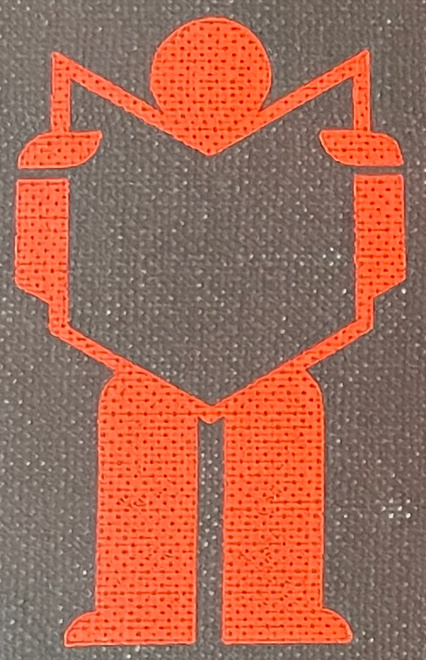

HOW TO USE PICTORIAL STATISTICS

MAURICE DONNELLY

HOW TO USE PICTORIAL STATISTICS

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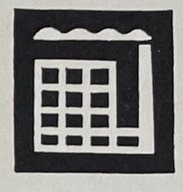

By RUDOLF MODLEY • Executive Director, Pictorial Statistics, Inc • Consultant, U. S. Department of Agriculture, Soil Conservation Service • Consultant, U. S. Rural Electrification Administration
• With one chapter on Symbols by FRANZ C. HESS, Huxley House



HARPER AND BROTHERS • New York and London

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FOREWORD

A geographer struggling to plot the boundaries of the human mind would have to label most of it "terra incognita." In all of this area of darkness there is but one really familiar landfall: that one port of call, the mysterious mental "land" through which ideas, thoughts and feelings are brought to light for communication and understanding. Since the dawn of civilization man has been pushing back that darkness which surrounds understanding. He has created words, a literature, painting, music, and as his control of the forces of nature has grown, he has invented radios, telephones, telegraphs, printing presses to increase the effectiveness of the essential tools of communication.

The pictographs which I discuss in this book belong in the category of essential tools with words and painting. They, too, push back the horizon of darkness which surrounds human thinking and contribute to articulate communication.

Those who have worked with the terms of human expression, whether practically or artistically, have had to face one fundamental problem: how to convey exact meaning. Words are inflexible but the minds which shape them into sentences, and the minds which perceive them differ. The "stately pleasure-dome" of Kublai Khan which Coleridge described may have been to him a brilliant variant of the dome of Saint Paul's. To us who

read his verse it may resemble anything from the Taj Mahal to a world's fair Crystal Palace. A dictionary will tell us what a word denotes, but its connotation is compounded of our experience and imagination. The correct pictograph has no dubious connotation. It is exact. Its meaning cannot vary as it passes an idea from one mind to another.

Obviously, the field of pictographs is limited in the range of ideas which can be translated intelligibly. But pictographs are basically so simple and direct that within their field they have the capacity for communication to unlimited numbers of men. They state facts in such a way that the exact meaning cannot be mistaken. They clothe otherwise forbidding information in an attractive dress which makes it pleasing and acceptable to a wide audience. From these two facts it follows that the producer of pictographs must have a sense of the limits of the medium and the skill to put his material in terms that are universally effective and comprehensible. Nearly everyone can write, but there are only a few writers. Nearly everyone can present facts but there are only a few who have developed a technique to present them dramatically and correctly.

An author, unless he be a Thackeray or Beerbohm, turns his book over to an artist to be illustrated. In the case of more technical works, which would require greater skill in illustration, this custom is by no means so common. Too often the author will draw his own charts, or diagrams, or direct the making of the illustrations with a none too happy result. His reasoning is that since he knows the facts, and what should be

illustrated, who but he is qualified to superintend such work? The author may be an authority in his field, but he usually is not an authority in illustration. He might better give his manuscript to someone who specializes in illustrating and let him find a way to present the story. Art directors, museum directors and all of those who are called upon to find illustrative material of a technical variety would get better results if they, too, would turn the outline of their projects over to a graphic specialist so that they may profit fully by his experience. If any of these men were to build a house they would most certainly consult an architect. If they needed advertising, they would consult an advertising agency. The chart-maker, the pictographer, if I may be permitted the word, is a specialist in the same sense, and his services should be used in the same way.

I believe that if pictographs are to take their place as an efficient means of communication, this concept must first be firmly established. For that reason this book is written not only as a technical handbook for those who wish to use the method; it is just as much an introduction for all others to a new and highly concentrated field of communication which is intended for a wide audience and penetrating statement. The laws and methods of pictographs as I have outlined them will, I hope, contribute to an understanding of their use as well as explain the intricacies of their application.

This book tells only the technical part of chart production. But before production is begun a firm foundation of facts must be prepared. The subject to be shown must be thoroughly

studied. Books must be consulted. The client must be interviewed, so that the aspects most vital to him may be properly emphasized. And there is the problem of finding the proper approach—shall it be direct or through some related field? This book presents primarily a discussion of technique of production methods and does not attempt to describe the scientific and artistic background which give to pictographs a particular distinction. Furthermore, I am attempting to explain *how* rather than *what* statements should be charted.

Any book which attempts to deal with the method of pictographs must acknowledge its indebtedness to the genius of Otto Neurath. He more than any one man created that method and made it into a significant tool of communication. This makes it more regrettable that Dr. Neurath has not found it possible to follow what seems to me the inevitable trend in the development of pictographs. I hope that the success of our American experiments will convince him that the restrictions he has set up are not fundamental implications of the method.

The crux of our difference of approach lies in our different interpretation of the character of the symbols. Dr. Neurath holds firmly to the belief that pictorial symbols should be international, designed within rigid limitations so that a pictorial Esperanto will be created. He wishes to circumvent a pictorial Tower of Babel and produce at once an international picture language. With that ultimate aim I heartily agree, but I believe his method of achieving it is Utopian.

I believe that pictographs must gradually be accepted as a

tool of communication. To achieve this, the symbols must first grope their way into the consciousness of a restricted national audience. They must speak in terms which are comprehensible. Obviously, such symbols must be prepared with their specific audience in mind.

The American and the Chinese farmer dress differently and use different tools; the symbol for "farmer" in America will, therefore, vary from the symbol of "farmer" in China. When national schools will have developed to a point at which they are generally accepted in their countries, then the time will have come to combine the best features of each to create an international picture language.

Rigid rules for symbol design now would retard the growth of pictographs. Such rules would impose on a prospective audience not only the task of assimilating a method, but also the chore of puzzling out the meaning of the terms in which the method is clothed. Rigidly stylized international symbols are a hurdle in the way of everyone trying to grasp technique. Nationally adapted symbols express the technique clearly, and they are well grounded foundation stones upon which a system of international symbols can be built.

Today few symbols have become tools for international communication. Even such general signs as + and − had to wait until the early part of the 17th century before they were generally accepted, in spite of the fact that they had appeared as early as the 1480's.

Even after they were definitely adopted, the conventional +

sign did not achieve a universal recognition. Of the three forms used, the Greek cross, the Latin cross, and the Maltese cross (somewhat simplified), the Greek had been prevailing from the 15th century on. But it was not until the 18th century that it definitely replaced the Latin cross.[1]

If abstract symbols of such simplicity as these developed so slowly, it would be indeed sanguine to expect pictorial symbols to be internationally accepted without a period of trial.

Clearer, and more emphatic than an argument of words is this fact; in the past few years pictorial symbols have been produced all over the world, and in no two countries are they alike. To close our eyes to this fact would be nothing more or less than a willful blindness toward reality. To accept it and learn from it opens the way to a future cooperation between the various agencies from which, in due time, an international symbol language may arise.

I owe my thanks to Mr. Franz C. Hess of Huxley House for his continuous assistance and for his contribution to this book; to Mr. Ayers Brinser for his editorial help; to Mr. A. Ford Hinrichs of the United States Department of Labor for his suggestions. Most of the charts for this book were made with the aid of Mr. Henry Adams Grant of Pictorial Statistics, Inc. The book itself could not have been written without the constant and friendly interest of Mr. Morris L. Cooke, former Administrator of the Rural Electrification Administration, Mr.

[1] See F. Cajori, *A History of Mathematical Notations*, vol. 1, pp. 230 ff. Chicago, 1928.

Edward Fisher Brown, Executive Vice President of the Milk Research Council, Inc., and of Mr. Evans Clark, Director of the Twentieth Century Fund, Inc.

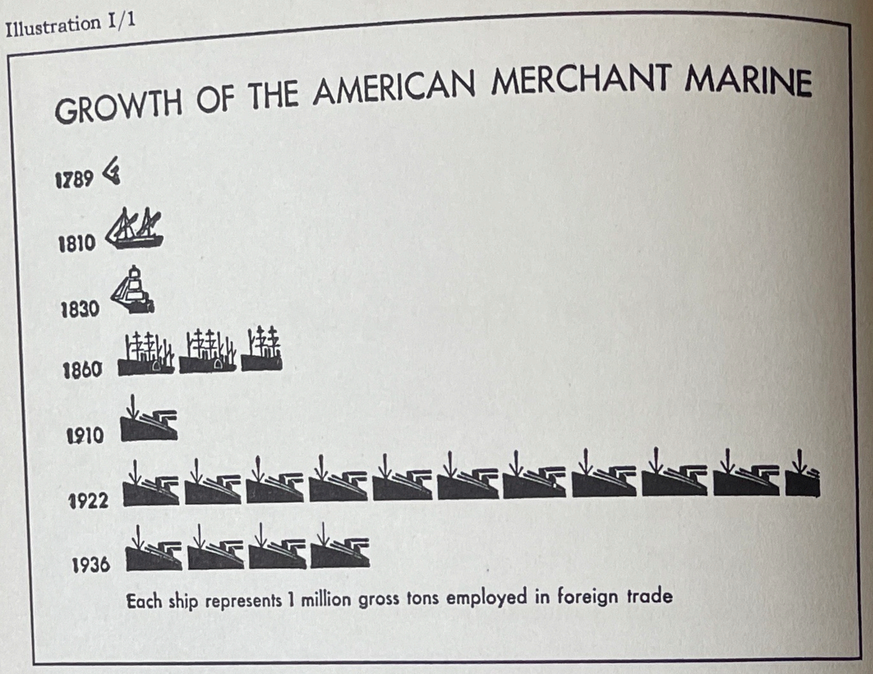
R. M.

New York City

April 2, 1937

HOW TO USE PICTORIAL STATISTICS

Illustration I/1



● A chart makes direct statements with dramatic simplicity. Through the use of symbols it explains and describes the subject. The chart used as an example is from *The United States: A Graphic History* by Hacker, Modley, and Taylor, Modern Age Books, Inc., New York, Fall 1937.

CHAPTER • I

The Story of One Chart

On the opposite page is a chart. It makes direct, declarative statements. One of them says that in the past 14 years the American Merchant Marine has declined rapidly. Like a newspaper headline, it states that fact with dramatic simplicity. But unlike any newspaper headlines, that chart tells the story in terms more comprehensible than the most monosyllabic tabloid vocabulary.

You may say, "That's true enough in this case; but most of the charts I see are just as abstruse as the text they vainly try to illustrate." That is often a valid criticism. Many charts are obscure and even misleading. But that does not mean that charts are necessarily inadequate. It is possible to plot an idea in a chart simply, honestly and clearly if a rational scheme is followed. The first step in this scheme is to decide precisely what a chart is to say before it is put on paper.

Let us go step by step through the processes that must be performed to produce an effective chart. Every one of these steps will be discussed in detail in later chapters. Here we will survey them only hastily.

First, we must have the facts, the statistics which show just what has happened. An honest judge does not hand down a decision without first examining the evidence. No more does an honest chart maker. A chart is based on facts, not impressions.

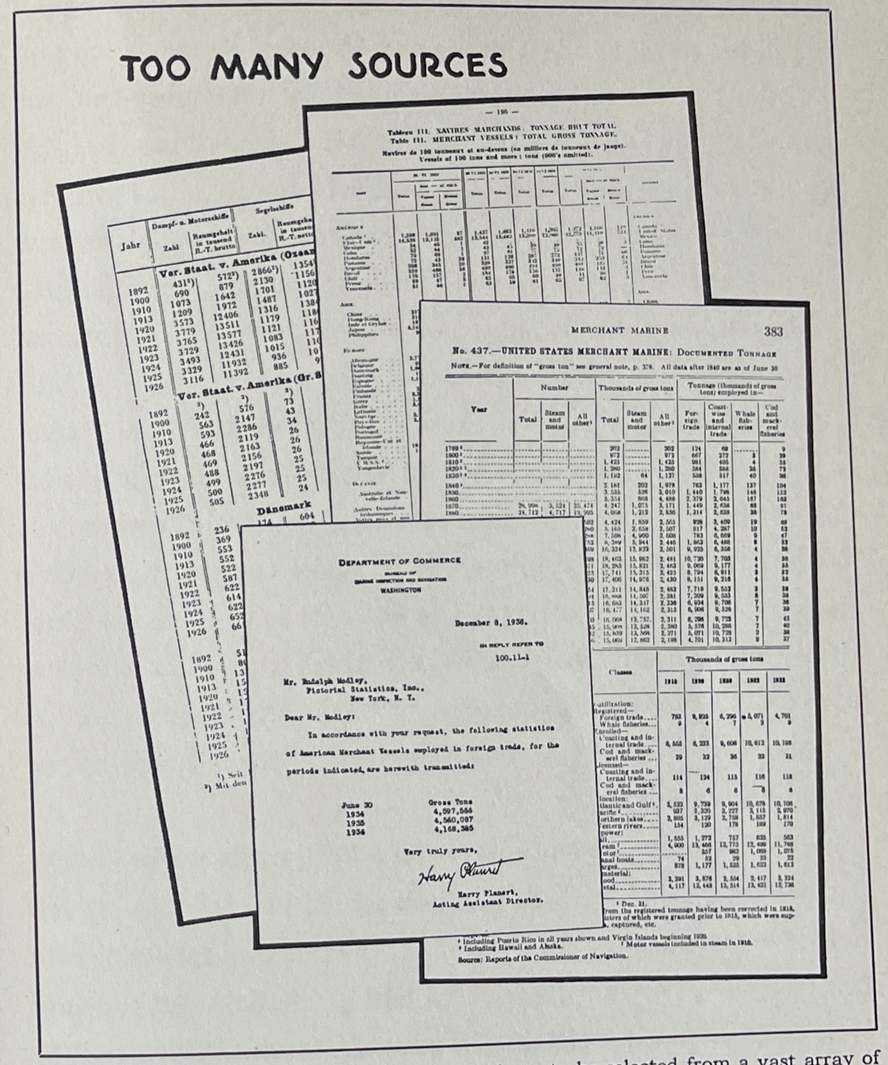
Occasionally the necessary information for a chart is supplied by a company's research department. More frequently, we will be simply told to show "what happened" to the American Merchant Marine, or King Cotton, or any one of a thousand things. In such cases we must consult the most authoritative sources of factual information.

Looking for material, we must face two problems. If there is too much data we will have to restrict our subject to the most indicative phase. We cannot draw a chart of a railroad, but we can plot the trend of carloadings, passenger traffic, rates or mileage. If there is too little material, we shall have to cast about for available data in closely related fields which throw some light on our subject.

When we have selected the figures that best illustrate our story, the next step is to weed out all but those which are absolutely essential. These final figures are the basis for the statistical layout which already contains all the elements of the final chart. It has a concise title and a clear legend. It indicates how many rows of symbols there will be, how many symbols in each row, and for what each one of these symbols stands.

There are a number of dangerous pitfalls we will have to avoid in the survey of material, in the selection of pertinent detail, and in the indication of graphic symbols to represent

Illustration I/2



- The most indicative statistics have to be selected from a vast array of material. The material listed on this chart comes from the *United States Statistical Abstract, Die Welt in Zahlen,* by Woytinsky, *The Statistical Yearbook of the League of Nations,* and a letter from the Department of Commerce containing the latest available material.

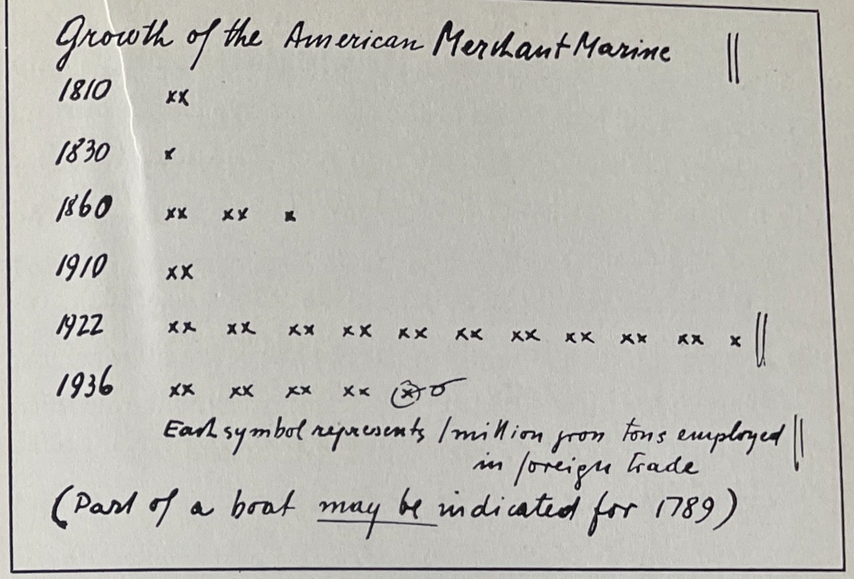
abstract numbers. We must keep in mind that the success of the chart will depend on its simplicity and clarity. If we plan to put too many symbols in one line they will be too small and crowded to stand out as units. We must also remember that the symbol must at all times be recognizable as something that can readily be identified with the subject. For a chart on the American Merchant Marine we may use conventionalized silhouettes of a typical ship of the period we are discussing.

The statistical layout, based on all the above considerations, becomes the blue print for the artist who must translate it into a graphic layout which is a rough sketch of the final chart; it gives symbols and lettering in the approximate size and shapes and is the basis for further discussion and criticism.

The artist's primary interest is to make the chart effective from a graphic point of view. Our interest is to have it statistically and visually correct. Where these two aims conflict, both sides have to make concessions. But neither may concede a point which would impair the fundamental accuracy or readability of the chart.

When the graphic layout has been agreed upon, we are ready to plan the final chart. The symbols which had been approved in sketch form will be drawn up in large size and mechanically reproduced. Title and legends will be printed in appropriate type sizes as designated in the graphic layout. Explanatory pictures will be drawn on the original. The printed symbols and type will be pasted on the final; tracing paper indications are added for the printer if it is to be printed. Then a final check

Illustration I/3



● A statistical layout contains all the elements of the final chart. All non essential elements have been eliminated and the material is ready to be handed to the artist. (The inclusion of a fraction of a symbol for 1789 is unusual. It is only done for historical reasons. See pp. 92 and 93 for objections to inclusion; also pp. 63–5.)

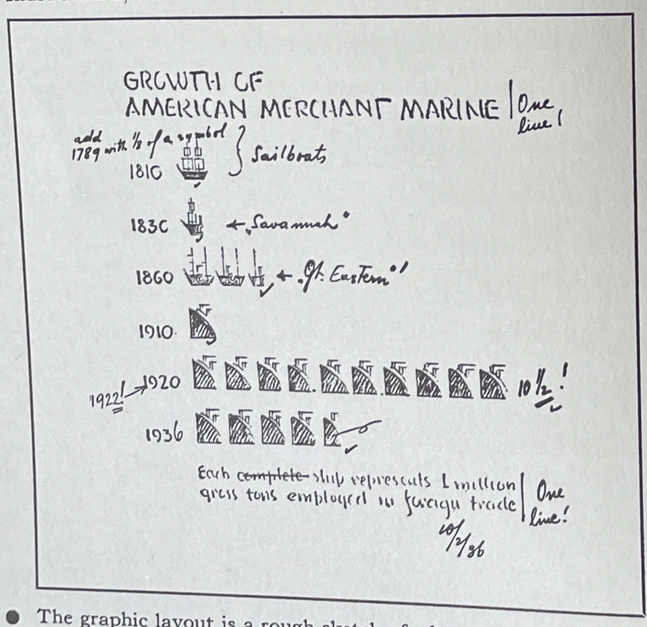
for accuracy, and the chart will be ready for publication.

After this preparation, the chart goes out to compete for the interest of the public. Well executed charts *win the attention* of modern men and women who in their hurry limit their attention to those things which are simple, informative and arresting. A chart tells a story. It has a statement and a climax. It is brief and packed with information. Most of us will stop to look at a publicity chart illustrating the growing number of depositors in the First National Bank. In newspapers, charts play the double role of headline and illustration. A wall chart

gives you the satisfaction of seeing important trends succinctly portrayed. To get an idea from type you must remember words and figures. When you look at a pictorial chart you have only to carry away an impression of the comparative length of rows of symbols; the simple conception of more and less, together with a visual impression of the "what." The chart is *quickly grasped* and *easily remembered*.

But this happy result can only be achieved if a chart is carefully prepared, intelligently thought out, and above all, honest and accurate. Like any other form of expression, chart making demands method. It is the purpose of this book to describe that method in detail.

Illustration I/4



● The graphic layout is a rough sketch of what the chart is finally going to look like. It is the basis for criticism and suggestions; when it has been approved the final chart can be prepared.

CHAPTER • II

Why Pictorial Statistics?

The method of communicating ideas would seem to be one problem which mankind has solved. Since the days of the earliest illiterate scribblings, the urge of man to transmit his thoughts and impressions has been materialized in written words, figures, photographs, paintings, bar charts, and a hundred other devices. Why add another method of expression? The answer is that in the midst of these complexities, pictorial statistics present a means of condensing and penetrating to the heart of an idea. Instead of adding confusion, pictorial statistics help to isolate ideas from their irrelevant fringe and make them easily understandable so that factual information may reach a wider public. Here are the advantages of this method which give it an important position amongst the graphic methods of presenting facts, and the limitations which define its uses.

An American Indian's horse was a reality to him. He described this reality when he wrote horse in his crude picture language. Like a photograph the image he drew was self-explanatory to all other Indians and to the white men who happened to see it. But to the same Indian the combination of

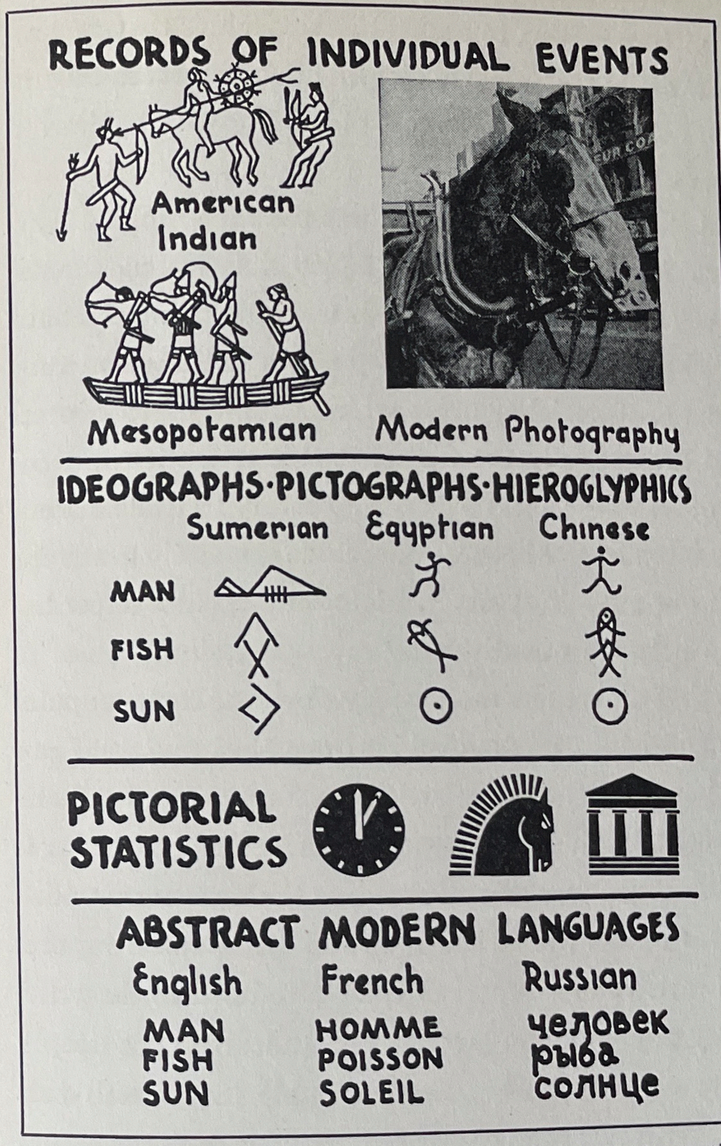
the five letters of the English word "H-o-r-s-e" conveyed no such picture. It was just a jumble of incoherent scratchings. Our modern written languages have lost the directness of the old picture languages.

We are trying to restore this direct image language with pictorial symbols. But we don't want to write the story of an Indian's ride in pictorial symbols. To do that we could use photographs, which with their accurate detail are infinitely more realistic than any conventional symbols. We are not concerned with individual events. We want to present pictures of social and economic facts. We cannot photograph the trend in population in the United States, and only experts are fascinated by the endless columns of figures of a census report. However, with pictorial statistics we can definitely make an interesting picture of population trends.

Modern pictorial symbols do not represent *one* horse or *one* American. They stand for *groups* distinguished by their peculiar characteristics. Instead of Henry Wilberforce, one American, pictorial statistics deal with *the* American, a unit of mankind. We draw a conventional symbol which clearly represents the American in general and distinguishes him from the Chinese and the Eskimo. With these symbols as "words," the rows of symbols as "sentences," and the charts as "stories," we can state pictorially just how our population has waxed and waned.

Pictorial statistics, which are in general a language of conventionalized pictorial symbols, go back for inspiration to the

Illustration II/1

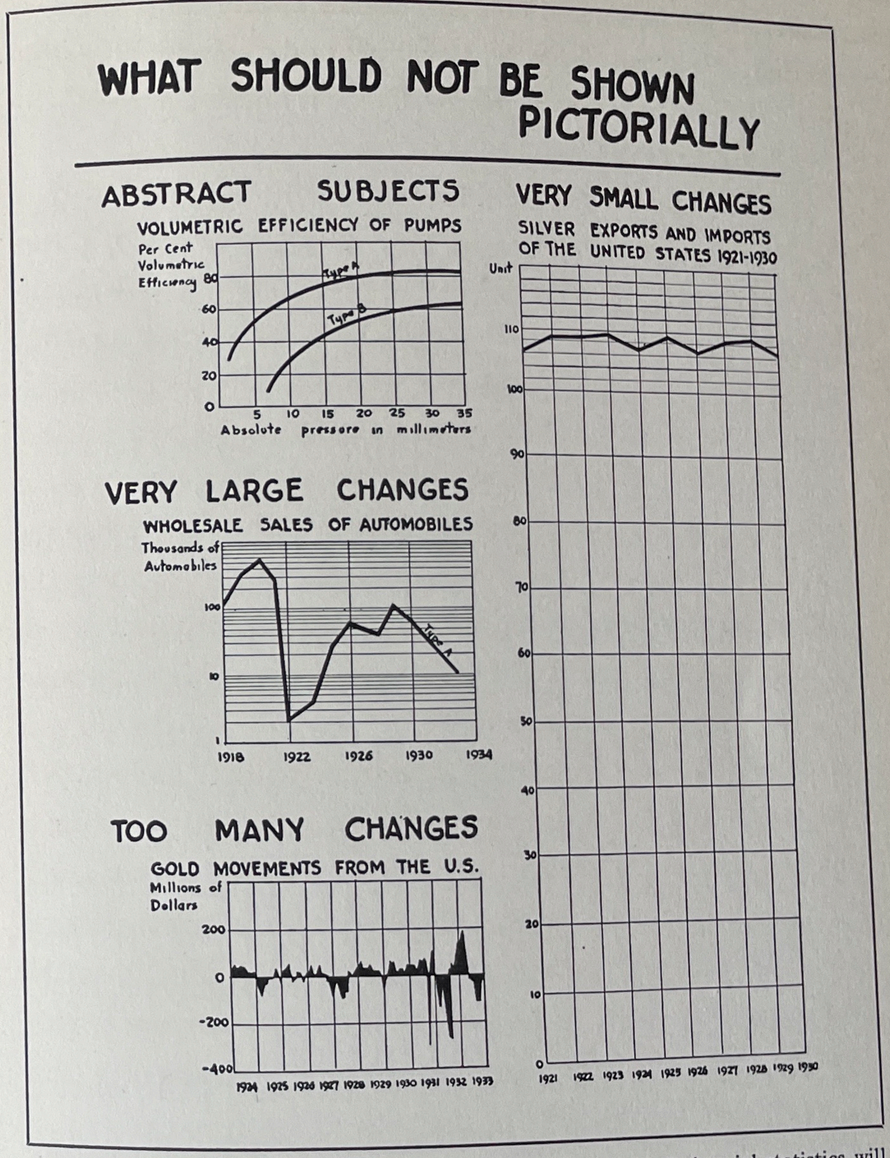


● Pictorial statistics go back for inspiration to the early Chinese and Egyptian hieroglyphics. They restore the direct pictorial appeal which our modern abstract languages have lost. (Photograph by Helen M. Post.)

early Chinese and Egyptian hieroglyphics which had reduced the early picture writing to conventional symbols that still retained their easily recognizable pictorial quality. Pictorial statistics lean heavily on the practices of the Mexican Indians in presenting quantities.

Pictorial statistics reduce to pictures the idea implied by a fact. They do not provide a series of pictorial symbols for the words in such sentences as "Since 1922 the American Merchant Marine has been reduced by over fifty per cent." Instead they give us a set of pictorial symbols which enable us to express simply and dramatically the fact that this reduction has occurred. In other words, it is no longer necessary to translate our vocabulary into pictures because our minds can easily grasp the meaning of our graphic symbols. Pictorial statistics show the relationship between quantities by arranging simple lines of symbols so that differences are visually obvious. If the population of the United States doubled between 1891 and 1937 our chart will show twice as many little men for 1937 as for 1891. The eye can quickly judge increase or decrease and counting is easily possible when we want to discover the figures on which the chart was based. Statistical tables in the Census reports and in the Statistical Abstracts of the United States show the detailed story of population growth. But unless we are deeply interested we would probably never trouble to unearth this information. With two rows of symbols, one for each year, pictorial statistics would show us the facts at a glance. We would only have to observe the different length of each line.

Illustration II/2



- A frank recognition of the limitations of pictorial statistics will prevent many abuses now prevalent. (In Chapter V some possible ways to show small and large changes are indicated.)

Pictorial statistics can be laid out clearly and simply. The charts are dramatic and hold attention like any other piece of good artistic composition. The symbols and a minimum of text make the charts self-explanatory. There is nothing superfluous to weigh down the idea or hide its essence.

The development from crude picture writing to our modern alphabet has widened immeasurably the scope of man's intellect. We can now express in written form subtle variations of abstract ideas, which cannot possibly be presented graphically. Unfortunately, during this progress the directness of early ideographs was lost. Pictorial statistics provide a method for making up some of that loss. Possessing a strong mass appeal they present a wide opportunity of spreading knowledge of social and economic facts. In a few years it will be possible to present factual information dramatically not only in books and classrooms but also in large exhibitions, social museums, and fact films. However, our faith and hope in pictorial statistics must not blind us to their definite limitations. To recognize them, frankly, will eliminate many future abuses and mistakes.

There are many facts that by their very nature cannot be shown pictorially. There is no conceivable picture of "the percentage of volumetric efficiency," or other such highly technical or abstract data.

Minute changes are not sufficiently arresting to be shown pictorially. If we attempt to illustrate the increase from 109 to 110 the second line in our chart would be a hair's breadth longer than the first. Besides, there is no way to put one hun-

dred and ten symbols in a line. Similarly, we cannot show vast differences like the spread between 2 and 600. (Some ways in which similar changes may be shown will be explained later.)

Each symbol usually represents a convenient sum of individuals. Assume that we use one symbol to represent five ships. If the rows on our chart are to show five, nine, and twenty-one ships successively we would have to use one, two, and four symbols. We could not show the nine and twenty-one exactly. There is rarely a suitable common denominator for a group of statistics; therefore, pictorial statistics cannot be expected to show exact figures but only approximate ones.

