

1918

Graphic charts for the business man

Stephen Gilman (1887-)

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GRAPHIC CHARTS FOR THE BUSINESS MAN

ONE OF A SERIES OF LECTURES IN A SYSTEMATIC COURSE

STEPHEN GILMAN, B.Sc., C.P.A.

Formerly Credit Manager Tennessee Coal, Iron & Railroad Company

La Salle Extension University

Chicago

BC-7



**GRAPHIC CHARTS
FOR THE BUSINESS MAN**

STEPHEN GILMAN, B.Sc., C.P.A.

Formerly Credit Manager, Tennessee Coal, Iron & Railroad Company

La Salle Extension University

· Chicago ·

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GRAPHIC CHARTS FOR THE BUSINESS MAN

The remarkable success of the moving-picture industry has one important lesson for the American business man. It has convinced him as nothing else could, that the most effective appeal to the public is through the eye—not by print, but by *pictures*.

This same peculiarity of human nature has been taken advantage of by the skilled advertising man. The magazine advertisement without illustrations is almost so rare as to excite comment.

The reason is obvious. A picture is universal in its appeal. It can be understood by the American or the Chinaman, by the Spaniard or the Hindoo without difficulty.

Printed words, sentences, and paragraphs, on the other hand, are distinctly limited in their appeal. The reader must get the author's meaning through a secondary medium, and not *direct*, as in the case of a picture.

The engineering profession has for many years recognized this trick of human psychology. Engineers use pictures to convey engineering facts. The kind of pictures which they use are termed "graphs" or "graphic" charts."

WHAT ARE GRAPHS

These graphs are merely "pictures of figures," sort of visual ledgers. Their function is to present to the

mind in a definite, clear, and comprehensive manner, the relation of important factors to one another.

Within the past half-dozen years accountants, credit men, production managers, sales managers, advertising men, and general business executives have come more and more to realize how greatly graphic charts may help them in their work.

Long rows of figures must be thoroughly studied in order to convert them mentally into *quantities* which may be compared as to size. This is a tedious task which many executives have learned to dread. The reason is a simple one—a row of figures does not tell a story of itself. A somewhat involved mental process is required to grasp fully the real facts.

The use of graphic charts or “curves,” as they are sometimes called, permits more rapid and accurate interpretation of data. Pages and pages of valuable figures might be laboriously prepared, yet they have little value unless *studied* as an aid to administrative guidance. A simple chart may convey more real information than the most elaborate written report. Always, of course, it is necessary to discriminate between important and unimportant data. There is a proper and an improper use for charts.

Collecting the statistics is only half the battle. The *method* of presentation is fully as important as the data itself. The charts should be put up in such inviting form that they will be studied by the executive. For example, anyone can write an advertisement, but the real art consists in so writing it that its attractiveness will make people want to read it.

We have, in the graphic chart, a mighty instrument for executive control—a mechanism which sifts figures, abolishes detail, and makes important points stand out, thus giving all the necessary information to the execu-

tive at a glance. It makes possible, without mental exertion in reading, accurately measured information of deviations and permits vital comparisons. Certain charts give the present status and indicate the trend. Abnormal conditions are shown by unusual "peaks" and "valleys." The executive should watch chance happenings. Properly used, a graph is simply an aid for executive judgment, never a substitute.

The extensive use of charts and curves in corporate reports furnishes ample demonstration of the high regard now held by business men for the graphic form of fact presentation.

COST OF CHARTS

In addition to the great utility of graphic charts, another splendid argument in their favor is the low cost of constructing and maintaining them. The materials are cheap, and it does not require a highly paid man to plot the data in graphic form. The operation is a simple one, involving only painstaking accuracy. A cost of one dollar per chart per year is the figure given by one corporation executive who uses a great many of these convenient curves for the purpose of administrative control.

PRINCIPLES OF CHART MAKING

What is the technique of graph making? What are the principles underlying the construction of graphs? When we consider the potency of this instrument, we may well be surprised at its extreme simplicity. As a very elementary illustration, consider the matter of finding out how hot or cold it is. If you read in the newspapers that the maximum temperature of a given

day is 95 degrees, you find it necessary to interpret this fact by mentally visualizing a thermometer. This we all do automatically, almost unconsciously. This involves a translation from printed facts to a picture—a roundabout method. How much more effective it would be actually to show a picture of a thermometer with the mercury in the tube at 95 degrees. Figure 1, therefore, represents a *graphic chart* of the maximum

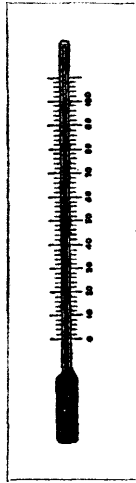


FIG. 1.—Thermometer—a Picture of Temperature

temperature on a given day. It is a *picture of temperature*. It has exactly the same story to tell to all men, regardless of their intelligence, nationality, or any other factor. It involves no mental translations, but tells a *direct story*.

DEVELOPMENT OF THE CHART FORM

To tell the same story for the seven days of the week, we may line up the pictures of seven different thermom-

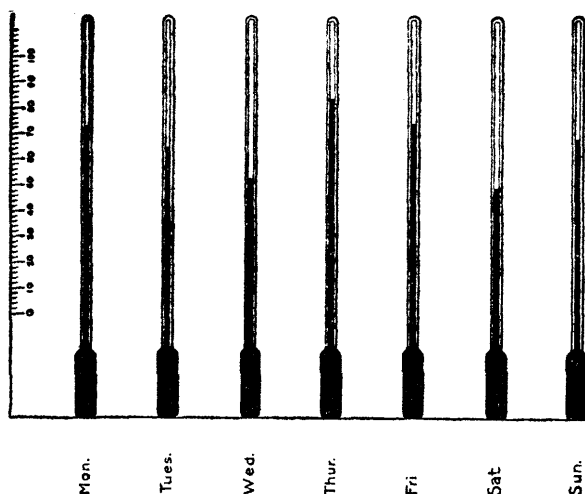


FIG. 2.—Maximum Temperature Picture by Thermometers for a Week

eters as shown in Figure 2. Comparison of these thermometers one with the other tells a running story of the temperature for a week which is much more vivid than a row of seven figures would be. A very slight study of Figure 2 clearly illustrates the importance of this use.

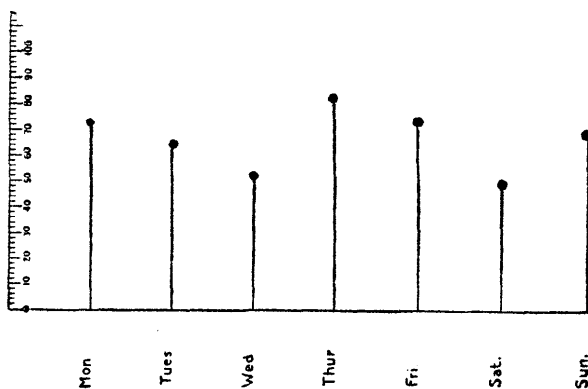


FIG. 3.—Maximum Temperature Shown by Lines

From Figure 2 to Figure 3 is only a very short step, since Figure 3 tells exactly the same story that is told by Figure 2. We simply have *conventionalized* thermometers. Instead of somewhat elaborate pictures of the thermometer, the height of the mercury in each is represented by a straight line.

In Figure 4 we have conventionalized even more. Clearly the important fact is the distance of the top of each line from the base. This can be readily

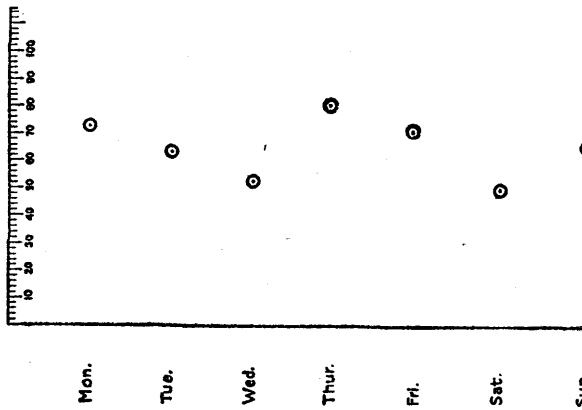


FIG. 4.—Maximum Temperature Scale Represented by Dots

grasped without the necessity of actually connecting the top to the base by a physical line. A series of dots, such as shown in Figure 4, is just as effective when the principle is once grasped.

In order to assist the eye in grasping the facts, we may connect the various dots shown in Figure 4 by a line which transforms it into the *curve* illustrated in Figure 5.

By a series of illustrations (Figures 2, 3, 4, and 5) we have shown the manner of developing graphic charts. Figure 5 is a very good illustration of a simple chart.

A careful comparison of the various illustrations used in the *development* of Figure 5 will help in understanding the basic principles of chart development.

Practically any series of facts involving two quantities, such as temperature and time, may be plotted graphically.

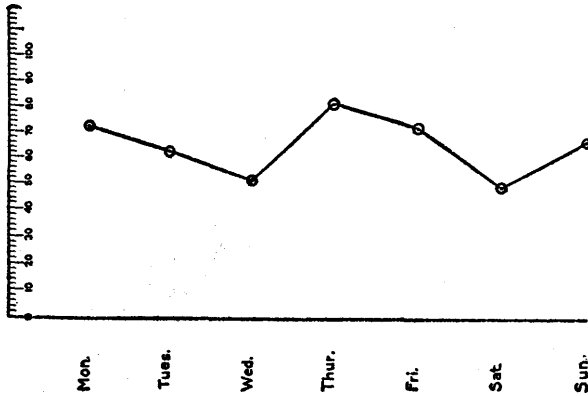


FIG. 5.—Maximum Temperature Shown by a Curve

THE FOUR STEPS

The steps involved in constructing charts are four in number. These are clearly demonstrated in Figure 6.

Step 1 consists in securing cross-ruled paper (often spoken of as coördinate paper).

Step 2 consists in laying out the horizontal and vertical scales in such proportion to one another that the chart may be well balanced.

Step 3 consists of translating the data from written figures to dots on the chart. This is done by measuring from the left-hand side and the bottom of the chart to determine the correct place to mark each point. This measuring need not be done with a ruler, but by the eye alone, assisted by the coördinate ruling.

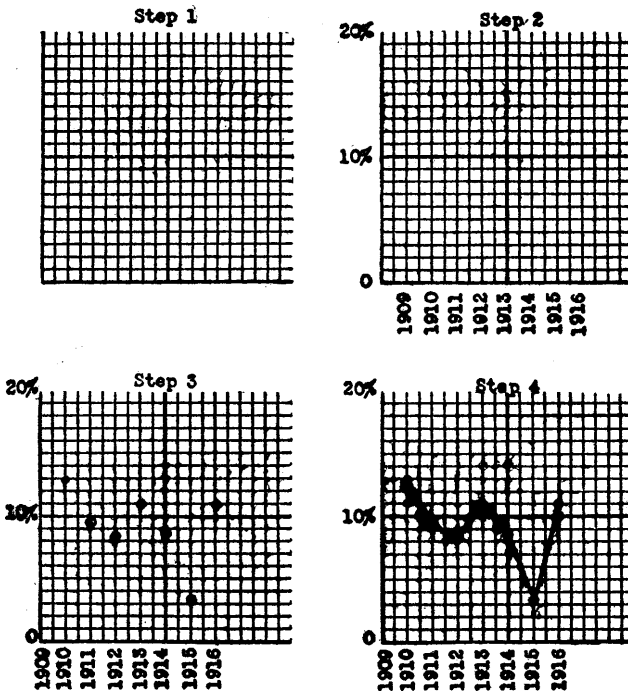


FIG. 6.—The Four Steps of Charting

Step 4 consists simply in connecting the various points by a line.

VARIETIES OF CHARTS

In addition to the simple type of chart just developed, there are other *kinds* of charts which are in common use. Some are good and some are bad. For general year-round utility, the line chart, such as is illustrated in Figure 5, is probably preferable to any other type. But for certain kinds of facts, other forms are useful.

For example, we may wish to show the component parts of a total—we may do so by the use of a so-called

“bar chart,” as illustrated in Figure 7. The total length of the bar represents 100 per cent. The various component elements of the total are shown as segments of the bar. Thus, in Figure 7, we see that the total expense of the company is equal to 100 per cent, of which 32 per cent represents manufacturing expense,

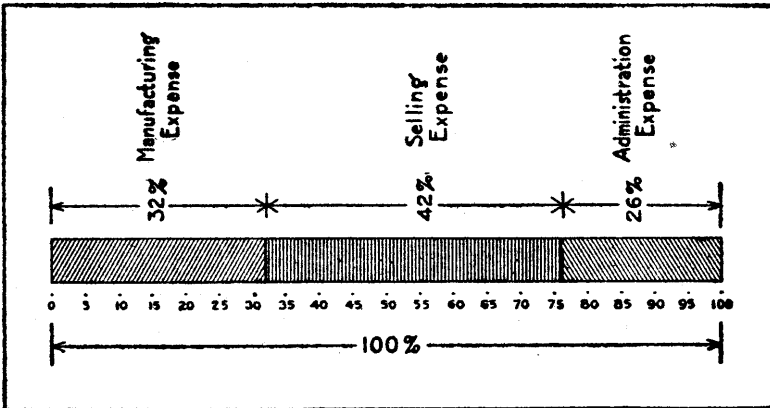


FIG. 7.—Chart Showing Percentage of Different Classes of Expense to Total Expense for the Blank Manufacturing Company for the Year Ending December 31, 1917

42 per cent represents selling expense, and 26 per cent administrative expense.

This represents a very good and simple way of clearly illustrating the relation of the various kinds of expense, one to the other and to the total.

The same facts may also be shown by means of a circle, the total area of which represents 100 per cent. This circle is divided into segments of 32 per cent, 42 per cent, and 26 per cent, respectively, for the three varieties of expense mentioned.

