absolute values, the coefficients of variability and of correlation as relative values. It seems to the reviewer that the latter, rather than the former, are absolute values; for they are the ones that are independent of the units of measurement used. The point is not one that is likely to cause confusion, as it is at all times clear what the authors mean.

In the chapter on species hybridization the "reaction system" idea is discussed at some length. According to this hypothesis, which has been developed by Goodspeed and Clausen on the basis of their species crosses with tobacco plants, the whole group of genetic materials of a species (the "reaction system" of that species) may behave as a single unit, or nearly so, in influencing dominance and viability in hybrids. The term "reaction system" seems to the reviewer to be rather unfortunate, as it is commonly applied to any system that is undergoing change, organic or otherwise. There can be no question of the very great interest of the facts that have been discovered by Goodspeed and Clausen, but in the opinion of the reviewer more detailed evidence is needed, especially as regards the cytological behavior of the F_1 hybrids, and the genetic behavior of the plants produced by back crossing the F_1 to both parent species, before the conception can be adopted as more than an interesting suggestion.

In parts 2 and 3 a large amount of data bearing on the genetics of domestic animals and plants has been brought together, and has been presented in a thoroughly scientific manner. This makes these sections useful also to the non-agricultural geneticist. To the practical breeder these sections should be invaluable, not alone because of the genetic data they contain, but also because of the discussions of methods of securing and recording information, and of the practical application of genetic knowledge. The chapter on beliefs of practical breeders is especially noteworthy; it gives in concise and convincing form the evidence against telegony, maternal impressions, and similar notions sometimes held by breeders.

The subject of eugenics is treated only very briefly and incidentally, and even then with a word of warning as to the reliability of the conclusions reached. No attempt is made to take advantage of the great popular interest in eugenics by exaggerating the importance and significance of the results that have been reported.

The authors are to be congratulated on a book that is well printed, well illustrated, well written, and that contains a surprisingly large amount of material that is conveniently arranged and adequately presented.

A. H. Sturtevant

SPECIAL ARTICLES

A NEW GRAPHICAL METHOD FOR COMPARING PERFORMANCE WITH PROGRAM OR EXPECTATION

The graphic method is generally recognized as a most important means to interpret facts to administrative executives as well as to the public. For the sake of simple comparison the well-known bar diagram (besides many other diagrams) is, of course, frequently used, but the latter, especially in the case of a variable delivery or production against time and a fixed quantity (requirements or expected production), loses its value. This characteristic rigidity of the bar diagram permits analysis of only one particular instant of the situation, with no reference to the past or future. For instance, if the total output of flour of a certain milling division starting from January 1, 1918, up to, let us say February 9, 1918, is expected to be 1,314,000 barrels, and up to

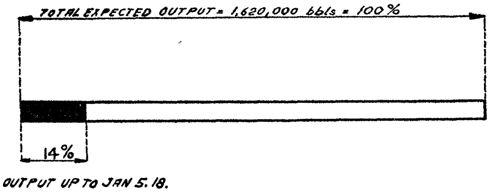

Fig. 1.

January 5, 227,000 barrels of flour have been manufactured, the situation expressed by a bar diagram (Fig. 1), using the expected output as a 100 per cent. basis, would be:

Total expected output = 1,620,000 barrels = 100 per cent.

Output up to January 5, 1918 = 227,000 barrels = 14 per cent.

We can see readily that no conclusions whatever could be drawn as to the output rate or as to the actual number of barrels of flour which should have been manufactured up to January 5, 1918, if the goal is to be reached on February 9, 1918. Besides that the bar diagram requires each time, when the output has been increased, a new calculation of the output in percentage of the total expected output.

To overcome this difficulty and especially to avoid the constant recalculation and redrawing of the bars a more efficient graphic method was devised. The new method with its new diagram automatically takes care of the whole period in which production is expected.

The expected output after having been carefully calculated is based on a uniform production rate throughout the given time. Graphically expressed the requirements or the expected output are a straight line, the tangent of which is the production rate or as shown in Fig. 2.