Pictorial statistics require more space than words or figures. However, they are more economical in space use than photographs.

With these limitations and advantages in mind, it is possible to formulate certain basic rules for pictorial statistics.

1. Pictorial symbols should be self-explanatory. If the chart is concerned with ships, the symbols should be representative of a ship. Ultimately, there will be evolved a pictorial dictionary of self-explanatory symbols for general use and reference. (This, however, does not mean that the ship symbol, for instance, must always be the same.)

2. Charts should indicate an increase in quantity by a larger number of symbols.[1] In 1860 there were about 8,600,000 milk cows in the United States. By 1936 that number had grown to

[1] See page 13 of *Bildstatistik nach der Wiener Methode in der Schule*, by Otto Neurath. Deutscher Verlag für Jugend und Volk, Vienna, 1933.

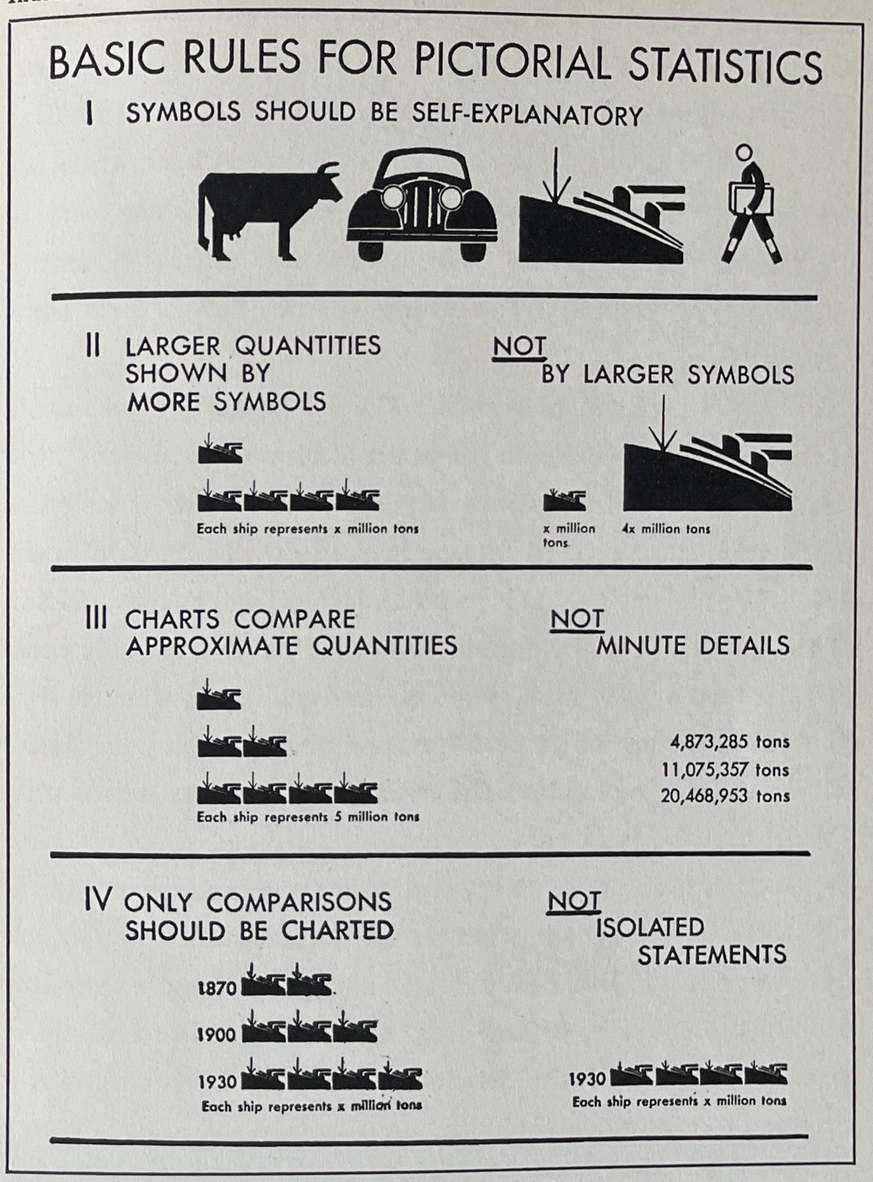
25,600,000. Obviously, the meaning of these statements is that the number of cows has increased three times. To represent this increase, some chartmakers draw a larger size cow, leaving the observer with the misleading conception that present day cows are three times the size of cows in 1860. Such comparison of area involves another fault. The eye cannot compare accurately two irregular areas. Unless the legend tells us, we would not know that a single cow representing the 1936 total is three times as large as the cow representing 1860. Pictorial statistics would show three times as many cows in 1936 as in 1860 and create a correct impression—both visually and factually.

3. Pictorial statistics compare approximate quantities, not exact figures. No method of graphic presentation can convey exact sums. The bar chart or statistical curve may be drawn almost exactly, but the human eye cannot detect the slight gradations such charts may show. Pictorial statistics are designed to show how much relative change has occurred, not that a certain sum is 8.1625 times as large as the one with which it is compared.

A chart is supposed to give the essential developments in a true relation to all other pertinent facts. If it makes that clear in such a way that it is fully understood by everyone, it is more valuable than the most accurate statistical table which few can read intelligently or remember.

4. Only comparisons should be charted. Isolated facts are like bullets fired at random. Take, for instance, the statement that the United States has 129,000,000 inhabitants. No

Illustration II/3



● Basic Rules for Pictorial Statistics.

one conceives of what 129,000,000 human beings really means. We all can visualize ten people because we all have seen ten people together. We may have been at a football match attended by anywhere from 65,000 to 100,000 spectators. But whether there were 65,000 or 100,000 we do not know until we read the newspaper reports the next day. Beyond a certain point figures are just words. We cannot understand their size unless they are related to something we understand, some comparative figure.[2]

Take the problem of showing the 129,000,000 inhabitants of the United States. From the point of view of pictorial statistics that isolated fact is meaningless. It must either be compared with some related fact or broken down into significant detail. We can say that it is so much larger than the population of the British Isles, or Japan. We could show that it is composed of so many men, women, and children, that it has doubled in the last 45 years. These comparisons bring the figure within the range of things the average man can understand.

Fortunately, it is rarely necessary to dwell on mere size. When such is the case, then, and only then are trite comparisons permissible. It is in such circumstances that weary imaginations calculate how many times 129,000,000 people would fit around the equator, or how few inches the level of Lake Erie would be raised if the whole 129,000,000 were summarily dropped overboard at Buffalo.

[2] Erich Kaestner says in his *Emil and the Detectives*: "For a lot of people a hundred Marks are just as much as a million. You might almost say they write a hundred Marks with six zeros. And how much a million really is—well, they couldn't even imagine it in their dreams."

The Simpler the Chart the Better It Is.

It is our aim to convey facts. We will cut out every detail which is not essential in proving our point. If we can prove it with three rows of symbols don't let us show four; if we can find a clear title of three short words let us use no more. If we can create a good symbol with simple lines let us avoid elaborate details. Simplification at every single point in the production will make for a clear and simple chart.

The rules listed above have been arrived at from experiences in Europe and in the United States. All over the world pictorial statistics are gaining in favor and it is important to ask if they are merely a new fad or if they contain some higher values to the educator, the business men, the writer. Unfortunately, little has been done in the United States to test the effectiveness of pictorial statistics in comparison with conventional graphs. The only survey made up to now was summed up by Mr. J. W. Wrightstone in *Progressive Education* of October, 1936. He says: ". . . pictorial statistics were more effective in allowing pupils to locate specific parts and information than were the more usual bar, circle, and line graphs. The average scores of equated pupils were 29.40 for pictorial statistics, and 27.36 for the regular graphs. Interpreted statistically this represents a significant difference between the two methods of presenting data. . . . When individuals were asked their preference for one form versus the other, the attitude of most individuals was favorable to the pictorial statistics."

CHAPTER • III

Grammar of the Picture Language

Symbols are the words of our picture language. As all languages must have a system of grammar if they are to be comprehensible, so our picture language also has a set of grammatical rules.

In discussing the elements of a chart, we will begin with these problems of grammar: the problem of arranging the symbols according to formal and comprehensible patterns.

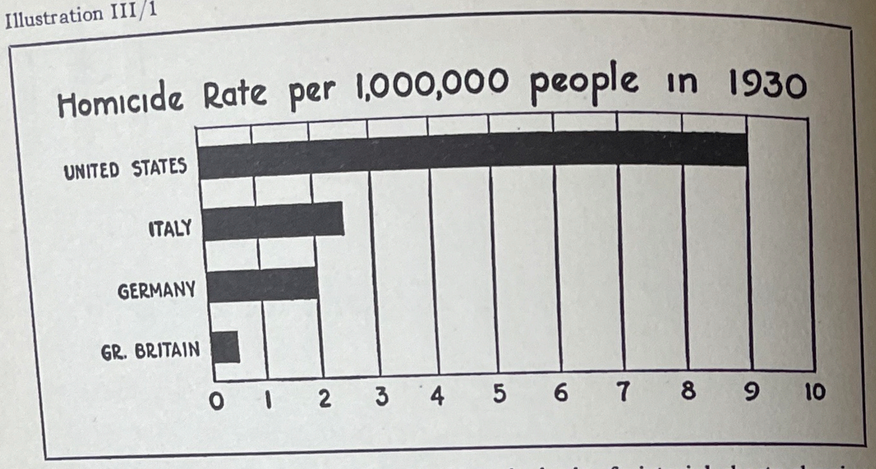
The Simple Comparison

What we call a simple comparison is merely the old familiar bar chart in terms of picture units.

The statistical foundation and the method of presentation are fundamentally the same. The simple comparison like the bar chart shows different quantities by bars of different lengths. The chief variation is that the bar chart can indicate the diversity in subject only in its printed legend, while the pictograph expresses the subject by the character of the symbols which make up each "bar." In other words, the bar chart is an abstract presentation of facts; the pictograph is concrete.

Like a printed page, the pictograph is to be read from top to

Illustration III/1



● Bar charts of this kind are the basis of pictorial charts showing simple comparisons.

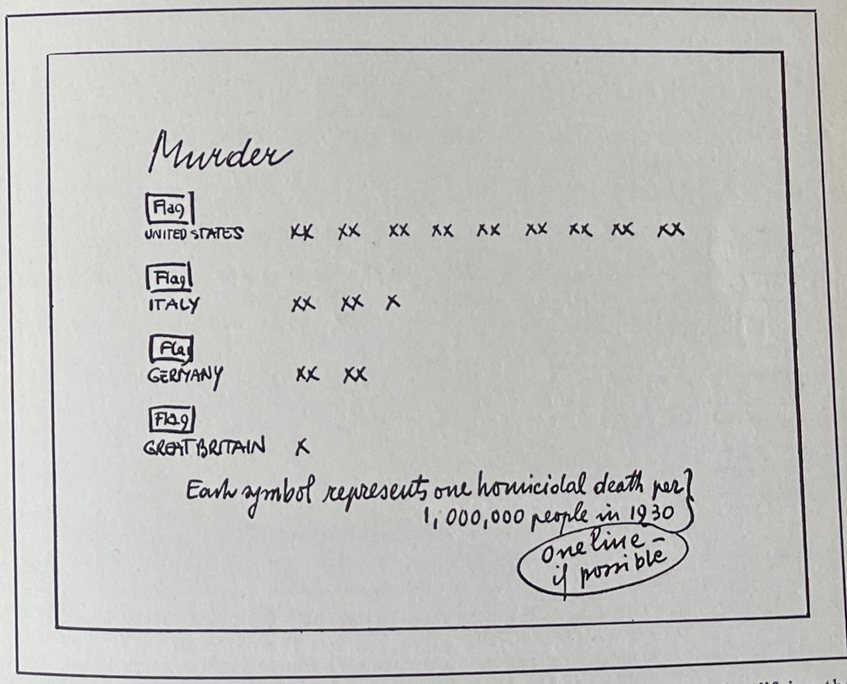
bottom, and from left to right. Naturally, at the beginning, the subject must be stated. For this reason the title is placed at the top. The rows of symbols on the chart are to be read like the lines of type in this book. The main difference is that the length of the lines varies and that the white space on the chart is as essential to the meaning as the rows of symbols. If there is more white space at the end of each successive line, it is clear that there are fewer units of the subject under consideration.

You may say that the length of the rows themselves indicates the trend of the statistics. True enough; but the pictograph has two main functions: to clearly establish the relationship between facts, and to be emphatic so that this relationship can be taken in at a glance. It is this last function that is abetted by the white space which emphasizes the trend shown by the lines of symbols. To preserve this emphasis, it is important that the

white space be left blank and not filled with lettering or pictures added for the sake of "artistic" balance.

Again, it is necessary to emphasize that simplicity is essential for pictorial statistics. For this reason, there should be as few rows of symbols as possible, and as few symbols in each row as the circumstances will permit. In the case of the chart of murder, the important idea to convey is that the number of murders per million people in the United States is many times higher than the number of murders in Great Britain and higher than in some other countries. The pictograph, considered as a

Illustration III/2



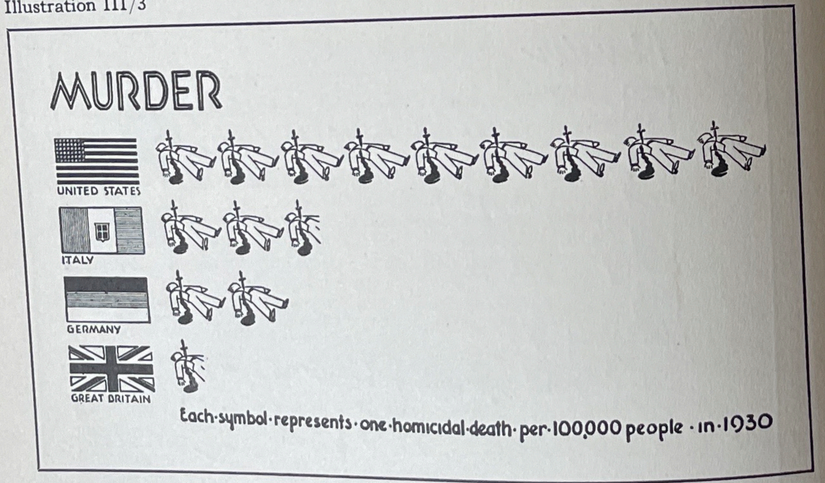
● By breaking the bar chart into separate units, simplifying the figures, and rearranging title and legends a statistical layout for the pictograph is made.

whole, not as a series of symbols to be laboriously read, states this comparison of murder rates in several countries of the world as one simple comprehensible unit.

In some cases, especially in making charts for annual reports, it may be necessary to include the actual figures because clients will demand them. If such is the case, the figures must be fitted into the layout so that they do not destroy the visual unity and emphasis of the pictograph.

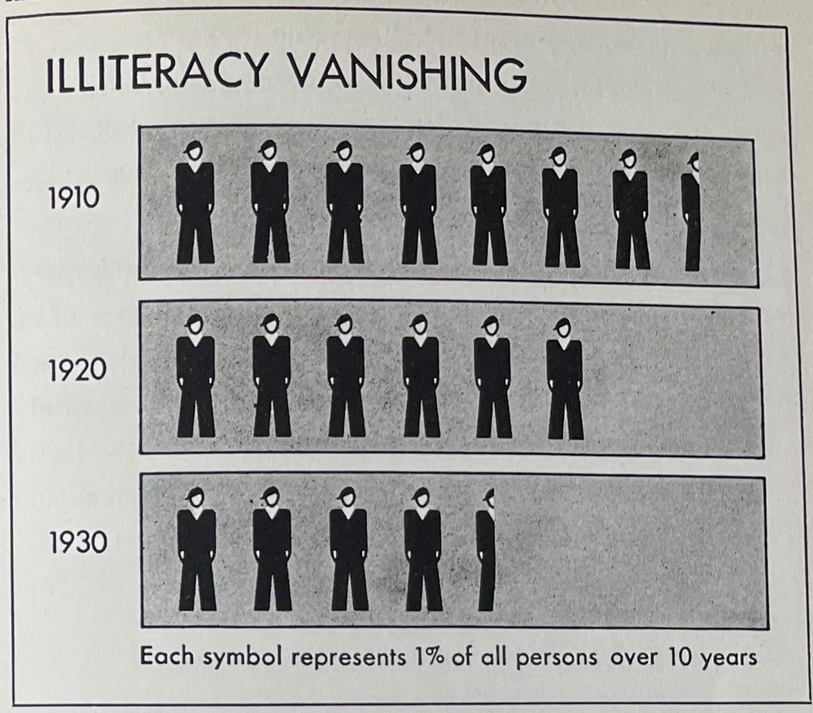
The flags in the murder chart are the explanatory pictures. They have the same function as the descriptive words in a text

Illustration III/3



● And here is the final chart. It reads from left to right and from top to bottom. The black bar has been broken up into units. Each unit represents a person who has been murdered. Thus, the subject of the chart can readily be identified from the symbols. (The fractions of symbols and the use of flags to identify the countries will be discussed later in Chapters V and VIII.) The above chart was used in *Every Week Magazine*.

Illustration III/4



● To stress the difference between absolute and percentage figures a background is frequently introduced to indicate that the figures shown represent parts of a total of 100%. If we were to show the *total* number of illiterate people we would omit the background. (For the technical questions in regard to backgrounds see Chapters VI and XII.) This chart was prepared for the United States Office of Education and used in the Texas Centennial Exposition.

devoted to exposition. They describe pictorially the field to which the symbols are limited. (Chapter VIII explains the use of explanatory pictures more fully.) Devices of this sort are to be used only when they are helpful, never as ornamental gewgaws.

At the bottom of the chart is the symbol explanation which

tells for how many units each symbol stands.

Sometimes we may want to indicate that we are dealing with percentages or ratios and not with absolute figures. This is the case in the chart on illiteracy; in it we want to show that out of 100 Americans fewer and fewer are illiterates as public education spreads.

If we would show the men only we might create the impression that we were showing the decrease in *the number* of all illiterate people in the United States which actually decreased much slower. To prevent such misapprehensions between absolute figures and percentages it is advisable to put the latter on a background. As this background represents 100% it should be of the same length in each row throughout the chart.

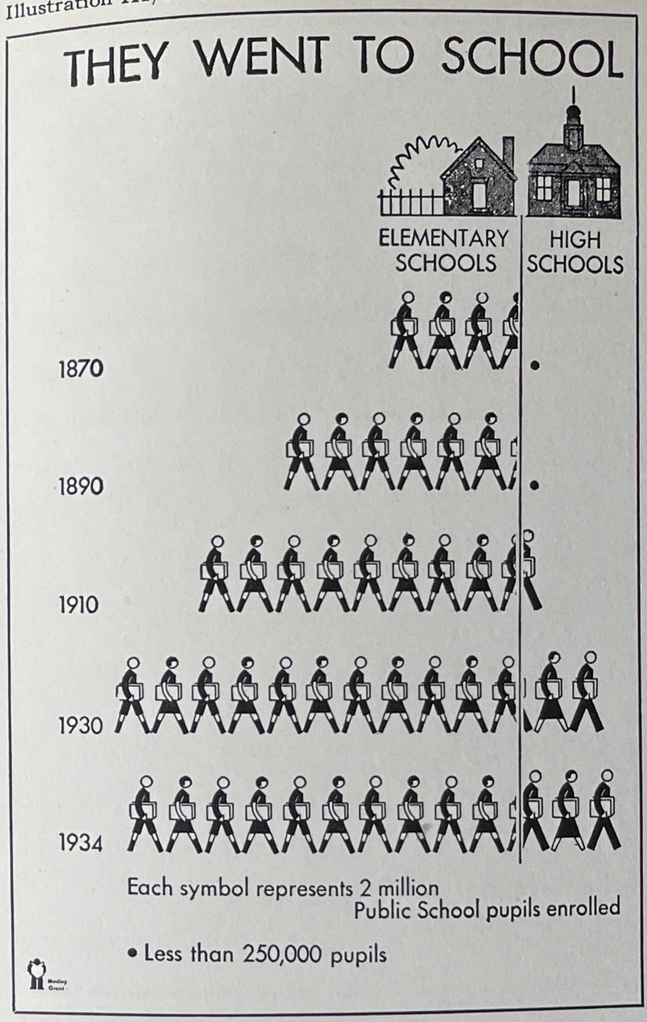
Components Stressed

In the charts discussed so far the main interest was centered on the development of one set of figures. Often we will have to emphasize not so much the change in the total number, but the changes in the parts which make up these totals.

This relationship between the parts can be shown by placing the symbols to the right and left of an axis which separates them. This arrangement makes it possible to compare the development of either part without destroying the advantage of keeping the totals in one uninterrupted line.

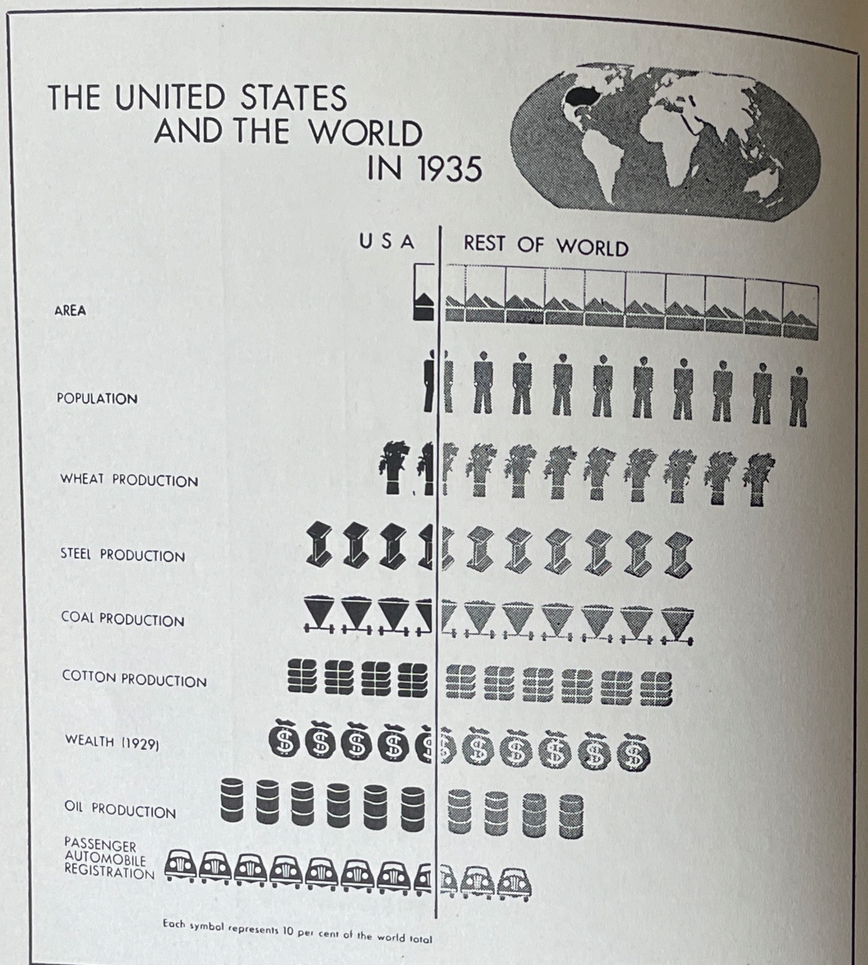
Here again a variation between "absolute" and percentage figures is possible. The absolute form is shown in the chart,

Illustration III/5



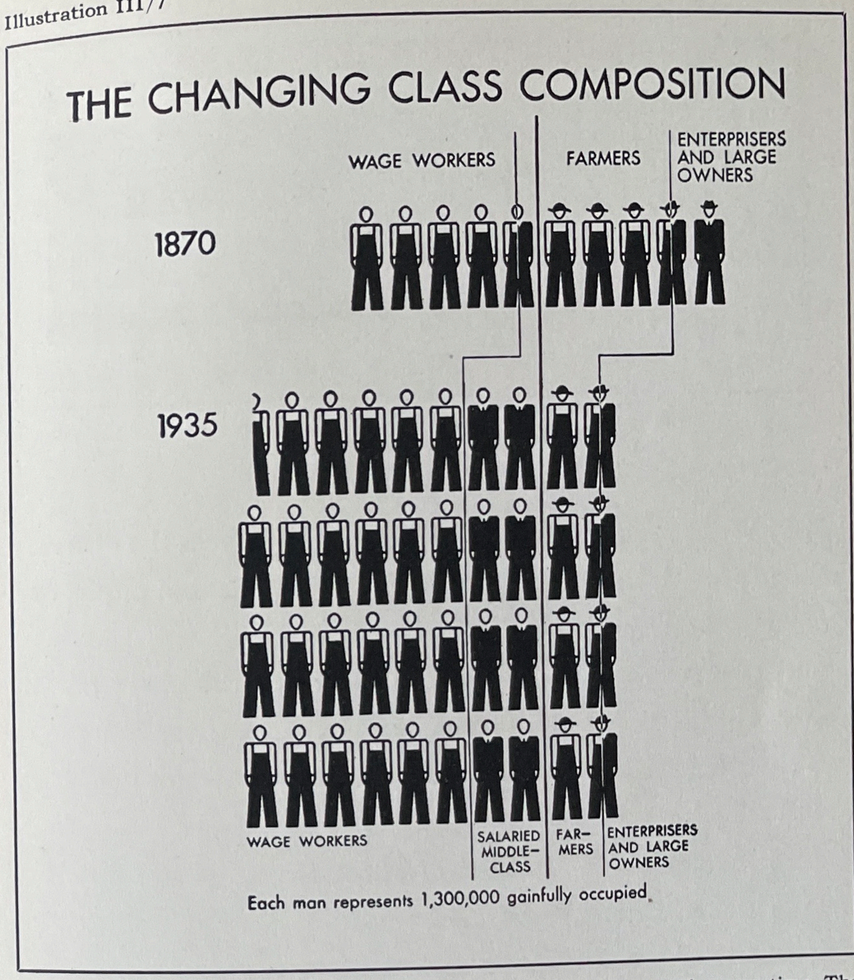
● Elementary school enrollment has been growing slowly up to 1930; since then the number of elementary school pupils has decreased. High school enrollment, negligible up to the beginning of the century, has been growing rapidly. The axial arrangement shown here permits to present these differences in rate of growth and still preserves the totals for each year in one continuous line. The chart was prepared for the United States Office of Education. (For the split symbols on either side of the axis see Chapter V.)

Illustration III/6



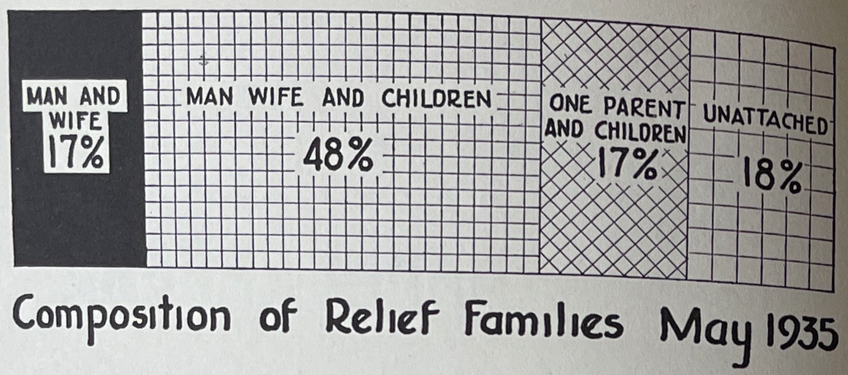
- The same axial arrangement as in the preceding chart may be used on a percentage chart. In the example shown here the two components of each row add up to a total of one hundred per cent. This fact makes it permissible to present the data without the background which is found advisable on charts which show percentages not adding up to a hundred per cent. (See Illustration III/4.) Chart from *The United States: A Graphic History* by Hacker, Modley and Taylor, Modern Age Books, Inc., New York, Fall 1937.

Illustration III/7



This chart indicates changes in absolute and in percentage figures at the same time. The four-fold increase in those gainfully occupied is obvious from the increase in the number of rows. Percentage changes can be counted in the bottom row for each year; as there are ten figures in each row 6 wage workers indicate that 60% of all gainfully occupied in 1935 were wage workers. In the same way we can figure out that 20% belonged to the salaried middle class, 15% were farmers, and 5% enterprisers and large owners. Thus, we can easily see that the farmers decreased from 35% in 1870 to 15% in 1935 while their number increased from 3½ symbols to 6 (four times 1½ symbols) during the same period. The illustration was prepared for *The United States: A Graphic History* by Hacker, Modley, and Taylor, Modern Age Books, Inc., New York, Fall 1937.

Illustration III/8



● A Single Bar Chart is the starting point for another form of pictograph, the Simple Breakdown.

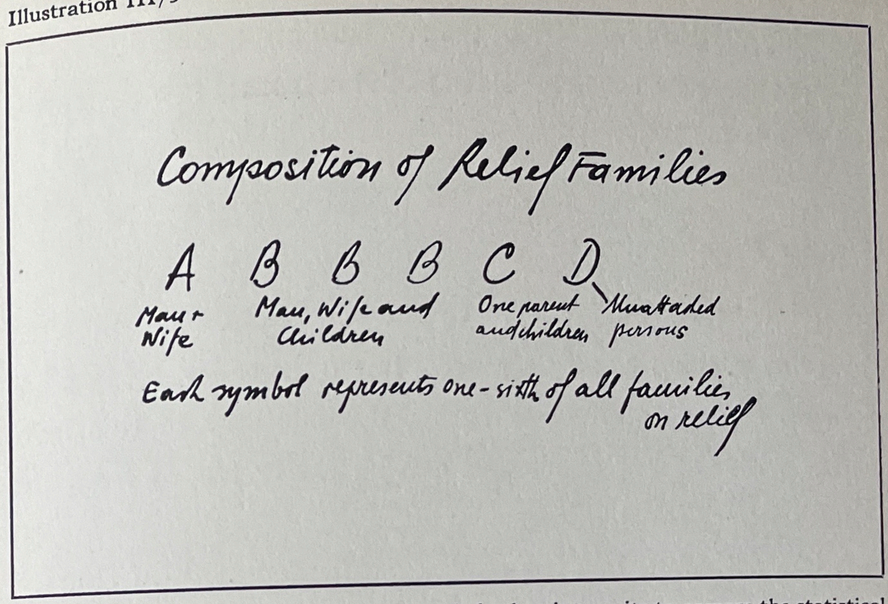
"They Went to School" where we wanted to stress the different rates of growth in the number of elementary school pupils and high-school students.

The percentage form is demonstrated by the chart on the position of the United States as a world power. Inasmuch as the two components in each row add up to 100% it is not necessary to use a background in this case.

An interesting combination of absolute and percentage figures is shown in the chart, "Changing Class Composition of America."

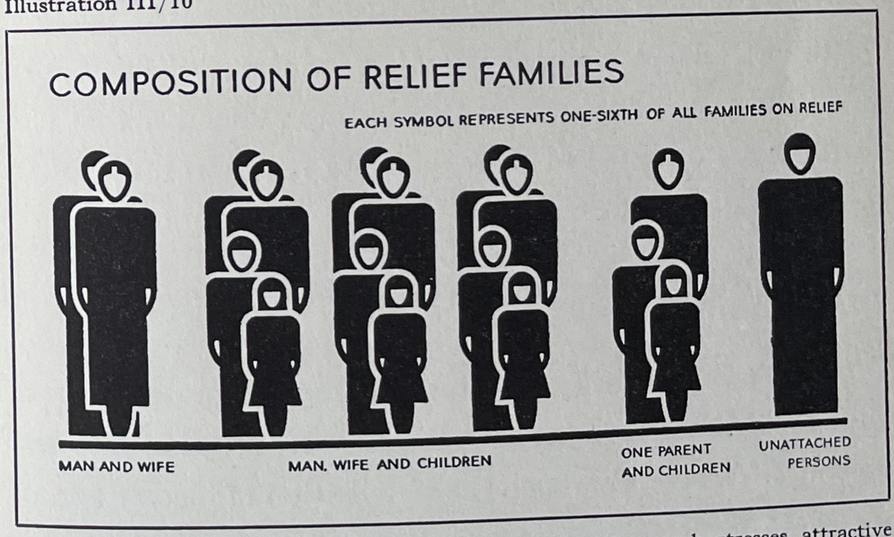
This chart presents among the changes in our working population an absolute increase in the number of farmers and at the same time a decrease in their share of the whole group. This is possible because ten symbols are selected as a basis for each of the two years. Increase in absolute figures is shown by an in-

Illustration III/9



● Again the bar chart is broken into units to prepare the statistical layout for the pictograph.