The bar chart, as illustrated in Figure 7, can be used for comparative purposes, i. e., by showing a number

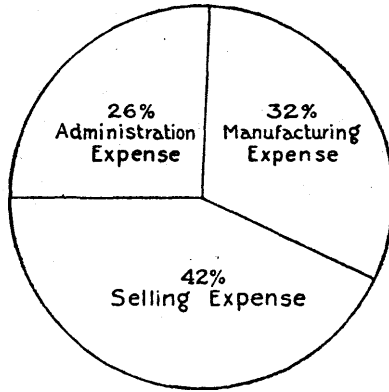


FIG. 8.—Chart Showing Percentage of Different Classes of Expense to Total Expense for the Blank Manufacturing Company, for the Year Ending December 31, 1917

of different bar charts on the same scale, each one representing a separate period of time. The bars may be lined up one over the other or side by side. The

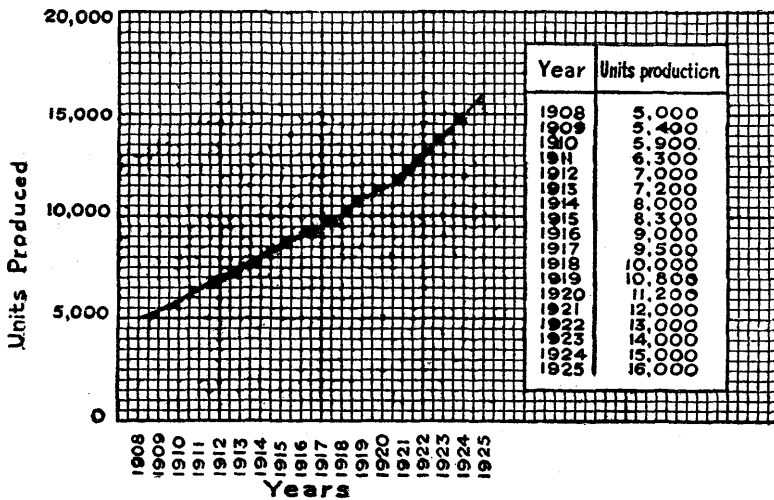


FIG. 9.—Forecast Chart Showing the Tendency or Trend of Production
The heavy line represents actual past production. The dotted line is an extension of the heavy line and represents a prophecy regarding future production.

circle chart is not useful for comparative purposes, however, and its field is probably limited to the illustrations of facts which are not intended to be compared from period to period.

PROPHECY CHARTS

The ordinary line chart is sometimes made to serve the purpose of prophecy. The *trend* of a line may be determined by extending that line into the future. For example, the history of a company may show:

Year	1908	5,000	units	produced
"	1909	5,400	"	"
"	1910	5,900	"	"
"	1911	6,300	"	"
"	1912	7,000	"	"
"	1913	7,200	"	"
"	1914	8,000	"	"
"	1915	8,300	"	"
"	1916	9,000	"	"

From these facts we may construct a chart, as shown by the heavy line in Figure 9. It will be observed that this line shows a "trend" or general direction in which it is headed, and we may extend it by the dotted line, as shown in the illustration. This, we may assume, represents a *normal trend* or direction which the line will follow during future years.

By reading from this hypothetical line we may obtain figures representing the probable production for any given future year.

Year	1917	9,500	units	produced
"	1918	10,000	"	"
"	1919	10,800	"	"
"	1920	11,200	"	"
"	1921	12,000	"	"

“	1922	13,000	“	“
“	1923	14,000	“	“
“	1924	15,000	“	“
“	1925	16,000	“	“

Such charts as these are being extensively used in certain lines of business, and also in municipal investigations where it is absolutely necessary to arrive at a fairly accurate forecast of population.

It is said of the Bell Telephone Company that it has charted many of its future requirements and much of its expected growth for many years ahead, using graphs very similar in principle to the one illustrated in Figure 9, in which the future curve is projected on the basis of past experience and known data as to future tendencies.

Engineers for municipalities use such charts to determine the probable population which will require the use of sewers, gas and water, which must be built for the future.

ORGANIZATION CHARTS

Even such a complicated thing as the organization of a large business may be reduced to the form of a picture. In Figure 10 is illustrated an organization chart which clearly shows how such a complex and intangible thing as organization may be crystallized into the form of a picture.

Organization charts are of the very highest importance in connection with expert consulting services such as accountants and engineers are called upon to perform. The defects of an organization are never so apparent as when an attempt is made to construct an organization chart. It is almost an invariable rule that public accountants engaged in system work construct organization charts for their clients before taking any other steps, for the very good reason that the accounts

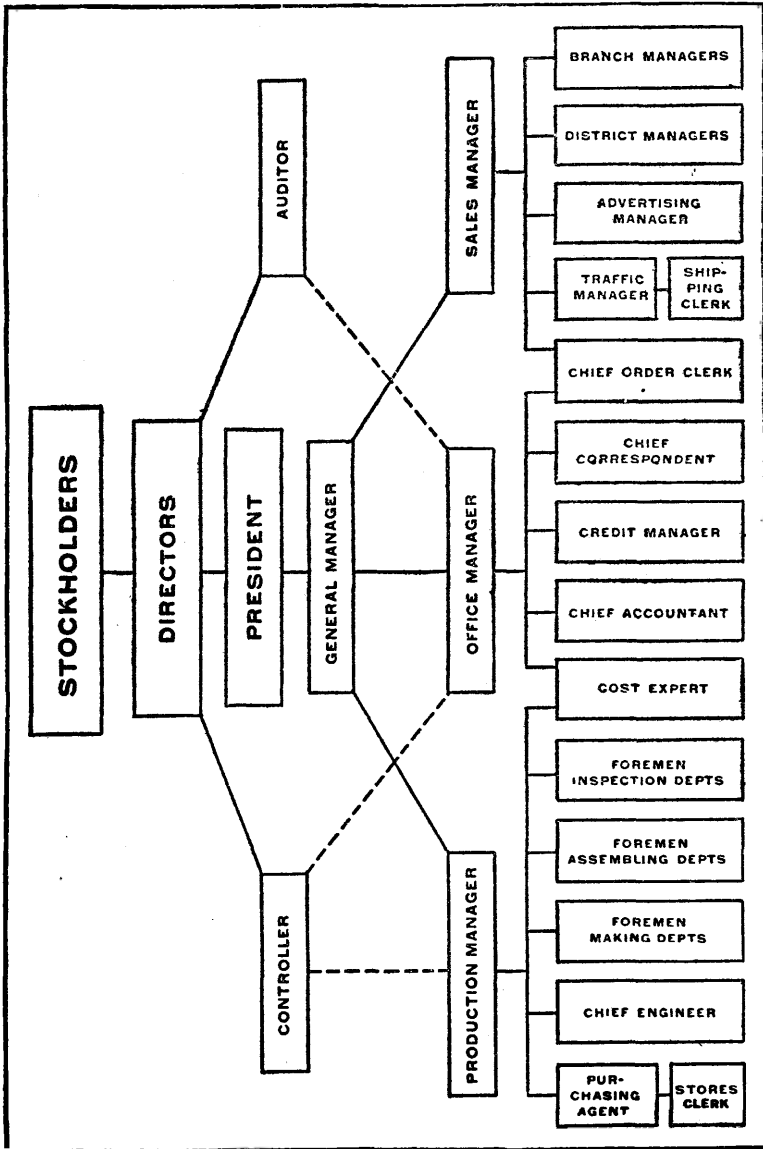


Fig. 10—Organization Chart

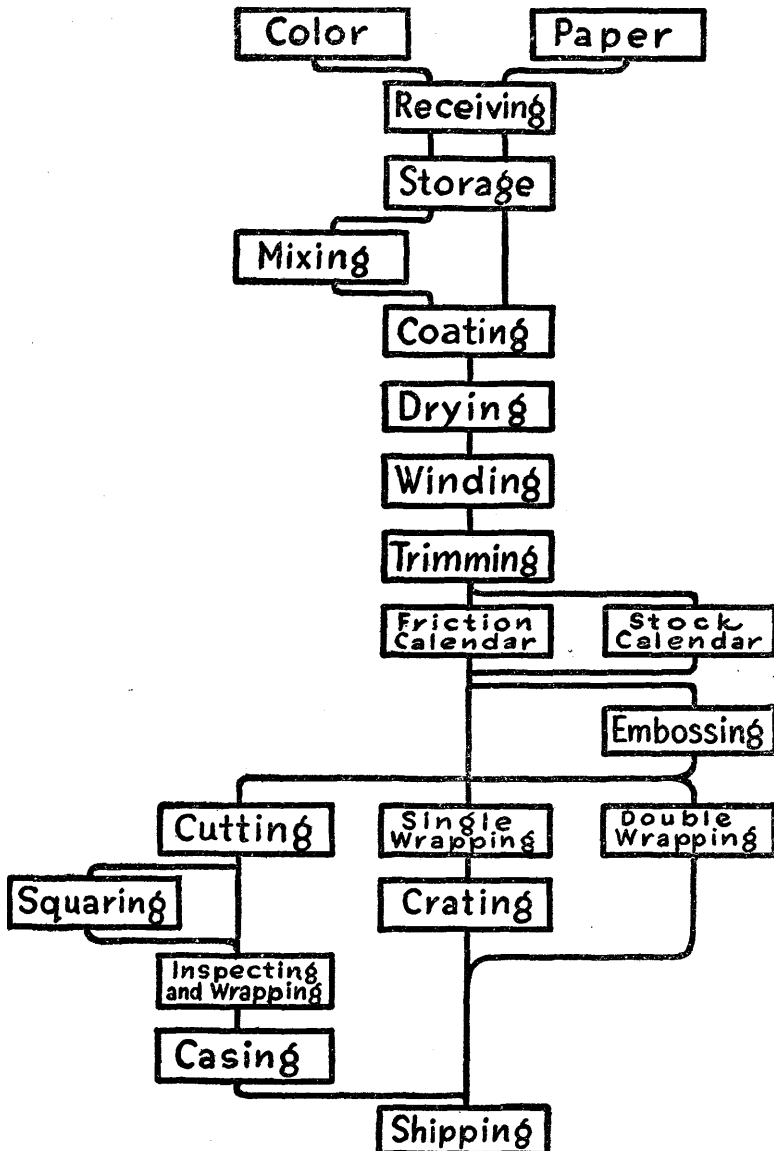


FIG. 11.—Illustration of Flow Chart Showing Flow of Materials through Various Processes

(Copied from article in *Industrial Management*, January, 1917.)

merely reflect organization activity, and until the organization is clearly determined, the appropriate accounting system cannot possibly be constructed.

There are no particular rules with regard to the *technique* of constructing organization charts. This is a procedure which is almost unstandardized. Each accountant or engineer follows his own fancy as to form and arrangement of these exhibits.

FLOW CHARTS

Another type of chart which has been in use for many years among engineers and which is attaining considerable vogue among accountants is what is known as a "flow" chart. The flow chart usually pictures the flow of materials through the various processes in a factory. Figure 11 shows a typical flow chart. Such exhibits are often very useful to the consulting cost accountant as well as to the efficiency man, since they enable them to visualize in a comprehensive way the activities of an organization.

As in the case of organization charts, we find there is no particular standardization as to form, although it is a safe rule that the simpler they are, the better.

LINE CHARTS

Returning to the type of chart which has the widest general use—the ordinary line chart shown on coördinate paper—we find there are a number of different ways of using them. For ordinary business use there are two applications for this type of chart that seem general. One is to serve a historical purpose—to tell a story in which *time* is a factor. Thus we have charts showing prices of various commodities from month to month and from year to year; fluctuations in the

stock market over various periods of time; fluctuations in the birth rate or death rate or pay roll or the number of accidents or the number of complaints received, or any data having to do with *time*. This is probably the most common form of line chart.

FREQUENCY CURVES

Another kind of chart which is very useful is known as the "frequency" chart.

The purpose underlying the frequency chart may be most easily illustrated by considering what happens

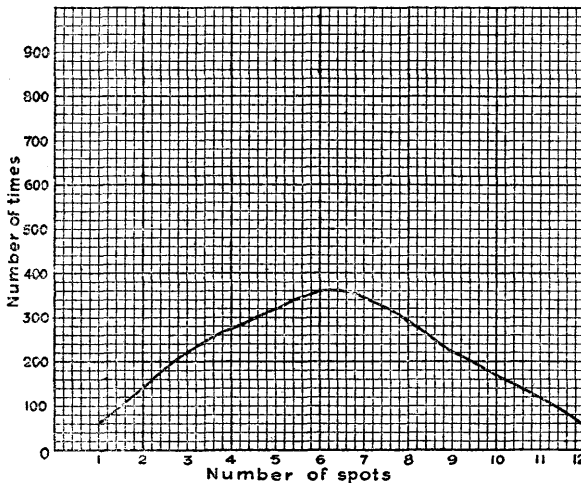


FIG. 12.—Frequency Chart Based on Throwing a Pair of Dice 2,500 Times

when we cast a pair of dice two thousand five hundred times. We know that the number of times any number turns up *must* be governed by the laws of chance. We can determine definitely that out of two thousand five hundred casts of dice, the number 2 will appear a certain number of times, the number 3 will appear a greater number of times, the number 4 a still greater, and so on

up to 7, after which the frequency will decline until we get to 12. If we now take these facts and plot them on an ordinary piece of coördinate paper, we shall have a curve resembling Figure 12, which clearly indicates that the appearance of the number 7 is most frequent. When a

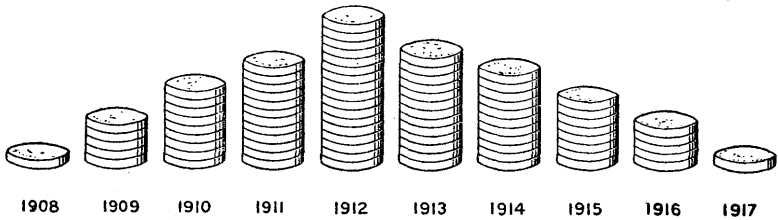


FIG. 13.—Frequency Curve Illustrated by Coins

number of observations are taken, the curve becomes a very smooth one, without noticeable irregularities.

