DISCUSSION

OBSERVATIONS ON FORECASTING ANNUAL CHANGES OF CROP YIELDS

IN an era when the control of production of leading crops is a watchword and when the problem of anticipating the output of the land placed under cultivation bears important economic implications, attention can be drawn very properly to changing ideas about the methods of forecasting acre yields.

Interest in making prophecies about the levels of crop yields was stimulated by the extension of higher mathematics to statistical problems. As the processes of multiple correlation became familiar, simple correlation for some unexplained reason remained fashionably taboo for many minds. The time is still not remote when the pursuit of elusive independent weather variables was a favorite indoor sport, and the monthly climatological sheets of the U. S. Weather Bureau provided a convenient hunting ground for the chase. The common practise was to plot an appropriate yield series first against precipitation, then to check the residuals from a fitted line against temperature. If this combination failed to produce the desired results another was tried until, after repeated trials, a reasonably high degree of correlation occasionally was obtained—but more often not! It is probably safe to say that the actual number of cases where success was achieved was few compared to the energy expended. A great deal of time, and in many instances money, was wasted in the blind faith that the magical combination of variables necessary for deriving an efficient regression equation would be discovered on the next search.

The futility of the old hit-or-miss system has given way to a new order of simplicity. All the impressions necessary for arriving at a conclusion are no longer thrown into a complex statistical hopper. The transition was occasioned perhaps more by the limitations of materials worked on than by the tools employed. The conviction grew that the number of the climatological forces, influencing growth and production, which could be taken into account, was insufficient to permit forecasting with confidence. A further restriction appeared in the fact that cases developed in studies on several crops where sets of independent weather variables were numerically the same or nearly so in different years, and yet the yields of these years were substantially unequal. This circumstance indicated the possibility that the degree of relationship between yield and factors regarded as being associated with it was changing with the passage of time.

Shifting correlation is a hurdle difficult to surmount whenever it occurs, but is especially perplexing in crop forecasting problems which deal with the weather. The hope may be expressed that research directed toward the isolation of definite climatic cycles eventually may throw some light on the causes of this statistical disturbance and indicate a means of coping with it. Meanwhile practical forecasting must proceed along lines of common sense and be devoid of ill-advised efforts to achieve by weird demonstrations of high-powered curve fitting what is at present impossible.

Current procedure in forecasting represents both statistical and non-statistical judgment. A single weather series is used in a simple correlation set-up with yield. The prediction arising therefrom is then modified as information comes from the growing area concerning crop conditions. The accuracy which is obtained by use of this system—embracing to an appreciable extent both quantitative and qualitative conclusions—compares favorably with the results formerly obtained. It is probably safe to say that the experienced estimator can amass a creditable record for having his prophecies come true within reasonable limits without resorting to the use of complicated technique at all.

Several years ago the writer discovered that a valuable preliminary impression for making a forecast frequently can be obtained months before weather information is available or the crop is even planted. This can be accomplished by taking advantage of the existence of negative correlation between the ratio of the yields of two successive years (dependent variable) and the yield of the first of these years (independent variable). A regression line is fitted to a suitable number of observations. The line is of the form $\frac{y}{x} = a - bx$, in which y = the yield of a specified year, x = the yield one year preceding, and a and b are constants to be determined. Usually when a ratio is correlated with one of its own elements, as in certain physical problems, the numerator and denominator are of different basic series. In the present case, although taken a year apart, they are both of the same series. The distinctive character of this type of relationship suggests that it may be designated appropriately by the term auto-variation.