Illustration III/10



● Instead of clumsy legends the pictograph stresses attractive symbols. From Federal Emergency Relief Administration, *On Relief,* Washington, 1935.

crease in the number of rows. This increase is reckoned by counting vertically. Shifts in percentages are counted horizontally; as there are ten symbols in each horizontal row each symbol stands for 10%.

Simple Breakdowns

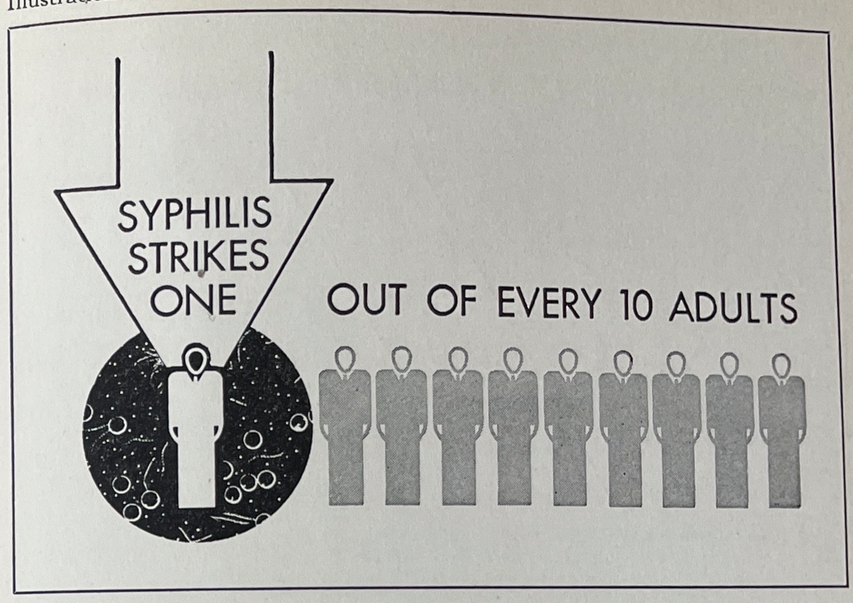
Sometimes we may not care to show a comparison between things at various times or places, but only the varying components of one total. Here again, the ancestry of this form begins with the bar chart and can be easily traced from the accompanying illustrations.

A less desirable, but frequently demanded form of chart is one which makes simple arithmetical statements supported by a component breakdown similar to those described above. Such charts are usually flat. Their emphasis is dissipated by such familiar statements as "one out of every three," "two out of five," and so on ad infinitum. It is well to remember that pictographs are designed to show quantity relations rather than arithmetical statements.

Other Forms

Often we combine the forms already described, or depart from their basic formulae to broaden the effective scope of pictorial statistics. The two charts on the distribution of income and of corporate ownership show possible variations. Such departures should not be motivated by a desire to be original. The

Illustration III/11



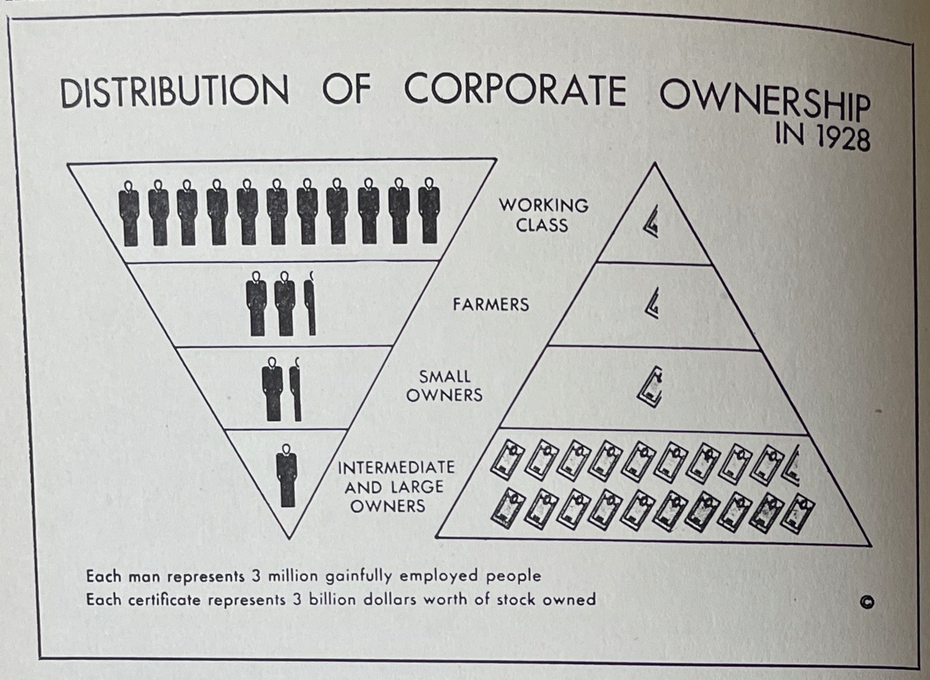
● Arithmetical statements like this should not be used too frequently. In exceptional cases they are valuable. From *Survey Graphic* and *Readers Digest*, July 1936.

criteria of their validity must be the definite contributions to understanding they make. Both charts can honestly plead this reason. One makes use of the pictures suggested by the words, "Income Pyramids"; the other stresses the share of income gained by the various income groups by super-imposing the man symbols on the money symbols.

When two developments are related in some way, they may be combined on one chart in various forms, depending on the kind of relation. The most important forms are given in the accompanying illustrations.

When we have decided on the form of the chart best suited to

Illustration III/12



● To stress the inequality of distribution of corporate ownership a symbol arrangement has been found effective which deviated considerably from the rules described elsewhere. The chart is from *The United States: A Graphic History* by Hacker, Modley, and Taylor, Modern Age Books, Inc., New York, Fall, 1937.

show a particular set of facts, our problems have only begun. Now there is the question of determining the number of rows per chart, the symbols per row, and the size of the chart.

Rows per Chart

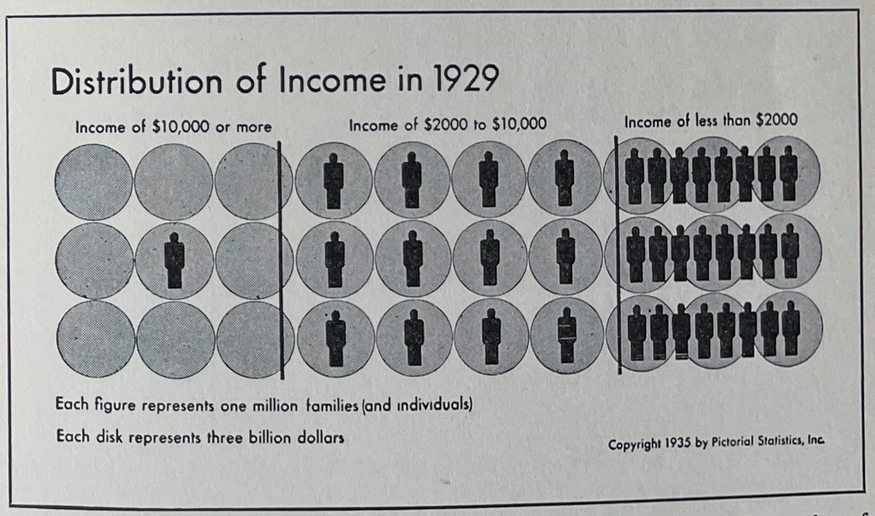
How many rows of symbols are to be in the charts? If there is enough space, there should be *as many as will be necessary to indicate clearly all important trends and situations.*

If a trend of continuous increase is to be described, three

rows will be sufficient to indicate the continuity of the increase. Three rows will also be enough to describe an "up" and a "down." In the chart of the American Merchant Marine six rows were necessary to show the three phases of decrease. The only rule to govern the number of rows of symbols is that there should never be more than are necessary to indicate clearly the trend of the statistics. However, it is possible to make this much of a definite statement: no chart, except simple breakdowns should have less than two rows of symbols, and only rarely less than three or more than six.

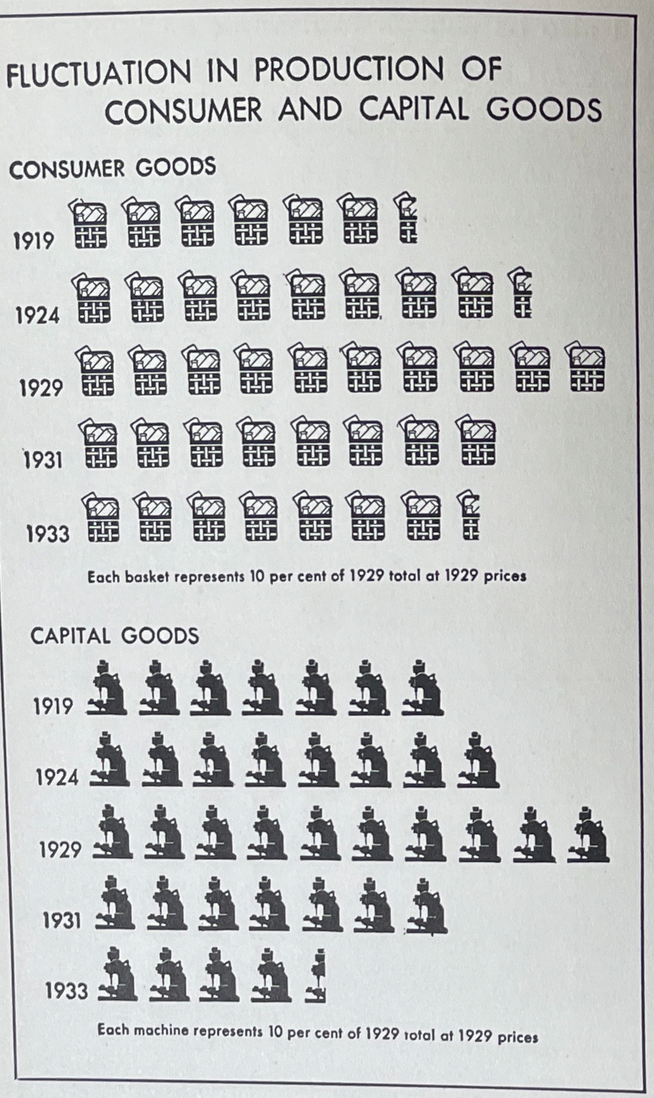
Sometimes the statistical material simply will not be crammed into six rows of symbols. Even under such circumstances, it is frequently possible to make a good chart if it is sufficiently

Illustration III/13



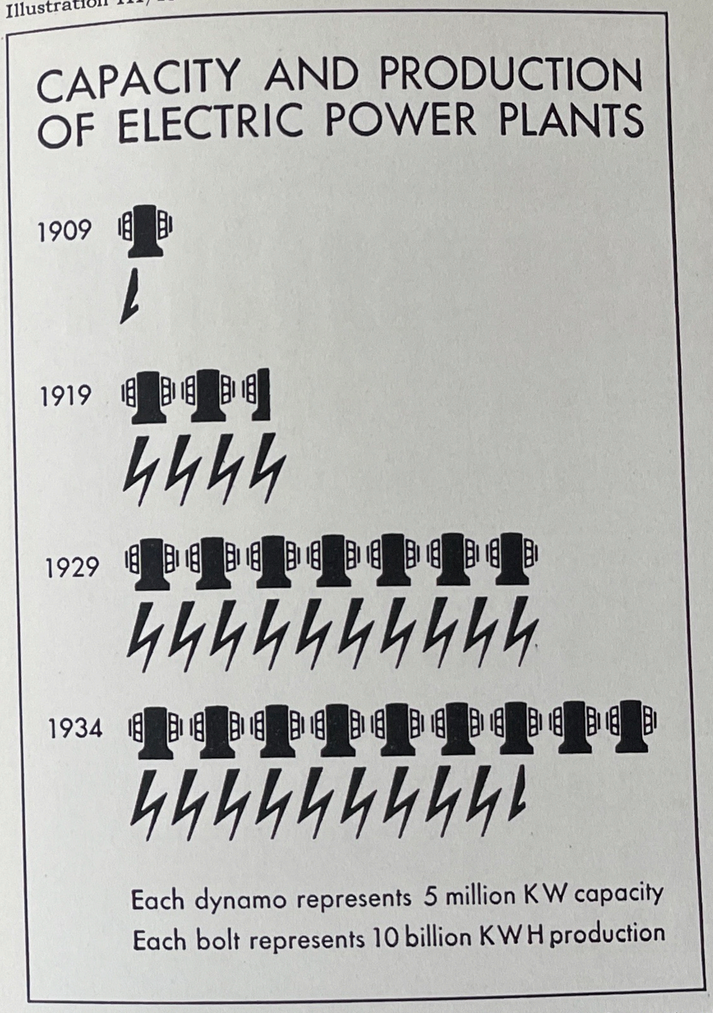
● In this chart each group of people is assigned to the number of money disks they received. The variation in the distribution of the income is thus clearly brought out. From *Recovery*, by Edward A. Filene, Workers Education Bureau Press, New York, 1935.

Illustration III/14



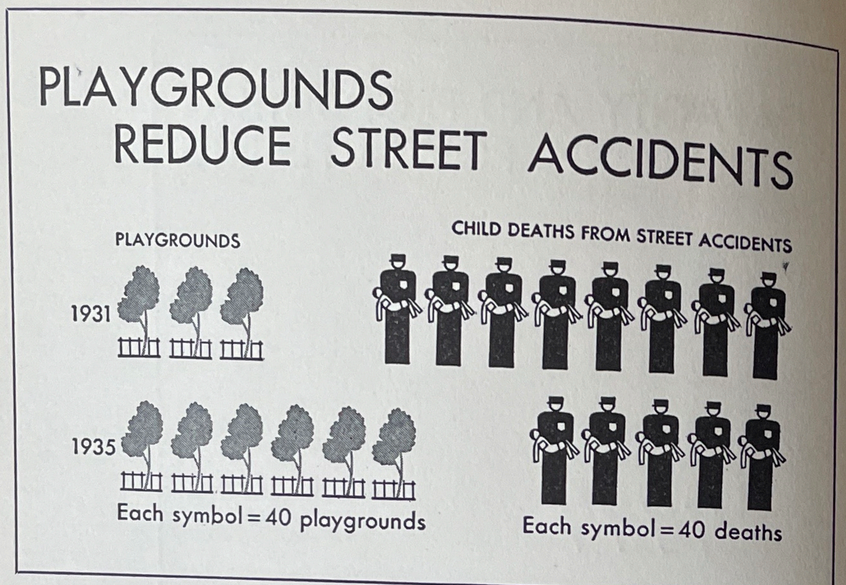
● In this chart two developments are brought together which are not very closely related. Each development is therefore presented independently; to make comparisons easier one year (1929) is chosen in which the rows of symbols in either development are of equal length. Chart from Public Affairs Committee, *Income and Economic Progress,* Washington, 1936.

Illustration III/15



● This pictograph deals with two developments which are closely related to each other. Again (as in the preceding chart) one year is chosen in which the rows of symbols in either development are of equal length. But in this chart the two developments are not kept apart from each other but are shown together for every period. From Rural Electrification Administration, *Electric Power on the Farm,* Government Printing Office, Washington, 1936.

Illustration III/16



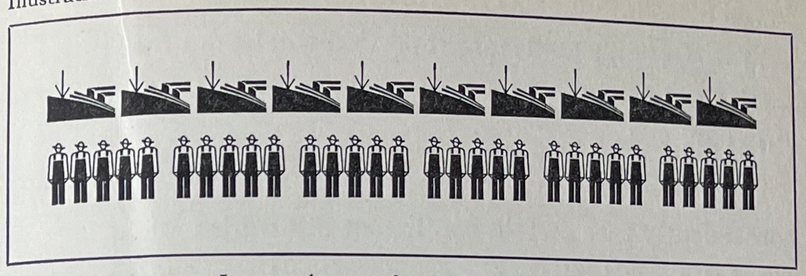
● Where the growth of one thing causes the decrease of another, the above layout is most indicative of this effect. Chart prepared for the Police Department, New York City.

simple and dramatic. As a general rule, wherever it is necessary to show accurate data on a great many points it will be better to use the regular statistical curve. (See Illustration II/2.)

Symbols per row

Each symbol (or block of symbols) must be isolated by a certain amount of white space if it is to retain its character clearly. Since space is valuable, the number of symbols per row is a problem that must be considered carefully. Again, we cannot lay down a definite rule. If a chart must fit into a given space,

Illustration III/17



● In general a row of symbols should not contain more figures than the one shown here. The sample shows narrow and wide symbols. Most other symbols will fall between these two extremes.

the maximum number will depend on how many symbols, large enough to be clear, can be placed in a given row. When no size is given, the limits of the chart must be determined by our sense of proportion. It is safe to say that the number of wide symbols (boats, for instance) should not be more than ten to twelve per row: that of narrow symbols (men) not more than twenty-five to thirty. These maxima can vary somewhat in relation to the number of rows in the chart. The minimum number of symbols per row should not be below half a symbol.

The rules about fractions of symbols and the possibilities of showing a larger number of symbols per row than prescribed here are discussed later. (Chapter V.)

Size of Chart

Often we will be free to decide on the size of the chart ourselves and then our problem will be simple. We will follow the principle of showing a complete picture of the situation with the

lowest possible number of rows of symbols and the least symbols per row. Our only guide for proportion will be our own discrimination which must prevent our making a chart too narrow in either dimension.

Unfortunately, the size will often be specified and we will consequently face certain contingent difficulties.

I shall try to indicate some approaches toward this problem. For instance, in presenting pictorially the growth of the American Merchant Marine, we found that a chart with six rows was fitting. (See Illustration I/1.) Let us assume now that a client requires a chart on this subject to fit on a narrow strip across the top of a page. In this case we have ample width, but very little height at our disposal.

One solution is to eliminate two rows of symbols. We would cut out the least important statistics, that is, those for 1810 and 1830.

If the size of the symbols can be reduced, we could possibly fit all six rows into the smaller space. In this case we would either have to make changes in the spacing or increase the number of symbols or the length of each of them.

From these examples it is evident it requires skill to lay out a chart of given size, correct statistical information and strong graphic effect. But nearly all of these difficulties may be solved satisfactorily.

CHAPTER • IV

The Vocabulary—The Symbols*

This chapter deals with the symbols themselves. It attempts to devise an approach and traces the steps necessary in the creation and development of a symbol. This is not a course in design; but I can say at this point that pictographs make use of all the principles of good design as they are established by the fine and applied arts, as far as this is possible within their obvious limitations. The designer will readily observe that the type of symbols used in pictographs has been motivated by the present trend in fine and applied arts. This statement, however, does not imply that a designer should overlook examples of former periods or the prototypes which have come down to us from the primitive and ancient civilizations.

Before we proceed we should define the word "symbol" as briefly as possible. "Object 'A' is called a symbol of Object 'B' if the observation of or the remembrance of 'A' continuously and regularly recalls in the mind of the observer an image of Object 'B'" (Toennies). This definition was chosen because it is most thoroughly in agreement with the requirements of pictorial statistics.

* Chapter IV was contributed by Mr. Franz C. Hess.

Whether we are conscious of it or not, the fact remains that our whole intellectual life depends upon symbols. Not only our sense of vision, but our senses of hearing, tasting, smelling and feeling all react to symbols. The smell of incense, the sound of bells and the sight of a priest will arouse the religious emotions in the faithful. The last four senses, however, do not concern us much in the following discussion. They are mentioned since in the creation of symbols they may be of value.

Languages are made up of sound symbols which in the process of transmutation have also been translated into graphic form. Our own language has been reduced to a system of twenty-six abstract symbols, the letters of our Roman alphabet. These twenty-six symbols form themselves into word images. A short survey of their origin will show that their earliest form was pictographic.

B. L. Ullman in his book, *Ancient Writing and Its Influence*,[1] traces the origin of our Roman alphabet back to the Sinai hieroglyphics. From these forms the Roman capital letter was developed. He shows, among other things, that "A" is derived from the picture symbol for ox, "B" from the picture symbol for house, showing the ground plan of a house; "D" from the symbol for door; "Z" from the symbol for sickle or weapon; "M" from the symbol for water; "N" from the symbol for serpent; "O" from the symbol for eye; "R" from the symbol for head. All these are symbols which in their basic form could readily be applied in pictorial statistics.

[1] Longmans, Green and Co., New York, 1932.

In another place the same author states that throughout the world all ancient picture writing has a similar symbol basis. He points out that the symbol for "nothing" represented by a human figure with arms outstretched appears simultaneously in the hieroglyphics of the ancient Egyptians, in the codices of the Mayas of Yucatan and also in the later pictographs of Indian hunters in Southern Alaska. Likewise he states that the symbol for "child" in ancient China, Egypt and primitive North America is rendered by an infant sucking its thumb. The symbol of "friendship" in Chinese is depicted by a conventionalized form of two hands, one above the other, and we ourselves still make use of this same symbol to express the same idea. That abstract thought can be expressed by a concrete object the same author shows by reminding us that a picture of a pipe represents in the picture language of the American Indian the symbol for peace. Pictorial statistics attempt to achieve the same universal appeal, to create a picture language which can be read without much verbal explanation.

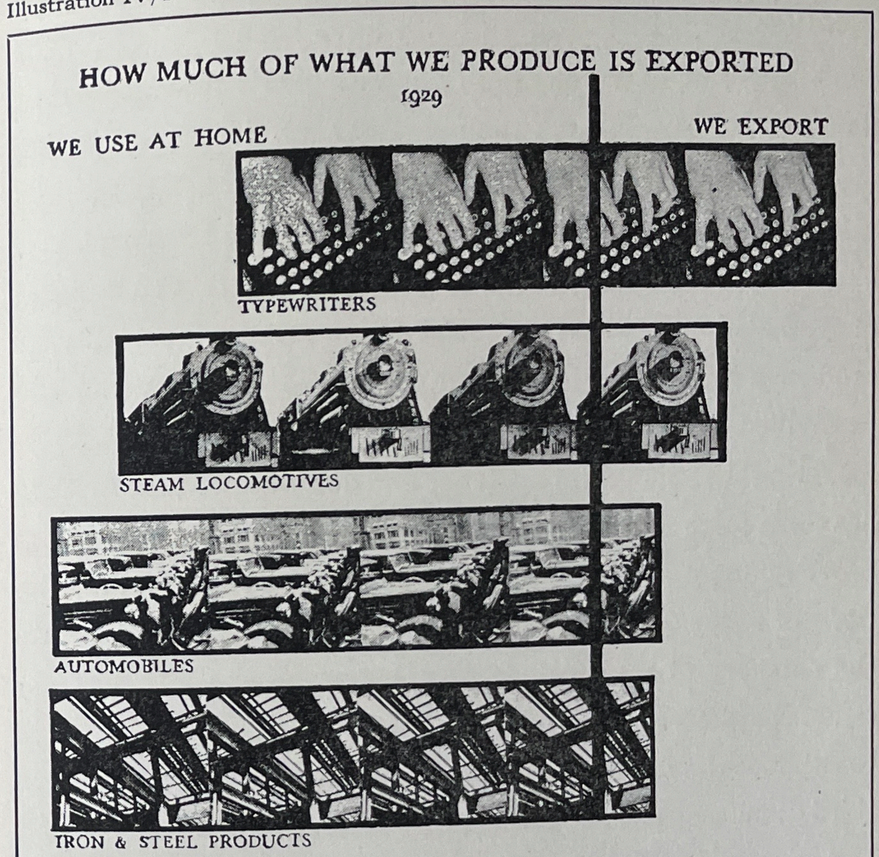
Anyone interested in pictographs should acquaint himself with the many symbols which have survived the changes of history and are ready to be employed today. The majority, however, have fallen into oblivion. Among the symbols of the past valuable to the pictographer are those applied in heraldics, mason and craft marks, religious symbols; the astronomical and the various symbols of the zodiac; old chemical symbols; the house marks of the ancient European farming population of which we on the American continent retain a remnant in the

brand marks of the cattle ranger; the water marks in paper; and the many trade marks of past and modern commerce and industry. In this category are certain symbolic motives applied in the decorative arts which are still universally understood. The latter can, and have been, adapted with modification for use in pictorial statistics. A general study of all these will reveal how symbols should be constructed and designed for effective use. Even though many of them have disappeared owing to a completely changed environment, some of them, with slight modification, can be readopted and reinterpreted for new functions.

Pictorial statistics, attempting to create a picture language comprehensible to our time and age, follows but somewhat these prototypes. The scene has changed considerably since the inception of picture language. Today we apply vastly enlarged vocabularies symbolizing new objects. For these objects new pictorial symbols must be created. We must always bear in mind that pictorial statistics apply their symbols for a definite purpose, namely, to tell facts in a pictorial language keyed to modern intelligence. They address or attempt to address a much wider audience than other statistical methods which have been discussed elsewhere in this book.

The pictorial method lays claim to a forthright clarity which these other methods do not possess. To maintain this claim it is necessary to stress clarity in the design of the unit symbol itself. Owing to the vast number of symbols required today it is essential that we be more specific than we were formerly. Not

Illustration IV/1



A reproduction of a Pictogram from MADE IN U.S.A.

● The Foreign Policy Association made this experiment with photographic symbols. Only the symbol of the locomotive indicates that photographs may, eventually, become valuable counting units. All other symbols are hard to recognize and difficult to count.

only do the symbols have to be clear and pleasant, they must have distinction in the sense that they must be distinguishable immediately from many other symbols already in use to express other objects. The ideal result will have been achieved if our symbol will at once release in the onlooker's mind a mental image or remembrance of the object we are describing at that moment.

The method in general, for reasons which have been explained elsewhere in this book, lays heavy restrictions on the designer of symbols inasmuch as it requires him, almost invariably, to produce a symmetrical unit form, or at least a form which can be divided without changing the meaning.

During the years of its existence and development the method has come forth with a definite type of picture symbol which has proven most practical, a type freed of all the rules and regulations of naturalistic drawing. A majority of symbols fall into the category of modified silhouette designs of somewhat abstract character. In the rare cases where a third dimension helps to enhance the distinction of our symbol we are free to add this third dimension as long as we observe the rules of simplification and strong contrasts as well as the requirement of divisibility without change of meaning.

The type of symbol described above is most effective for the following reasons:

1. It eliminates unnecessary detail.

2. It does not detract attention from the initial purpose of the symbols as counting units.

3. It permits combinations of one symbol expressing one object matter with another symbol expressing another, thereby creating a third symbol denoting another fact or thought.

4. It answers the quest for universal adaptability in space, large or small, as the case requires. It produces equally strong effects in giant form on billboards or posters and stands out clearly if reduced to two columns in a newspaper.

Attempts have been made to substitute photographs in place of the drawn symbol. These, however, as our illustration shows, have not been successful owing to the fact that certain elementary principles listed above have been overlooked. We are well aware that the aggregate of symbols, as employed in our charts, produces a pleasing pattern and conscious of this fact, we attempt to enhance it wherever possible. But let us never forget that our symbols are primarily counting units and nothing more. Should they lose this first distinction they become meaningless. In the few examples in which attempts have been made to apply photographs in place of drawn symbols, this factor was entirely overlooked. The result was an interlaced pattern, pleasing to the eye, but statistically misleading. This criticism does not exclude the use of photography altogether. Properly conditioned and applied, photography can be successfully employed, especially in cases where our pictorial chart assumes poster dimensions and where the objects photographed are themselves free of details, as for instance a picture of an airplane. Experiments of this sort are under way and probably in the near future photographic symbols may occasionally be successful.

Illustration IV/2

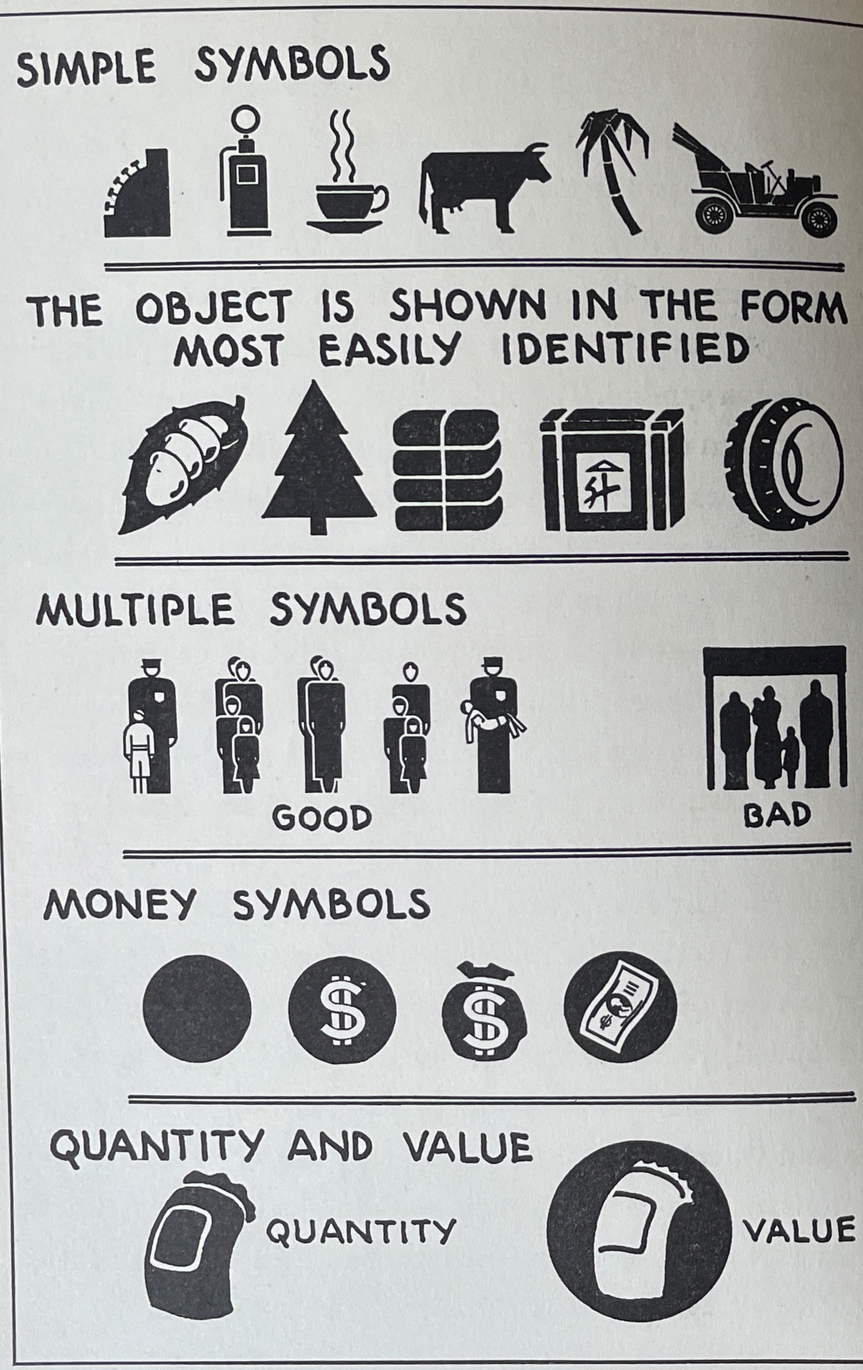


Illustration IV/3



As we have tried to point out, a symbol should be clear, concise, in short, simple. It should be free of all unnecessary detail —factual and even abstract in so far as this is possible. No matter what prototype prevails in the designer's mental picture, it has to be simplified to the point where it appears free of all detracting matter. A symbol should never, speaking of human beings, represent a specific person, i.e., one who happens to be a New Yorker, but a component or a cross-section of all New Yorkers. It should not represent a specific type of blast furnace but again a component or cross-section of all blast furnaces. Pictorial statistics, dealing with aggregate numbers of dogs, oxen, New Yorkers, blast furnaces, and other objects which can be statistically summarized, do not require definite breed, type or individual characteristics but a symbol which answers the image of dog, ox, New Yorker, blast furnace or Chinese, without the aforementioned details. The symbol, as it is used for statistical purposes, has evolved in this form, bare of naturalistic details, without reference to the dramatic side of the story. In short, it is free of characteristics which call for the human side of the story inasmuch as these symbols, once introduced as New Yorkers, blast furnace, dog, ox and Chinese recede again to their primary function, namely, counting units.