As another illustration we might accumulate at random eighty-three 25-cent pieces, none of them minted before 1908. If they were sorted into piles by dates and

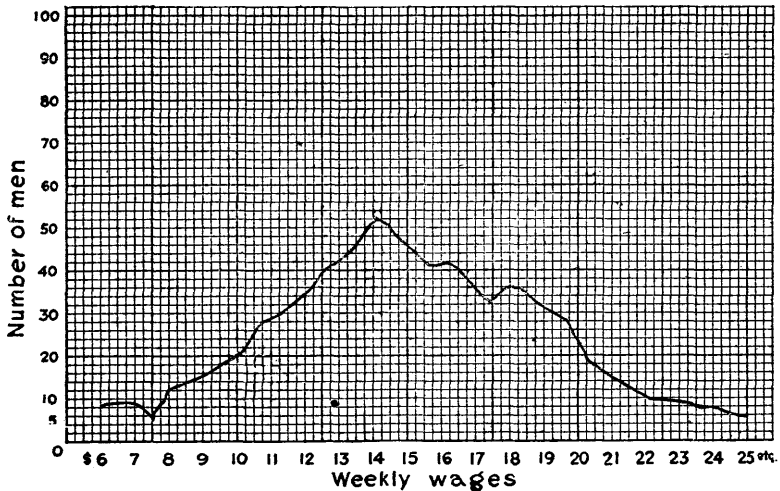


FIG. 14.—Frequency Chart Showing Number of Male Employees of the Blank Manufacturing Company at Different Amounts of Weekly Salaries

A chart of this sort is very useful in making a wage study.

the piles arranged side by side according to years, we would obtain a true frequency curve by connecting the tops of the various columns of coins with an imaginary line.

The foregoing illustrations are not taken from the field of business, but have been used to illustrate the theory underlying the use of this type of graphic exhibit. The business utility of these curves may be illustrated by Figure 14, which represents a frequency chart showing the results of a wage study in a large corporation. It will be impossible to illustrate the many ways of applying such charts to ordinary business, but experience has shown that frequency charts may be very valuable when properly used in connection with research studies.

CHART STANDARDIZATION

The use of charts being so general within the past years, it was recently decided to form a joint committee of a number of scientific and statistical societies in order to work out standard procedure and technique for the construction of graphs.

This joint committee has not yet submitted its final report, but it has suggested certain fundamental chart standards, many of which seem well worthy of adoption.

It should be observed that these tentative standards are intended to apply only to the construction of ordinary line charts.

RULES GOVERNING PRESENTATION OF GRAPHS

The general rules which apply in the presentation of graphs are given in the following:

1. The general arrangement of a chart should proceed from left to right and from bottom to top.

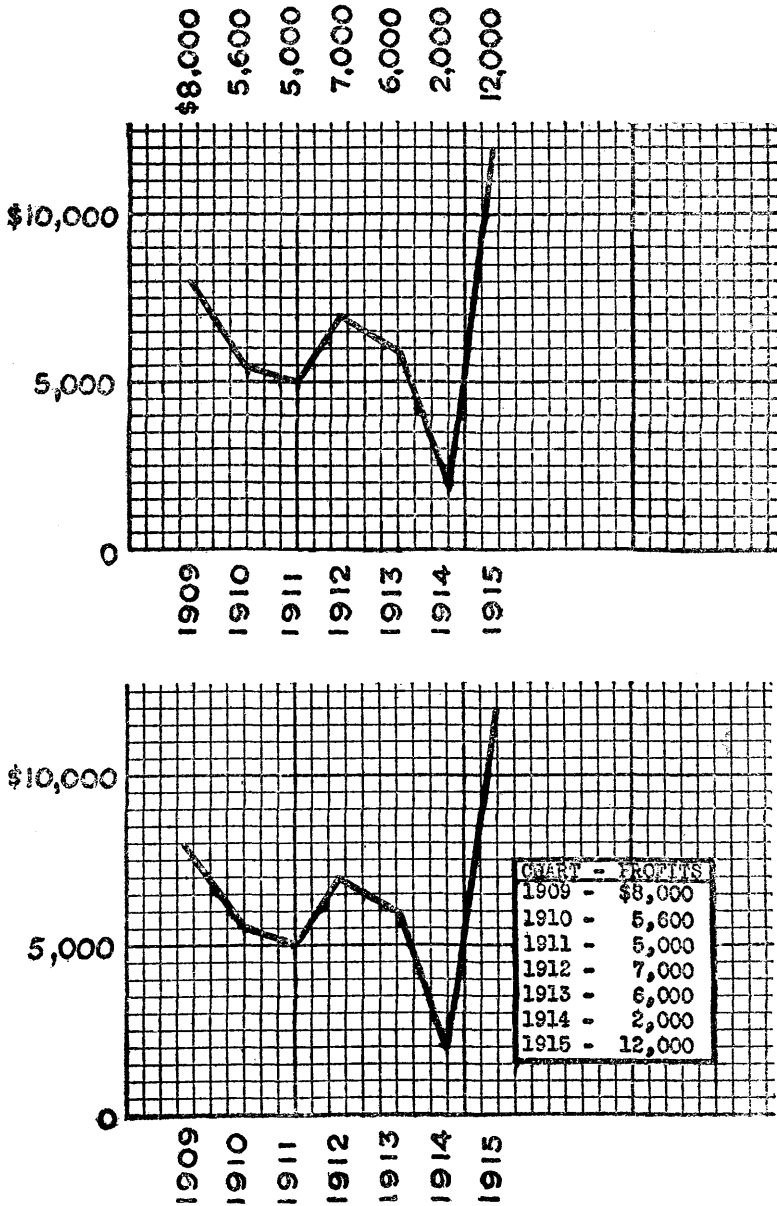


FIG. 15.—Charts Showing Two Methods of Exhibiting All Data Right on Face of Chart

2. Horizontal scale figures should always be placed at the bottom of the chart, and the vertical scale figures at the left of the chart, although if the size of the chart warrants it, these scales may be presented again on the top and right-hand side.
3. In all cases where it is possible to do so, the zero line should be shown on the chart.
4. The zero line on both the vertical and the horizontal scale should be much heavier lines than the average coördinate lines.
5. The curve lines should be much broader than the coördinate ruling, so that they may be clearly distinguished from their background.
6. Make the title of a chart so complete that it will be impossible to misinterpret its meaning.
7. Do not overcrowd the chart with too many different curves. This makes a chart very difficult to read.
8. Whenever possible, show the data right on the face of the chart itself. This may be done in one of two ways, as is illustrated in Figure 15.

The best method is the one shown on the upper section of Figure 15, where the data is shown on the top edge of the chart. Occasionally this form is not feasible, and the alternative tabular arrangement, as shown on the lower section of Figure 15, is allowable.

SELECTION OF SCALES

A matter of technique which assumes importance is the selection of vertical and horizontal scales for curved plotting. If ordinary good judgment is not exercised in the selection of these scales, the curves plotted will lose somewhat in effectiveness. As an illustration of the difference in the shape of a curve when various

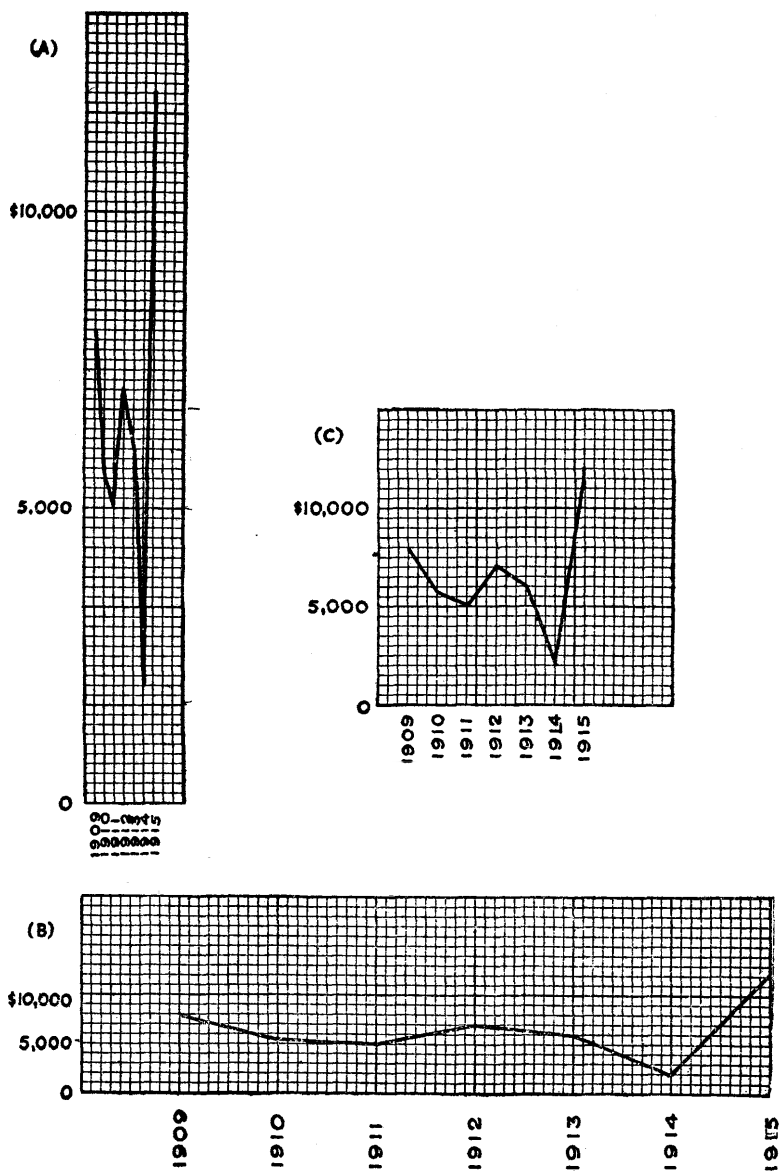


FIG. 16.—Illustration of the Effect Produced by the Plotting of Exactly the Same Information on Different Scales

scales are used, see Figure 16, where exactly the same facts are plotted on three different charts. Some care should be exercised in selecting the coördinate scales in order that the final curve may be in good proportion. It is obvious that the optical and psychological effect of the plotting of data may convey an erroneous or exaggerated impression concerning those facts. For example, if Figure 16 were used to represent the net profit for each year, Form A would convey the idea of extreme fluctuations, Form B would suggest only slight variations, while Form C would indicate a more intermediate tendency.

MATERIALS USED IN MAKING CHARTS

A few words might be said regarding the materials of graph construction. Practically the only material required is coördinate paper, and this may be obtained in a number of different rulings and styles. A few of these are illustrated in Figure 17.

In addition to the ruled *paper*, which may be punched for loose-leaf books, coördinate ruled cards are becoming popular. Such a card is illustrated in Figure 18.

The principal utility of the cards is the fact that the whole charting procedure for a large organization may be standardized, and a central charting room, or statistical department, as it is sometimes called, may be maintained, and the cards may be systematically filed in drawers for ready reference. These cards are manufactured of a special paper stock which is tough and durable and yet thin enough so that blueprints may be taken of the curves.

When a charting department is maintained, these curved cards are plotted periodically and carry a serial number which remains the same year after year and which renders cross-indexing easy. It is customary

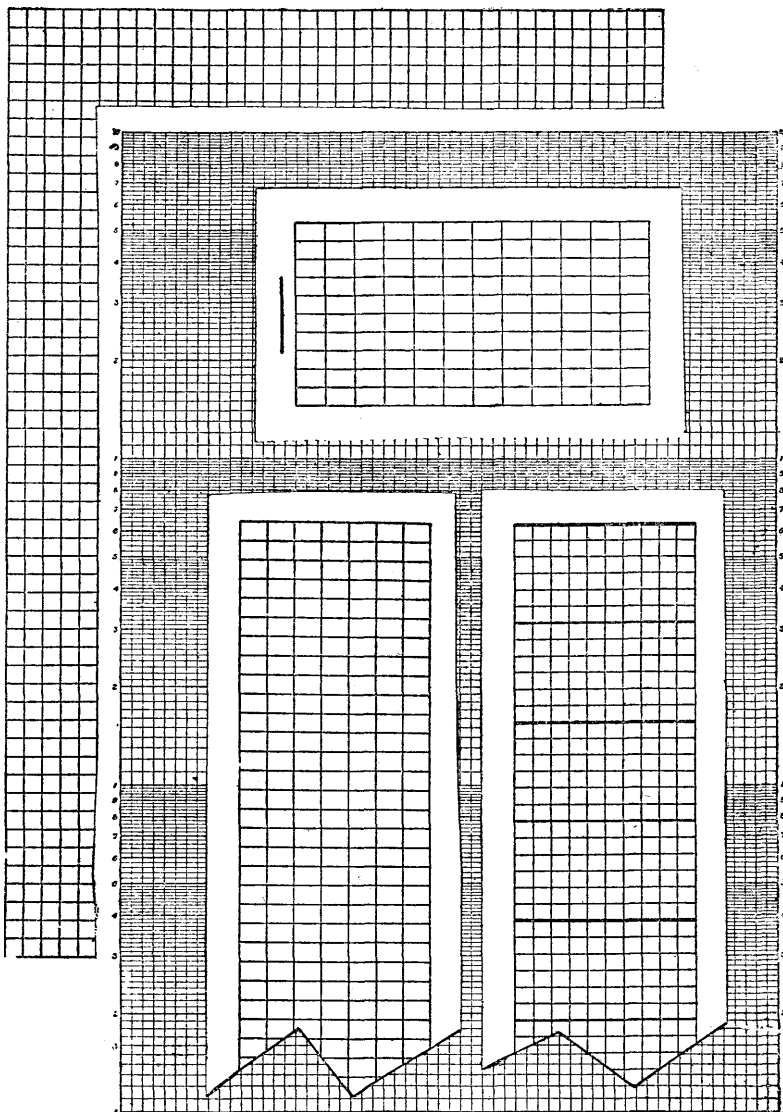


FIG. 17.—Types of Coördinate Paper
 Courtesy of Educational Exhibition Company.

to plot only one set of facts on a card and to obtain desired comparisons between different curves by laying out the proper cards in vertical or horizontal rows.

