Comment on "The Use of Asphalt Coatings to Increase Rainfall"

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The suggestion that rainfall might be artificially increased by asphalt coatings laid on the ground is indeed intriguing, and studies of the influence of such heat sources on air flow have in the past been very fruitful. However, the suitability and accuracy of the computations made by Black and Tarmy (1963) are questionable, and the sanguine economic expectations expressed both in the abstract and text of their article are little likely to be realized.

Although the idea of calibrating the rain-stimulating effect of an equivalent thermal mountain by comparison with real mountains appears sound, the application of the principle by Black and Tarmy is open to several objections. While they predicate the effectiveness of the asphalt strip on extraction of rain from "weak disturbances or from the undisturbed atmosphere," the principal rainfall of the chosen calibrating regime in North Africa comes rather from overcast skies during and after cold front passages behind active Mediterranean cyclones in the winter season. The citation of Riehl (1949) is likewise inapplicable here and in similar situations since, after establishing that in northern Oahu large disturbances tend to produce general and heavy precipitation, he goes on to remark that this is "in marked contrast to observations in other parts of the world, for instance at the California coast, where the difference between rainfall on the windward and leeward sides of the mountains continually increases with storm intensity," an effect which he ascribes to the orientation of the mountains parallel to the coast.

In the second place, in three of the four cases illustrated in Fig. 3 (Black and Tarmy, 1963) the mountain and rainfall profiles do not conform to the picture where "mountains . . . average 20 to 30 inches of annual precipitation in contrast to only 3 inches on nearby flat coastal zones. In three of the four illustrations the rainfall maxima lie 80 to 125 miles upwind of the height of land and appear much more closely related to the water than to the mountains, not a surprise when one considers that the warmth of the water is the principal source of instability during the rainy season rather than the warmth of the land, which in winter is not very effective; and in the fourth illustration the rainfall maximum appears downwind of the mountain ridge, that is to say, beyond the end of the equivalent asphalt strip.

Finally, it might be asked whether a mountain ridge athwart the wind is the best approximation to the equivalent mountain of an asphalt strip aligned with the wind.

With respect to Black and Tarmy's economic evaluation, the irrigation of 2 acres with 30 inches of water or of 3 acres with 20 inches from each acre of asphalt would seem to require collection of 60 inches per year on the average from the asphalt strip. Since the rainfall nowhere attains this high a value in any of the four examples of Fig. 3, this reader is left wondering from whence the figures came. If the average of the four examples of Fig. 3 were taken, the values of Fig. 5 would be two to three times too large.

Nor should it be assumed that an inch of water can be collected from an inch of rainfall; the high losses that rainfall suffers before being deliverable to an irrigation system make such an assumption useless. The assumption that rainfall in an area of 10 to 15 inches or more annual rainfall can be gathered and delivered to irrigate another area would be more acceptable if there were a case where this has proven practicable. Virtually all irrigation systems draw water from often not arable land, where the annual precipitation is relatively high. In an instance with which this correspondent is familiar, of an irrigated zone in Peru, a catchment area where the annual rainfall exceeds 30 inches over an area of about 2,000 km^2 serves the irrigation needs of about 200 km^2, nor could the irrigated area be much increased without recourse to season-to-season storage. The asphalt strip is at a special disadvantage when called upon to double as a catchment, because its temperature advantage then serves greatly to increase the losses by evaporation. A further loss in the utility of the water arises from the fact that losses are greatest when rainfall is lowest and hence the agricultural need is most pressing, and from the other extreme when excessive rainfall outruns the capacity for distribution and use and may threaten severe flood damage. For the same reason, the cost comparisons of Table 2 are meaningless unless reliability and the values that attach to availability from the several sources at the time and place needed are likewise compared.

It is clear that the asphalt strip aligned with the wind produces an equivalent mountain in the form of a ridge aligned with the wind. A conical mountain as studied by Förchtgott (1951) is therefore a closer approximation than a cross-wind barrier ridge. The situation of the Sierra Nevada de Santa Marta, on the north coast of Colombia in the northeast trades, in general verifies Förchtgott's model except that the rainfall maximum in the lee of the massif is considerably stronger than the two over the upwind shoulders (López and Howell, 1961). The inference is that the equivalent mountain of the asphalt strip will produce convergence and possibly rainfall principally at some distance to leeward of the end of the strip, and this inference seems well borne out in the companion article by Malkus (1963) with respect to Anegada. From this it would appear that the best experimental design would be to plan the asphalt strip pointing downwind toward an arable zone which would be watered directly by the showers trailing from the strip.

While the use of free solar energy for this experiment is attractive, one might ask whether atomic energy used to boil sea-water and thus add both heat and vapor to the air along a short strip of coastline would not be cheaper and more flexible.

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