A symbol which can be drawn direct from memory is generally best. After all, the purpose of the symbol is to recall continuously and regularly in the mind of the observer an image of an object which he has stored in his memory. Therefore, the more spontaneously a symbol or object is drawn, the more penetrating it will be. Naturally, every symbol should be tested many times before it is finally used in a chart. This can be achieved best by placing it before as many people as possible and observing and registering their reactions.

Not all symbols, however, can be designed from memory. A great number fall into the category of highly specialized objects which the designer never had an opportunity to observe with his own eye. Others may require some detail with which the designer is not familiar. Others again present abstractions for which all the pertinent associations must be considered in order to give them graphic expression. Research and logical deduction are necessary to arrive at the "telling" point.

In cases where it is necessary to gather pictorial material, for instance, drawings, paintings, photographs, the designer should never be content with only one picture. He should accumulate as many prototypes as possible and should always bear in mind, as we have mentioned before, that he is not to draw a symbol representing one individual object but a cross-section of all his prototypes.

For his research material the designer draws primarily upon specialized literature. Various encyclopedias and dictionaries often provide a short cut to the correct general form he is seeking. He should be advised not to confine himself entirely to encyclopedic material in the English language but to examine, wherever available, the vast foreign encyclopedic literature. This likewise contains a large store of pictorial material. The use of encyclopedic literature for symbol research is often most

desirable since there the material is already condensed to the essential factors. This procedure also has the advantage that the reader will have an opportunity to draw upon the same sources for further information if this should be necessary.

Thus the mere assembling of factual matter necessary for the design of a symbol may often require much painstaking labor. But all this labor may not solve our problem even when we believe that the necessary underlying facts have been assembled. We may have a presentation of an object which we intend to show, but have we at the same time arrived at the "telling" point? We can answer this question in the affirmative if our audience understands what we mean. All those objects which in themselves afford a distinctive silhouette that impresses itself with ease upon our mind present no problem to the designer. Modern steamships, river boats, locomotives and railroad cars, people, animals, blast furnaces and automobiles all belong in this category. Other objects lack entirely the quality of a distinguished silhouette. Balls, apples, oranges, etc., reduced to their silhouette form, lose most of their characteristics which enable us to distinguish one from the other. In these cases it is necessary to add, as in the case of the ball, the seam or, in the case of the fruits mentioned, a distinguishing leaf as a modifier. But we still depict our object literally.

The procedure, however, becomes more and more difficult when we turn to such objects as chemicals in general, rubber, the various minerals, soap and like things. To depict these we turn to the nearest associated object which offers the most dis-

tinguished silhouette or three dimensional form. Rubber we symbolize by the all familiar picture of the rubber tire. For wheat we show the spike; for iron, bars of pig iron; for coal, the coal-car; and soap, generally merchandized in cakes, we may depict in three dimensional form with the word "soap" superimposed on it.

More difficulties arise if we are requested to portray strikes, ton-miles, installed horsepower, unused productive capacity or the merchant marine—all too abstract to be seen or caught by the photographer's lens. Value-symbols showing the price of goods, negative symbols to imply the lack of things will also present problems. In all these cases it is necessary to distill the essence of the subject and by logical deduction attempt to find a pictorial symbol which still tells the story.

To present values pictorial statistics make use of a device developed by Dr. Neurath. Borrowing from the disc form of coins we express values of things by placing the symbol of the thing on a coin. Thus we are able to differentiate the thing as such (wheat) from its value (wheat symbol on disc).

In a similar way we present negative or non-existent facts by the outlines of the actual symbol. Debts thus are shown as circles, potential population as outlines of men.

In many cases where we are called upon to present highly specialized technical matter it is questionable whether the man on the street or on the farm will easily respond, owing to the fact that he has never had occasion to acquaint himself with such things. No matter how literal, no matter how distinctive

our symbol appears to the expert's eye if a general audience does not understand it we have not arrived at the "telling" point.

Realizing that we are not speaking the language of our audience at large, we turn to a search of the principles involved to find a more primitive application at an earlier stage of our object's development with which, for one reason or another, our audience may be familiar. This familiarity with the object may be owing to the fact that in grandmother's day the implement was used in the household, on the farm; that the principle was taught in schools or that our public has had occasion to see an earlier application of the principle in quaint old prints, paintings, or other illustrative matter.

Not all conceptions can be shown pictorially. While it is impossible to conceive the image of a ton-mile, this borderline case can still be presented by a combination of concrete facts, tons moved for a certain distance. But many concepts still more distant from our visual conception cannot be shown pictorially.

The standardization of symbols aimed at by this method does not mean the elimination of all but one symbol for one thing. There is room for synonyms, with their modification of meaning. We may be required to stress one detail at one time while at another time another detail must be emphasized. Thus new symbols will be created and old ones replaced.

While grammar and vocabulary of our modern languages seem to be static they are actually in a state of flux. Just as any

Illustration IV/4



● A good symbol can often be used for a trade mark or a poster. This symbol became the emblem of the Third World Power Conference in Washington, 1936.

language sires new words to fit new situations, so will our picture language—only much faster. An accepted dictionary of symbols may ultimately become a reality but it will have to be edited frequently to embrace addenda and to record changes which have been made necessary by changing conditions.

CHAPTER • V

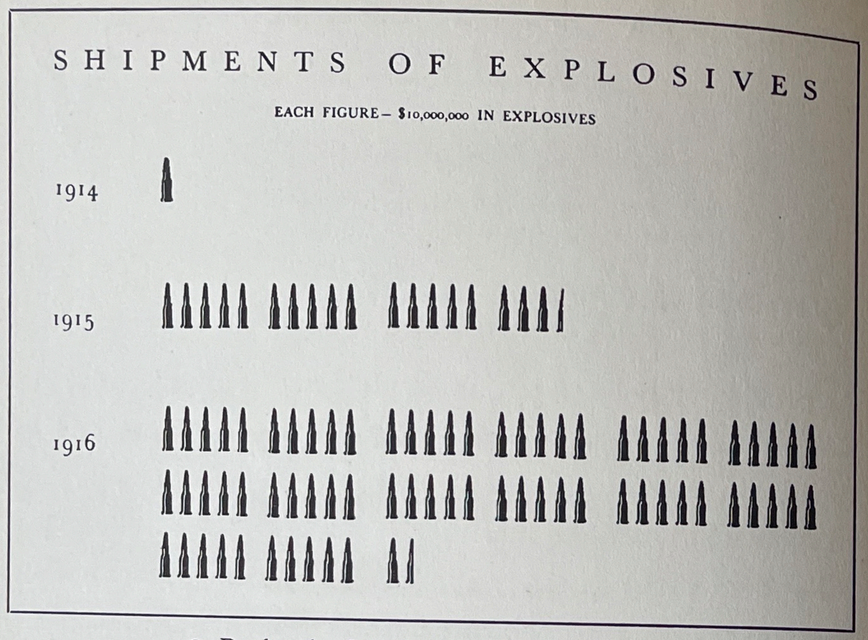
Symbol Arrangement

As previously pointed out, most pictographs are pictorial versions of bar charts. This similarity of method was clearly indicated in charts in preceding chapters. But what can be done to show a hundredfold increase? It would be impossible to put a hundred times as many symbols on one line as on another. For this reason, those who are not well versed in the technique of pictorial statistics often show more than one line of symbols when they are faced with such a problem. They fall back on area diagrams which increase in two dimensions instead of one.

Pictorial charts with an area diagram layout are seldom effective and often visually misleading. Below are the layouts of two charts of this kind.

The chart, "Shipments of Explosives," is a clear example of the faults of an area diagram layout for pictorial statistics. While the development from 1914 to 1915 follows the general scheme of the bar chart, there is a sudden change to the area diagram layout when we come to 1916. This is misleading, because at first glance, the short line at the bottom of the section for 1916 gives the impression of a decrease. The eye does not

Illustration V/1



● By changing from an increase in length of the rows to an increase in the length and in the number of rows it becomes difficult for the eye to judge the extent of the change. From Foreign Policy Association, *War Tomorrow*, New York, 1935.

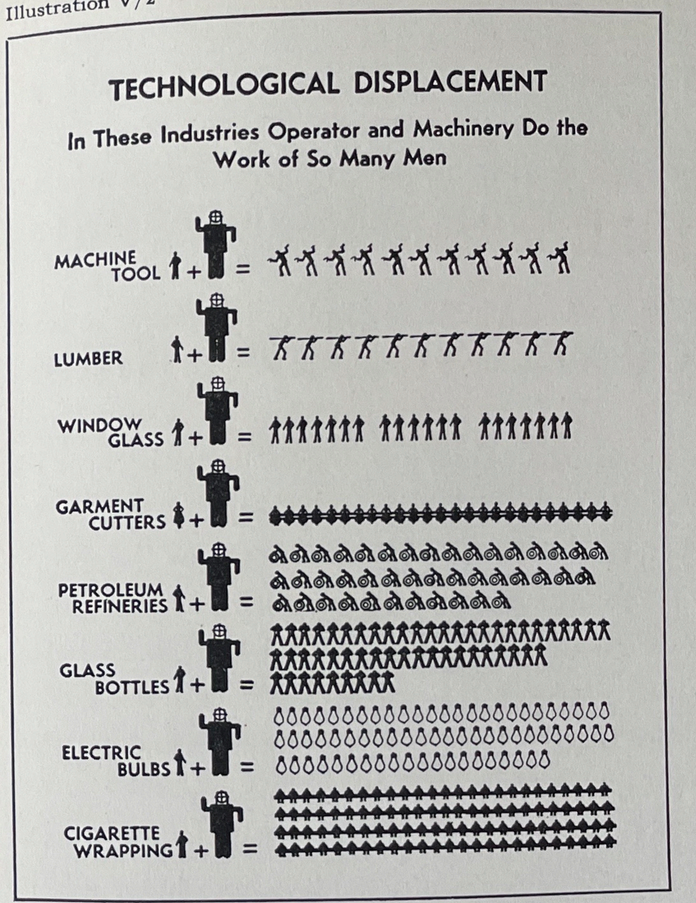
expect the sudden change from length-comparisons to a comparison of height and length and has difficulty judging the different values.

Another example of this fault is the chart on displacement. This chart, by the way, is a good example of a number of serious mistakes in pictorial technique. Here is a list of the more important faults.

(1) It abandons the bar chart concept in two ways.

(*a*) The symbols are not equally spaced so that the eleven symbols in the first two rows extend as far across the page as

Illustration V/2



● This chart contains numerous incorrect usages. The symbols are not equally spaced, the first row showing eleven, the third twenty, the fourth twenty-five symbols covering almost the same length. The change from a linear treatment in the first four rows to an irregular area treatment in the following four is confusing. The symbols differ too much and show too much detail. Light bulbs are used to represent workers. The chart does not actually show displacement but an equation between operator plus machine and workers employed before. From R. A. and O. P. Goslin, *Rich Man Poor Man*, Harper & Brothers, 1935.

the twenty symbols in the third row.

(*b*) Whenever the number of symbols is too great for one row, another row is added and the eye is supposed to judge the total area in the four lowest rows and compare them with the varying length of the four upper rows.

To show how this chart would look if correctly presented, we are reconstructing the bar chart from which it should have been derived.

(2) The symbols should indicate displaced workers. In some cases they do, but suddenly a light-bulb is used to represent people!

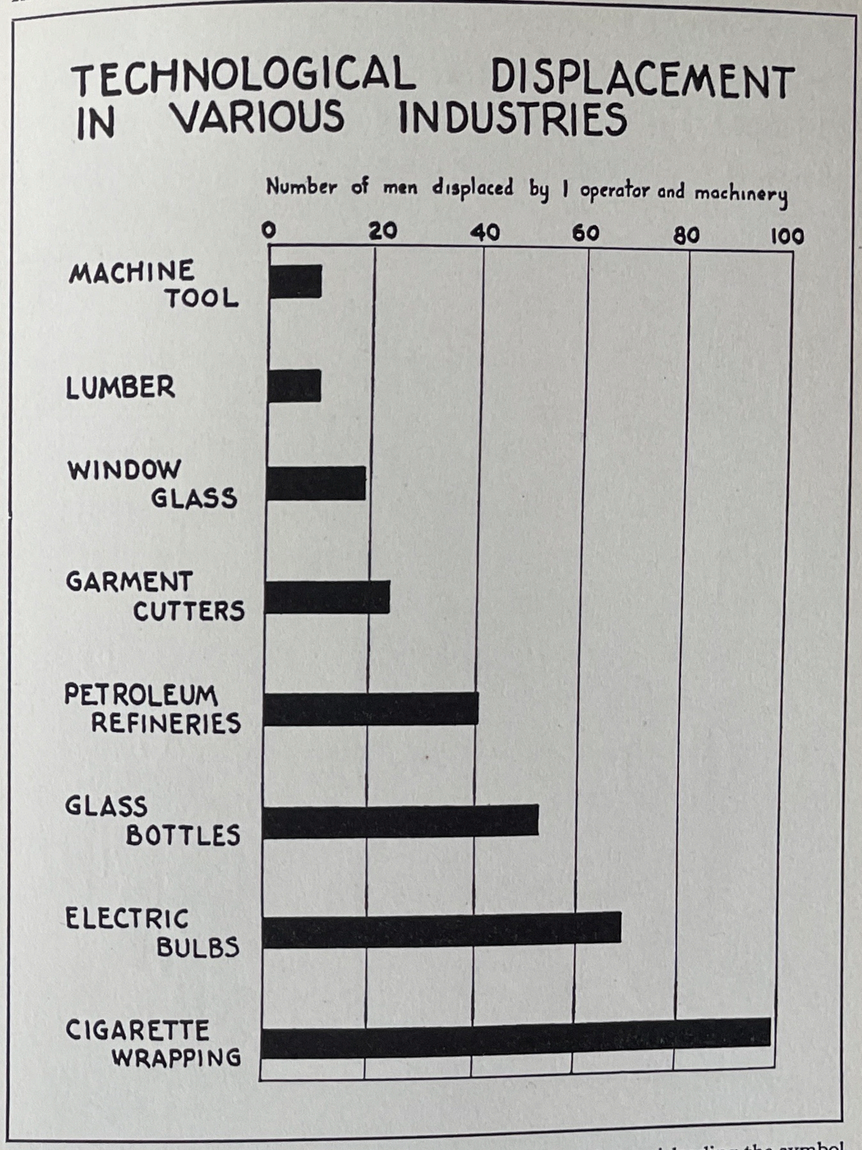
(3) The symbols should show a strong similarity because the idea throughout is the one of *displacement* of workers. Instead, the symbols pull in different directions. As the sample shows, they are too complex to reduce well.

(4) The concept of displacement would have been better emphasized if *displacement* had been shown and not a complicated equation between operator-plus-machines and the work of displaced men.

Returning to the main discussion, we can definitely state: the eye can judge varying lengths of bars; it cannot judge a horizontal and vertical expansion at the same time. Let us consider what should be done in cases where it is necessary to show large increases.

For those who particularly want to give correct visual impressions, it is advisable to keep well within the range of a maximum of ten to thirty symbols to a line. (See Chapter III.)

Illustration V/3



● This chart has been prepared to show how misleading the symbol arrangement in the preceding chart actually is. The bars give the correct length relation which should show up just as clearly in the pictorial chart.

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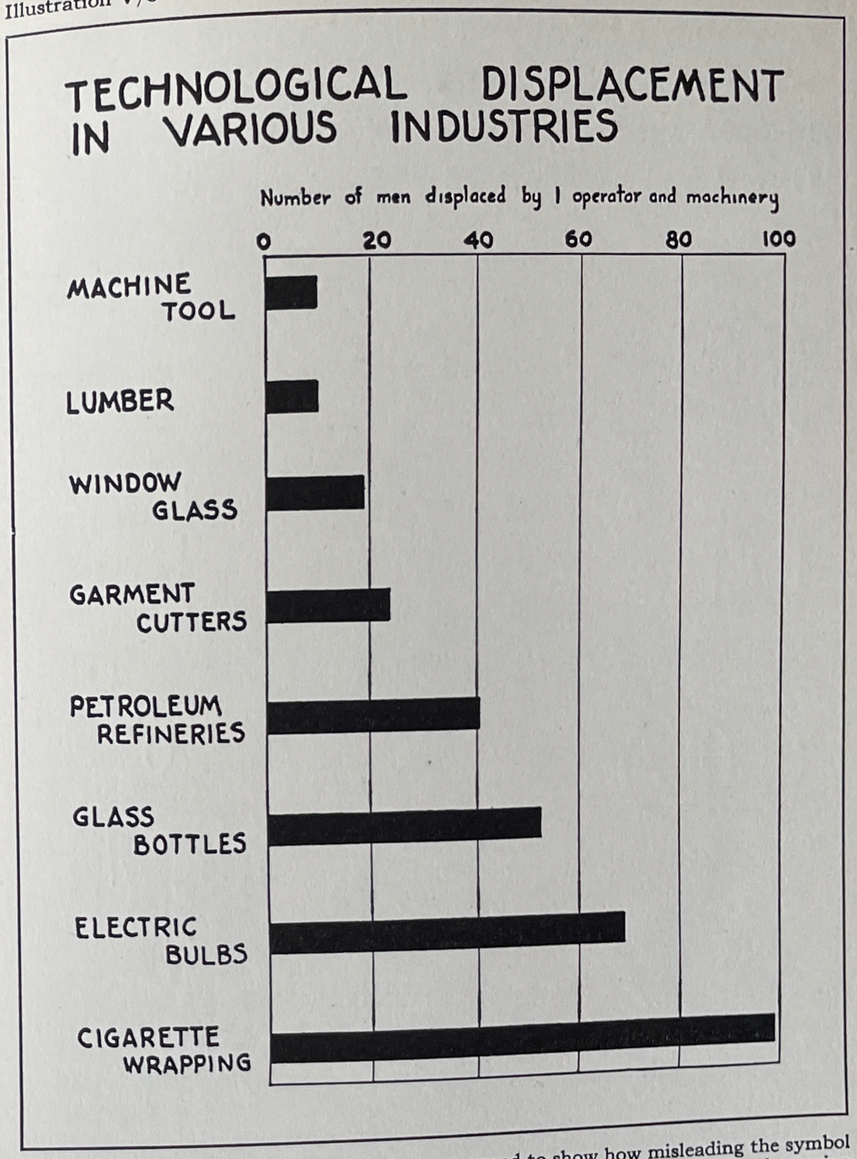
Illustration V/3



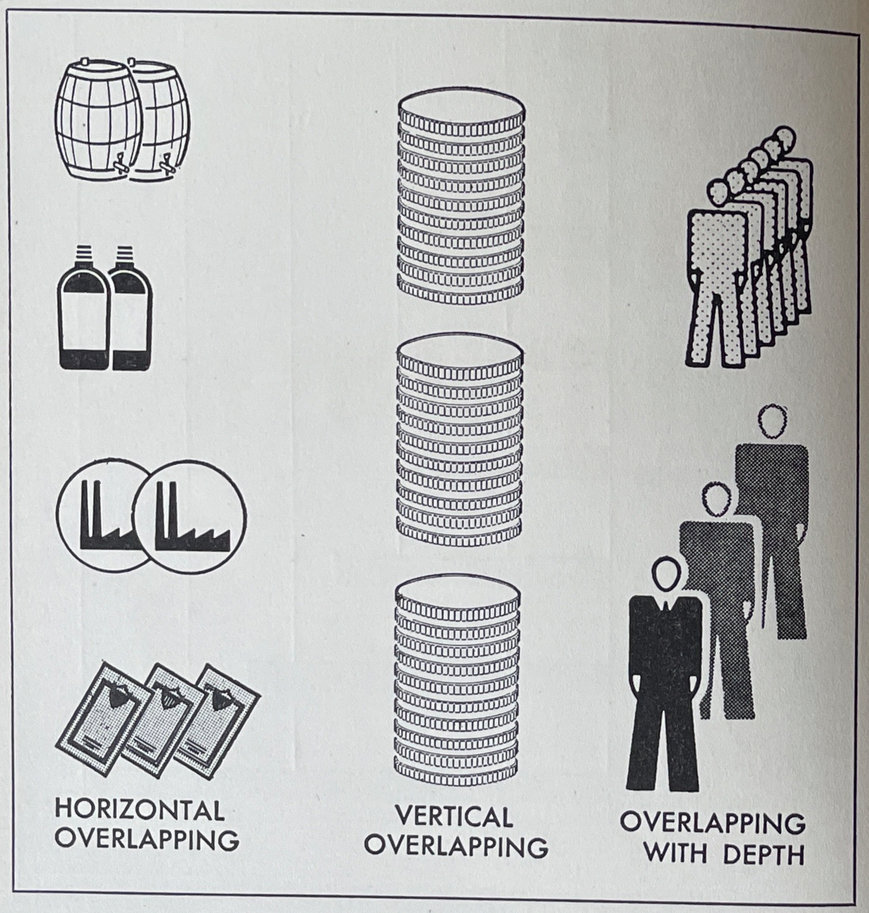
● This chart has been prepared to show how misleading the symbol arrangement in the preceding chart actually is. The bars give the correct length relation which should show up just as clearly in the pictorial chart.

If wider differentiations have to be shown use other methods.

For those who believe that pictorial methods are the most effective idiom for their ideas, even where great variations are to be shown, I recommend the use of overlapping symbols.

The first symbol would stand alone; according to the require-

Illustration V/4



● In this sample several symbols have been forced into a group with only one of them standing out in full, the others being partly covered. Overlapping symbols distort the correct length relations slightly.

Illustration V/5



● To make it easier to count the number of symbols in the longer rows several symbols may be arranged in a block which is separated from the next through a slightly wider space. From Public Affairs Committee, *Security or the Dole*, Washington, 1936.

ments of the chart, two, three, four, or even more symbols would be forced into a block. That is, a block not of independent symbols, but of overlapping symbols. These symbols may be lined up horizontally or given some indication of depth.

The illustration makes it apparent that with this method the correctness of the length relation between one and two or more

symbols is lost. Nevertheless, it is far superior to the method which would extend single symbols as far as possible horizontally, and when that extension is exhausted, hook rows underneath.

We can assume that a chart is at its best when it contains no rows with less than a half symbol and none with more than 10 to 12 wide or 25 to 30 narrow symbols. Inasmuch as it is hard to count every single symbol when there are more than five it is frequently advisable to group a number of symbols together as a "block."

Extra spacing is introduced after each "block" of symbols so that the symbols may be counted as blocks rather than as units. The wider spacing between the blocks makes the row longer than a bar chart of the same facts would normally be.

When symbols are grouped in blocks, the following rules should be observed:

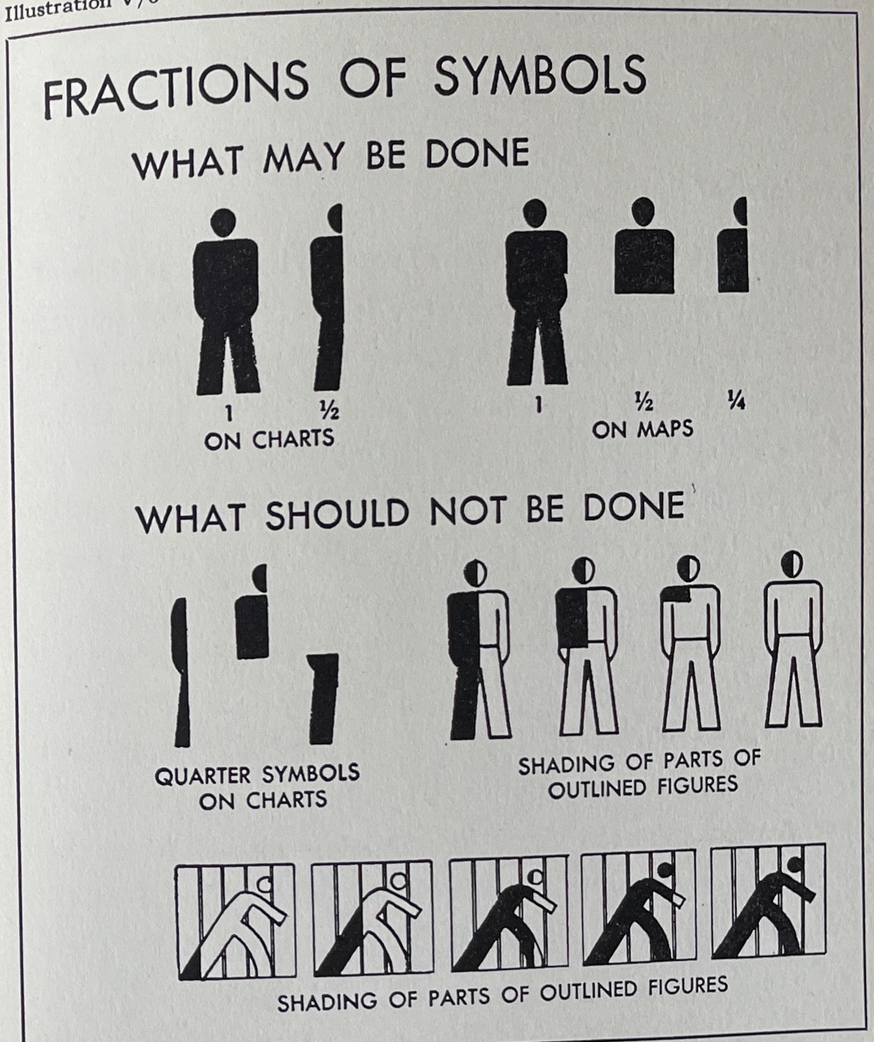
(1) Whenever possible, select the number of symbols per block so that the block stands for a round number.

Symbols Per Block

Each symbol represents:	*Symbols per block*	*Block represents*
1 or tenfolds thereof	5	5 or tenfolds thereof
2 " " "	5	10 " " "
3 " " "	5 or 10	15 or 30 " " "
4 " " "	5	20 " " "
5 " " "	4	20 " " "
6 " " "	5	30 " " "
8 " " "	5	40 " " "

If each block represents a round number it is easy to calculate the statistics upon which the chart was originally based.

Illustration V/6



- Fractions of symbols become confusing when they are divided beyond halves. The practice of shading parts of outlined figures to indicate fractions is unsatisfactory because the outlined part is visually too strong and because outlined symbols mean different things from full ones. (The meaning of outlined figures is discussed in Chapter IV.)

(2) Do not use blocks of symbols if they do not contribute simplicity to the chart.

Fractions of Symbols

It is possible to make the length of rows in bar charts accurate statistically, although this accuracy is wasted on the average spectator whose eyes have not the exact discrimination of the draftsman's tools. Pictographs are made with the intention of giving a quick visual impression; the question is, just how accurate should they be? The smallest fraction that can be shown with visual effectiveness is one-half symbol. A bar chart can be divided indefinitely, a symbol cannot.

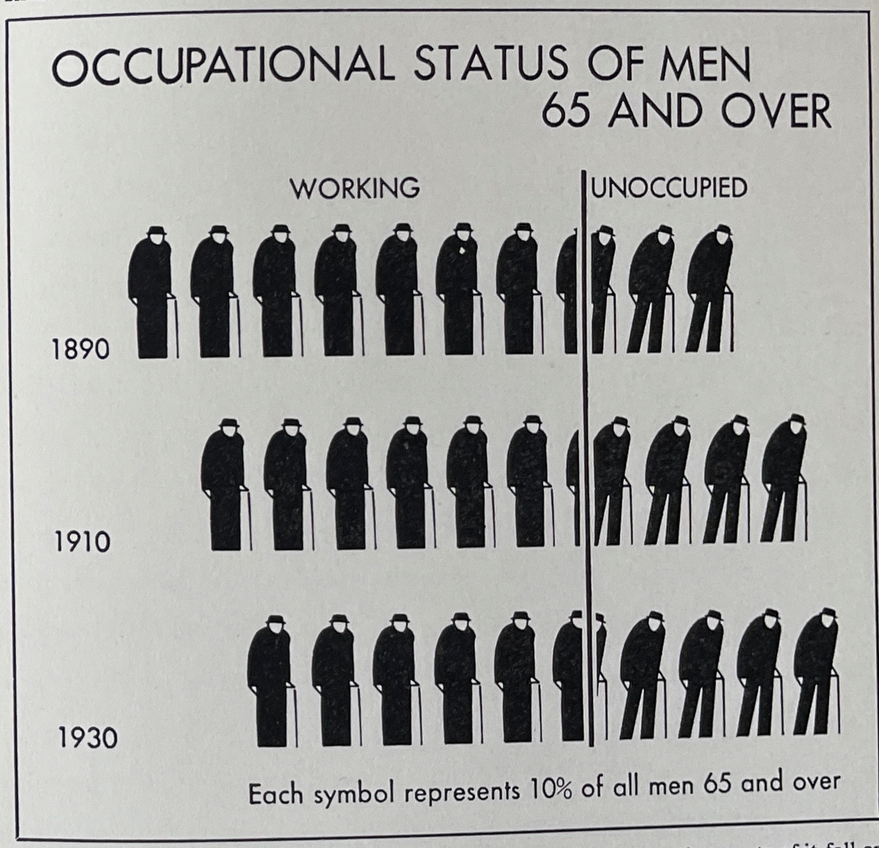
The important distinction between the pure bar chart and the pictograph is that the former is primarily an accurate statement of fact, while the latter aims to give above all an accurate impression of a whole situation. The picture makes the *point* clear. Any attempt to reduce the symbols to sizes at which they are no longer recognizable obscures the point. Therefore, this drastic reduction is inconsistent with the purpose of the pictograph.

Novices in the pictorial method have attempted to present smaller fractions by showing the whole figure in outline and the fraction solid. Aside from the fact that the outline has another definite function which should not be distorted (Chapter IV) the visual impression made by such a device is confusing. In

the accompanying chart, one-sixteenth has almost the same visual emphasis as one-eighth. This bears out our contention that symbols on charts should never be divided into segments smaller than half a unit.

On maps, a fourth of a symbol is sometimes used. So long as

Illustration V/7



● Here the axis cuts through a full symbol so that parts of it fall on either side. The pictorial quality remains intact even if smaller fractions than halves are used. This system should be used only where greater exactness is demanded. A less satisfactory solution of a similar type is indicated on Illustration III/5. Chart prepared for Public Affairs Committee, *Security or the Dole*, Washington, 1936.

the fourth is recognizable this practice is permissible. As symbols on maps are arranged geographically, and not from one axis the smaller fraction of symbol is not confusing.

On charts with an axis in the middle and symbols to the right and left adding up to a total, smaller fractions can be shown on one side of the axis if the component fraction adjoins it on the other side of the axis. This should only be done when exactness is imperative.

CHAPTER • VI

Color and Shading

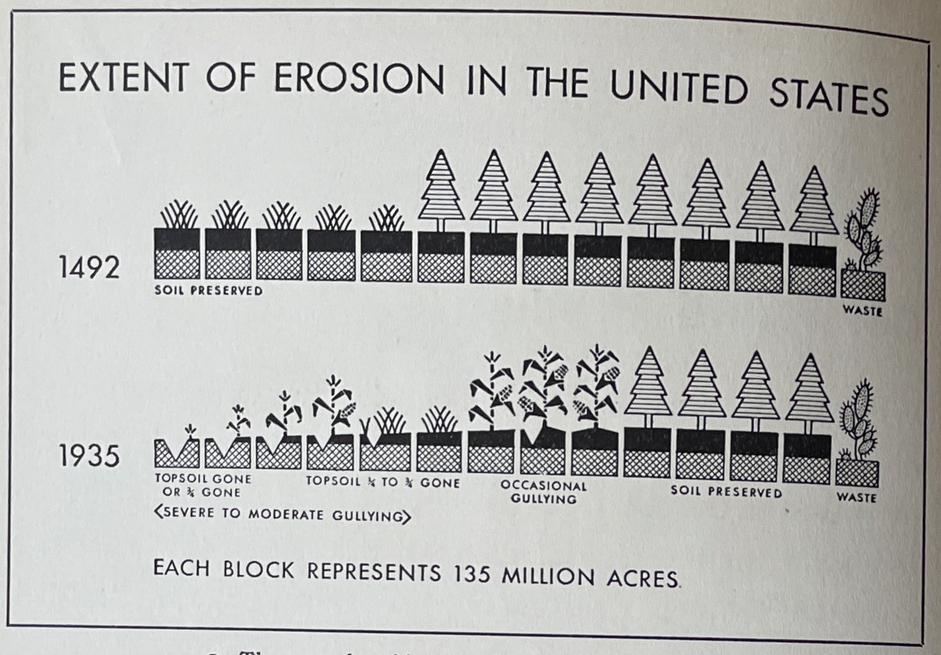
When we consider the problem of color, two questions must be answered. First, is color a help? It is a help both in focusing attention on the chart, or on a single part of it. Color also helps to clarify the meaning of the statistics. When that answer is accepted, the next question is where to get color, and, if it is not easily available, how to find a substitute for it.