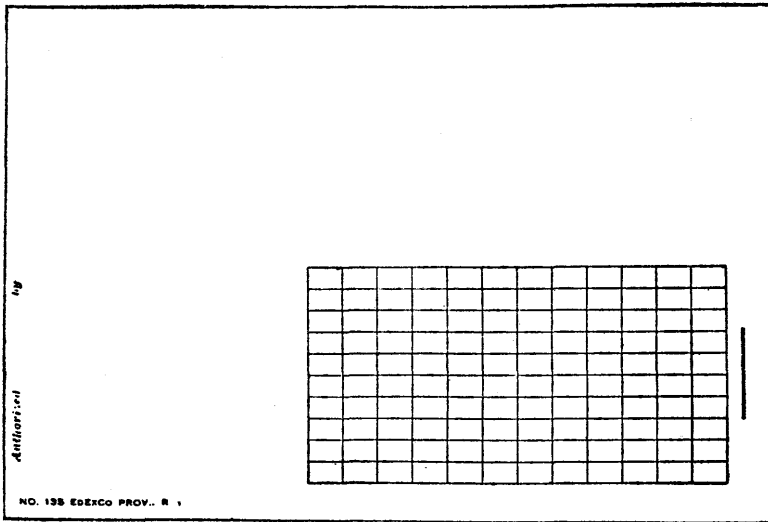


FIG. 18.—4x6 Curve Card

Thick enough for card index file; transparent enough to blue print.

The purpose of using semitransparent coördinate paper or cards is to enable the charting department to make blueprints of the curves each month for the various department heads.

CHECKING LIST FOR GRAPHIC PRESENTATIONS

After a chart has been constructed, it is wise to proof read it carefully against the original data in order to make sure that nothing has been omitted or carelessly "posted." Willard C. Brinton is responsible for many of the items of the following checking lists:

1. Are the data of the chart correct?
2. Has the best method been used for showing the data?

3. Are the proportions of the chart the best possible to show the data?
4. Are all scales in place?
5. Have the scales been selected and placed in the best possible manner?
6. Are the points accurately plotted?
7. Are the numerical figures for the data shown as a portion of the chart?
8. Have the figures for the data been copied correctly?
9. Are all dates accurately shown?
10. Is the zero of the vertical scale shown on the chart?
11. Are the zero lines and the 100 per cent lines made broad enough?
12. Is all the lettering placed on the chart in the proper directions for reading?
13. Is a key or legend necessary?
14. Does the key or legend correspond with the drawing?
15. Is there a complete title, clear and concise?
16. Is the drafting work of good quality?
17. Is the chart in every way ready to mark O. K.?

A number of cautions might be given regarding the construction of charts, since we find there may be opportunity for optical illusions.

MISLEADING CHARTS

Serious errors may result if curves not having the same zero line are compared, but perhaps the most potent cause for error is due to the construction of charts which compare areas of circles instead of diameters only. As an illustration of this error, Figure 19 is worthy of attention. Here are the same facts charted

in three different ways. These facts are very simple ones, the comparison covering the net profits of a company for three consecutive years. The upper chart shows a graphic presentation of these figures, the relationship being expressed by the *diameters* of the circles. This gives an entirely false idea of the comparative profits, because the 1916 profits appear very much larger than they should as compared with 1914 and 1915. The

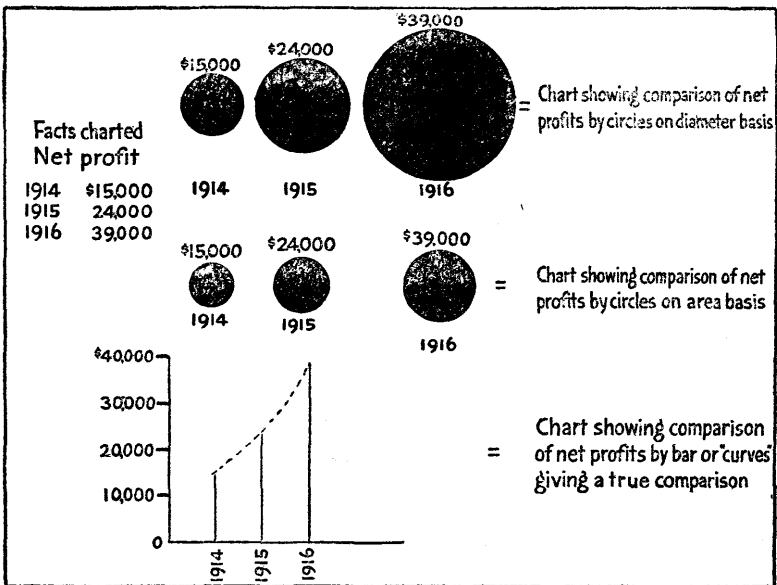


FIG. 19.—Comparison of Three Different Graphs Showing the Same Facts
The use of circles for comparative purposes is very misleading.

next chart shows the same comparison except that instead of the diameters, the *areas* of the circles have been used. This is more scientific, but it results in an optical illusion, since the circle for 1916 does not *seem* so large as it should in order to exhibit the proper relationship with the other years.

In the line chart shown at the bottom of Figure 19 we find a device which tells the entire truth about the

comparative profits for the three years, in the simplest possible manner.

Were it not for the fact that many writers in financial and business magazines use circles of various sizes for graphic *comparisons*, it would seem unnecessary to call attention to the serious error involved. As a matter of fact, the use of circles in such a way surely defeats the whole purpose of graphics.

Practically the same objections that are inherent in the use of circles for comparative purposes apply also to the triangle, the square, the cube or any other area or volume figures which involve the use of more than one dimension in the comparison. The mind cannot readily comprehend the comparative importance of such illustrations.

COMPARATIVE CHARTS

The maximum benefit of graph presentation comes when two or more curves are to be compared. A single curve of itself is valuable, but a *comparison* of curves where a "cause and effect" relationship exists is infinitely more useful. For this reason, we find very few charts where only *one* curve is shown. Usually two or even more curves are reproduced on the same field.

A very popular type of chart shows similar curves for successive years. For example, the net profits per month for twelve months for a series of years may be plotted and the general characteristic operations be determined. Or gross sales and net profits may be charted together in order to determine the exact relationship existing between them. The use of different colored inks sharply distinguishes the various lines.

It frequently happens that a cause and effect relationship is suspected between various sets of facts. Thus it is claimed on good authority that there is a distinct relationship between prices on the New York stock

market and general business prosperity and depression. If a rise in prices on the stock exchange causes an increase in business prosperity, then a chart of average prices should serve as a splendid guide to the business man. Some attempt has been made by economists to graph the general condition of business. If such a curve be plotted on the same field with one showing average stock prices, it may be clearly seen that a true cause and effect relationship actually exists.

This is merely one illustration taken from many that are available. The science of expressing business facts graphically is only in its infancy. We find the chart form of reproducing statistics to be a particularly effective instrument of business research, since relationships between various sets of facts become much clearer. A great deal of clever work along these lines has been accomplished by organizations such as the Brookmire and Babson statistical bureaus.

Figure 20 illustrates a chart typical of those used by many business men. The relationship between prices on the stock exchange and the gross sales and net profits of a *particular business* are well worth study by its executive. If a distinct cause and effect relationship can be discovered, then a very important guide to business administration is at hand.

CHARTS FOR EACH DEPARTMENT OF BUSINESS

Each separate department or function of business has its own peculiar uses for charts. In every department there are facts and statistics which require comparison and analysis. Every department head requires those facts to be placed before him in a form easy to interpret. Again, however, the warning may be thrown out that important as these charts are as a means of control, they are only an aid to management.

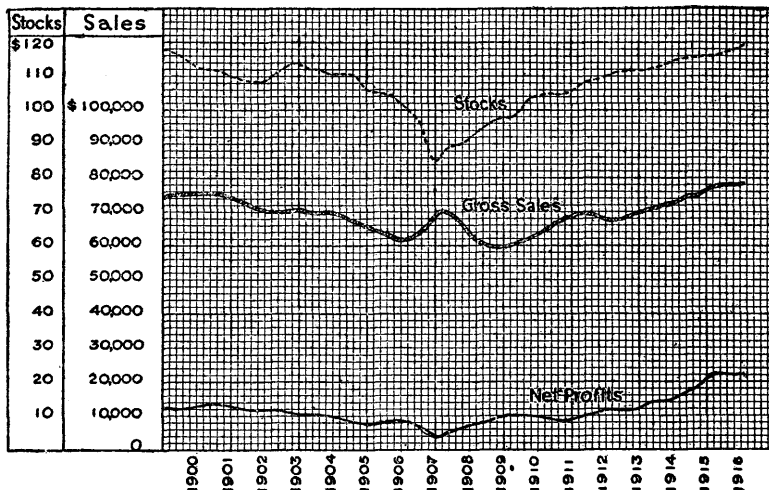


FIG. 20.—Chart Showing How Two or More Curves May Be Plotted on the Same Sheet

This graph shows the relationship between the state of the stock market (as shown by average prices of twelve industrial stocks) and the gross sales and net profits of the Blank Steel Company.

THE SALES DEPARTMENT

In the Sales Department we find that the manager is vitally interested in facts and figures relating to gross sales for *the business as a whole*, and also relating to the *individual efficiency* of each salesman.

The prime importance of sales statistics is evident from the increasing tendency to put sales administration on a scientific basis—to apply the budget idea, or, as it is better known, the “quota” plan.

It is absolutely essential, therefore, for a sales manager to keep in daily touch with the volume of sales actually made, compared with the sales quota. The quota data may be charted in advance and actual accomplishments charted as results come in. The direction of the latter curve then shows how results are measuring up to the quota.

To secure a satisfactory volume of total sales requires

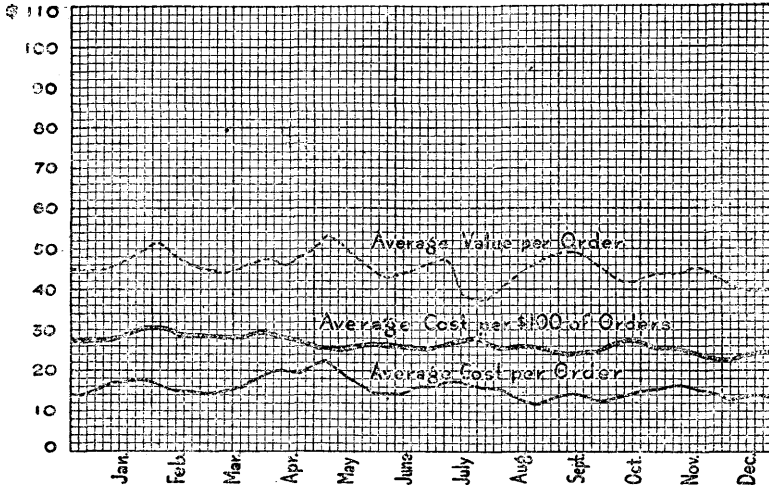


FIG. 21.—Chart Showing Single Salesman's Record

constant watchfulness over the current sales of *individual* salesmen. Statistics reflecting the individual's activities, the number of orders he has obtained, the average profit per order, and his cost of obtaining business, are splendid aids to the manager.

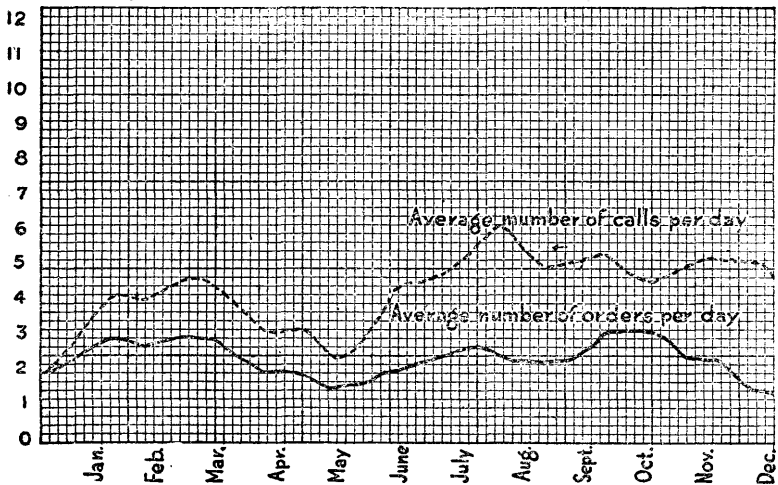


FIG. 22.—Chart Showing Single Salesman's Productivity

Figure 21 exhibits the individual record of a salesman for a year. It requires but little imagination to see how a chart of this type would be of great value to the executive.

Figure 22 shows the individual salesman's efficiency, not in terms of *money*, but of his *activity*—the number of calls made per day and the number of orders taken per day. Any serious discrepancy between the two indicates some fault in the salesman's selling technique. It is an undeniable fact that salesmen frequently go "stale," and a chart like this is the quickest way of finding it out.

A chart such as the one shown in Figure 23 can be both current and cumulative. To give the best effects, such charts should show figures for at least two years, so that unfavorable comparisons between them may be investigated.

THE ADVERTISING DEPARTMENT

To the advertising man also the graphic charts have value. His problem is similar to that of the sales man-

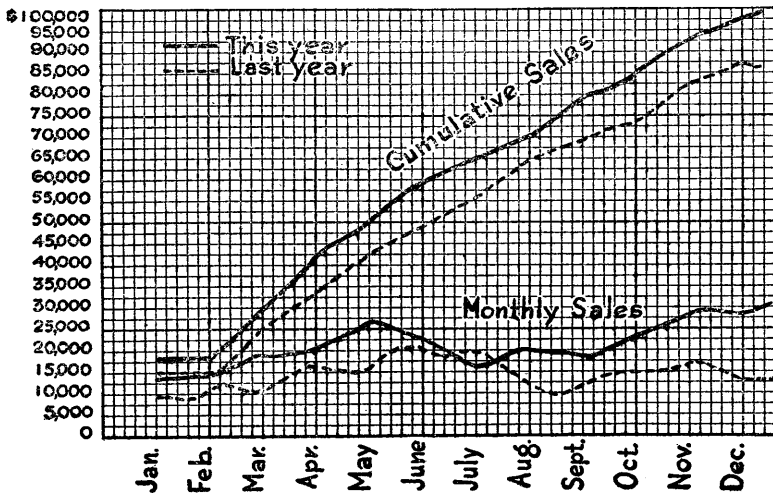


FIG. 23.—Chart of Gross Sales

ager, except that instead of dealing with salesmen, the advertising executive deals with various magazines and other periodicals.