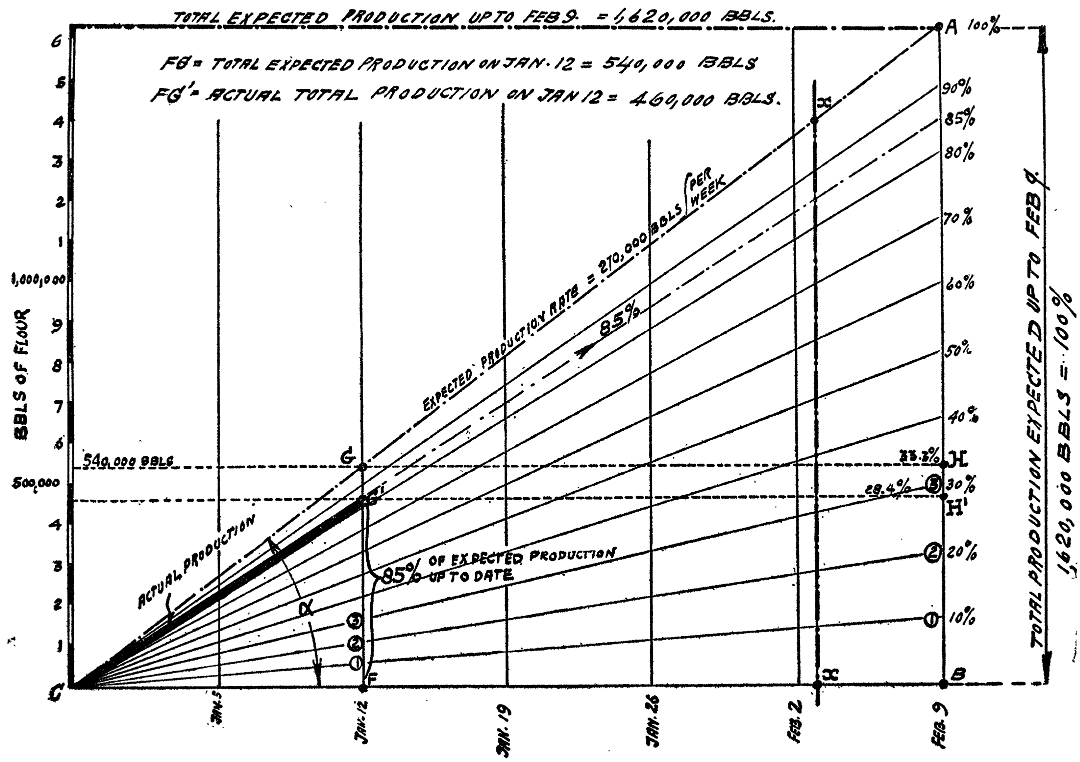

FIG. 2.

$$tg\alpha = \frac{\text{Total expected production}}{\text{Total time}} = \frac{AB}{CB}$$

$$= \frac{1{,}620{,}000}{6} = 270{,}000 \text{ bbls. per week.}$$

Based on this average uniform production rate the total required production at the end of the sixth week (February 9, 1918) would be

$$270{,}000 \times 6 = 1{,}620{,}000 \text{ barrels.}$$

For any time interval the total expected production can be easily deducted from the following proportion (Fig. 2):

$$CB : BA = CF : FG,$$

FG being x,

hence

$$x = \frac{BA \times CF}{CB} \text{ or in figures,}$$

$$x = \frac{1{,}620{,}000 \times 2}{6} = 540{,}000 \text{ barrels,}$$

which represents the required production of the milling division for a two-weeks period.

If now the line AB is divided into 10 equal parts, then $AB/10 = 10$ per cent.; $2 \times (AB/10) = 20$ per cent.; $3 \times (AB/10) = 30$ per cent., etc., of the total expected output. From the preceding it is clear that a line drawn through point G, parallel to BC, (Fig. 2) which intersects with the vertical line AB in H will express in its total magnitude BH the amount of barrels of flour manufactured *up to date* in per cent., of the total expected production (requirements) or:

$$\frac{540{,}000}{1{,}620{,}000} = 33.3 \text{ per cent.}$$

If furthermore FG is divided into ten equal parts and FG–1 is connected with AB–1, and FG–2 is connected with AB–2, it is easily seen that all vertical lines between C and B, for instance X—X, are also divided into 10 equal parts, and as the magnitude of all vertical lines represents production, we can express the actual production in two ways:

1. Production in *percentage of total production or output at the end* of the expiration date (in our case February 9, 1918),

or

2. Production in percentage of the total production up to *any period between* the start of production and the expiration date.