The Importance of Color

Good prose is filled with color. We have come to expect word-pictures in any effective writing. In our speech such terms as "yellow" press, in the "red," "yellow" peril, and "red" army, are common. The underlying elements of these word-pictures can easily be translated into symbols to make equally effective statistical pictures.

There are other effective uses for color. Symbols can be reproduced in the color native to the objects they represent. Also, a color can be assigned to everything belonging in a certain group; for instance, green for agriculture, blue for water, black for mining, red for activity. Thus color gives us another tool

Illustration VI/1



● The cross-hatching and shading on this chart has been done by hand. From H. S. Person, *Little Waters*, Washington, 1936.

with which to define our subjects.[1]

Obviously there will be a certain amount of overlapping of color meanings. Furthermore, higher costs will often limit printed charts to two colors, and in this case red and black are the most suitable for general purposes. Red, because of its higher intensity will be used for the outstanding facts, and black will suffice for the less important material. Under these circumstances, red may happen to stand for some facts, which, if more colors had been used, might have been better shown in green or blue.

[1] Gesellschaft und Wirtschaft, p. 99, Leipzig, 1930, gives color meanings used by Dr. Neurath.

Illustration VI/2



● Stack screens have been used on this chart. Notice the difference in tone and the slight smear in the third figure in the top row. The original of this chart was exhibited by the Social Security Board at the National Conference of Social Work, 1936. The statistical layout for this chart has not been found very effective; it is therefore not discussed in this book.

COLOR	SYMBOLIC VALUE
Black	Negroes, assets, Fascism, mining, coal
Red	Debts, war, Indians, activity, industry, labor, labor parties, Soviet Russia
Green	Agriculture, forestry, greenbacks, fiat money, farmers' parties
Blue	Administration, government, distribution, water, Union side in Civil war
Yellow	Chinese, Japanese, desert, strikebreakers
Gray	Confederate side in Civil war, miscellaneous, anything unimportant

Color and Its Substitutes

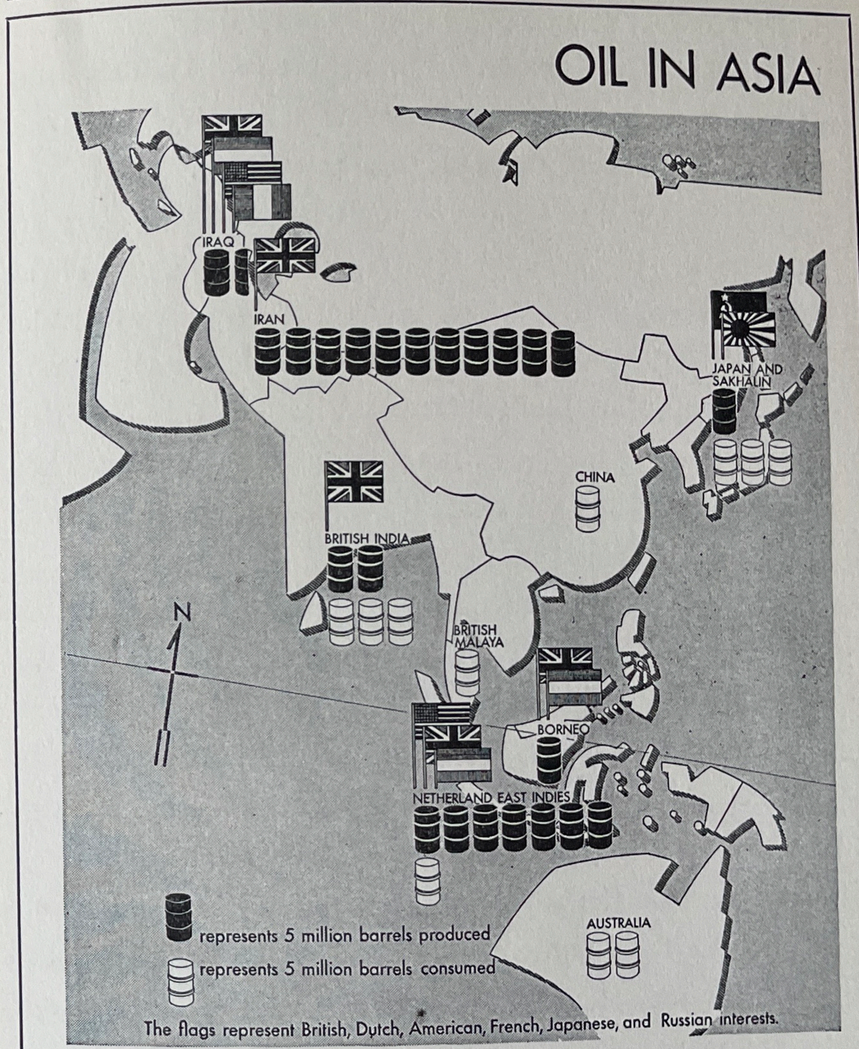
There are many cases where the cost of color is prohibitive. Let us consider the various methods of chart production and reproduction in their relation to color or color substitutes.

Usually an original chart is made by pasting symbols on a background. These symbols are usually printed in black, and if they are to be printed in color, the cost will be slightly higher. If only one or a few copies of the chart are wanted, the paste-up of colored symbols is the simplest and cheapest way to use color.

If the final chart is entirely hand drawn and painted, the use of color is a very simple matter which does not increase the cost.

In most cases, however, the chart is to be reproduced in newspapers, magazines, books or pamphlets. Here the use of color involves such a large expenditure that it is usually impractical. Under these circumstances, shading can be used to bring out the differences between various groups or areas. This can be done in three ways.

Illustration VI/3



● The map contains two different Ben Days—one half-tone Ben Day on the water and a heavy line Ben Day on the edge of the land. The flags are shaded by hand. From *Asia*, January 1936.

1. By hand.
2. By stack screens.
3. By Ben Day screens put on the plate by the engraver.

Hand shading is shown on the first chart (VI, 1). This process is not entirely satisfactory because it is never quite accurate and requires considerable time to execute.

Stack screens can be bought at most stores which carry artist's material. They are rubbed or pasted over the part of the chart which is to be shaded. Two kinds of screens are available: some which make a white area gray and some which make a black area gray. Both kinds come in various densities and patterns. Stack screens usually do not make an even shading. They get much darker when the chart is reduced, much lighter and coarser when it is enlarged.

Ben Day screens are put on the plate by the engraver; all that the chart-maker has to do is to indicate the shading he wants on the drawing. Sample books of Ben Day "values" or tones are available from engravers. An example of two different Ben Days is given on the map "Oil in Asia." (Water and edge of land.)

Shadings are particularly useful in subduing less important parts of a chart (explanatory pictures), in stressing changes (different components), and in differentiating areas on maps (water and land).

CHAPTER • VII

Title and Legend

The ideal chart would have no lettering. It would be self-explanatory. No charts ever reach this ideal, but if we plan carefully we can approach it.

The form on page 75 gives the normal lettering, its size and location; lettering which appears but occasionally is indicated in parenthesis. Only title, some qualifications, and symbol explanation appear in practically all charts; subtitle, other qualifications, source, footnotes, and producer are given only when necessary.

Title

An effective chart must have a concise, clear title. Frequently such a title is as difficult to find as the necessary statistics. The best procedure is to write the complete descriptive title on a piece of paper and then eliminate all non-essential words and replace the technical words by more common ones. For instance, we began with "Documented Tonnage of the United States Merchant Marine Employed in Foreign Trade," and whittled it down to "The American Merchant Marine." The essential

material left out of this cryptic title was included in the symbol explanation. If necessary, a small footnote can always be added to supply essential details. "Number of Strikes and Lockouts and Man-days Lost" became "Industrial Conflict."

In most cases, descriptive titles such as these are best. Sometimes it is wise to add an indication of the trend described in the chart. Such a title would be "Growth and Decline of Industrial Conflict" or "The Growing Public Debt" or "How Our Public Debt Grows."

Sometimes titles are oblique, describing by inference. For example one title was "We Stand Up To Be Counted." (Membership of American Association of Social Workers). "They Went To School," (Enrollment in American Public Schools). (See Illustration III/5.) The disadvantage of these titles is that they are not fully descriptive and are meaningless when reproduced out of their original text.

In selecting a title, two other rules should be followed.

1. A title should not include facts which the chart does not show.

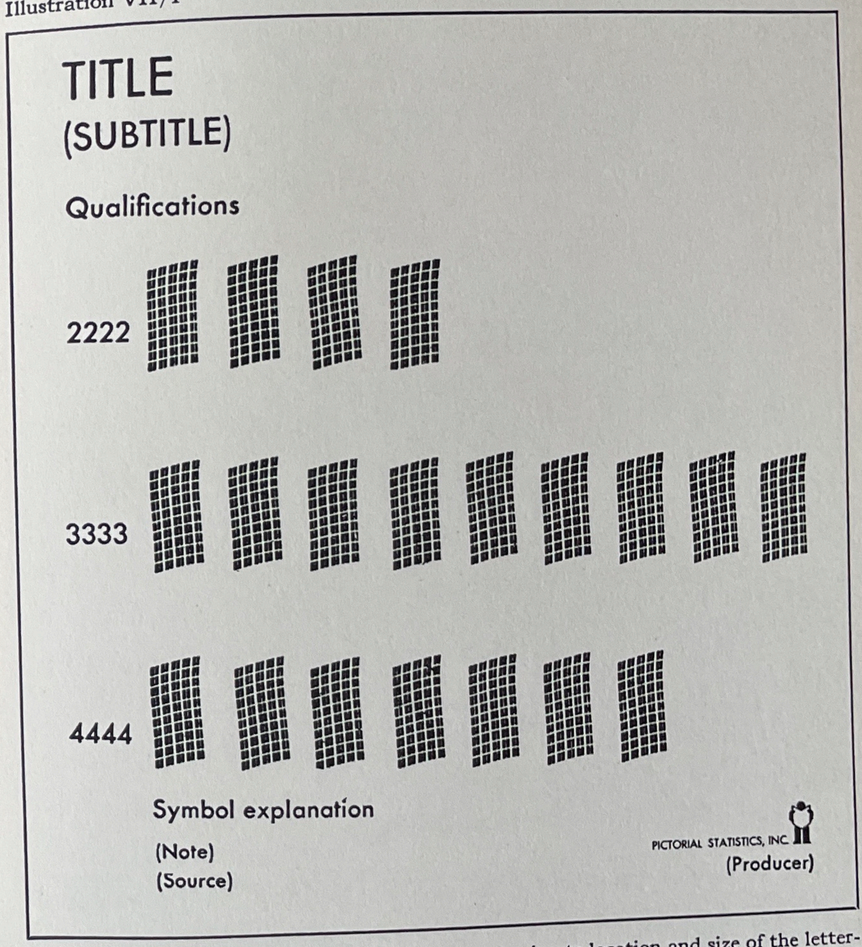
2. The title should be placed at the top of the chart. (See Chapter III.)

Subtitles should be used to state facts which are not sufficiently important to be included in the title, or which would make the title too long. Frequently, subtitles are necessary when the title is non-descriptive. Often the facts that would go in a subtitle can be put into the explanation of symbols. Subtitles should be placed below the title.

Qualifications

All pictorial charts show comparisons. They may be comparisons of the status of things at various times, or various places,

Illustration VII/1



● This sample gives the approximate location and size of the lettering of a simple development chart. Note that title, subtitle and qualifications start from the same line at the left. The symbol explanation begins directly under the symbol which is farthest left.

or of various components of one total. These various points of measurement are labeled *qualifications*. Qualifications are usually dates or the names of places. Less often they are other distinguishing facts: cancer, heart disease, and pneumonia as causes of death; parents with children, parents without children, one parent with children, unattached persons as components of families on relief. (See Illustration III/10.)

Qualifications appear most often at the left of the symbols. Occasionally they are placed elsewhere. (See Illustration III/10.)

Symbol Explanation

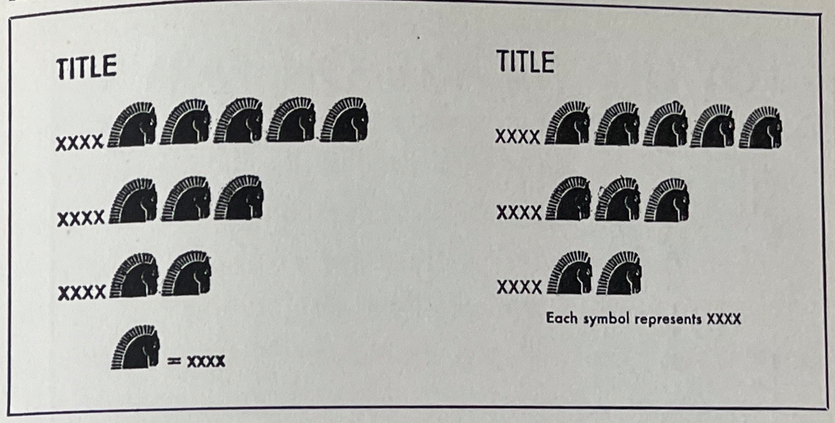
Each symbol stands for a certain figure; either an absolute figure or a percentage. For those who want to get the actual data underlying the chart (by multiplying the number of symbols by the figure each symbol indicates) this figure must be given. The best way is to write "each symbol (man, boat, or whatever it happens to be) represents so many people (or tons, or bales, or gallons)."

The symbol explanation should generally appear directly under the last line of symbols, in line with the symbol farthest left.

It is not advisable to reproduce the symbol in the symbol explanation because that may lead to confusion.

A *source* should be given if necessary. Since a chart is the less effective the more non-pictorial material it shows, it may

Illustration VII/2



● The two examples given here illustrate why the symbol explanation should not include a reproduction of the symbol. The latter may easily assume a statistical meaning and create a misleading visual impression. In most cases it is preferable to have the symbol explanation entirely in type.

be better to show all sources and all the underlying data outside of the chart, preferably in the appendix if the chart appears in a book. If not, the sources may be included on the chart in small type. One must be extremely careful not to destroy the visual impression by adding too much detail and lettering to the chart.

Similar rules apply to *footnotes* as long as they specify or limit the material on which the chart is based. Footnotes, indicating that no symbol was shown in some part of the chart because the quantity was too small, should, however, appear directly at the bottom of the chart.

The *producer* of the chart should be given; he is the one to

or of various components of one total. These various points of measurement are labeled *qualifications*. Qualifications are usually dates or the names of places. Less often they are other distinguishing facts: cancer, heart disease, and pneumonia as causes of death; parents with children, parents without children, one parent with children, unattached persons as components of families on relief. (See Illustration III/10.)

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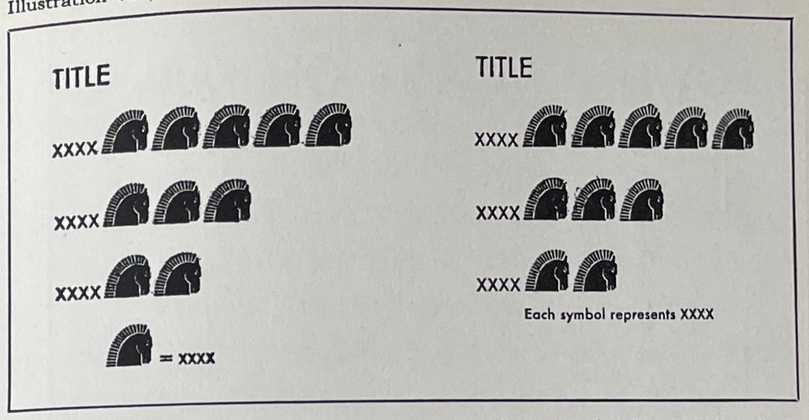
Illustration VII/2



● The two examples given here illustrate why the symbol explanation should not include a reproduction of the symbol. The latter may easily assume a statistical meaning and create a misleading visual impression. In most cases it is preferable to have the symbol explanation entirely in type.

be better to show all sources and all the underlying data outside of the chart, preferably in the appendix if the chart appears in a book. If not, the sources may be included on the chart in small type. One must be extremely careful not to destroy the visual impression by adding too much detail and lettering to the chart.

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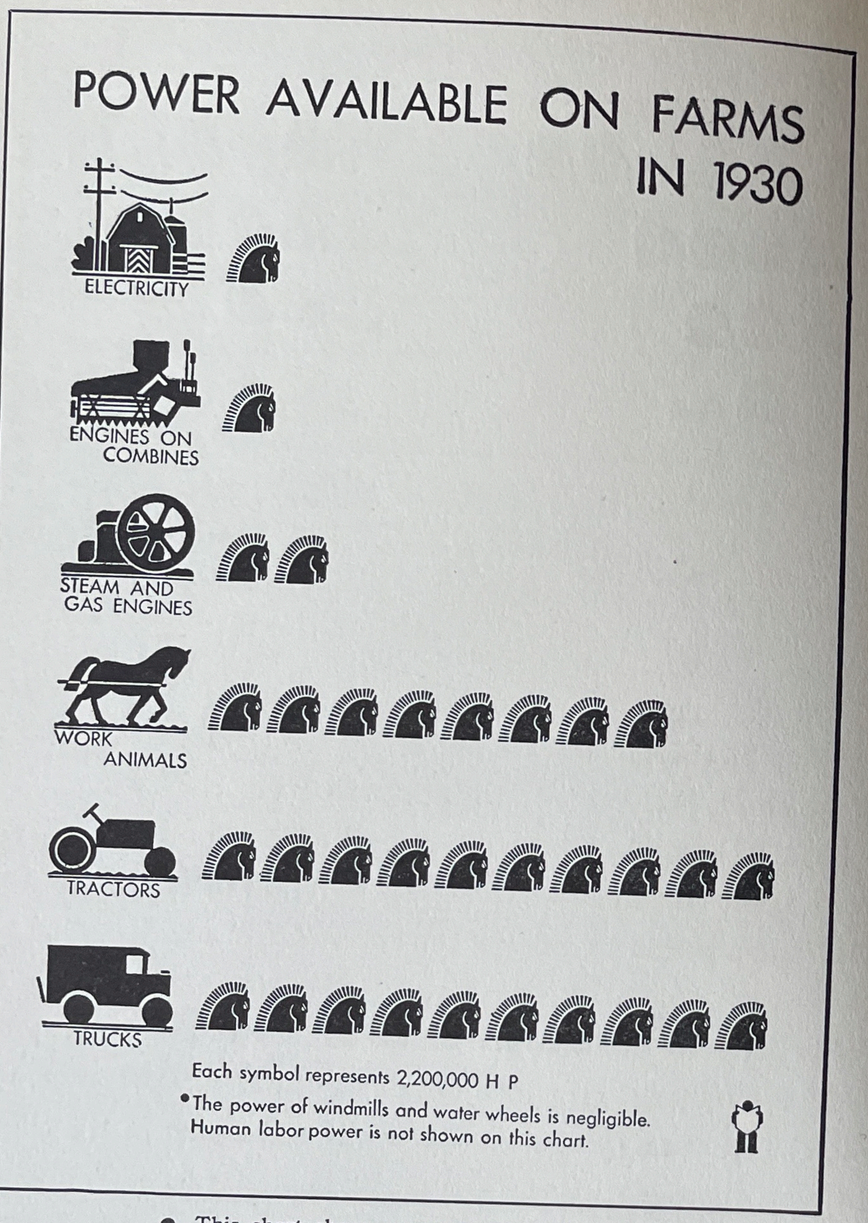
The *producer* of the chart should be given; he is the one to

Illustration VII/3



● This chart shows a comparatively long footnote in the proper location. From Rural Electrification Administration, *Electric Power on the Farm,* Washington, 1936.

whom inquiries as to sources or other supplementary information can be directed. His name therefore, should not be omitted except for special reasons.

When *source, footnotes,* and *producer* are given, they should appear on the bottom of the chart.

Size of lettering. The title obviously should have the largest lettering. It should, however, be held to one line if that is possible. Qualifications and subtitles are next in importance, usually about half or three-quarters the size of the title. All other lettering should be as small as possible, depending on the use of the chart. If it is to appear in print, six points is the minimum; if it is to appear on a two by three foot wall chart, eighteen points should be considered the lower limit.

Type used

Pictorial Statistics, Inc., generally uses Futura type because of its legibility. This type also reduces well because all letters are of even width throughout and have no light lines which tend to disappear in reduction.

CHAPTER • VIII

Explanatory Pictures

Even the most effective symbols are often insufficient to state the idea of the chart fully. Let us take, for example, the increase in the Japanese Merchant Marine. If only boats are shown the *pictorial* part of the chart will not indicate that we are discussing Japan. The chart shows pictorially only the one fact:

Illustration VIII/1

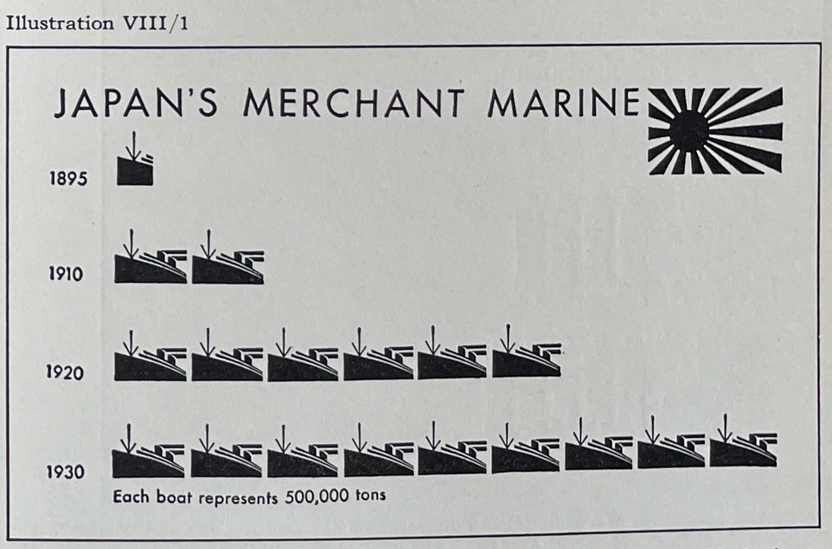
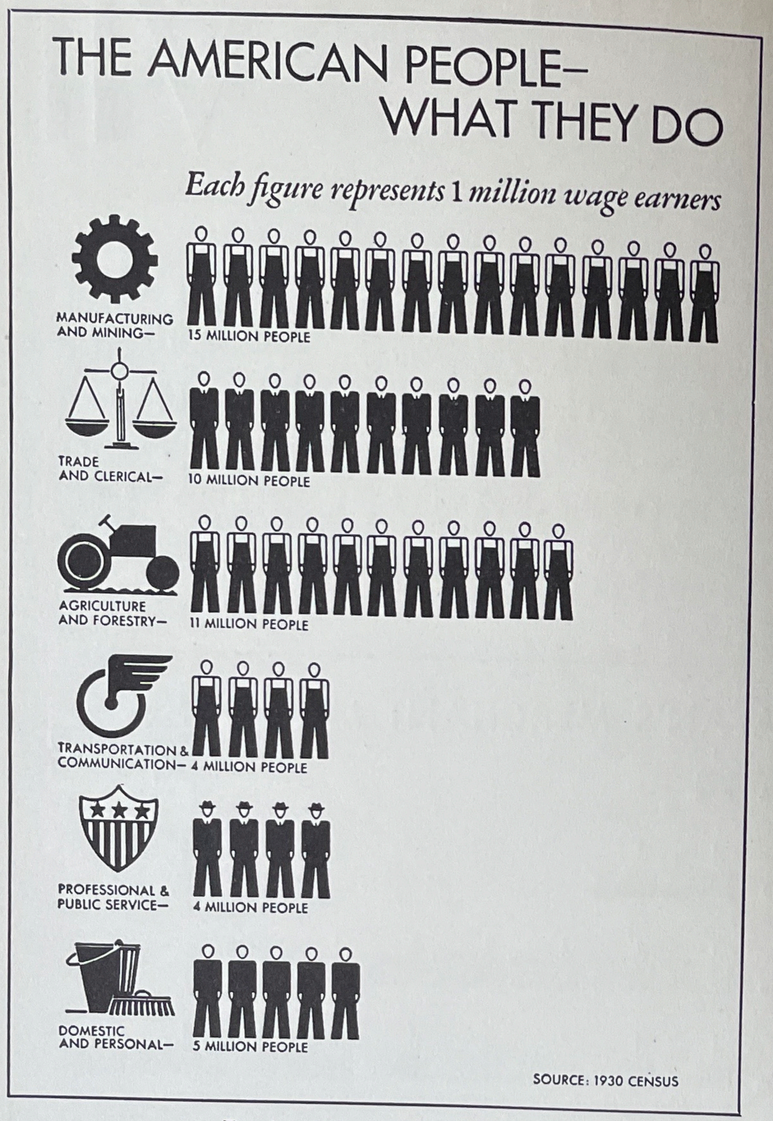


Illustration VIII/1

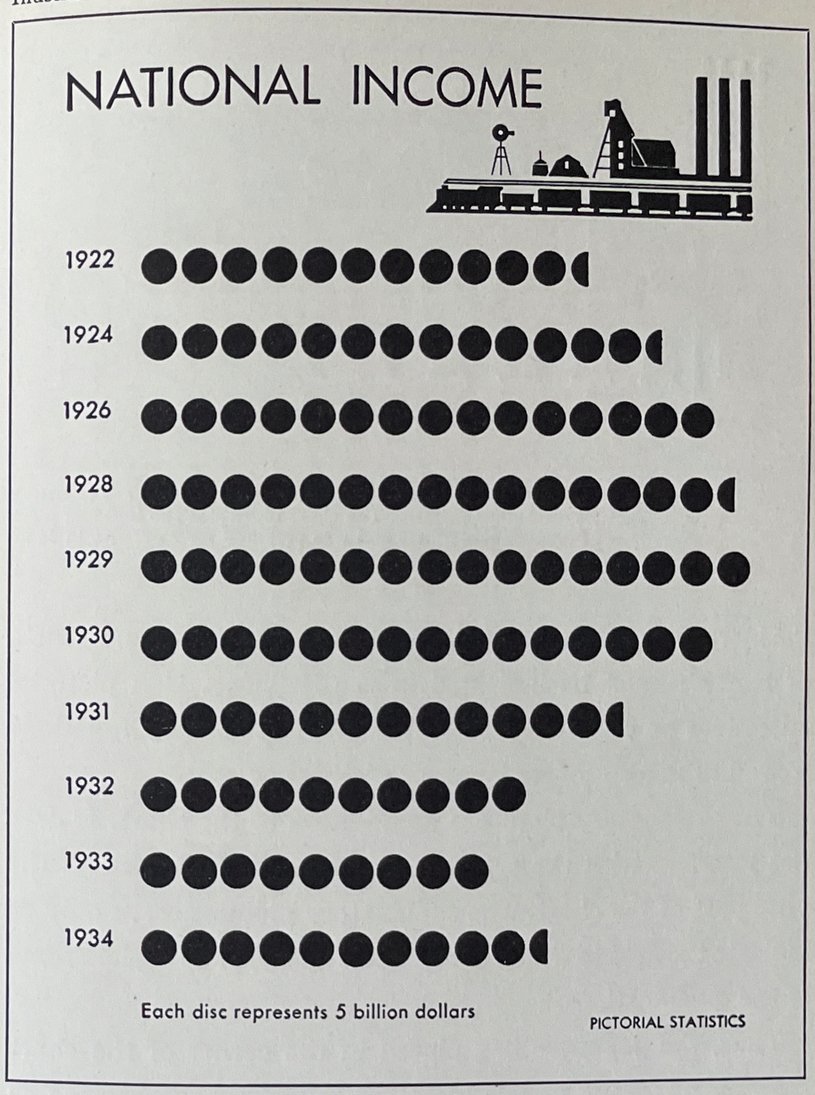
● The explanatory picture on this chart serves to identify the boats shown as Japanese. The use of explanatory pictures makes the chart less dependent on lettering. From *Asia*, January 1935.

Illustration VIII/2



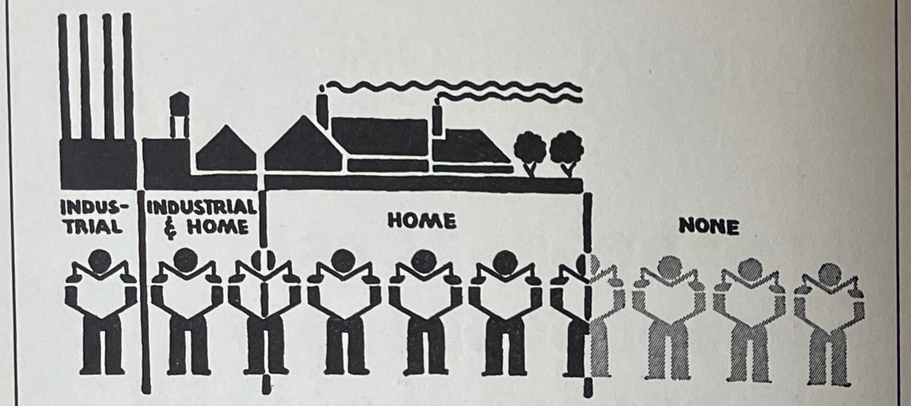
● To pictorialize qualifications the pictures are placed above the type. In this chart the symbol explanation was placed above the symbols upon request of the Social Security Board, for which it was prepared.

Illustration VIII/3



● Here the corner symbol helps to explain the symbols, which, without this explanation would merely indicate that the chart deals with money values. From Public Affairs Committee, *Income and Economic Progress*, Washington, 1936.

Illustration VIII/4



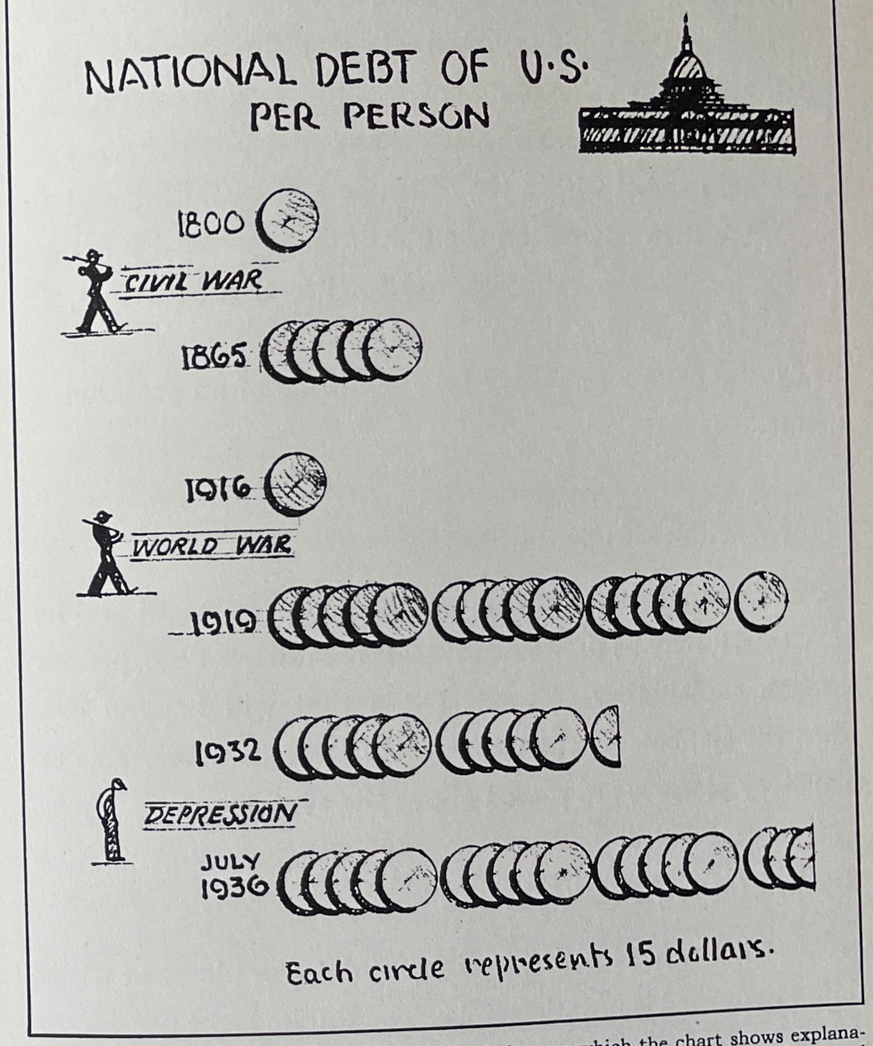
● The important parts of this "Simple Breakdown" are identified by explanatory pictures. The chart illustrates the building plans of *Fortune* subscribers and was prepared for *Fortune* in 1936.

the increase in boats. That the boats may be Japanese, French, or English must be indicated in the lettering. Can pictorial adjectives be created to take over this explanatory function? Yes—in the form of explanatory pictures.