Requests for information from interested readers of an advertisement are known as "inquiries." It is usually figured that a certain percentage of the total inquiries received will result in orders. That percentage indicates the effectiveness of the "follow-up" material, consisting of letters, pamphlets, and other forms of sales literature.

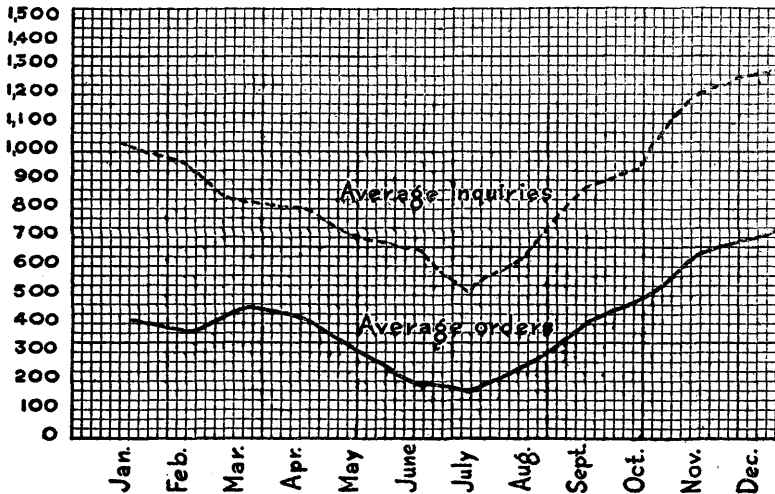


FIG. 24.—Chart Showing Average Number of Inquiries and Orders by Months

One of the principal figures which should be watched by the advertising manager is the current ratio between inquiries and orders. Such a chart is illustrated in Figure 24. As the two lines get closer together, it shows that the efficiency of the "follow-up" is increasing. The farther apart they spread, the more unfavorable is the indication. Such a comparison may be made of different advertisements or of different mediums to

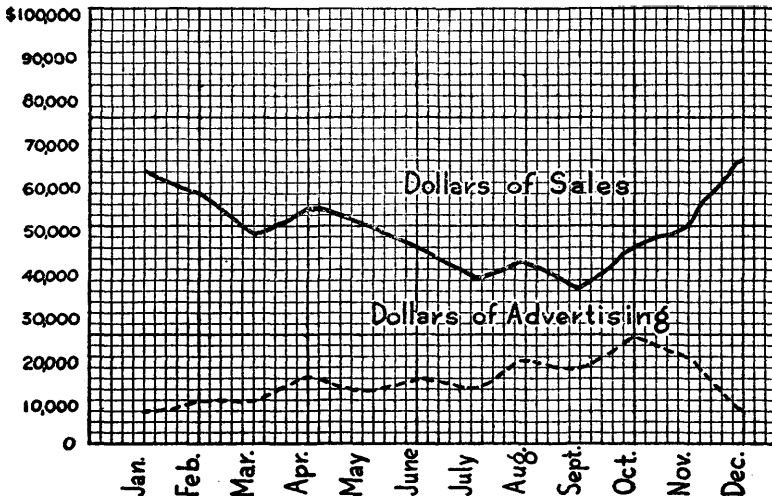


FIG. 25.—Chart Showing Relation between Sales and Advertising

show the number of inquiries and the value of the inquiry, because inquiries and orders may spread apart on account of poor inquiries as well as poor follow-up. The curve showing *orders received* also reveals the efficiency of the advertising in general.

Another important comparison is between the total dollars of sales and the total dollars spent for advertising; such a chart is shown in Figure 25. The closer together the two lines come, the less efficient is the advertising. The farther apart they spread, the better.

Of course the sales plotted should be only advertising sales and not the total sales including those from advertising and from salesmen; also there should be a definite understanding as to what is included in the advertising figures. They may include only the cost of space or they may include every item of advertising expense.

A valuable cumulative chart is shown in Figure 26, which compares the pulling power of the advertising for successive years.

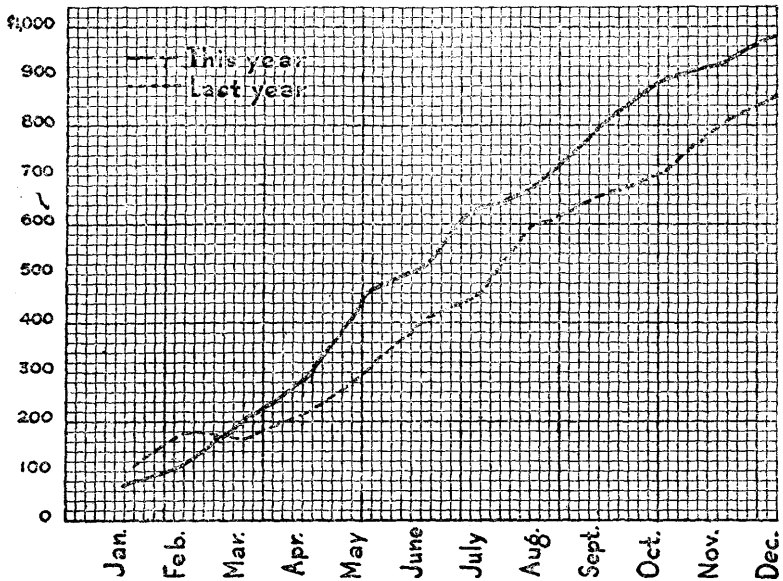


FIG. 26.—Chart Showing Number of Inquiries Received Cumulatively by Months

A more complicated chart is shown in Figure 27, which compares actual sales by states with the population. Ordinarily the sales in each territory should be proportional to the number of possible customers in that district. A chart similar to Figure 27 can be easily constructed from the census report. The states run from left to right in order of population. On the same sheet are posted the number of orders taken during a period—a year, two years, or even ten years. All points under the black line represent fields where more intensive cultivation would probably be worth while.

It is, of course, impossible to exhaust thoroughly the possibilities of graphic charts in the advertising department or in any other department within the brief space of this lecture. Only suggestive charts can be described, and anyone familiar with the general principles of



FIG. 27.—Chart Showing Relation between Number of Customers and Number of Prospective Customers in Each State

curve making can readily think of many other charts which would be useful.

THE CREDIT DEPARTMENT

From the standpoint of the credit manager, who takes the responsibility for extending large amounts of credit to customers, there are a few forms of graphic charts which are very useful. To determine the efficiency of the credit and collection department as a whole, the chart shown in Figure 28 is valuable. Ordinarily, the circle chart is not recommended, but in specific cases such as this it may be entirely appropriate.

Occasionally the credit manager has a few accounts on his books which are so large and so profitable that he feels he must continue to extend credit, even though

the risk is doubtful. It is then worth while to make a chart, or a series of charts, for each such customer.

One significant figure in credit analysis is the relation between the customer's liquid assets and current liabil-

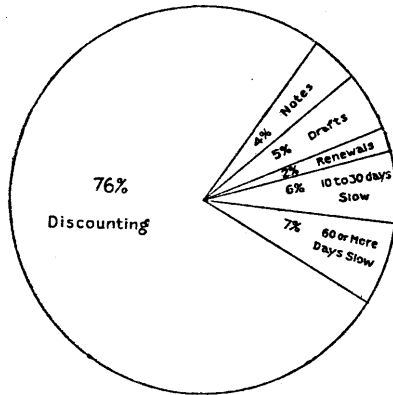


FIG. 28.—Analysis of Total Collections during Year 1916 for the Blank Company

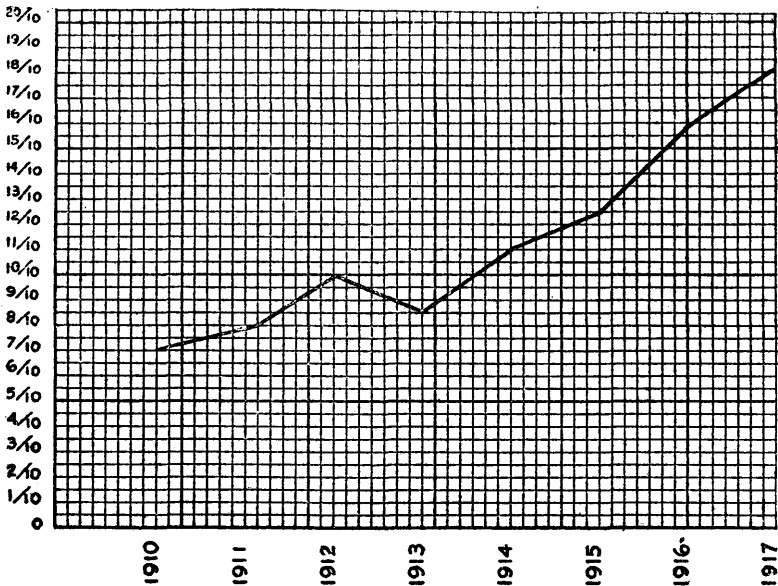


FIG. 29.—Chart Showing Ratio of Quick Assets to Current Liabilities as Shown by a Customer's Balance Sheets for Successive Years

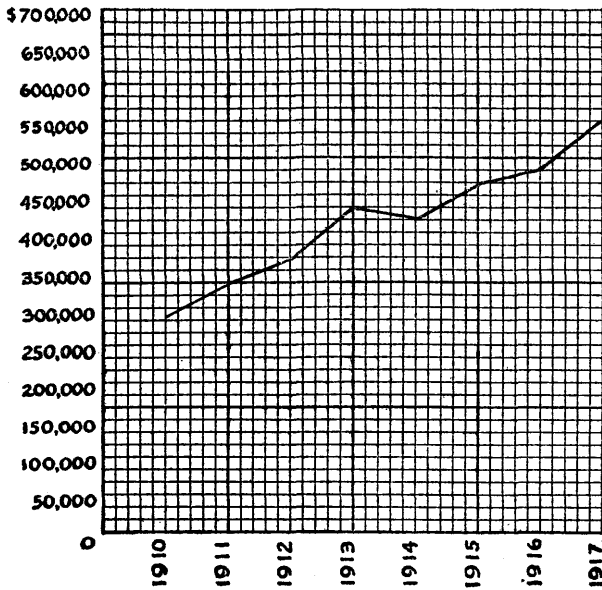


FIG. 30.—Chart Showing Net Worth as Shown by a Customer's Balance Sheets for Successive Years

ities. Figure 29 shows a curve of these ratios for a series of years. Its upward tendency is, of course, favorable, since the proportion of the liquid assets as compared with the current liabilities is increasing. Had the trend been downward, an unfavorable symptom of the company's condition would be revealed.

A chart similar to the last is shown in Figure 30, which depicts a curve comparing the customer's *net worth*, as revealed by its different balance sheets, for a period of years. The upward tendency of the curve is, of course, a favorable indication, since it shows that the company is making money.

Where the credit risk is extremely doubtful, it may be worth while to maintain a graphic chart similar to that shown in Figure 31, where the relation between shipments to, and collections from, a doubtful customer are

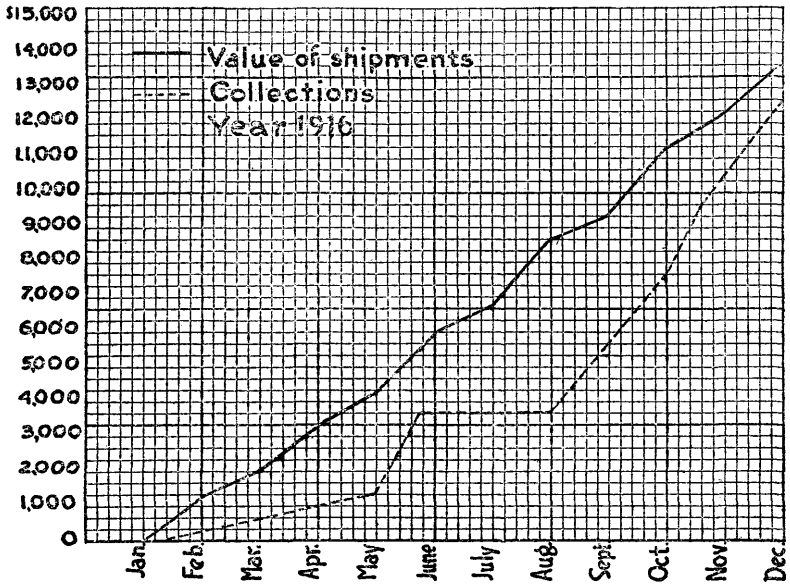


FIG. 31.—Chart of Shipments to and Collections from a Customer Who Is a Doubtful Credit Risk

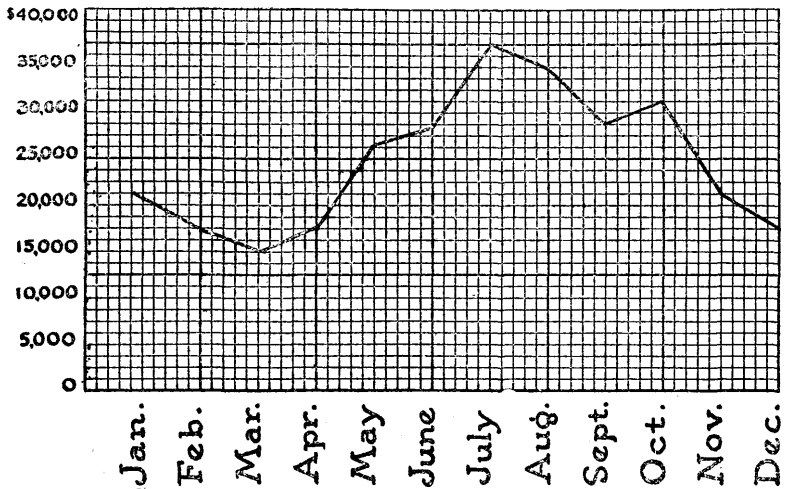


FIG. 32.—Chart Showing Cash Balances Monthly for One Year

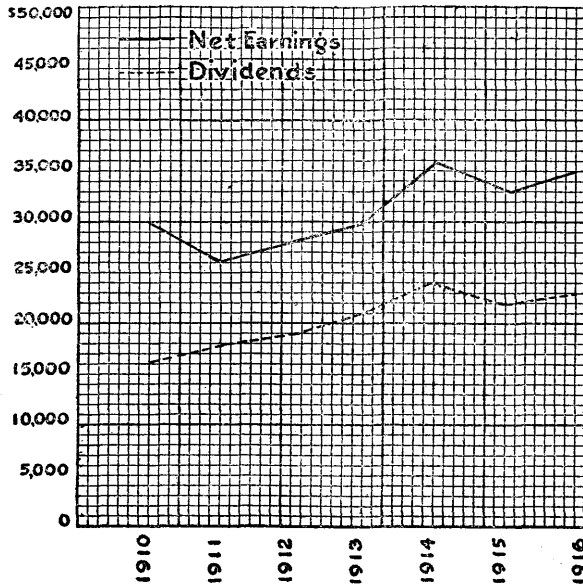


FIG. 33.—Chart Showing Net Earnings and Dividends Declared for a Corporation

shown in a vivid way. If the upper line diverges too far from the lower line, it is a clear signal that collections should be pushed.