Sometimes the relationship established between the variables, by use of such simple technique, is very favorable. For example, a study of the acre yields of flue-cured tobacco (Old Belt, Type 11), as published by the U. S. Department of Agriculture for the period 1910–1931, revealed a coefficient of correlation of -0.895 after the removal of secular trends. No extravagant claims are made, however, about the application of the principle of auto-variation to crop forecasting problems. It is used merely as one basis for formulating a judgment. The writer has experimented with it in about 25 different cases involving tobacco, cotton, wheat and corn. Presumably it can be extended to other crops. In every case where it has been tested the ratio of the yields of two successive years and not the absolute yield of the second year has served as the dependent variable. If for some reason primary statistical interest should rest on the absolute yield, instead of the annual change, the method outlined would have to be modified and a curve of the form $y = ax - bx^2$ fitted to the observed data. In actual practise the need hardly arises for following this alternative procedure.

Simplifications which have been effected in the technique of forecasting still leave ample ground for further improvement. Econometricians familiar with this field perceive that the day is not yet in sight when the extent of an annual crop change can be foretold with anything like complete accuracy. The results of climatological investigations eventually may help to clarify the reasons for errors which are made. Measurements of the periodicities of possible component curves of the total solar energy curve by Dr. C. G. Abbot, of the Smithsonian Institution, are being regarded in a sympathetically critical and hopeful spirit. Likewise the studies of Dr. A. E. Douglass, of the University of Arizona, on tree rings as a medium for determining annual growth variations of the past, and of the staff of the Scripps Institution of Oceanography of the University of California on the relationship between ocean temperatures and solar energy, are being watched with interest. The suspicion persists that if the research of these and other investigators should lead ultimately to the development of long-range weather forecasting on a practical basis, long-range crop forecasting also may follow. In that event both the old methods of predicting crop yield changes and those lately developed will be revealed at best as being only makeshift attempts.

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IS METHYLENE-BLUE ANTI-CARCINOGENIC?

WARBURG[1] in his study of yeast found methylene-blue to counteract the effect of carbon monoxide and potassium cyanide. This protective action of methylene blue upon the respiratory enzymes was extended by Sahlin,[2] Eddy[3] and Brooks[4] to small mammals, and ultimately by Geiger[5] to human cases.

Now, as already shown,[6] malignant growth is based upon the suppression of respiratory enzyme (oxidase-dehydrogenase) activity by (a) dietary enzyme depletion and (b) environmental inhibition.

In cases where malignant growth is dominated by such specific industrial conditions as the effect of coal-tar and mineral oils, we find the respiratory enzymes are influenced by definite carcinogenic substances such as 1:2:5:6 Dibenzanthracene, 5:6 cyclo-penteno, 1:2 Benzanthracene, 1:2 benzpyrene, etc., the activity of which may perhaps be likewise counteracted by methylene blue.

Some support to such a possibility is afforded by (1) the action of carcinogenic substances upon the dehydrogenase group of enzymes,[7] (2) the existence of anti-carcinogenic substances, as, for example, dichloro-diethyl sulphide (mustard gas),[8] and (3) the intimate connection existing between respiratory enzymes and certain coloring matters,[9] the function of the latter being that of a co-enzyme rather than substrate.

Bearing in mind the colloidal nature of the enzymes in relation to the whole system of their contact and inductive activity—the characterization of the cancerous cell by its abnormal state of colloidal dispersion and the suggested extension of Bancroft's physico-chemical corrective treatment to such malignant cell colloids[10] is also in full accord with the conception put forward here.

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COURSES IN THE LITERATURE OF BOTANY

FOR several years, the writer has been developing a graduate course entitled "Literature of Botany," the aim being to acquaint advanced students with classic and current literature related to botany. This work has proved both difficult and interesting, having opened new worlds of botanical thought, appreciation and knowledge. Since the work has been crystallizing, it was thought desirable to compare the course with similar courses in other educational institutions. This led to the study of the university and college catalogues which were on file in the Kansas State College library. With few exceptions the 1931–1932 catalogues were available. The institutions which included courses in botany in their curricula totaled 545. Of these, 20 were outside of the United States. Of the 545 institutions, only six offered courses in or including literature of botany as such. These are as follows: University of Montana, "Botanical Literature"; University of Nebraska, "Botanical Literature"; Kansas State College, "Literature of Botany";