The explanatory picture is an addition to the chart. It does not interfere with the symbols, which, as before, remain the vital part of the chart. The explanatory pictures serve only to indicate the field to which the symbols apply, or to explain some of the qualifications.

Thus, the Japanese flag placed in the corner of the chart showing merchant vessels identifies the Merchant Marine as Japanese, while the flags for the various countries in the chart Murder (Illustration III/3) pictorialize the qualifications

Illustration VIII/5



● To explain the cause of changes which the chart shows explanatory pictures may be used. The *Graphic Layout* was prepared for Keohane and McGoldrick, *Government In Action*, Harcourt, Brace & Co., Inc., New York, 1937.

which otherwise would have to be expressed in type.

Explanatory pictures are particularly useful in the case of the most common symbol—the disk, symbolizing value. As we have seen, an identifying symbol may be put within the disk: a cogwheel to show value of manufactured goods, a cash register to show value of trade. But often the subject precludes the use of another symbol within the disk (for instance, National Income). We then depend on the use of an explanatory symbol (for National Income a composite picture of Agriculture, Industry and Services).

In many cases a map may take the place of an explanatory picture.

Identification of Components

For a chart in which symbols are arranged to the right and left of an axis, it may be desirable to stress the different components through explanatory pictures. Often that will happen even when the symbols on the two sides of the axis differ. The explanatory pictures are placed above the symbols.

Explanation of Qualifications

Frequently the mere listing of different dates or places at which things happened is unsatisfactory. The Public Debt per person of the U. S. for instance, did not change much between the 1880's and 1916. From 1916 to 1919 it increased twentyfold. By putting an explanatory picture between the row showing the

1916 figures and that showing the 1919 figure symbolizing "War," we have given the cause for the sudden change which our symbols indicate.

An explanatory picture may be carried through a whole series of charts to identify them as belonging to a certain subject. This was done in eight charts prepared for the *Survey Graphic* of July, 1936, where a new symbol was created for Syphilis and used as identification on each chart.

Like the symbol, the explanatory picture should be simple, clear, and self-explanatory. If planned well and carefully it adds not only to the clearness of the chart but also to its visual attractiveness.

Nevertheless, it is not advisable to use explanatory pictures where there is no real need for them; in such cases they will distract attention from the purpose of the chart rather than contribute to its clearness.

CHAPTER • IX

Sources of Statistics

Pictorial statistics usually show comparisons of facts at various times, places, situations. But the maker of the chart or map is rarely the one who has surveyed the facts for illustration. From where do the facts come? They may either be supplied by the client or they may have to be searched out of the various books or reports in which they are published.

In the first case the job will be to transform a given set of figures into clear fact pictures, and in the second to find the facts which will tell the story best. The latter task is more difficult but more satisfactory as it permits the selection of material which lends itself best to prove the point, a selection which someone unacquainted with the method is often unable to make cogently.

In most of the fields in which statistical material can be found there are a number of detailed figures from which a selection has to be made. A thorough analysis of the data and of the specific purpose for which they are to be used will often be necessary before a decision can be made as to which figures will show the desired facts. (See Illustration I/2.)

Let us take a case in which we want to show the growth of the American Merchant Marine. We find a great variety of material on page 408 of the *United States Statistical Abstract—1936* and in other source books. What part of it do we want to use? The number of vessels or their tonnage? Should we show total tonnage or only the tonnage employed in foreign trade? We shall have to analyze the meaning of each set of figures before we decide which one is to be the basis of our chart.

But the reverse may happen too. Instead of too many facts we may find none at all. We may want to show the development of child labor, and find no data on the subject since the 1930 census. In a case like this it is not necessary to give up in despair. Searching for later material one may find that although there are no figures on the number of children at work in the years after 1930, data are available on the number of employment certificates issued to children in various cities. These will give a good indication of the trend of child labor.

The rule is then: From rich material we select that which, after careful analysis, describes most accurately the chosen aspect of the subject. If material on the subject itself is not available we search for related subjects which make it possible to draw pertinent conclusions.

Having settled on a certain series of figures as being the most fitting, we will have to eliminate from this series all of those which are not essential. For example:

1923	1	can be shown thus:	1923	1
1924	2		1925	3
1925	3		1927	5
1926	4			
1927	5			

If ups and downs occur:

1923	1	we can show	1923	1
1924	3		1925	5
1925	5		1927	1
1926	3			
1927	1			

A similar selection can be made to show downward trends or situations which change irregularly.

This selection demands skill and honesty from the person who performs it; it must warrant the confidence of the people who look at the chart. Abuse of statistics by eliminating essential data has been practiced frequently and it is just as possible in pictorial statistics as in other forms of statistical presentation. To keep the confidence of the public it is necessary to use only reliable statistics as a basis and only honest methods to show them.

It depends on the purpose of a display, whether the highest or lowest points or annual averages over a longer period should be shown. To explain the great fluctuations in the number of stocks traded on the New York Stock Exchange it would undoubtedly be best to show the most outstanding years, months, or even days.

To show the long term trends in immigration it would be

appropriate to select long periods and show annual averages during these periods.

For how much should each symbol stand?

Pictorial charts show rough approximations of the actual data. How are these approximations calculated? Let us follow the development of one set of figures all the way through from the source to the statistical layout.

The source: U. S. Merchant Marine (thousands of gross tons employed in foreign trade).

1789	124	1870	1449	1923	9069	1931	5576
1800	667	1880	1314	1924	8794	1932	5071
1810	981	1890	928	1925	8151	1933	4701
1820	584	1900	817	1926	7719	1934	4598
1830	538	1910	783	1927	7309	1935	4560
1840	763	1915	1863	1928	6934	1936	4168
1850	1440	1920	9925	1929	6906		
1860	2379	1922	10720	1930	6296		

In this chart we want to demonstrate the ups and downs. We shall therefore look for the highest and lowest points. The figures (exclusive of 1789, for which see p. 5) are:

1810	981,000 tons
1830	538,000 "
1860	2,379,000 "
1910	783,000 "
1922	10,720,000 "
1936	4,168,000 "

Our lowest figure is 538,000, our highest one is 10,720,000, or about 20 times as high as the 1830 tonnage. We know from preceding chapters that we should not go below half symbols and

not much above 10 wide ones. In this case we could keep within this rule if 1,000,000 tons is a good unit; that is, if there are not too many inaccuracies when we use it. The only way to discover this is by actual calculation, using different units and calculating the amount of the inaccuracy in each case. If that calculation is made we will find that our choice lies mostly between 800,000 and one million as the unit which each symbol should represent. One million will have many advantages; the longest row is not too long and the underlying statistics are easy to figure by multiplying each symbol by a million. For these two reasons we decide upon one million tons as the unit even though we would have fewer half symbols to deal with if we selected 800,000 tons.

It is important to select a unit which tends to bring out changes in proportion correctly. Neurath[1] gives the following example:

"Assume that two rows should be compared

36,40,44

72,80,88

"Dividing by *ten* as the common denominator we would get

4,4,4

7,8,9

"The proportion between the two rows remains intact if *five* is used as unit:

7, 8, 9

14, 16, 18."

[1] *Bildstatistik nach Wiener Methode in der Schule*, p. 23.

The greatest attention should be paid to the proper selection and handling of statistical data. This book indicates ways and means of using the material so that it will be visually correct, attractive, and easily remembered. To make graphically vivid presentations worth while they must be based on good factual material.

For those who want to find general statistical material on social and economic facts the following list of books is suggested:

League of Nations, *Statistical Year-Book,* (Geneva, yearly)
League of Nations, *Monthly Bulletin of Statistics,* (Geneva, monthly)
International Institute of Agriculture, *International Year-Book of Agricultural Statistics,* (Rome, yearly)
Statistical Abstract of the United States, U. S. Dept. of Commerce, (Washington, yearly)
The World Almanac, N. Y. World Telegram, (New York, yearly)
Survey of Current Business, U. S. Dept. of Commerce, (Washington, monthly)
Foreign Commerce Yearbook, U. S. Dept. of Commerce, (Washington, yearly)
Biennial Census of Manufactures in U. S., Census Bureau, (Washington, biennially)
Yearbook of Agricultural Statistics, U. S. Dept. of Agriculture, (Washington, yearly)
Minerals Yearbook, U. S. Bureau of Mines, (Washington, yearly)
Publications of the National Bureau of Economic Research, New York
Publications of the Brookings Institution, Washington, D. C.
The Statesman's Yearbook, Macmillan, (London, yearly)
Encyclopaedia of the Social Sciences, 15 Vols. Macmillan, (N. Y., 1930–35)
Field, F. V., *Economic Handbook of the Pacific Area,* Doubleday, Doran & Co., (Garden City, N. Y., 1934)
Zimmerman, E. W., *World Resources and Industries,* (Harper & Brothers, N. Y., 1933)
Annalist, (229 West 43rd Street, New York, weekly)
Statistisches Handbuch der Weltwirtschaft, (Berlin, 1936)

Statistisches Jahrbuch für das Deutsche Reich, (Berlin, yearly)
Weltstatistik, L. W. Seidel, (Wien, 1936)
Wl. Woytinsky, *Die Welt in Zahlen,* 7 Vols., Mosse, (Berlin, 1925–28)
Recent Social Trends, Whittlesey House, (New York, 1934)
Recent Economic Changes, 2 Vols. McGraw-Hill, (New York, 1929)
Putnam's Economic Atlas, G. P. Putnam's Sons, (New York, 1925)
Paullin, C. O., *Atlas of the Historical Geography of the United States,* (Washington and New York, 1932)

CHAPTER • X

Maps

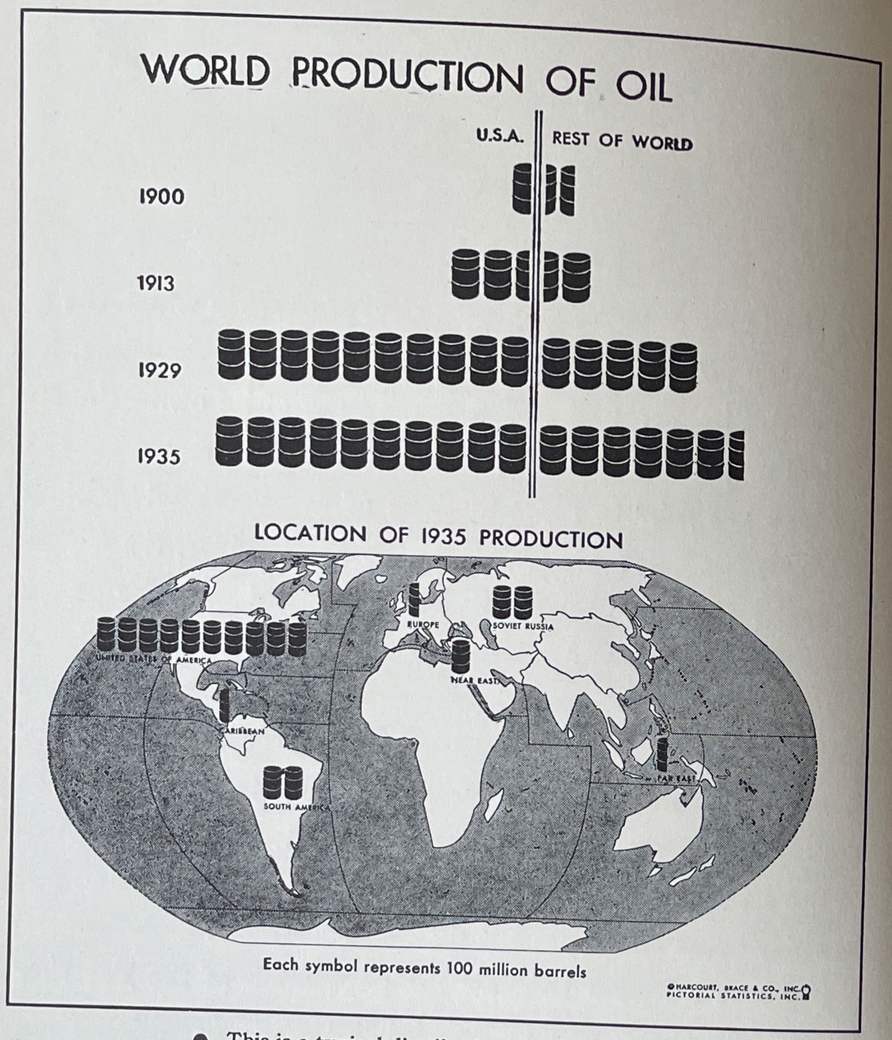
We shall now describe a specific kind of chart in which the explanatory picture becomes an essential part of the chart, fills the entire background and requires rules of its own—the statistical map.

Maps are minute reproductions of areas—visual symbols, oversimplified, devoid of life but generally familiar. What could be easier than to use maps when statistical facts for certain areas must be shown?

In doing so, we shall find some changes necessary, some limitations advisable. Let's go through the process step by step. A word must be said at this point about maps. Maps are backgrounds only. They do not need to show accurately each curve of the coast line and each bend of a river. All they have to do is identify areas and represent their size correctly.

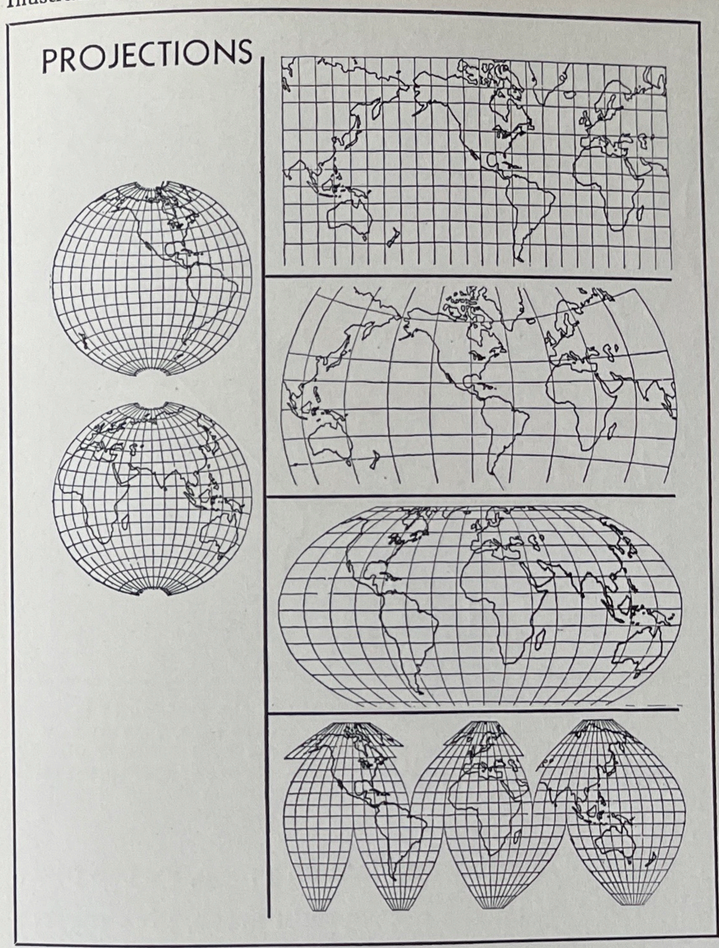
Suppose we want to show the population of the Far East. China has about 450 million inhabitants; Manchoukuo, 30 million; Japan, 95 million. If we used a simple pictograph we could show only half of the story—because China's area is almost 30 times as large as that of Japan, and the density of population

Illustration X/1



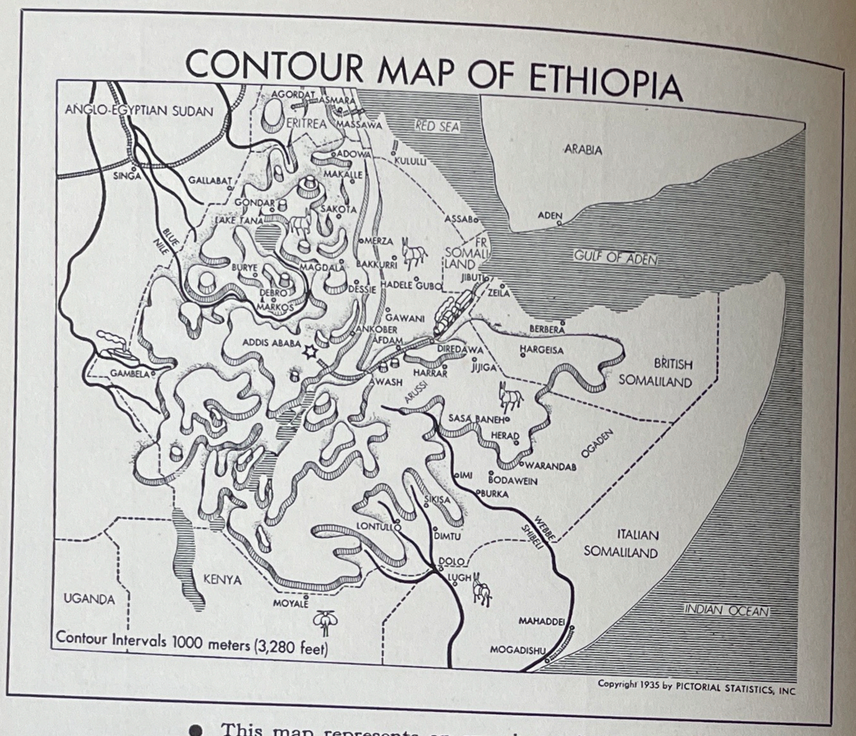
● This is a typical distribution map using pictorial symbols instead of dots or circles. The map is part of an illustration used in Casner and Peattie, *Exploring Geography*, Harcourt, Brace & Co., Inc., New York, 1937.

Illustration X/2



This page indicates several different approaches of map-making. The Mercator projection (top right) distorts the areas close to the poles very badly and should not be used for distribution maps. The hemispheres (left) and Goode's projection (bottom right) don't permit one continuous picture of the whole world and are therefore not advisable. The Van der Grinten projection (second on the right) and Mollweide's projection (third on the right) are both well suited for statistical presentations. It will be obvious from the projections shown on this page that the Mercator projection is the only one in which any one meridian may be chosen as the center line without redrawing the whole map (because all meridians are parallel). In all other projections shown the center meridian is the only straight one; all others are curved. If, therefore, another meridian is chosen for a center line the whole map has to be redrawn.

Illustration X/3

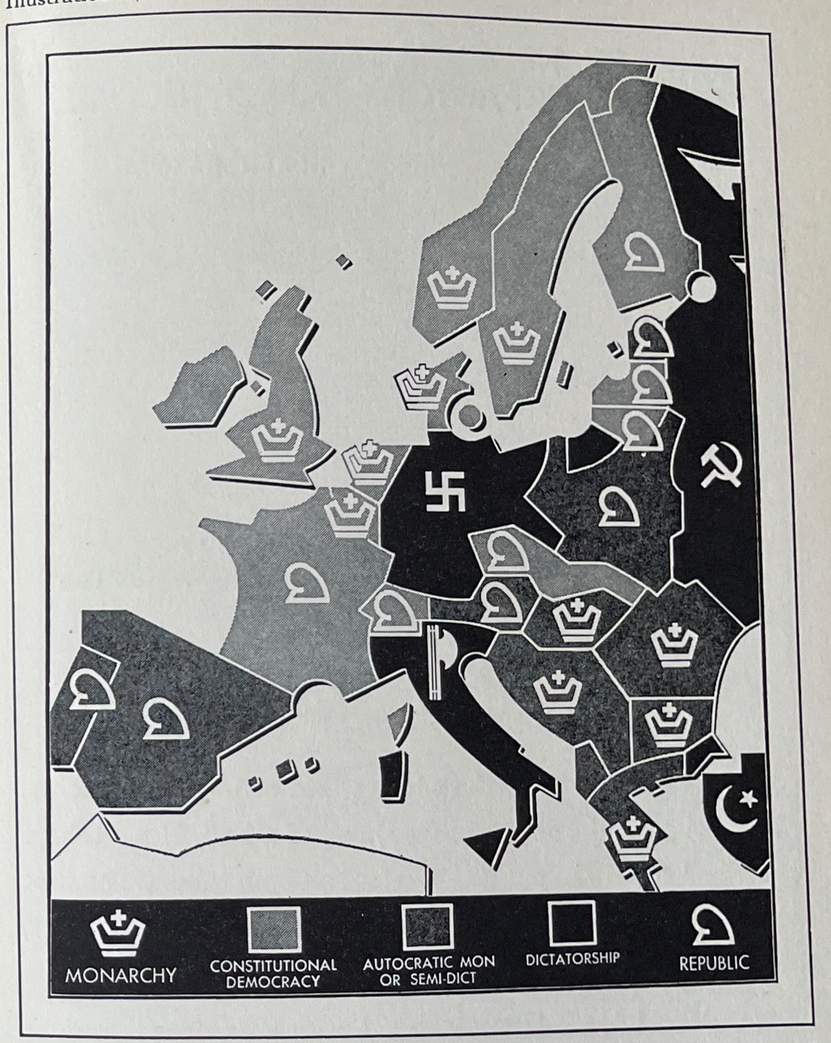


- This map represents an experiment in the showing of different altitudes. Higher areas look higher on the map. This attempt to replace the old-fashioned contour lines by something visually more obvious led to further developments one of which is shown in Illustration XV/2.

is an important factor. Putting our data on a map, we can place the population symbols on the appropriate areas, give correct proportions and, moreover, put our symbols in a location which is geographically correct.

When showing countries or smaller areas it does not make very much difference which projection is used, since the amount of distortion is negligible. But the desire to give the areas in correct size relations forces us to limit ourselves mostly to equal area

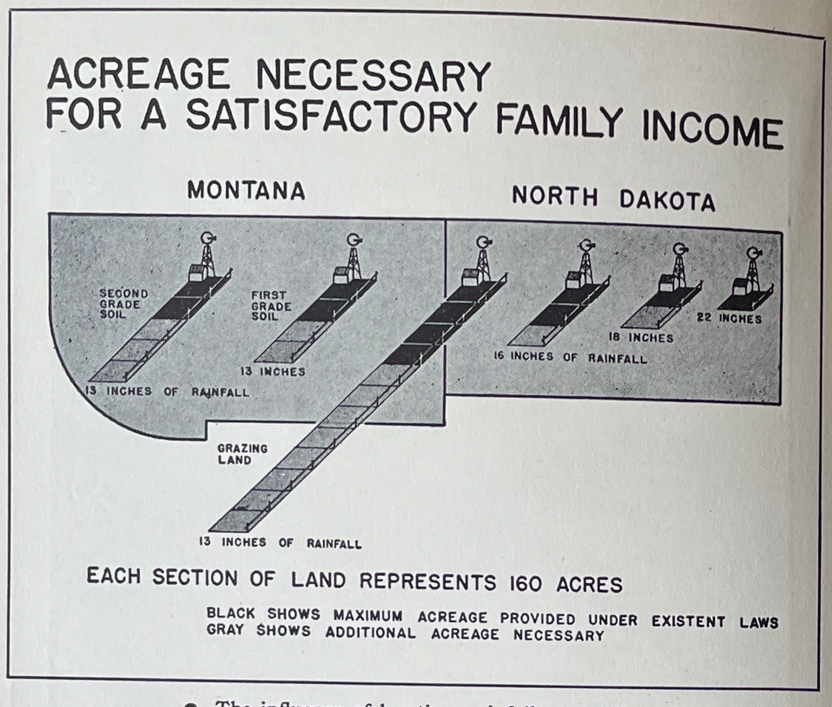
Illustration X/4



- Political symbols may be placed on areas to indicate the form of government. From Foreign Policy Association, *Dictatorship*, New York, 1936.

MAURICE DONNELLY

Illustration X/5



● The influence of location, rainfall, and soil on farm land is indicated on this map. From the report of the *Great Plains Drought Area Committee*, Washington, 1936.

projections when we show the whole world or large continents.

The globe has the approximate shape of a ball. If we take a rubber ball and try to put its covering flat on a table we cannot avoid tearing it in some places. Since our maps have to be flat, they must be put down in a somewhat distorted form. This distortion can be very great. On the globe, the meridians meet at the poles and only the parallels are parallel. The mercator projection makes the meridians parallel also. The poles thus become lines of equal length parallel to the equator. Land lying

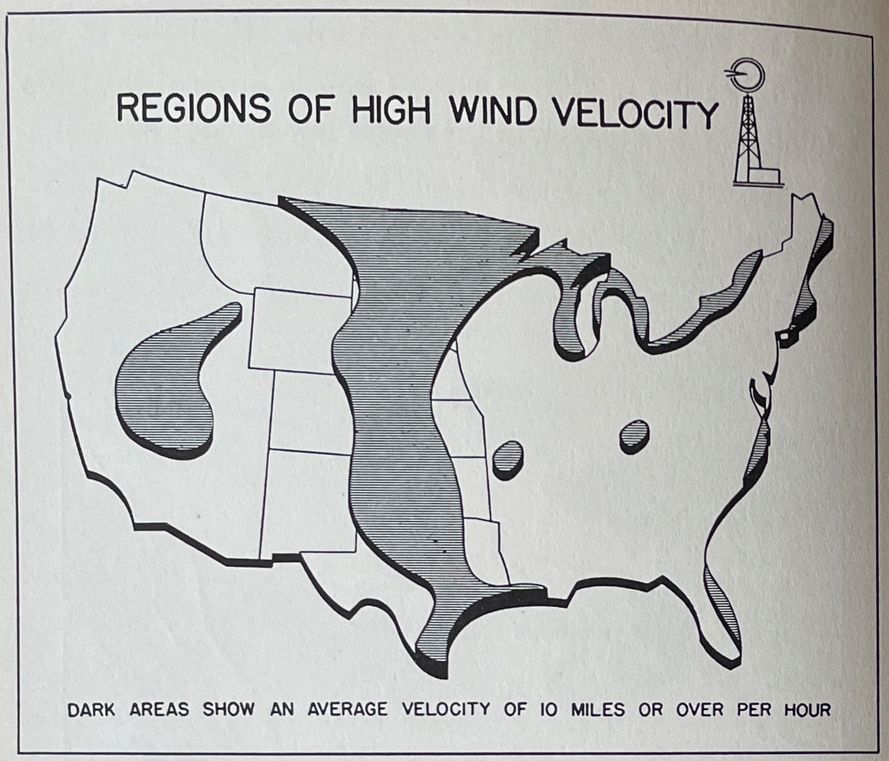
close to the poles is greatly exaggerated in area. This projection is used by navigators. It permits an easy calculation of distances. Since the meridians always remain straight lines any meridian may be selected as the center line without necessitating a redrawing of the map. In all other projections the meridians to the east and west of the one in the center have an in-

Illustration X/6



● After the spring floods in 1936 the *Survey Graphic* used this pictorial map as a cover design. In this as in the preceding illustrations the main effort was directed to stress the essential elements and to omit all the things which are not important to the story.

Illustration X/7*



● A method similar to the one used in the preceding map is applied to bring out the higher wind velocity in the Great Plains Area. From the report of the *Great Plains Drought Area Committee* Washington, 1936.

creasing curvature and choosing a new meridian as the center one makes it unavoidable to redraw the whole map. Nevertheless the distortion towards the poles is so large that mercator maps should not be used to show quantity distributions.

Equal area maps do not distort the area but instead modify the shape of the land by squeezing the surface of the globe to provide one continuous map. The meridian in the center of this map is a straight line connecting the North and South Poles

of the meridian; the farther east or west one goes the greater becomes the curvature and deviation of the actual shape of the area. As these projections give equal areas and one continuous map, we have selected them as the basis for our world and continent maps. The projection used is Mollweide's.

Goode's equal area projection is better inasmuch as it does not distort shapes so badly; it tears the surface where that tear makes least difference. Our reason for not selecting it is our aversion to putting a no-man's-land (no land, no water) between continents.

Distribution Maps

The most common method of showing distribution of quantities over specified areas is to use maps with circles or dots of various sizes. The pictorial distribution map replaces the dots or circles by quantity symbols, subject to the rules laid out in preceding chapters (See Illustration X/1.)

The labeling of the areas should, wherever possible, appear below the first symbol in each area so that it can be easily identified.

Relief Maps

Altitudes are usually indicated by lines connecting points of equal height. These lines do not give the impression of one area really being on a higher level than another one. However, this feeling can be created by giving the appearance of relief to the map. (See page 100.)

Direction Maps

When a flow from one point to another is to be indicated, arrows may be used to show the direction, the number of arrows giving the quantities involved.

Political Maps

Symbols on maps may also be used to show forms of government or political situations. (See page 101.)

Other Maps

Specific problems call for a number of other solutions. Tariff walls can be indicated by graduated walls surrounding countries, each layer of the wall representing a certain percentage of duty. Floods may be shown pictorially. So may many other subjects occurring in certain areas.

CHAPTER • XI

Pictorial Diagrams

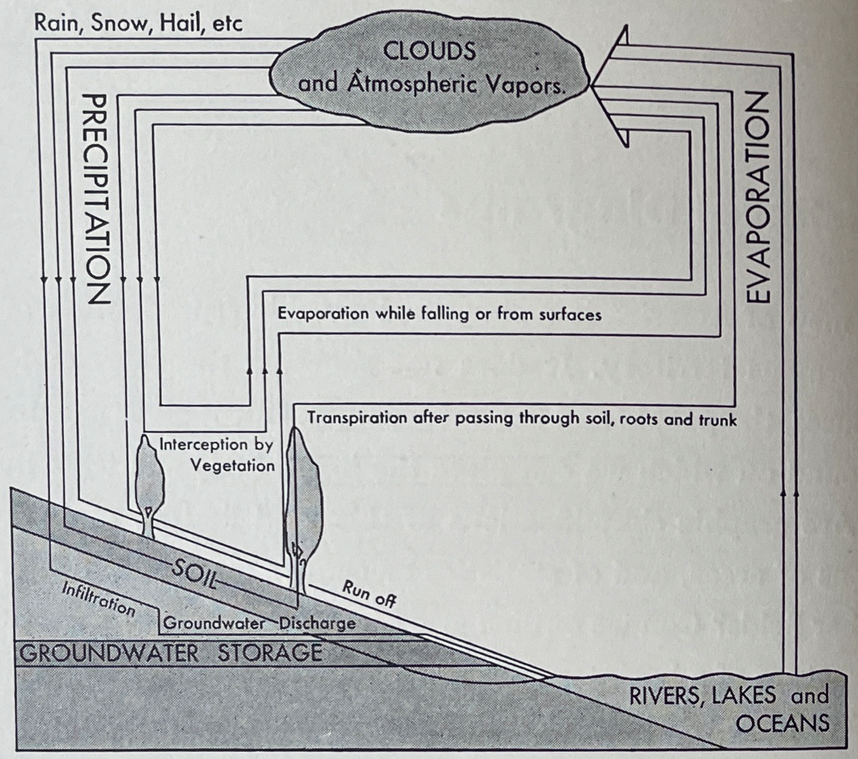
A map of America is a simplified graphic reproduction of an enormous territory. It does not show us the trees and the houses, the people and the automobiles. But it gives us a background on which we can place the individuals and their lives.

Are graphic simplifications of this kind limited to descriptions of areas, and of statistics or can we do similar things in other fields? Can we outline graphically the cycle of water, the structure of a business enterprise, the life of a river valley?

We have tried our skill in some other fields and we are presenting the results of this work. It is a new field and we are still feeling our way. We are encountering people who think that pictorial diagrams are very effective and more valuable than charts. We find others who tell us that the diagrams are nice playthings, but that nobody will stop long enough to read them.

It will take more time before we will know where pictorial diagrams can be used to greatest advantage—in classrooms, books, or meetings. All we can do now is to show what we have done and explain how we achieved these results.