ACCOUNTANTS' REPORTS

Until recent years accountants have used graphic charts very little, but an increasing tendency toward this form of expressing figures has recently been noted. In many annual reports published during the last few years, graphic charts have been employed. The results seem fully to justify their use.

Not only in the annual report, but in the current accounting work, curve charts are becoming more popular. Many executives demand that their weekly and monthly reports be in graphic form.

As an example of such a chart, the one shown in

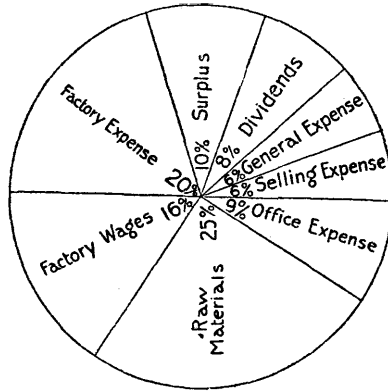


FIG. 34.—Chart Showing Distribution of Gross Income for the Blank Company, 1916

Figure 32 is interesting. Instead of the usual dry report of cash balances, we find an easily interpreted financial history of the company, showing the various fluctuations in the state of its treasury.

For annual report purposes the graph shown in Figure 33 gives stockholders in a nutshell the informa-

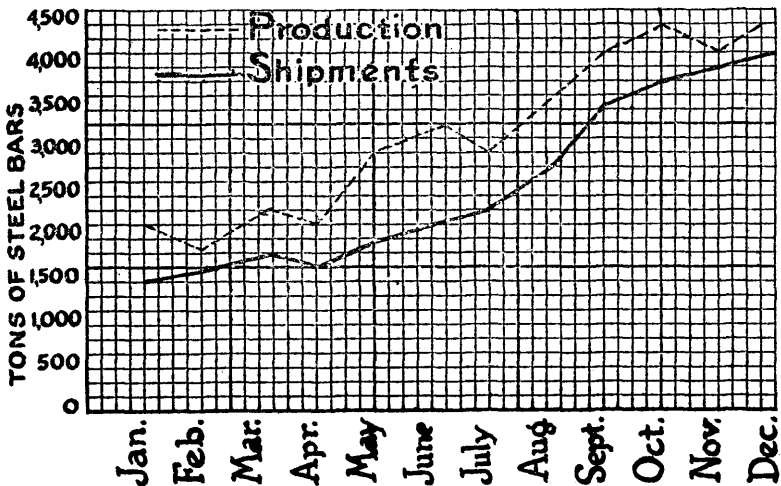


FIG. 35.—Chart Showing Production and Shipments (in Tons) of Steel Bars

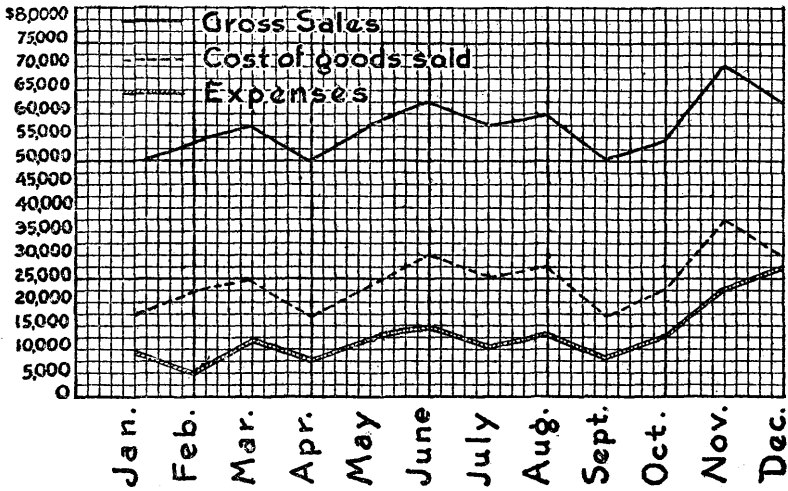


FIG. 36.—Chart Showing Sales, Cost of Sales, and Expenses by Months

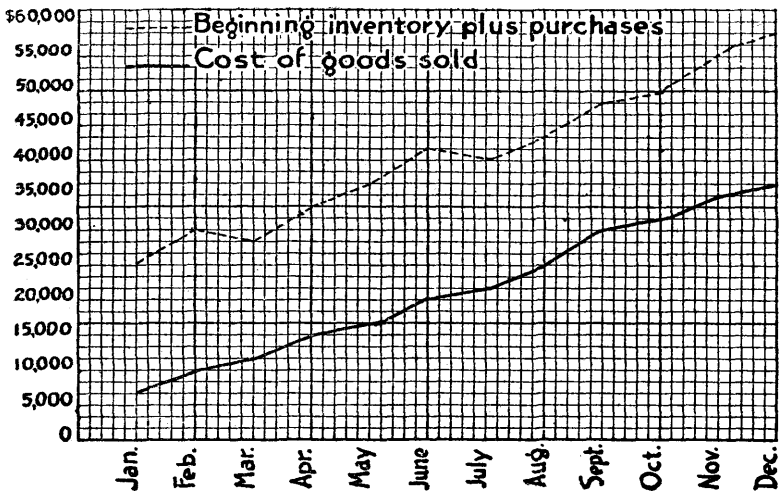


FIG. 37.—Cumulative Chart Showing Relation between Purchases and Sales

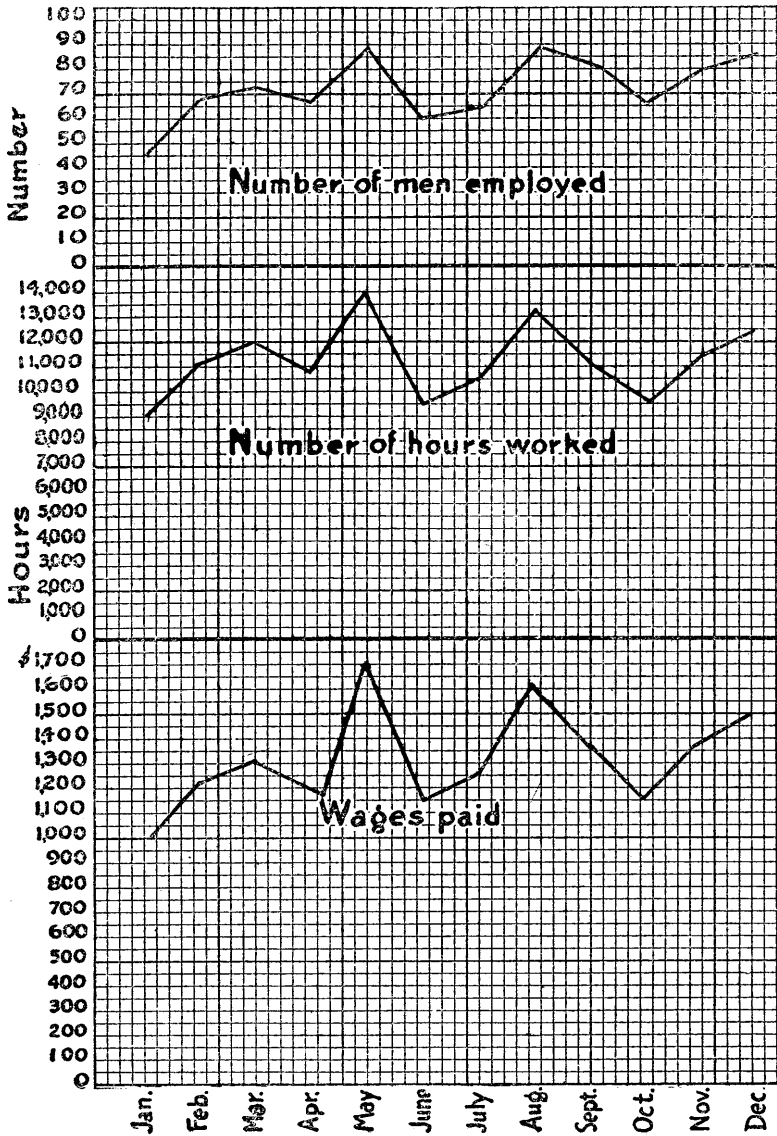


FIG. 38.—The Blank Company Pay-Roll Charts

tion they really desire. The difference between the net earnings and the dividends declared is known as the "margin of safety" of the dividend rates. Figure 34 is also very interesting to those who read such a report.

The head bookkeeper or the accountant of a corporation can make himself popular with his superior officers by presenting for their inspection charts like those in Figures 35, 36, 37, and 38.

The relation between the total production of a given commodity and the total shipment of that commodity to customers is very important from a financial standpoint, since it is desirable to keep as little money as possible tied up in inventory. The closer together the two lines in Figure 35, the more favorable the situation from a financial standpoint. A similar chart for a trading concern is shown in Figure 37.

The pay-roll analysis is very important, particularly in the manufacturing business. It is easier to interpret if in chart form similar to Figure 38. This is a chart which differs slightly in form from those previously studied. It consists of three charts, one placed above the other, each using the same horizontal scale, but having three different scales for the left-hand side. The purpose of this arrangement is to permit ready comparison between the three factors charted.

Where graphic charts are used for annual reports or even for departmental reports, it is frequently desirable to have them appear as a preface to detailed sheets showing all the figures. The chart, therefore, should represent only a summary, fully supported in each case by full detail.

PRODUCTION CHARTS

A number of different charts have been devised by the consulting efficiency specialist and the shop executive.

Maximum efficiency in a machine shop or foundry demands careful record keeping and close analysis of operating results.

For the time-study man, a chart like the one in Figure 39 visualizes increased efficiency. Where a complete operation consists of a chain of suboperations, it is

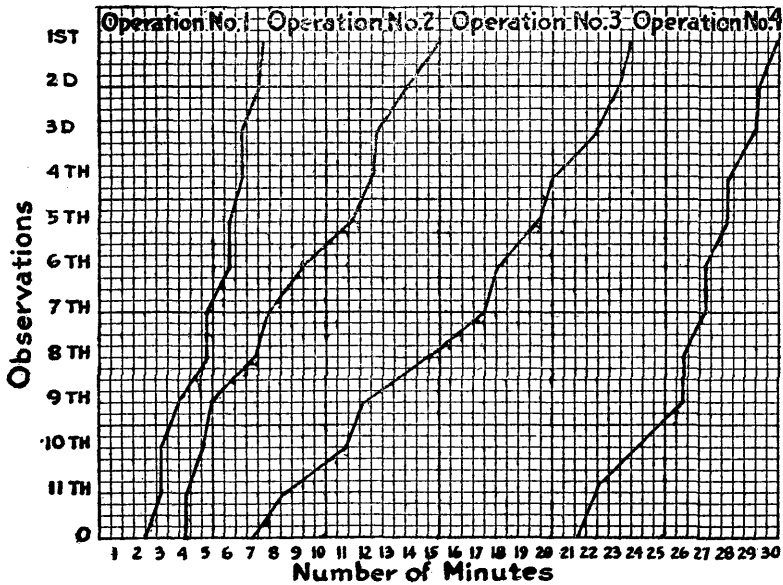


FIG. 39.—Chart Showing Results of a Series of Eleven Time Studies on Four Consecutive Operations

Note that one of the principles regarding directions of curves had to be disregarded here because there is no combination that will permit these facts to be shown by curves going from bottom to top and from left to right.

essential to study these various components in order to reduce the total time required. This chart shows the results of a series of time studies taken at regular intervals. Increased efficiency is very vividly shown by this graph.

Idle time on the part of machines or workmen is the bane of the shop superintendent, and unless carefully watched, the amount of idle time is likely to prove alarming, even in the shop of average efficiency.

