

the event approaches the true mean as a limit. Since the two values are constant, their ratio is constant for a given stream; in other words, the ratio ϕ_1 to ϕ_a approaches a constant limiting value as the duration of the record increases.

Now, for different streams in the same region, the causes which operate to produce floods operate in the same way, but in different degrees both for different streams, and for different floods of the same stream. Apparently any condition which tends to increase the maximum flood stage increases the average flood state in about the same degree, consequently the limiting values of the ratios of ϕ_1 to ϕ_a may be very nearly the same for different streams in the same region.

THE RELATIONS OF WEATHER AND BUSINESS.¹

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[Excerpts.]

Agriculture is, and probably will be for generations, the main business of this country and the main foundation of its continuing welfare. Agriculture is largely dependent upon the weather for its results, especially in those sections and States west of the Mississippi River, where the annual precipitation sometimes varies from 10 inches to 30 inches. Obviously, any intelligent and reasonably accurate long-distance forecast of the probability of weather happenings will be of incalculable value to the business world in such States and sections, seeing that all business in such regions hangs largely upon the results of agricultural production. * * * Such a forecast, in the present state of our knowledge of the weather can not possibly be absolutely accurate, as everyone would certainly, even though unreasonably, expect it to be. * * *

[Some attempt at such a forecast] has been essayed by the committee on statistics of the Chamber of Commerce of the United States, as set forth in their two bulletins, "The Relations of Business and Weather in Relation to Rainfall" and "In Relation to Temperature" [1919]. The general method followed in this investigation, extending over a long number of years, concerned itself as much with personal travel and study in every section of the country as with mere analysis of figures. For instance, the observer learned that two most important features of the effects of drought upon growing plants, especially corn, in the Great Plains States are as to whether such droughts were marked by the presence or absence of exceedingly high temperatures and hot winds. * * *

The basis of the two bulletins of the committee on statistics is [that] the weather has a tendency to recur in the way of the extremes of heat and cold, rainfall, and the lack of it. Also, in common with most other things in nature, that the same kinds of seasons have a tendency to flock together in the way of the association of dry years with dry years and wet years with wet years for a comparatively brief period. There are unexpected exceptions to this tendency, but in an experience of a number of years this general statement has proved to be fairly reliable for business purposes in from 75 to 80 per cent of the time—which of course is rather better than guessing or trusting to that rather absurd law of averages in such a case, or consulting the wishbone of the goose or a local almanac. * * * So it was perfectly immaterial for the purposes of practical business, whether the theory proved mathematically correct when it indicated, some months in advance, the mild open weather of the winter

of 1918-1919 and the wet spring and summer of 1919 for the locality of St. Louis and vicinity; also the comparatively colder autumn of 1919 as compared with the similar period of 1918.

[In the southern Great Plains, which for two or three years previous to 1919 suffered from severe drought, and in the northern Great Plains, where a long drought ended in the fall of 1919, it is reasonable to expect relatively favorable conditions in 1920.]

Let us consider the value of a possible forecast of the weather, some months hence, in relation to the sale of what are known as seasonable goods, namely, goods which sell only at certain seasons and then because of the prevalence of certain kinds of weather. Lawn mowers, for example, in wet weather because grass grows best then, and rubber hose naturally sells best in dry weather. These goods have to be made up by the manufacturer and contracted for by the distributor many months in advance of their actual use by the consumer. Whether the weather be wet or dry very seriously affects the sale of both of the lines. Now, suppose a distributing house handling both lawn mowers and rubber hose wished to find out in August, 1918, about how they should order these goods for the coming season of 1919 compared with their sales in the season of 1918 just past. The theory I have spoken of forecast very definitely a wetter spring and summer in 1919 than in 1918 in the vicinity of St. Louis, and that is exactly what happened. Now, suppose this same house wished to know in February, 1919, what kind of an autumn and winter 1919-20 would prove, as to temperature and snowfall, as compared with the similar season of 1918-19, as affecting the sales of ice skates and snow shovels. The theory answers, a somewhat colder autumn and winter and rather more snow. Now, these incidents are the stories of actual happenings. It needs only a little thought to have you realize the far-reaching benefit to business of any system of weather forecasting which will indicate, if only approximately, what kind of weather may be expected in the near future. * * *

DISCUSSION.

Prof. A. E. Douglass called attention to the fact that the recent drought in the southwest was the worst since 1821.

Mr. A. W. Douglas showed that the climate in the southwest has not changed, but that after two or three years of unusual rainfall a dry year may be expected. Business men in that region, however, have gone on preparing for more wet years.

Prof. J. Warren Smith mentioned that a tabulation of 35 winters in Ohio have indicated, as Mr. Douglas had pointed out, that the general character of a winter could be determined by probability.

Prof. H. J. Cox said that the studies of Mr. Douglas are rather more of probabilities than meteorology, and inquired if there is any reason to suppose that a warm winter will follow a warm one.

Dr. C. F. Brooks replied that these changes in the character of the winter are controlled by centers of action, and if, in turn, through such studies as those of ocean temperatures, the general forecasting of the location of such centers of action can be accomplished, the general character of the season can be forecast with more basis than simple probability.

Dr. F. L. West remarked that the prospective purchaser of a water power plant in Utah inquired concerning the relation of the rainfall of the last 10 years to the 35-year mean and found that it had been 25 per cent in excess of normal, whereupon he was somewhat skeptical regarding his purchase, since the succeeding years would probably not yield so much water power.

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