flight Center.

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