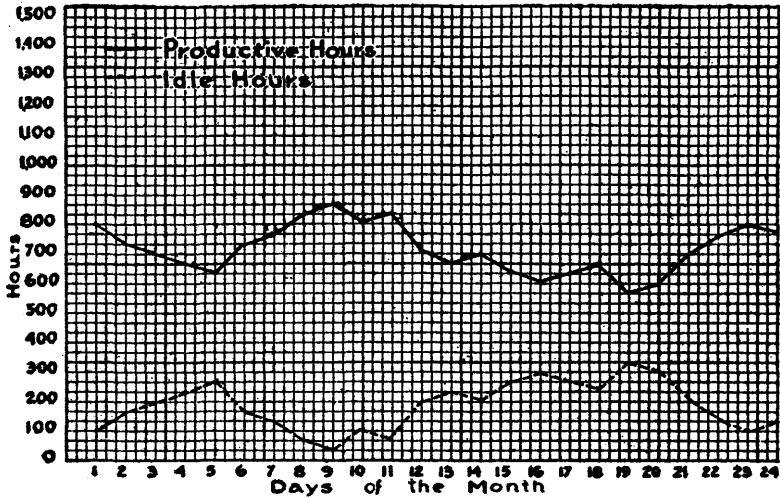


Fig. 40.—Chart of Productive and Idle Time for the Machine Shop of the Blank Company during March, 1916

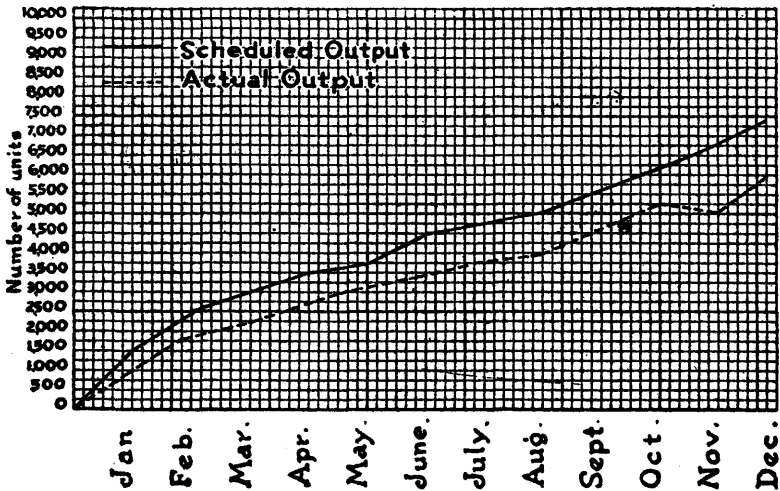


Fig. 41.—Chart Showing Manufacturing Schedule for the Blank Company

Many shop executives have a chart like that shown in Figure 40 before them constantly. It shows at once when the amount of idle time is becoming dangerous.

Modern competitive conditions require a close scheduling of manufacturing output, and every attempt is made by the shop force to keep production up to the program. Figure 41 shows a graphic history of actual

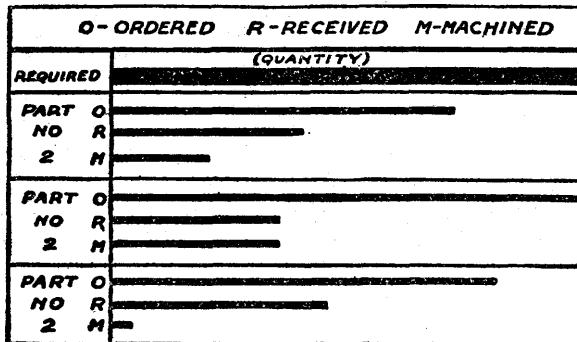


Fig. 42.—Chart Showing Progress of Parts Entering into an Assembly¹ production as contrasted with scheduled production of a manufacturing plant. Of course there should be one separate chart for each kind of product manufactured.

Mr. C. E. Knoepfel, the efficiency engineer, is responsible for the chart shown in Figure 42. This pictures the progress of each part entering into an assembly. The various part symbols are listed on the left-hand side, and the distance from left to right is used to represent the number of units. The heavy black line across the top expresses the number of assemblies required for each part; the quantity ordered, received, and machined is indicated by separate distinct lines.

Figure 43 graphically compares scheduled and actual dates, and it is almost self-explanatory. The lines connecting scheduled and actual dates show by their inclination whether production is running ahead or behind schedule.

¹ Figures 42 to 46 inclusive are reproduced from the *100% Magazine* by the courtesy of its publishers.

assembly. In the same way, lines "M," "O," and "T" represent time required for machining, purchasing, and tooling, and this chart is elaborated to include every subassembly and part. It is clear that lines extending

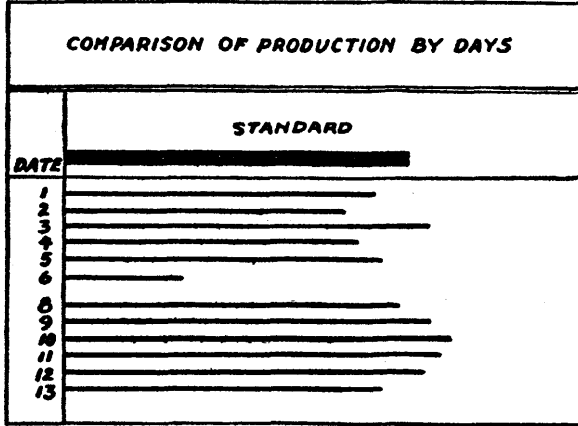


FIG. 45.—Chart Showing Comparison of Production by Days

farthest to the left point to the activities which must be started first. As operations begin the accomplishments may be charted parallel to the schedule and thus the exact status of the work is visible at a glance.

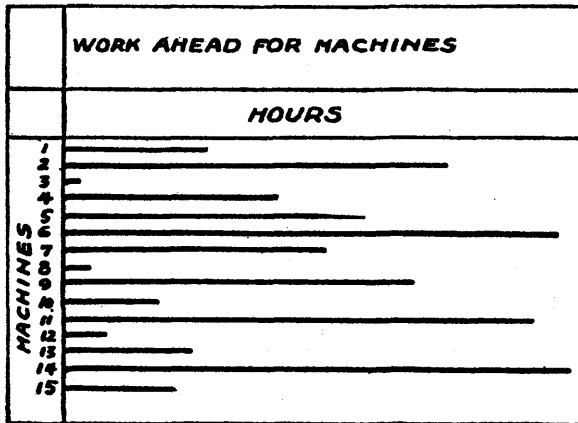


FIG. 46.—Chart Showing Work Ahead for Machines

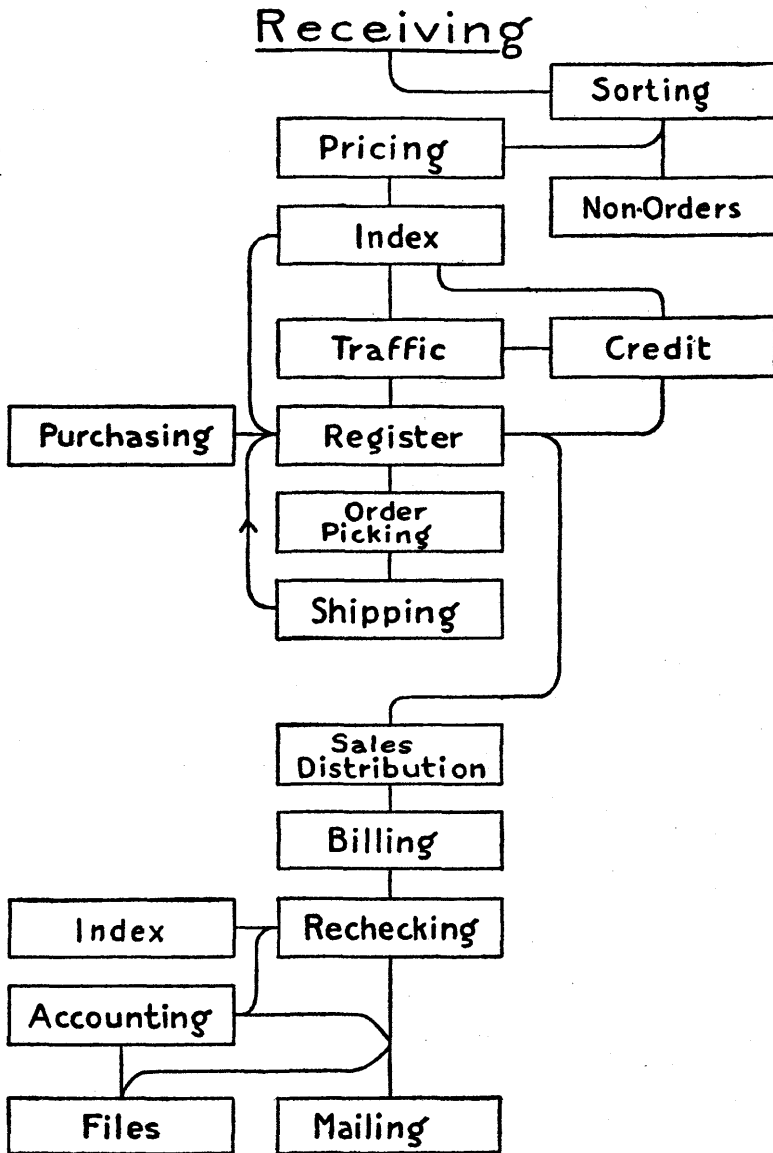


FIG. 47.—Order Flow Chart of the Blank Company

CHART "E."

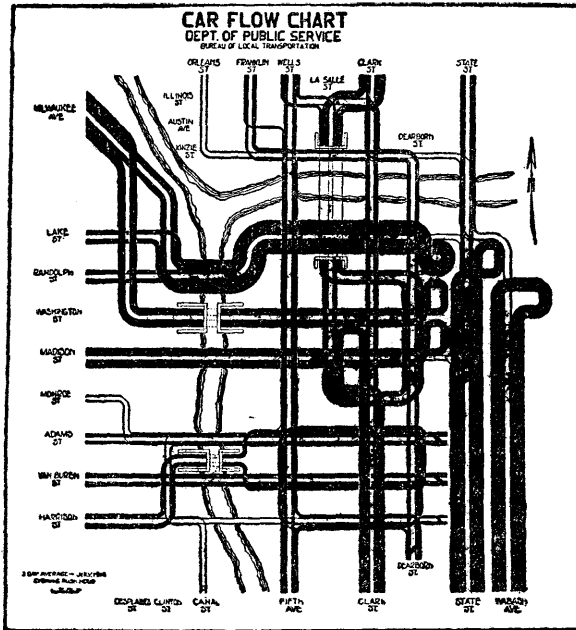


FIG. 48.—Car Flow Chart

The chart in Figure 45 is similar to the one shown in Figure 41, except that a different technique is used. The purpose of the two charts is approximately the same. They compare the production with the standard.

Figure 46 is useful in machine-shop planning, since it affords a graphic presentation of the number of hours of work ahead of each machine. Proper adjustments and revisions of the schedule can be made, based upon this chart, in order to bring all lines as nearly as possible to a uniform length.

In nearly all efficiency work it is necessary to construct flow charts. This type of chart has already been illustrated (see Figure 11). Another type of flow chart is shown in Figure 47, representing the procedure of handling orders in a large mail-order house.

Another flow chart built on a different basis is shown in Figure 48, which represents a traffic study made in the city of Chicago, based upon which some startling recommendations for rerouting of cars were made.

RESEARCH WORK

In certain types of research work it is customary to use so-called "shotgun" diagrams, of which Figure 49 is a good example. The usual manner of making such graphic charts is to make a large number of observations, or to accumulate a large amount of data, and to

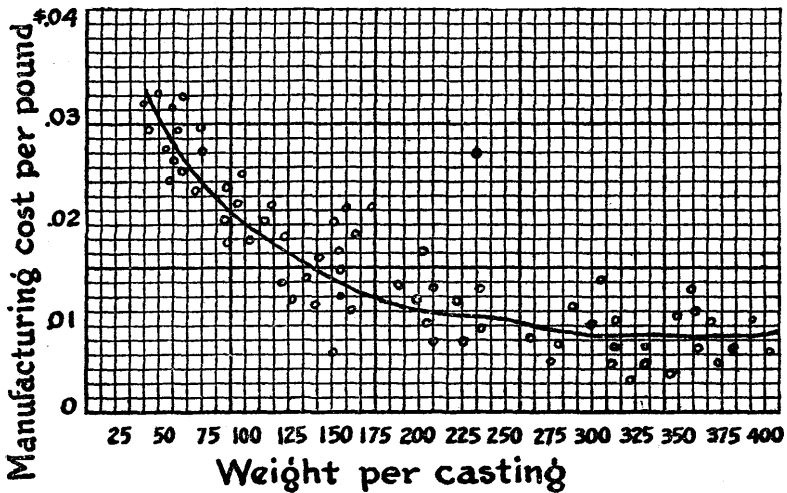


FIG. 49.—Chart Showing Manufacturing Cost per Pound of Castings of Different Sizes

plot them on coordinate paper, either a dot or a small circle being made for each observation. Ordinarily the dots will center along a fairly definite path, and a curve line can be drawn through them in such a way as to cut through all points where the dots are most dense. This represents a graphic means of arriving at a fair average for all the data plotted.

Figure 49 shows the results of graphing a number of cost cards representing the cost per pound of making castings.

In certain kinds of industrial research work it is necessary to make great numbers of these "shotgun" charts. The statistical department of one large company uses small rubber stamps with needle points just projecting through the center to plot data on the coordinate paper. For different *kinds* of data, different rubber stamp designs may be used, such as squares, triangles, and circles.

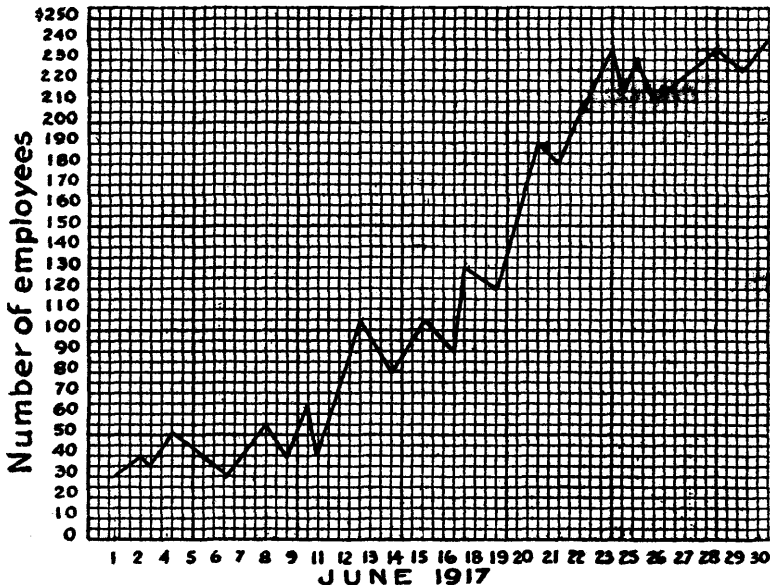


FIG. 50.—Chart to Study Effect of Introducing Bonus Wage Method in Factory
Curve shows number of employees making bonus.

