

It has been the purpose of this article to show that—

A. Owing to the popular form in which these expectations are produced, Capt. Cave formed an erroneous conception of their aims, so that his arguments were unsound and his conclusions misleading.

B. A careful examination of a series of diagrams indicates that

- (1) Variations from week to week are not great, and generally tend towards improvement as time advances.
- (2) Although it is not claimed that rain amounts are correctly anticipated, the peaks and dips of the expectation curves correspond with those of the facts curve in many cases to the actual day, and in most cases to within 24 hours.
- (3) There is a degree of correspondence between expectations and facts which cannot be wholly due to chance.

C. The above is confirmed definitely and conclusively by the calculations based on the theory of probability.

If these propositions are accepted, and it would seem hard to dispute them, then it must be agreed that the claims made in the *Daily Mail* are more than substantiated, and that what Capt. Cave condemns as no better than fortuitous prediction has been proved to be something of the order of a billion times better, and represents in fact a notable advance in meteorological science.

R. P. BUTLER.

CAPT. BUTLER complains that my weather and forecast numbers are unfair, and appeals to the *Daily Mail* for April 30. The only relevant sentence seems to be that the greater the height of the curve above the datum line the greater the probability of rain, but not necessarily the amount of rain; I do not think that this fact invalidates anything I have said. I have already explained the method of comparing the forecast diagrams with the weather, and I am quite content to leave it to the readers of NATURE to say whether the method is fair or unfair.

It is also said that the forecasts are not meant to be day-to-day forecasts; they are, however, given in a day-to-day form, and are, I think, generally so taken by the public; Capt. Butler, however, emphasises the point and says that the author is quite satisfied if the timing of his expectations is correct within twenty-four hours either way. The number of wet days with 0.04 inch of rain or more is about 120 in the year for the south-east of England, or one day in every three; any one forecasting rain for to-day and claiming a success if rain comes yesterday, to-day, or to-morrow, is putting his forecast in a very favourable position. If one were to forecast

by drawing counters out of a bag, the successes under the above conditions would be very marked.

I do not understand Capt. Butler's complaint that I only took one forecast for each week for the purpose of comparing them with the weather in my diagrams. I took the complete week nearest to the actual happenings as being the most fair to the author. Capt. Butler says that each 50-day forecast has a character of its own, which is exactly what I maintained. I have selected one of the seven varying forecasts for each week and compared it with the actual weather, and I have done this for the whole period from April 15 to Oct. 27. To say, as Capt. Butler does, that doing this is like "criticising a 12-hour forecast by examining the weather of 103 minutes out of each day," seems to me to be a statement devoid of meaning. If the forecasts are in the main similar, there is nothing unfair in taking any one in preference to the six other forecasts for the same week; if they differ, it is reasonable to suppose that the one nearest to the period for which the forecast is made would be the most correct; I therefore took the first complete week of the latest forecast. Capt. Butler's diagrams show exactly what I maintained, that the forecasts for each week vary so materially as they are issued week by week that they cannot all be guides to the coming weather. Nor are his diagrams of facts compared with forecasts very striking. I pointed out that August was a particularly favourable month for the forecasts, especially in south-west England; I do not see anything very remarkable in the diagrams as extended to July and September.

The method of the forecasting is still wrapt in obscurity on the plea that to disclose the method would be an act of disloyalty to those who have backed the forecasts. Such an attitude to scientific truth has probably never before made its appearance in the pages of NATURE. It precludes one from examining the worth of the forecasts except in so far as the results declare it, and nothing that Capt. Butler has brought forward changes my opinion that chance operates largely, if not entirely, in the relation of forecasts to facts. His probability figures do not impress me very much. He has evidently treated each of the seven weekly forecasts as entirely independent, which he himself claims not to be the case. If they were not treated as independent variables, I fancy that the impressive figures he brings forward would dwindle to very modest proportions. In any case he has attempted to prove too much; if the forecasts are a billion times better than would be expected on pure chance, failures should practically never occur, whereas it is obvious, even from his own selected diagrams, that the method cannot be relied on by the farmer for his agricultural operations, or by the man in the street who wants to know whether or not to take out his umbrella.

C. J. P. CAVE.