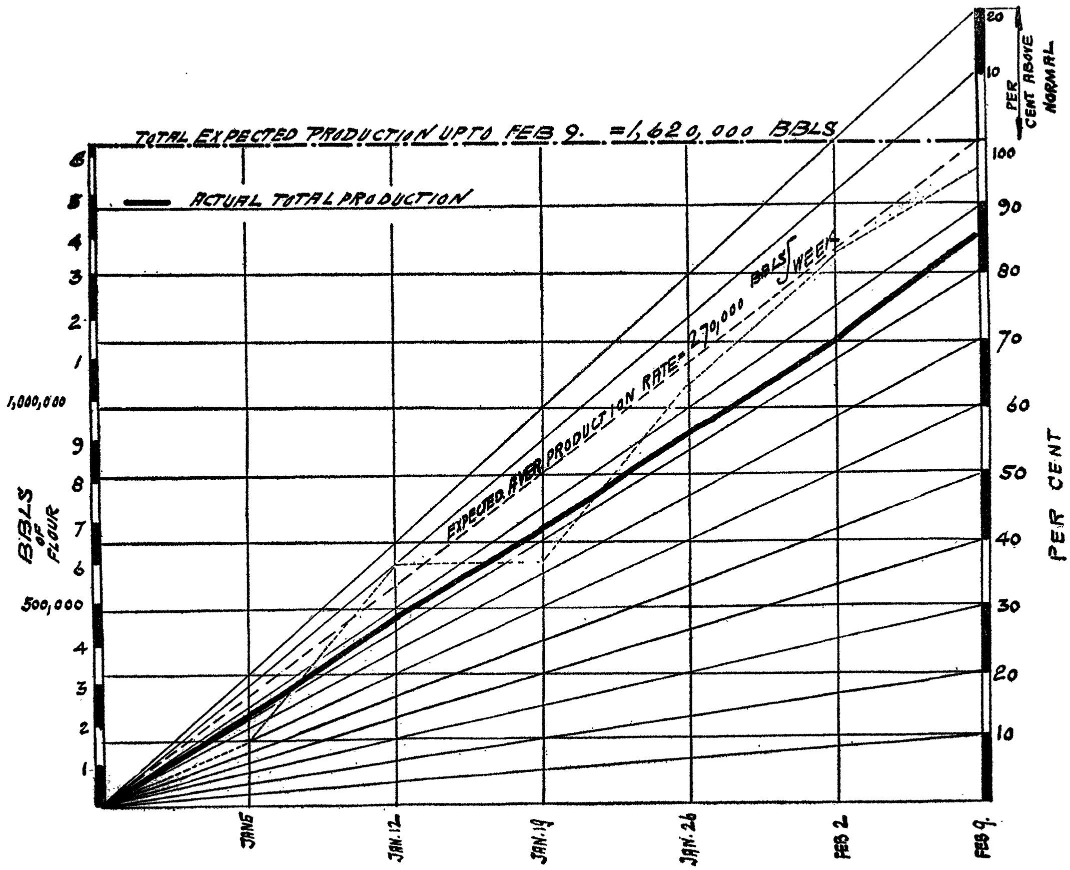

Fig. 3.

To illustrate that; if for instance the total production of a milling division up to January 12 should be 460,000 barrels instead of the expected 540,000 barrels production up to January 12, 1918, equals the magnitude of

$$FG^1 = \frac{460,000}{540,000} = 85 \text{ per cent. (Fig 2),}$$

which is the total actual production up to January 12 expressed in percentage of the total expected production up to *that date*. The other 15 per cent. are a *deficit* which can only be equalized through an *accelerated production rate* during the rest of the time which is available for production. Whereas:

$$\frac{460,000}{1,620,000} = 28.4 \text{ per cent.}$$

is the production of the milling division expressed in per cent. of *the total* production in barrels expected at the *expiration date* of the total time interval in question. Both instances are easily recognized in the diagram and read off on the right-hand scale. The left-hand scale in the diagram gives the *actual* number of barrels of flour *produced*. Through this graphical method all the different functions which are at work during the total production period are easily analyzed and are thus made available to the executive for rapid information and decision.

In the following one simple case of the design of such a diagram (Fig. 3) is given with the statistical data. Given:

Expected Uniform Average Weekly Production Rate: 270,000 barrels.

Time: 6 weeks.

Total Expected Production at the End of Sixth Week: 1,620,000 barrels.

ACTUAL PRODUCTION, PER WEEK ENDING

Actual Production During the Week Ending in Barrels		Cumulative Barrels
January 5	227,000	227,000
January 12....	233,000	460,000
January 19....	211,000	671,000
January 26....	237,000	908,000
February 2 ...	231,000	1,139,000
February 9 ...	246,000	1,385,000

The actual production line shows that the production during the entire period has been about 15 per cent. behind the expected output. Suppose, to show the universality of the diagram, production would have been according to the next table:

Actual Production During the Week Ending in Barrels		Cumulative Barrels
January 5	170,000	170,000
January 12....	430,000	600,000
January 19	No production. Strike	600,000
January 26....	430,000	1,030,000
February 2 ...	320,000	1,350,000
February 9 ...	200,000	1,550,000

If these facts are plotted (as shown by light dotted line) the diagram will give the following analysis: On *January 5* only 60 per cent. of the expected output was produced.

On *January 12* the production rate was above normal and therefore the intersection with the "above normal line" indicates that 10 per cent. more than expected was produced.

On *January 19* the mills were not in operation on account of labor trouble. The parallel line indicating no production.

On *January 26* again about 95 per cent. of the expected output up to date is produced.

In this way all actual production phases against time and requirements, expected deliveries or needs can be graphically analyzed.

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THE SPECIFIC CONDUCTIVITY OF WATER EXTRACTS OF WHEAT FLOUR[1]

THE attention of cereal chemists has long been attracted to the development of methods for determining the grade of flour and meals. As early as 1884 Girard[2] suggested a procedure for estimating the proportion of fibrous structures in a cubic millimeter of the material. Vidrödi[3] (1893) called attention to the close parallelism between the grade of Hungarian wheat flours and the percentage of ash which

[1] Published with the approval of the Director as Paper No. 123 Journal Series Minnesota Agricultural Experiment Station.

[2] Girard, A., *Ann. d. Chim. et de Phys.*, 6 ser., 3, 293, 1884.

[3] Vidrödi, *Ztschr. angew. Chem.*, 1893, 691.