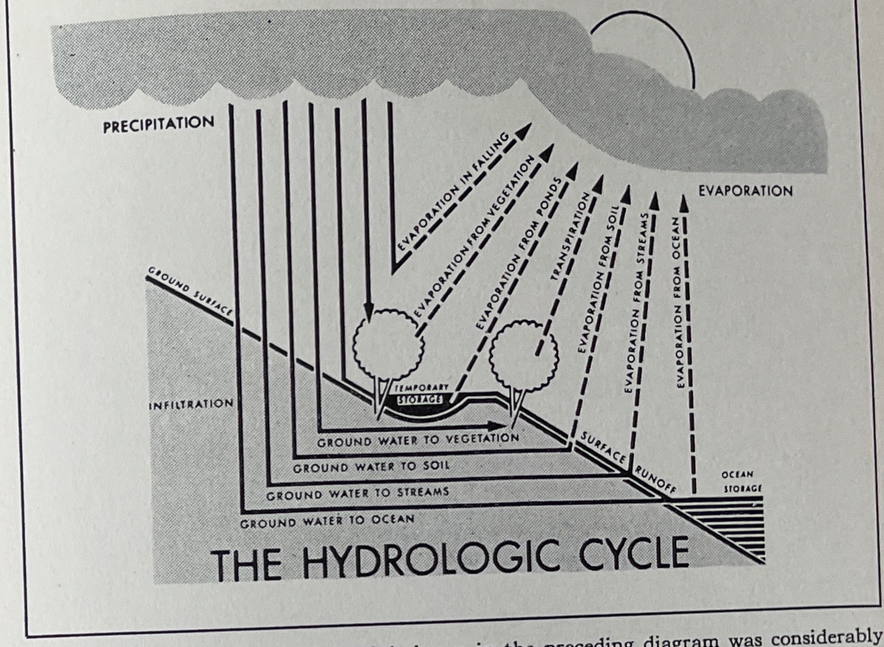
Illustration XI/1



● The sketch for this diagram—the first of its kind—was prepared after considerable study. The finished diagram appeared in the report of the *Mississippi Valley Committee*, Washington, 1934.

The first pictorial diagram we ever did was the one shown on this page. It required three weeks of preliminary reading of scientific books and reports before graphic work could begin. It was published in the *Mississippi Valley Committee Report* and in *Dramatization of Social and Economic Facts*.

Illustration XI/2

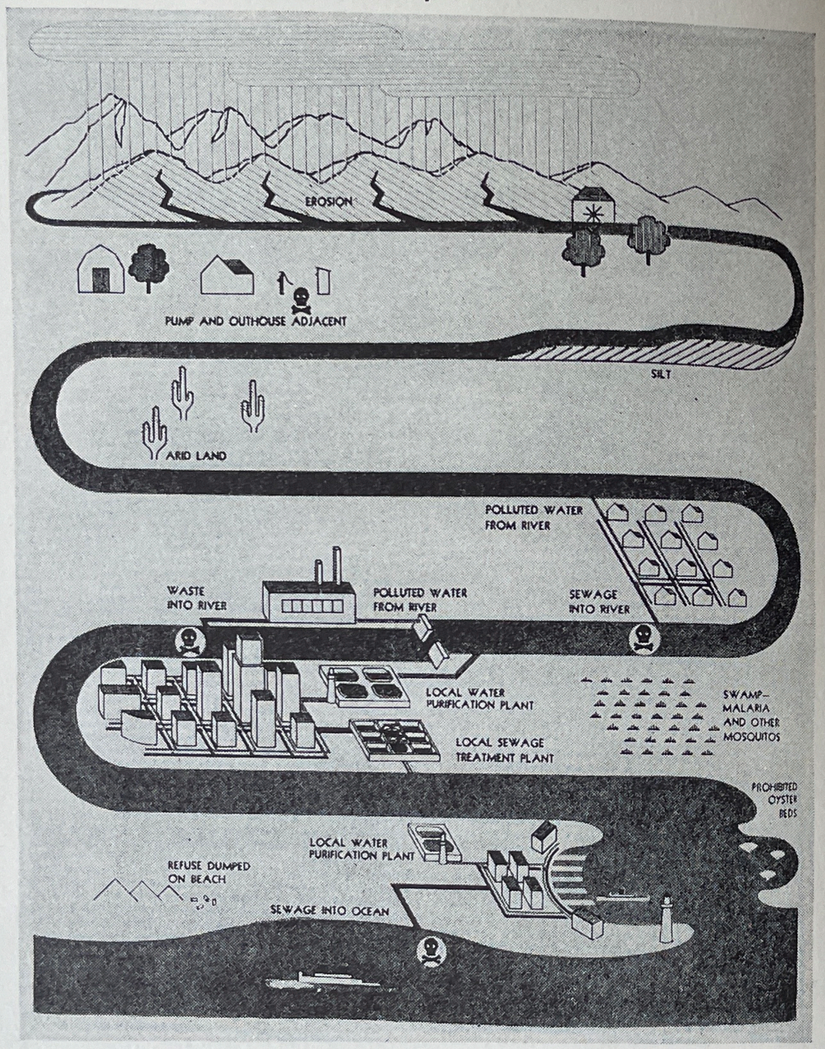


● The material shown in the preceding diagram was considerably simplified for inclosure in H. S. Person, *Little Waters*, Government Printing Office, Washington, 1936.

It has been checked and rechecked and was considered the best simplification of the subject until we conceived the presentation shown in the second chart. This was published in *Little Waters* in 1936 and—at present—we think it is the simplest presentation of that subject which is possible.

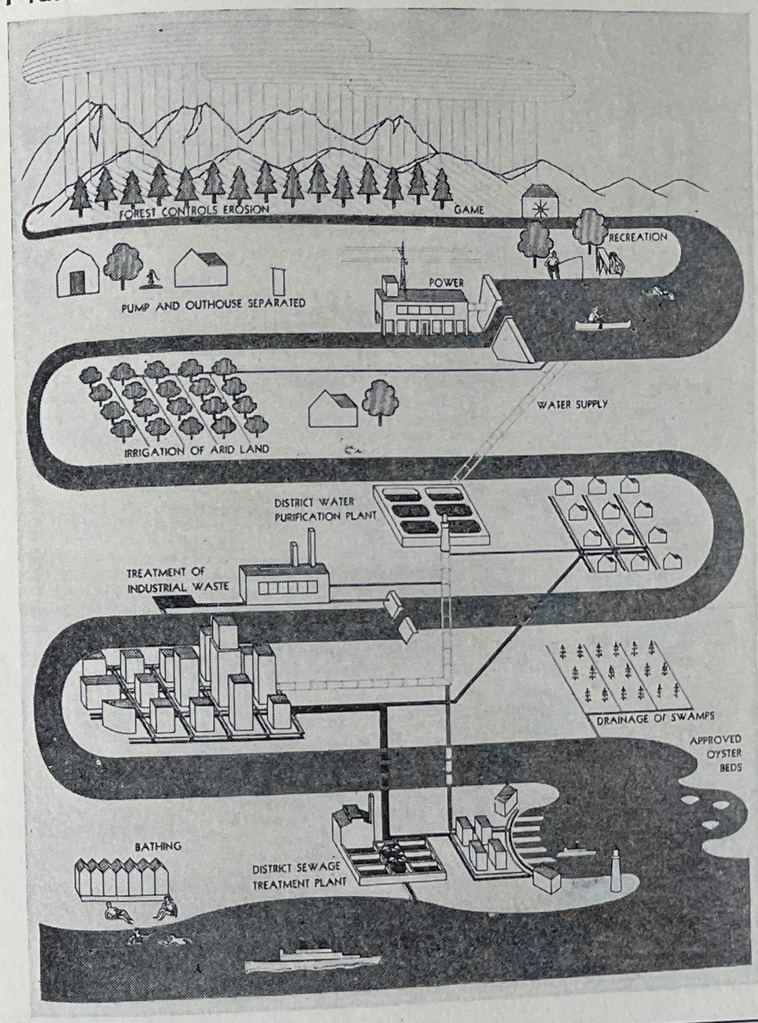
The line of thought was simple. First, a cycle must show continuity. Precipitation must fall vertically; we must clearly show what happens to the water on the ground; we must have evaporation equal to precipitation.

Unplanned River Development



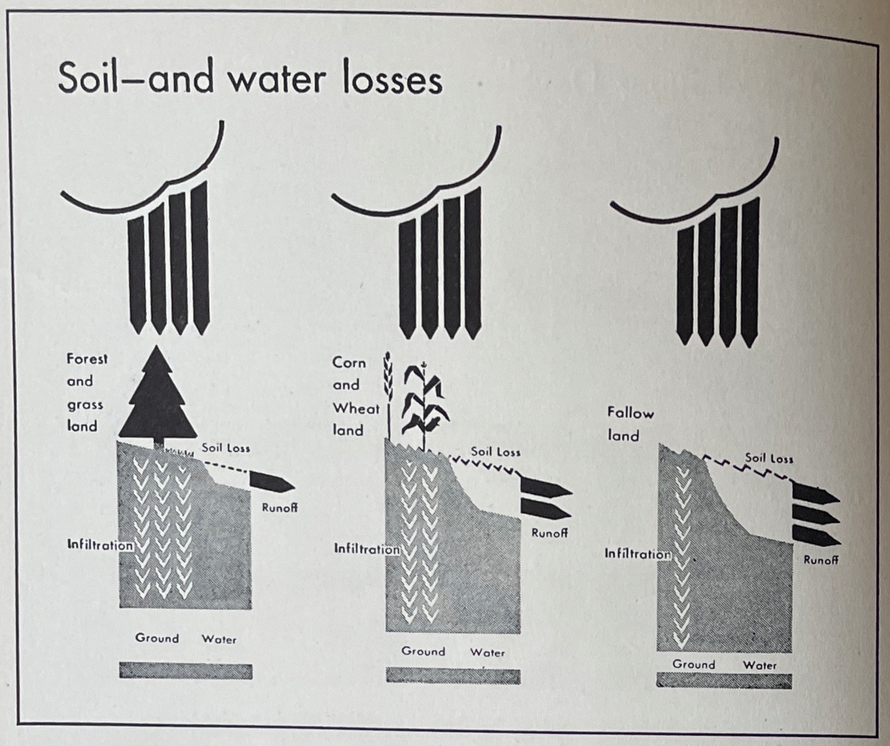
● The unsound aspects of an uncoordinated river valley are listed on this diagram. The eye can follow the course of the river and take in all the aspects listed. From *National Resources Board Report*, Washington, 1934.

Planned River Development



● The counterpart of the preceding chart, indicating the conditions in the same watershed with better coordination. From *National Resources Board Report*, Washington, 1934.

Illustration XI/5



● A pictorial diagram simplifying complicated processes of soil erosion. Prepared for the Soil Conservation Service, Washington, 1935.

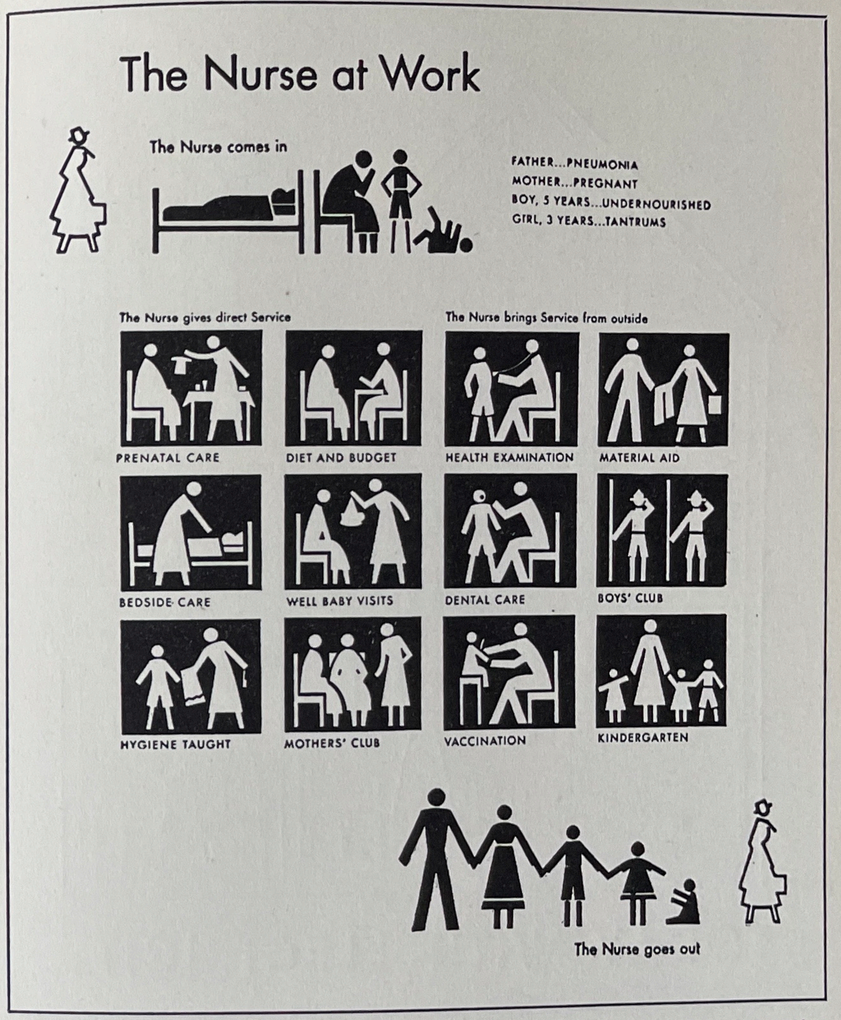
The difficulties in making a clear presentation arise chiefly from the following causes:

1. *Source Material.* The written sources are so divergent, vague, and incomplete that it is hard to get clear cut facts.

2. *Arrangement.* The diagram should look simple but be accurate. That requires considerable planning to eliminate unessential details.

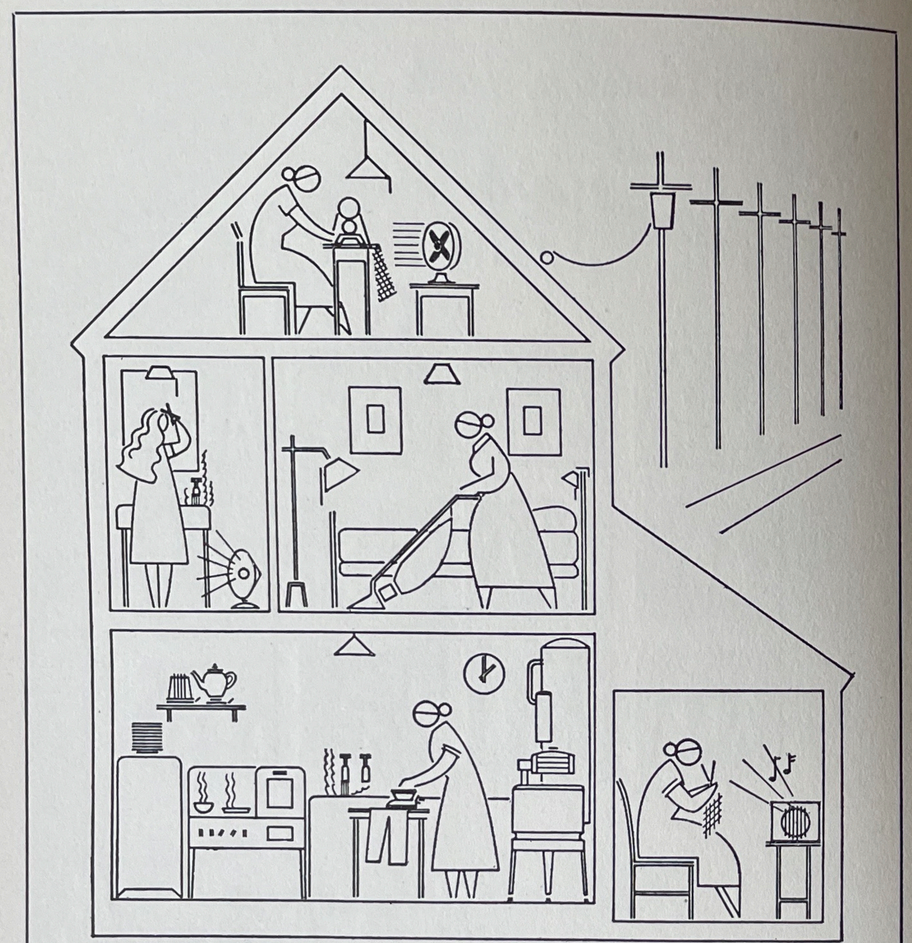
3. *Labeling.* Shortening of labels is one great problem; plac-

Illustration XI/6



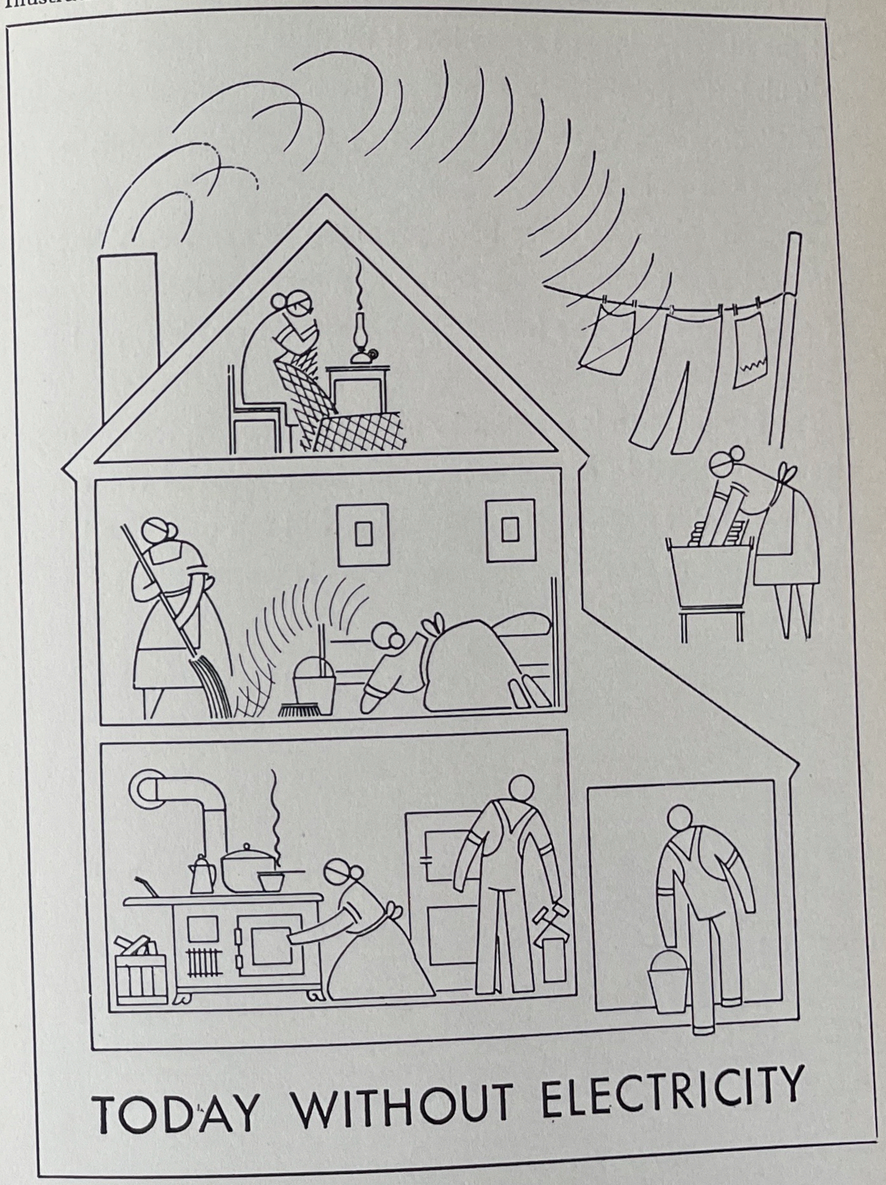
● The listing of functions very frequently does not get any attention from readers. The above way to dramatize the activities of a nurse was used in the 1935 campaign of Henry Street Settlement, New York.

Illustration XI/7



● This and the next chart were used by the Rural Electrification Administration to portray to farmers and their wives the changes which electric wiring may cause within their house.

Illustration XI/8



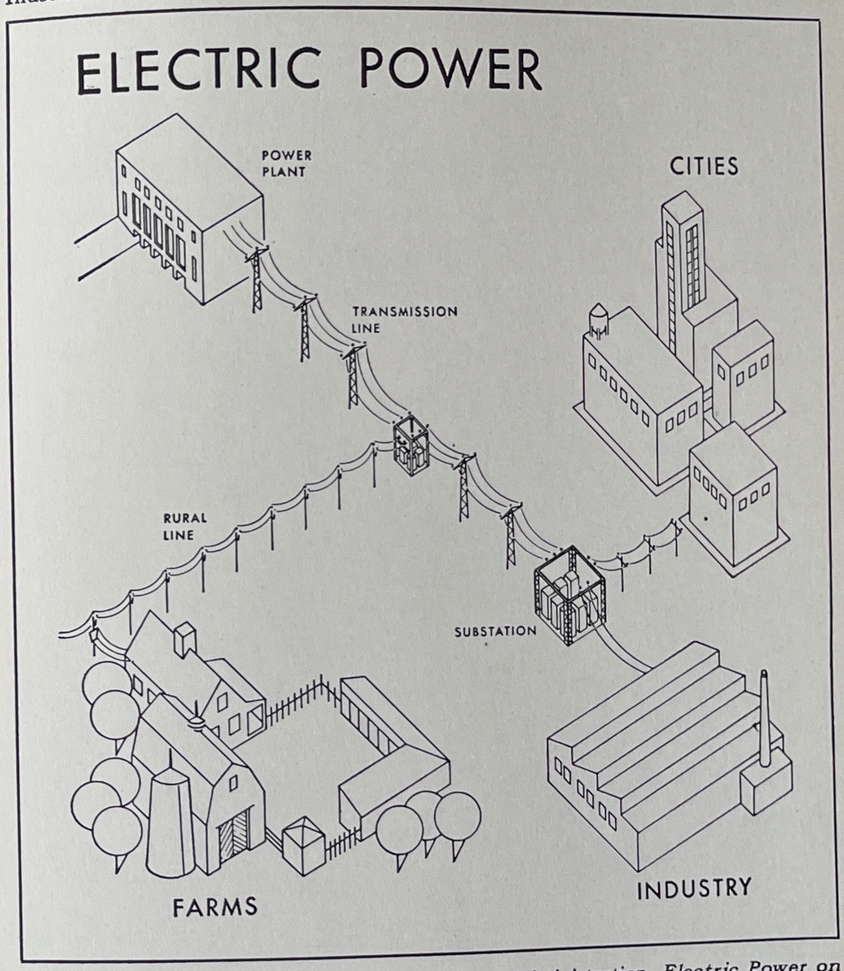
ing them on the diagram another. We feel certain by now that the reader wants to follow a definite line of thought in looking at the diagram—that he gets lost if he does not have it.

This latter point will become clear from the "River Development" diagrams where the course of the river establishes a definite line to be followed.

Pictorial diagrams have been prepared to show subjects as different as the organization set-up of a corporation, the work of a visiting nurse, the influence of crops on erosion, and the activities of a foundation.

The field as such is practically unlimited; so are the difficulties encountered in each specific case. Only tests of the effectiveness of this method of presentation will tell us if the labor and the cost of preparing such diagrams is warranted.

Illustration XI/9



● From Rural Electrification Administration, *Electric Power on the Farm*, Washington, 1936.

CHAPTER • XII

Production and Reproduction

So far we have discussed what may be called the *production* of the chart; the various processes of selection and planning executed. Let us review these steps briefly before going on to discuss the most practical methods of *reproduction*.

Statistical Layout (see Illustration I/3)

Preparation of a statistical layout is based on

(1) the statistical material and its proper arrangement (see Chapter IX)
(2) the rules governing the number of rows per chart and symbols per row (see Chapters III and V)
(3) the rules governing the size and arrangement of the chart (see Chapter III)
(4) the rules for appropriate symbols (see Chapter IV)
(5) the rules governing title and lettering (see Chapter VII)

Graphic Layout (see Illustration I/4)

The statistical layout is discussed with the artist. The artist

may indicate that the given layout will not make a well-balanced sheet. He may ask for a longer or shorter title, for more or fewer symbols. Anything which can be done to insure a good graphic presentation should be done as long as the accuracy and clarity of the chart does not suffer.

Next, the artist makes a rough layout of the chart on a piece of tracing paper. This gives him a chance to balance type and pictures. It also provides an opportunity for criticism and changes before any final work is begun.

Blue prints, red line prints, or photostats of the graphic layout are made and submitted to the client, or other interested people, for suggestions, corrections and approval.

Symbols

As soon as the layouts are approved the symbols can be worked out in their final form. The usual routine is to draw one symbol in a large size and have it reproduced mechanically in a size which fits the original. Only rarely will all symbols on a chart be drawn by hand. The reproduction of the symbols may be made by photostat, letterpress or photo-offset.

Photostats are advisable only when few symbols are needed; they are expensive, and sometimes distorted. Photostats are made in black and white.

Letterpress reproduction is the clearest and best method but expensive since a cut has to be made and symbols printed from this cut. Proofs can be made in color at a somewhat higher cost than proofs in black and white.

Photo-offset is cheap, somewhat slower than letterpress, and not likely to be so black and clear. Proofs can be made in colors other than black only at considerably higher cost.

Final Layout

After the symbol has been finished and sent out for reproduction, the final layout is made on a drawing board. It usually is several times larger than the tracing paper layout, and indicates the placing of the symbols, and lettering.

Lettering

The lettering is indicated on the statistical and the graphic layout; the exact type sizes are calculated from the latter or from the final layout. The type most generally used is Futura medium. When calculated, the type is ordered from a printer.

Paste-up

When type and symbols are received from the printer they are cut out and laid on the final layout so that last-minute changes can be made. Rubber cement is used for the paste-up.

Explanatory Pictures

Explanatory pictures are put on the chart directly or made first in larger size and pasted on the final layout in reduced size.

Checking

The final chart is checked from the original sources to discover

any mistakes which may have occurred in the process of production.

Screens and Ben Day Indications

If a chart or map is to contain shading, various methods can be used. (See Chapter VI.)

(a) *Hand work*. Hand work is time-taking, inaccurate, dangerous because of possible smearing.

(b) *Stack screens*. It should be noted that screens become denser in reduction, coarser in enlargement. Screens of various density can be bought and applied to the chart. Some can be used to whiten black areas, others to darken white areas. Various screens are on the market. Some stick to the chart when pressure is applied, some have to be pasted on.

(c) *Ben Day*. If the chart is to be printed, it is sufficient to indicate, either in blue on the original or on a tracing paper flap clipped to it, which areas should be shaded. The shading will be applied by the engraver when the plate is made. There are many kinds of Ben Day screens. Their intensity is measured by percentage of blackness, their fineness by screen numbers. A 55 line screen is a very coarse one (newspapers), 130 a very fine one (magazines).

Directions for the Printer

If the original is made in larger size, the size to which it is to be

reduced should be marked. Color indications should also be made on the chart. It is also advisable to mark how many, and when, prints should be delivered. Originals should be protected by a tracing paper flap.

Planning Around the Chart

Attention should be given to fitting the chart into the surrounding in which it finally will be displayed.

It will be advisable to have wall charts placed in simple frames which harmonize with the color of the wall or background on which they are shown.

A chart printed in the pages of a book may appear on the same page with other illustrations or with text. The layout of such pages should bring out each component effectively and with the proper emphasis. Charts should not be enlarged so much as to become gross, or reduced so much as to become illegible.

The circumstances which will surround the chart are so varied that it is practically impossible to give specific advice. All that can be done is to stress the fact that the job is not finished when a chart is finished—a new job begins, that of rearranging the area around the chart into a unified design.

A Hope for the Future: Symbol Type

To anyone who works continuously with recurrent symbols, there naturally occurs the idea of cutting in type the most frequently used symbols, and of setting up charts just as type is

set. Unfortunately the number of symbols is still too large and the demand for charts too small to permit this process. We have all confidence, however, that the near future will permit us to expand experiments which we have done in this field.

The closest approach to type is the use of dies in the making of charts by the Museum of Science and Industry in Chicago. The embossing process used is the one applied in the making of display cards for stores.

CHAPTER • XIII

History of the Method

In earlier chapters we have described the development of pictorial writing from primitive event-pictures to abstract symbol writing. Here we want to give a short account of the return to statistical pictorial symbols—when it happened and where.

Instances of pictorial symbols with statistical significance have occurred occasionally in the past. In the Seventeenth Century we find pictures of old battles; a city in the background, formations in the foreground, a primitive pictograph.

Even more strikingly similar are some old American writings one of which is reproduced here.

But it is only in this century that we can discover proof of a conscious return to pictorial symbols in fact presentation.

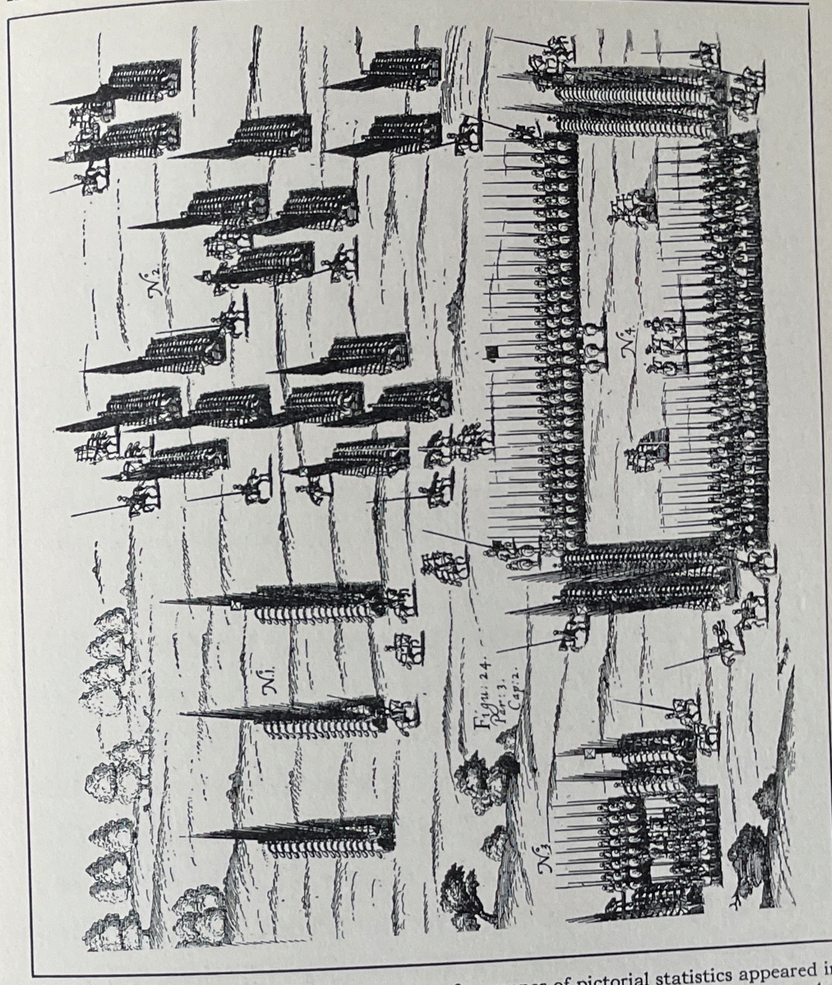
The first modern pictograph which I have been able to discover, appeared in W. C. Brinton's book on *Graphic Methods for Presenting Facts,* published in 1914 by the Engineering Magazine Co. On page 39 is a chart showing the number of passengers carried on the railroads of the United States in 1899 and 1911. This chart uses most of the principles laid out in this book. Today, we would not consider the symbol to be very

well designed; but it clearly represents a traveler. The increase in the number of passengers is represented by a larger number of symbols, the qualifications are at the left.

Mr. Brinton is clearly aware of the advantages of the method. He says: "It was not a larger passenger but more passengers, that the railroads carried. The ratio expressing increase in business can be clearly and accurately seen from this method of portraying the facts." It is interesting to note that from this first sample to the time of the reintroduction of pictorial statistics from Europe around 1930, I have not uncovered a single other example. It is also interesting to note that in spite of the similarity of this American sample to our presentations of today, it was not known in Europe and consequently the European pictograph had to go through numerous stages of development before it arrived at a stage comparable to the chart shown in Brinton's book.