This has been found to be very quick and efficient when a large number of charts must be prepared.

Another type of chart used in business research work is shown in Figure 50. This represents the history of an attempt to introduce the bonus wage method into a

factory. It shows clearly that the attempt, at least from one standpoint, has been successful, since an increasing number of employees "make" the bonus as time passes.

THE PURCHASING AGENT

The purchasing agent has occasion to use many charts, particularly in keeping track of raw material prices. These are the usual line charts showing unit values on the vertical scale and time on the horizontal scale, and they are not illustrated, as their technique is very simple.

Another curve which is useful to the purchasing agent is one which really acts as a perpetual inventory record. Such a chart is shown in Figure 51. It clearly signals the danger point in the consumption of raw stock by the factory, showing both the consumption of material and

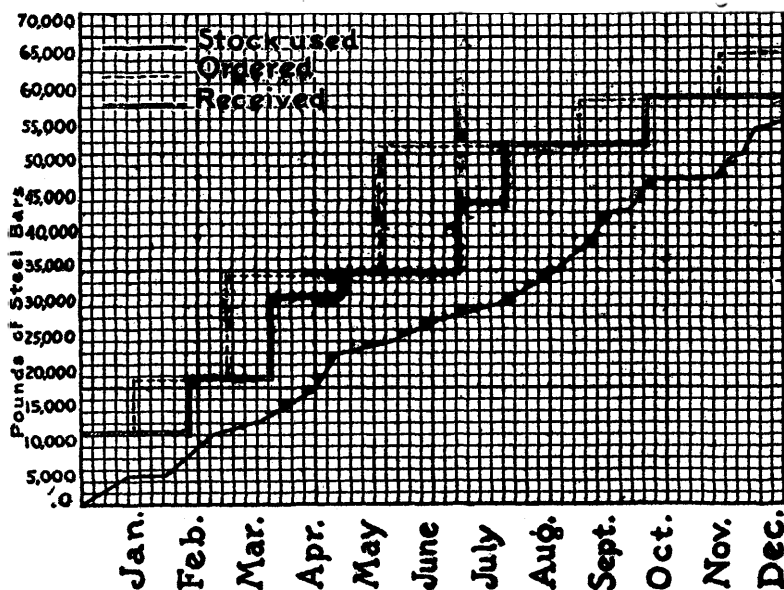


FIG. 51.—Chart Showing Relation between Raw Stock on Hand and Ordered, and Raw Stock Used by Factory

the replenishing of supplies received; the addition of lines indicating orders placed makes the chart complete.

MISCELLANEOUS

In connection with bank advertising it has frequently been found that a graphic chart showing the growth in deposits tends to increase public confidence in the institution. The simpler such a chart is, the better. A graph like Figure 52 is probably the most effective single form of advertising that a bank can display in its windows.

The Department of Public Service in Chicago has been responsible for the creation of a number of interesting charts which they have used in their annual reports. One is reproduced in Figure 53 and represents a graphic analysis of telephone service complaints.

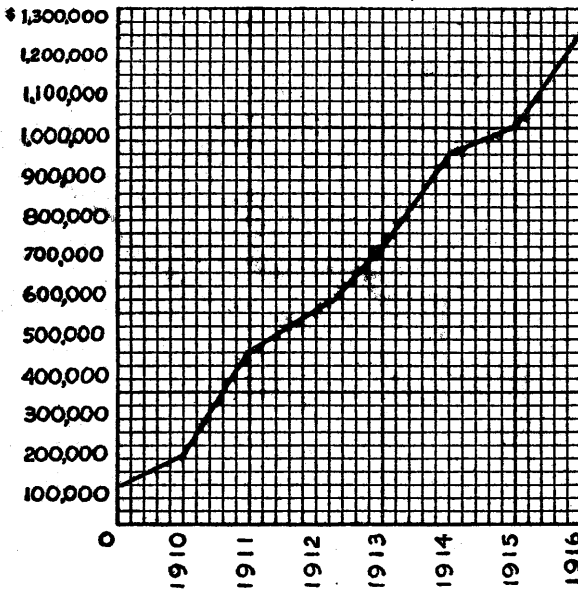


FIG. 52.—Banking Chart Showing Growth in Deposits for a Series of Years

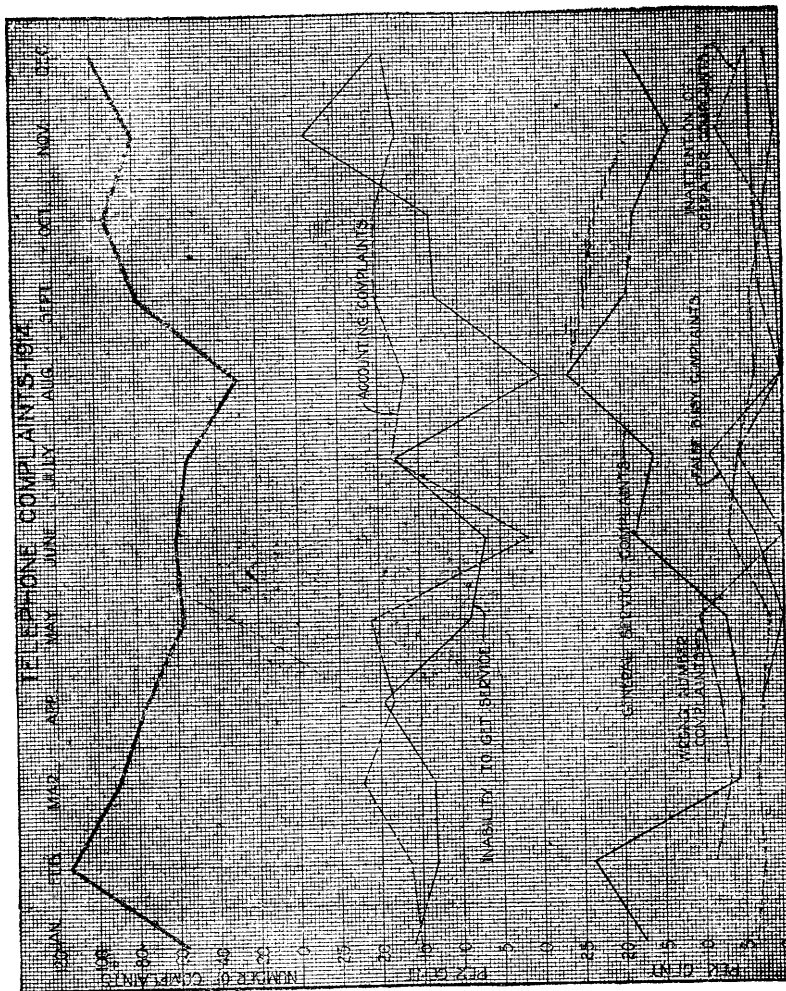


Fig. 53.—Chart Showing Complaint Analysis

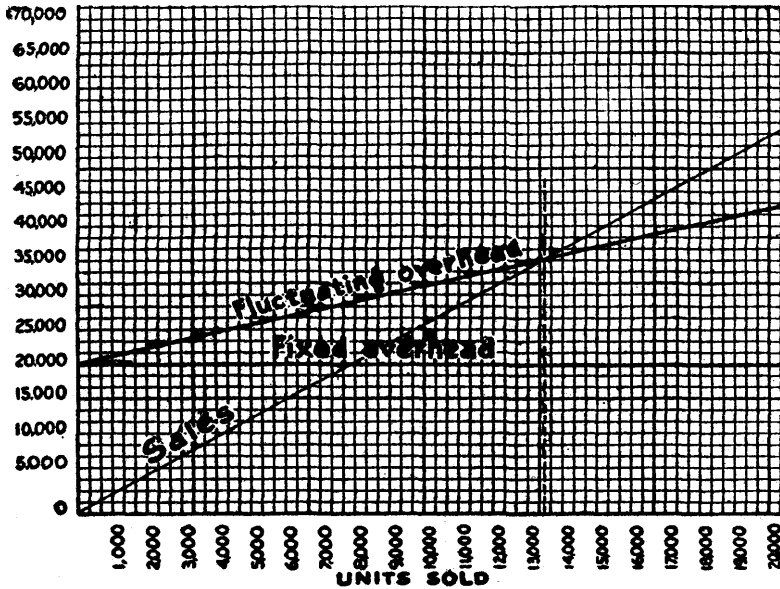


FIG. 55.—Chart for a Company Making Only One Product Shows yearly volume of business necessary to make a profit.

Another chart appearing in the same report shows results of a telephone study in a large Chicago store. This chart is reproduced in Figure 54. From such a chart as this a vivid idea of the density of telephone traffic can be obtained.

As an aid to the proprietor or the manager of a business in determining the volume of sales required to produce a net profit, Figure 55 suggests a valuable chart, illustrating, as it does, the relation between sales, fixed overhead, and fluctuating overhead expenses. The chart here illustrated indicates that sales of thirteen thousand units must be made before any profit at all can be obtained.

Much more complicated charts are such as those issued by statistical bureaus like Babson's or Brookmire's. Such a chart is reproduced in Figure 56. Space

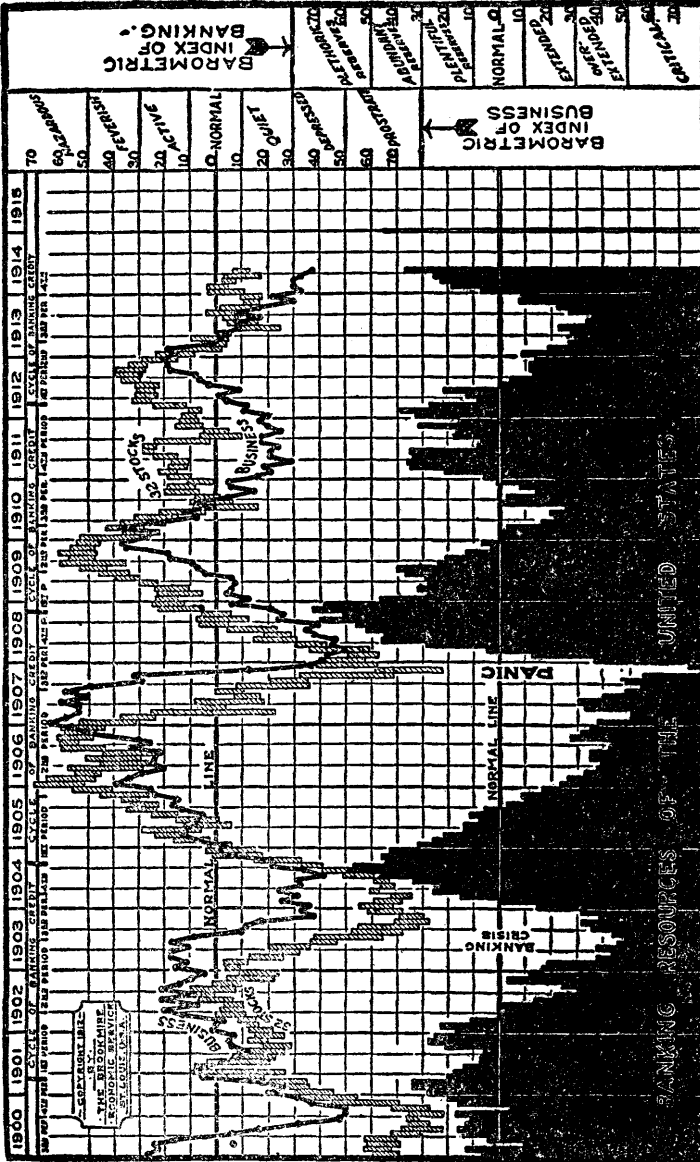


Fig. 56.—Brookmire Barometer Chart of Business

does not permit a complete description. It is sufficient to say that a study of the various factors plotted in these charts should give an investigator or a merchant a fairly good basis for determining general financial trends and tendencies.

PHOTOGRAPHS AND CHARTS

Somewhat allied to graphic charts are *progress photographs* used by contractors and builders. A photograph of a structure under construction is taken at regular daily or weekly intervals; in this way is produced a running history of the work accomplished. When these are mounted side by side on long sheets, they tell a very vivid story of the progress of the contract.

Photographing is also used in connection with charts where it is desired to send copies to distant points. A photograph of a large wall chart may be taken daily or weekly and a number of prints taken off and sent to branch offices or absent executives.

This operation is, of course, somewhat expensive, and as a substitute charts are frequently made on thin paper, or tracing cloth, and blueprints are made in the usual way. The curve cards and coördinate paper illustrated in Figures 17 and 18 are constructed of a thin, tough paper which is sufficiently transparent to permit blue-printing.

CONCLUSION

The nature of graphs and the principles which underlie the construction of useful graphs have now been discussed. Suggestions have been made for their use in organization, administration, sales, advertising, credit, research, business economics, and other activities of

business. The aim of this treatise has been to present suggestive charts which will enable the reader to see the possibilities of graphic illustration in his own particular line of business. The entire subject is only in its infancy, and it may reasonably be expected that the art will be developed very extensively within the next decade. Unquestionably, the enthusiasm of business men and accountants for these "pictures of figures" is becoming greater every day.

SELF TEST QUESTIONS

These questions are for the reader to use in testing his knowledge of the lecture. The answers are not to be sent in to the University.

1. What is meant by graphs? By what other names are they sometimes known?
2. What is the proper use for graphs in managerial and executive work?
3. What is meant by a line chart?
4. For what purposes are bar charts suited?
5. Explain the use of prophecy charts.
6. What is meant by organization charts?
7. When may flow charts serve a useful purpose?
8. Enumerate eight general rules given for the effective presentation of graphs.
9. What caution should be used in the selection of scales?
10. For what purposes are comparative charts useful?
11. Describe some of the uses of graphs in the sales department.
12. What data from the advertising department lends itself readily to graphic presentation?
13. How may a credit man use graphic charts in his work?
14. Indicate some of the possible uses of graphic charts in accountants' reports.
15. Enumerate at least six different uses of graphic charts in the production department.
16. Explain some of the uses of graphic charts made by the Department of Public Service in Chicago.
17. Explain some of the uses of photography in graphic presentation of facts.