

Letters

"Backlash"

Something more than a year ago one of your editorialists offered wry commentary on the film *On the Beach* [*Science* **130**, 1679 (1959)]. At that time it struck me as most unfortunate that the editorialist devoted all his attention to the dramatic and emotional content of this movie without the slightest suggestion that the film was based upon a scientifically absurd plot. In the year that has elapsed, *On the Beach* has had whatever impact it was capable of having. I believe that, on balance, the film has had a subtly unfortunate impact, and that at least brief discussion of its absurdity from the standpoint of radiology is now very much in order.

As mere symbolism about man's desperate plight in an age of ever more awesome military technology, the film's story of slow but sure extinction in Australia resulting from a nuclear war in the Northern Hemisphere may be acceptable, but *only* in a symbolic sense. To most laymen walking out of the movie houses, however, the story surely came through as a dramatic interpretation of what *could* happen. My own inquiries among residents of Tucson who saw this film lead me to conclude that many in the audiences have since gone on to an exceedingly dangerous inference: If nuclear war would be so totally lethal, no country could be so irrational as to start a nuclear war; hence, nuclear war has its own built-in deterrent. That is, if Australians in the Southern Hemisphere could die like flies when the fallout wafted across the Equator a few months after attack, then clearly all the Northern Hemisphere aggressor's population would have been lethally irradiated weeks earlier. And this being the case, who would ever elect to start such a suicidal action?

The melancholy fact, which all of us should clearly realize, is that the alleged "backlash effect" on a would-be nuclear aggressor would be by no means large enough to constitute a powerful deterrent: *On the Beach* was in error by many orders of magnitude.

To see this, consider a 20,000-megaton nuclear war in the Northern Hemisphere (five times greater than the hypothetical nuclear war considered in the latest Office of Civil and Defense

Mobilization paper exercises). And, to give death the benefit of all possible doubt, assume the weapons to be 100-percent fission weapons, rather than the less deadly 50-50 weapons assumed in recent analysis of hypothetical attacks. Then, scaling up the calculations summarized in 1959 in expert testimony before the Joint Congressional Committee on Atomic Energy [*Biological and Environmental Effects of Nuclear War* (Government Printing Office, Washington, D.C., 1959), especially pages 464-469], we can readily obtain a quantitative estimate of the backlash-cost of nuclear aggression.

If 80 percent of the fission yield descends as local fallout in the *target* areas (we need not specify for the moment whether the 20,000 megatons all fall on the victim country or are split in some way between aggressor and victim, for our concern is with prolonged world-wide fallout), and if we assume, like Machta, Dunning, and other contributors to the cited Congressional testimony, that 75 percent of the residual world-wide fallout is deposited in the latitude belt from 30° to 60°N, then we find that the total external and internal irradiation in the next 35 years after the attack would induce about 250,000 leukemias per 200 million of survivors in the Northern Hemisphere and 50,000 bone tumors per 200 million survivors, when, in order to maximize the effects, no thresholds are assumed. (As for the dosage magnitudes underlying the above estimates, it may be noted that almost exactly half the leukemias are due to strontium-90, which, according to the model used here, is deposited over the middle-latitude zone, including the attacker's homeland, with a density of 8 curies per square mile, yielding about 800 strontium units in man at the end of the food chain.) Just over 1 million tangible genetic defects would be mutationally induced during the roughly 35 years required for 200 million survivors to yield 200 million live births (the corresponding natural-incidence figures for 200 millions over 35 years are about 400,000 leukemias, 70,000 bone tumors, and 4 million tangible mutations).

Now, if all the 20,000 megatons went off in the victim country and the aggressor's untouched population were just 200 million, the *upper* limit to the

backlash-cost of aggression, which is the chief concern of this letter, is provided by the figures given above. Horrible as is the human meaning of those numbers, we must recognize that the price is such as to be considered negligible by any and all *military* standards. The price Germany and Japan paid for electing aggression in World War II—a total of 4 million German and Japanese military deaths, paid out all in one comparatively short period—was so very much greater than the backlash price of nuclear aggression, amortized over a 35-year period, as to make it starkly obvious that no built-in deterrent of the kind suggested by *On the Beach* can be relied upon to protect the world from nuclear aggression.

Instead, the actual situation appears to be one in which weapon technology is rendering aggression more and more likely on the terribly simple ground that, in a period of great international tension, a worried nuclear power may feel it cannot afford *not* to strike first. Thus, *On the Beach* produced a comforting but extremely dangerous misinference. A massive nuclear attack would not produce a backlash of fallout of deterrent magnitude on an aggressor country that lay thousands of miles downwind from the target country. Neville Shute and Hollywood widely missed the mark, and I fear that more than a little mischief has been done thereby.

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The Scientist and the Dominant Danger

I would like to comment on the address by Sir Charles Snow [*Science* **133**, 256 (27 Jan. 1961)]. It seems to me that the meat of his remarks may be summarized in two statements. First: Scientists have direct technical knowledge in areas of political relevance, and since they are required by training to be moral individuals, they must accept a special responsibility—a greater one than that of mere citizens. Second: Without test cessation we face a certainty of disaster, while with it, we have a chance. (The implicit conclusion is that Western scientists must with great verve lead their countries to permanent and, if necessary, unilateral cessation of nuclear weapons testing.)

I have not observed that scientists are any more or less moral outside of their metier than are professional people generally. May I remind Sir Charles that Benjamin Thompson (Count Rumford) was both a notable