The development of the pictograph in Europe can be traced back to the Siedler- and Kleingaertnerverband in Vienna in the early 1920's. Under Otto Neurath, diagrams and graphs were developed which reached the eye of the public first at a housing exhibit in front of Vienna's City Hall and later in a permanent "Settler's Museum" with a small "General Department" in the back of an old building of Vienna's famous Ringstrasse. There were exhibited building materials, models, furnished rooms, and—some pictorial charts, showing the building activity of the City of Vienna. In 1925, generously supported by Vienna's Liberal Finance Minister Breitner, Neurath founded

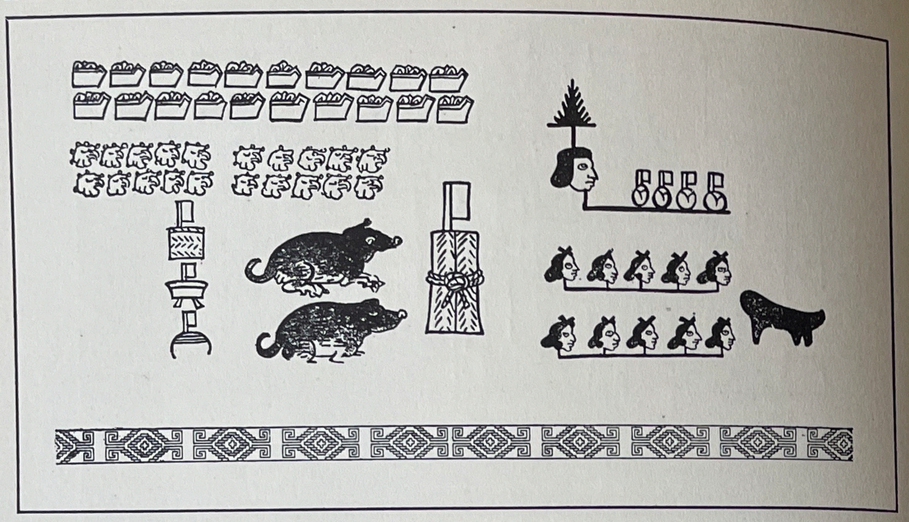
Illustration XIII/1



● This early European forerunner of pictorial statistics appeared in 1616 in Frankfurt-am-Main, Germany in Wallhausen, *Art Militaire à Cheval.*

the Gesellschafts- and Wirtschaftsmuseum, well known to many Americans who visited Vienna between 1927 and 1934. Arntz, by far the best artist in the field, joined the Museum

Illustration XIII/2

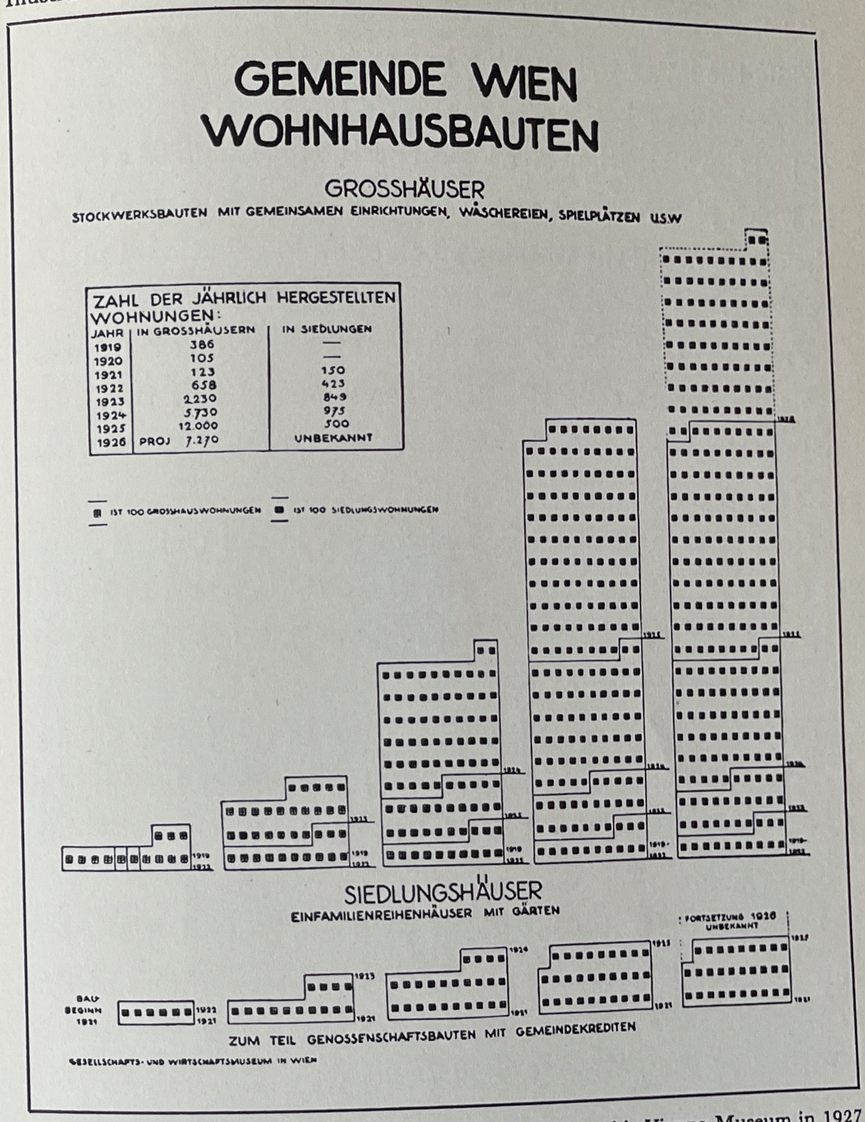


● Four hundred years ago the Indians made this list of a requisition for supplies by the Spanish conquerors. From Codex, vol. 13, fig. 2, *Codices Valle de Oaxaca*. Courtesy Museum of Natural History, New York.

before 1929. Bauermeister and Reidemeister handled the bulk of statistical work. The author of this book has also worked there since 1923 joining the permanent staff in 1928.

The importance of the Museum reached far beyond the borders of Vienna and Austria. The Social Museum in the City Hall of Vienna was opened in December, 1927. It served as a classroom in the social sciences for hundreds of foreign visitors to Vienna and thousands of Viennese. Exhibitions all over Europe placed orders in Vienna. A branch museum opened in Berlin. In 1930 appeared *Gesellschaft und Wirtschaft*, still the standard work in the graphic method of fact presentation. Soviet Russia adopted the method; it spread to America, Holland, and England.

Illustration XIII/3



● This chart was made by Dr. Neurath's Vienna Museum in 1927 (?). It is particularly interesting because it shows how crude the method was not more than 10 years ago. From *Bildstatistik*, Leipzig. (1928?)

What is the difference between Neurath's work and the chart which we mentioned before as appearing in Brinton's book? While the latter was nothing but an accidental occurrence in the search for a better way to present facts, Dr. Neurath tried to build up his method on a logical basis. He visualized a system in which picture words would be combined into a symbol dictionary, forming the working stock of an international picture language.

From the beginning it was Neurath's aim to establish contacts with other countries. The Mundaneum and the International Foundation for Visual Education, both with their seat at The Hague, Holland, serve this purpose.

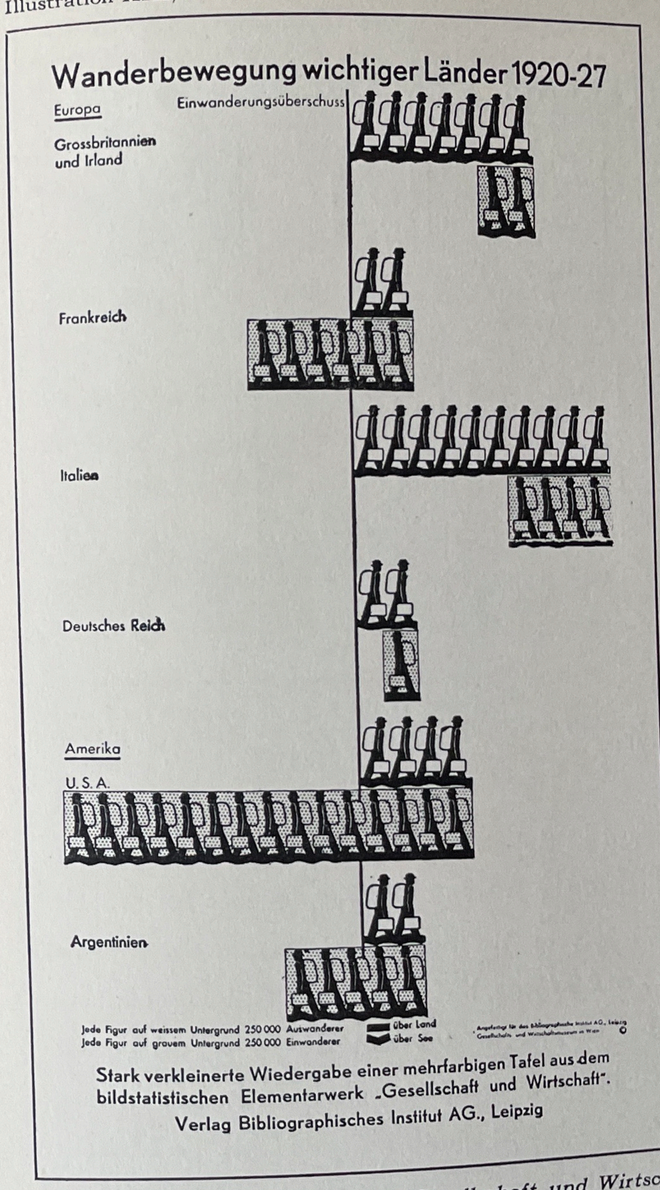
None of the organizations which work in the United States at the present have adopted Dr. Neurath's system to its full extent. Most of them feel that his approach is too rigid to permit general adoption of the method.

Dr. Neurath left the Vienna Museum in the tragic days of February, 1934. The old "Museum" has changed its name to "Austrian Institute for Pictorial Statistics," and continues without him.

In Russia the method is widely used and abused. Some former Vienna staff members are there. The best samples of this work which have come to my attention are "Economic Reconstruction of the Soviet Union" (done with Neurath as consultant; in English), and "China and Japan" (done without Neurath's help; in Russian).

In the United States, some charts and an article of Dr.

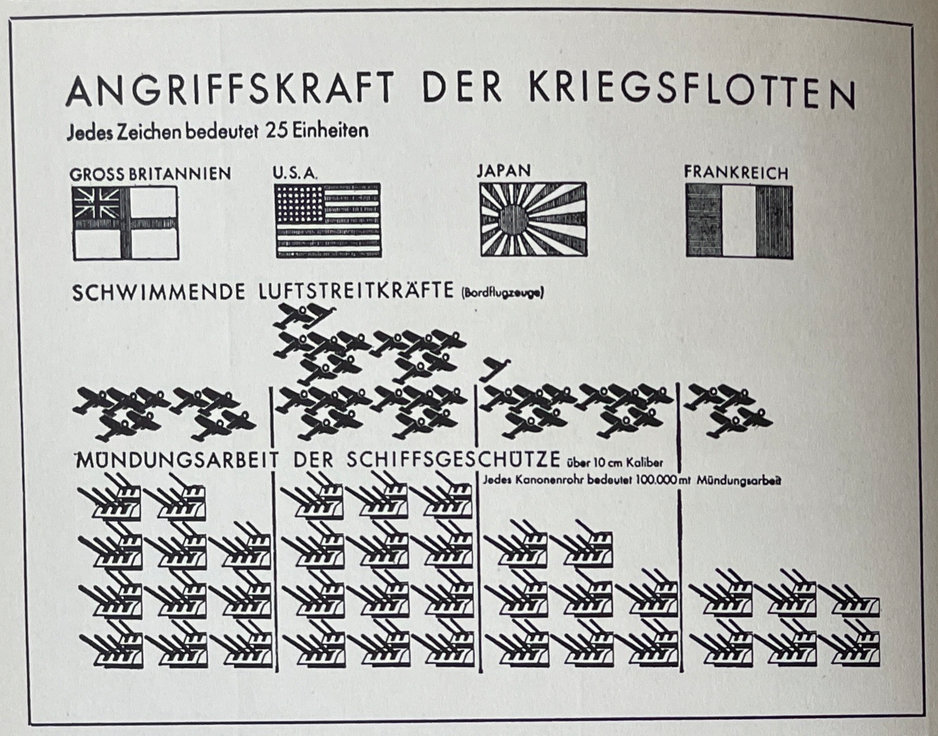
Illustration XIII/4



Stark verkleinerte Wiedergabe einer mehrfarbigen Tafel aus dem bildstatistischen Elementarwerk „Gesellschaft und Wirtschaft". Verlag Bibliographisches Institut AG., Leipzig

● A chart from *Gesellschaft und Wirtschaft*, Neurath's best piece of work, published by the Bibliographisches Institut, Leipzig, in 1930. The chart shows emigration and immigration by land and water.

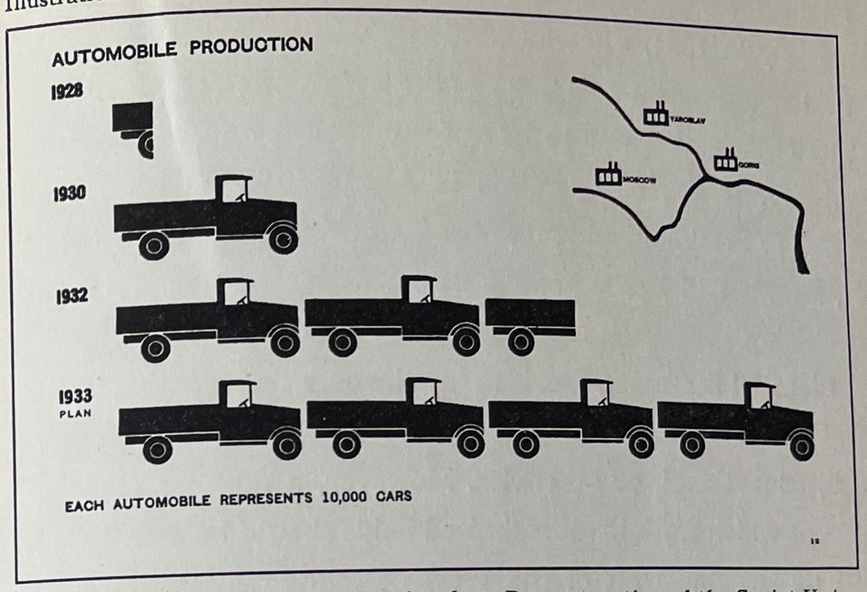
Illustration XIII/5



● This sample of the work of the Austrian Institute for Pictorial Statistics on the equipment of various navies is a good indication of the work done in Vienna since Dr. Neurath left.

Neurath's appeared in the *Survey Graphic* in March, 1932. Ann Reed Brenner of the *Survey* was responsible for creating much of the early interest in the method. Waldemar Kaempffert, now of the *New York Times*, but then of the Chicago Museum of Science and Industry, visited Vienna in 1929 and became greatly interested in introducing this method in his Chicago Museum. As a result, I joined the staff of the Chicago Museum in 1930, and worked for about two years on plans for social and economic exhibits, some of which were ordered from Vienna.

Illustration XIII/6



● This chart is taken from *Reconstruction of the Soviet Union Under the Five Year Plan*, Moscow, 1933.

At about the same time the Metropolitan Life Insurance Company published a booklet, *Seeing is Believing*, influenced by Neurath's work.

Neurath himself came to the United States in January, 1933, with the help of Miss Mary van Kleeck of the Russell Sage Foundation and established numerous contacts. An article by Waldemar Kaempffert in the *New York Times Magazine* of January 22, 1933, and by Neurath in the *Survey Graphic* of September, 1933, received considerable attention. To investigate the possibilities of introducing pictorial statistics in the United States an organizing committee of the Institute for Visual Education was formed with Harry W. Laidler as chair-

man and myself as Field Secretary.

Early in 1934, Pictorial Statistics was incorporated under the leadership of Evans Clark of the Twentieth Century Fund. The organization was to be self-supporting, and received no subsidy. It started operation in August, 1934, with Evans Clark as President, and myself as Executive Director. Edward F. Brown and Franz Hess were its active friends from the beginning.

Pictorial Statistics, Inc. is today the only organization in the United States which does pictorial work in all fields—commercial, educational, or otherwise. However, a number of other groups which work in more limited fields should be mentioned.

The Graphic Unit of the Works Progress Administration (formerly FERA) published *Need for Economic Security* under the direction of M. Shaffer, *On Relief* and *Youth on Relief* under the direction of Calvin Banwell and later Burns Price and myself as consultant.

Sociographics in Philadelphia and the State Department of Labor in Harrisburg, Pa., have published pictorial charts under the direction of Philip Ragan. The art work of these charts is very good, the statistical transformation, however, is not always clear.

Several Relief and Works Projects have also produced charts. One group worked at Columbia University but was disbanded in 1934. I directed another unit for over a year but resigned from it early in 1936. Still another project worked at the University of Chicago for a while. None of these project

Illustration XIII/7



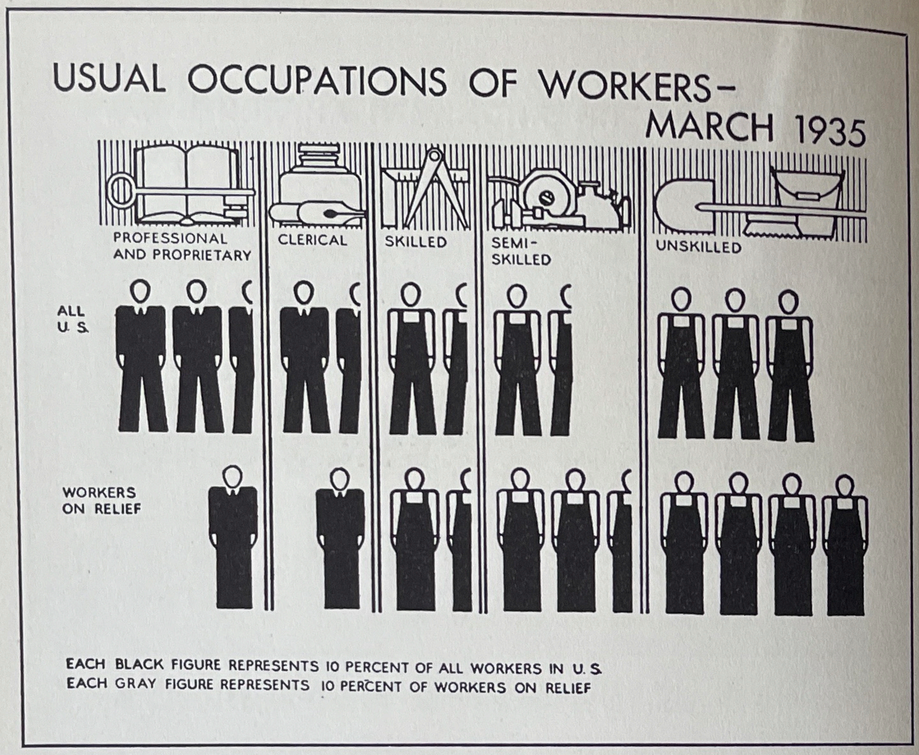
● This chart on Japanese and English textile imports to China appeared in *Japan and China* (in Russian), Leningrad, 1932.

groups produced work which I consider outstanding.

The National Education Association uses pictorial statistics frequently as does the U. S. Department of Labor, the American Federation of Labor and the National Forum in Chicago.

In *Rich Man, Poor Man* (Harper & Brothers, 1935) and in the *Headline Books* of the Foreign Policy Association, graphic charts were used but the symbols often failed to represent the things they supposedly visualized; some charts have no symbol explanation. The detailed criticism of one chart in *Rich Man, Poor Man* (see Illustrations V/2 and V/3) applies to many charts in these books.

Illustration XIII/8



● A pictograph from *On Relief*, published by the Federal Emergency Relief Administration in Washington in 1935. Another chart made by the same group appears in Illustration III/10.

An attempt is being made to establish cooperation between all the groups which produce pictorial statistics in this country and abroad, so that they can make use of the best methods and symbols. Monopolistic tendencies of any one group are not only hopeless but hurt the cause of graphic presentation since they lead to inferior replacements and necessitate modifications of the highest standards. It is regrettable that Dr. Neurath has not found it possible to cooperate with any group which does

Illustration XIII/9



● The opening scene of "The G Man on the Milk Trail," an experimental dramatization of a research study on milk. Produced for the Milk Research Council, Inc., New York, by Pictorial Statistics, Inc. and Karl Koehler.

not agree with the rigid standardization of symbols he demands.

A new departure for pictorial statistics is indicated by experiments in fact-films. Although some animated statistical films have been made in the late 1920's in Vienna, it was only in 1936 that the first experiments with a consecutive story were made by Pictorial Statistics, Inc. The results of this experiment promise a wide field of new possibilities for factual information in educational and other films.

CHAPTER • XIV

Other Graphic Methods

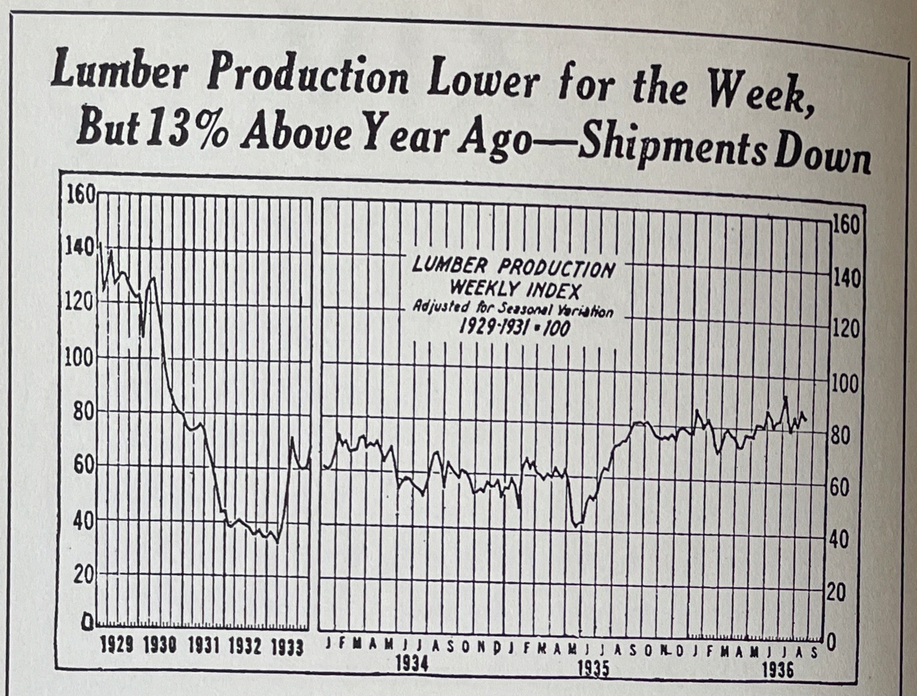
In Chapter II we outlined the advantages and limitations of pictorial statistics. Let us now apply our measuring stick to the various methods of simple graphic presentation and point out where our method is superior and the reasons why.

The line graph is frequently used to show the movement of quantities over long periods.

If fairly accurate data for a considerable number of points are necessary, the line graph is superior to the pictograph; but on further thought it will often be found that many of these points do not have to be shown and that the material could have easily been transformed into pictographs (see Chapter III).

Both line graphs and bar charts are visually correct forms of graphic presentation; they show changes of quantity by proportionate changes of the length of the bar or of the height of the curve. Although not broken into units, and therefore not easy to count they permit our eye to judge increase or decrease easily. Their great disadvantage in comparison with the pictograph comes from the lack of a pictorial correlation with the

Illustration XIV/1

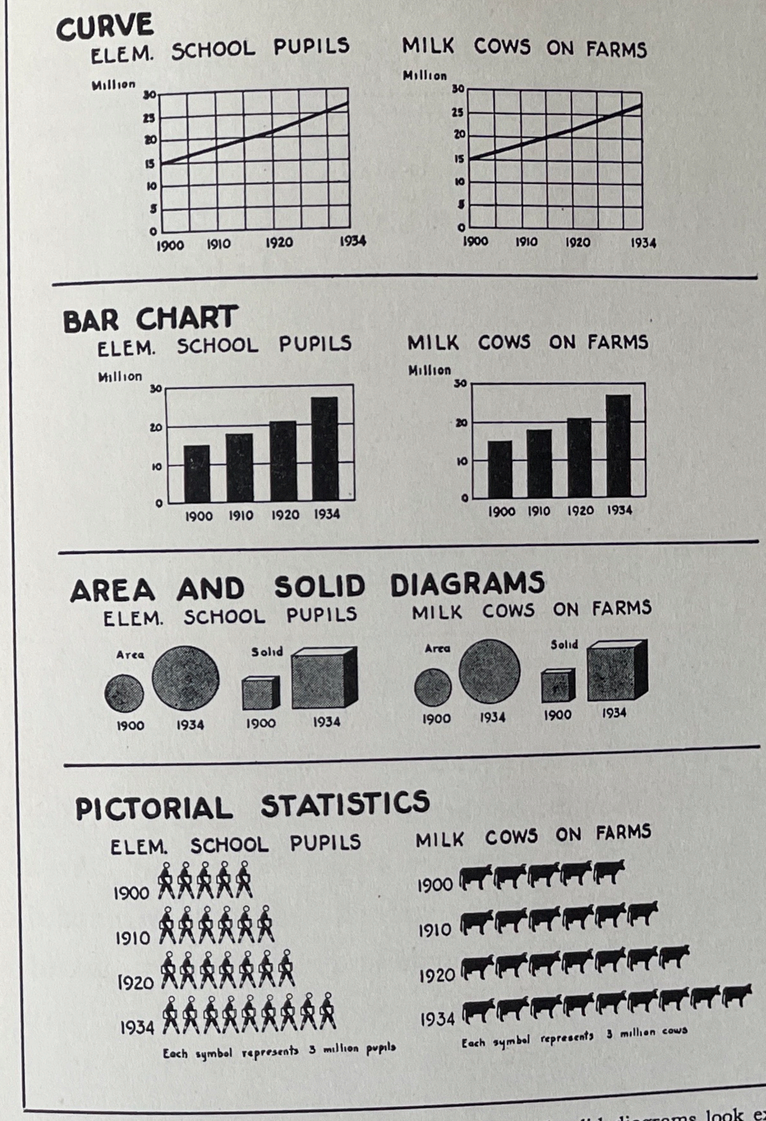


● Where numerous points of measurement have to be shown the statistical curve is most satisfactory.

subject of the graph. This leads to a sameness of the graphs whenever there are similar quantities or quantity relations. One example of this is shown on the opposite page. The resulting difficulty is, that after viewing a number of graphs a person is naturally confused in trying to remember which curve applies to which data, a confusion which cannot occur where pictorial symbols are used. Wherever large quantities of statistical data have to be presented this confusion becomes a serious threat to the effectiveness of statistical displays.

While bar charts and line graphs definitely help the eye, the

Illustration XIV/2



● Curves, bar charts, area, and solid diagrams look exactly alike when equal quantities are shown, however much the subject itself may vary. Only through pictorial statistics can the subject itself be clearly expressed within the graphic part of the presentation.

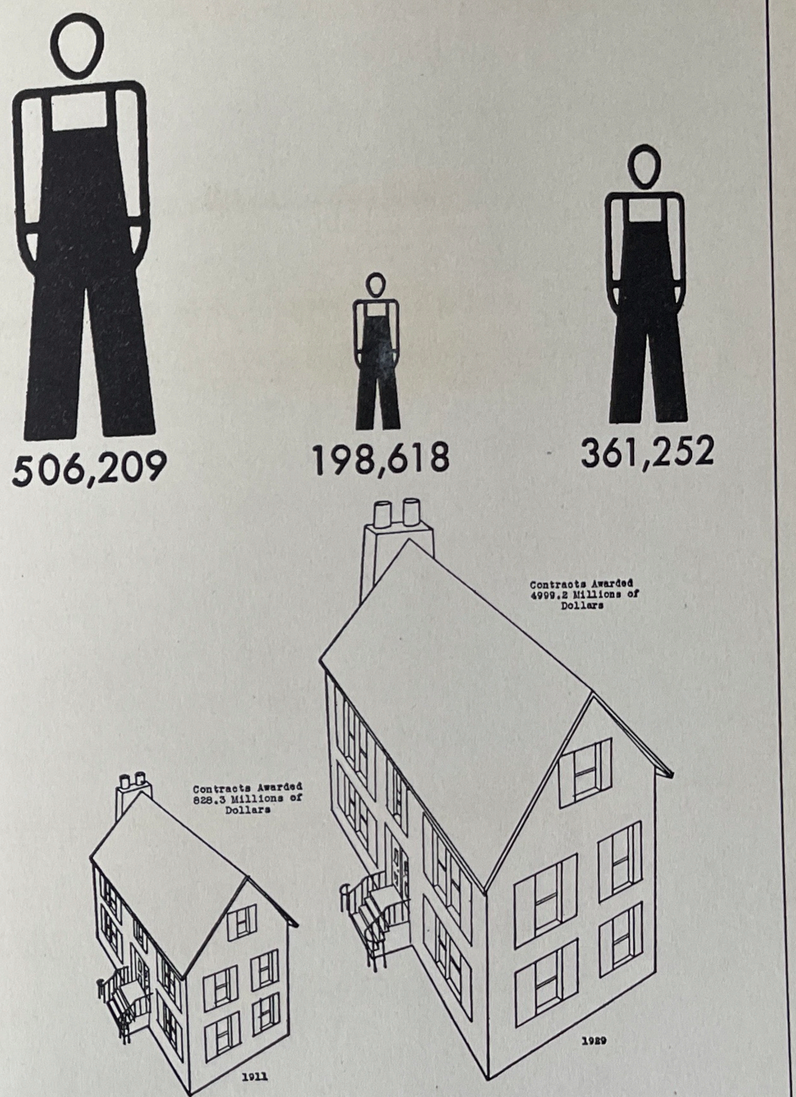
same is not true of area diagrams. Area diagrams change in different dimensions, and the eye is unable to judge the extent of the change. The same argument, only somewhat stronger, holds true in respect to the use of larger vs. smaller pictures to represent a simple case. The population of the United States is about twice as large as the population of Germany. The American, usually dressed as Uncle Sam, would therefore be larger than the German. But how much larger? If he is twice as tall he would cover much more than twice the area. If he would be correct as to area covered (the figuring of which would mean a major mathematical operation), people would still wonder if the ratios selected are height or area or volume.

Summarizing we can say: Of the simple statistical graphs only the statistical curve, the bar chart, and the pictograph should be used.

For scientific accuracy, in presenting a large number of figures to a trained audience, statistical curves and bar charts are more instructive and cheaper.

Where simple fact-relations should be impressed on the mind of an untrained audience, pictorial statistics are advisable. Area (two-dimensional) and solid (three-dimensional) diagrams and pictures should not be used for correct visual presentation of facts.

Illustration XIV/3



Source: F. W. Dodge Corporation

It is difficult to make an accurate visual comparison with solid diagrams. Frequently the height is used as the ratio of comparison, sometimes the area, sometimes the volume. From Arkin and Colton, *Graphs*, Harper & Brothers, 1936.

CHAPTER • XV

Pictorial Statistics in School

Pictorial statistics are primarily a medium for mass education. As such they are useful in a great number of fields, in fact, wherever factual information has to be transmitted to laymen.

The foregoing chapters have shown that the making of pictographs has become a specialized craft; it needs highly trained people who know where to find the available statistical material and can present it simply and clearly; it needs specialized artists who can visualize objects in their abstract form and create standard symbols; it needs a first-rate typographer for layout of legend and page. It needs, in short, a well-coordinated group of people.

If we believe that the making of pictographs needs a highly specialized and trained group, why, then, has this book been written? It has been written for several reasons.

First of all, it tries to give a better understanding of the method to all who have seen it, liked it, and plan to use it in presenting facts in which they are interested. They will be able to visualize better what can be done; they will be able to check up if work done for them can stand criticism.

Moreover, it formulates the basic principles of the method for those who want to devote themselves to this field. It gives to them the outline of the development of a new and logical method of presenting facts, which has permanent value.

And, last but not least, we believe that we have found a method which will be of wide use in teaching and in school-work. And while teachers and pupils will not be able to follow all the intricacies of the production process, we feel that this book will give them some suggestions for making geography, history, civics, enonomics, and many other subjects clearer and closer to reality.

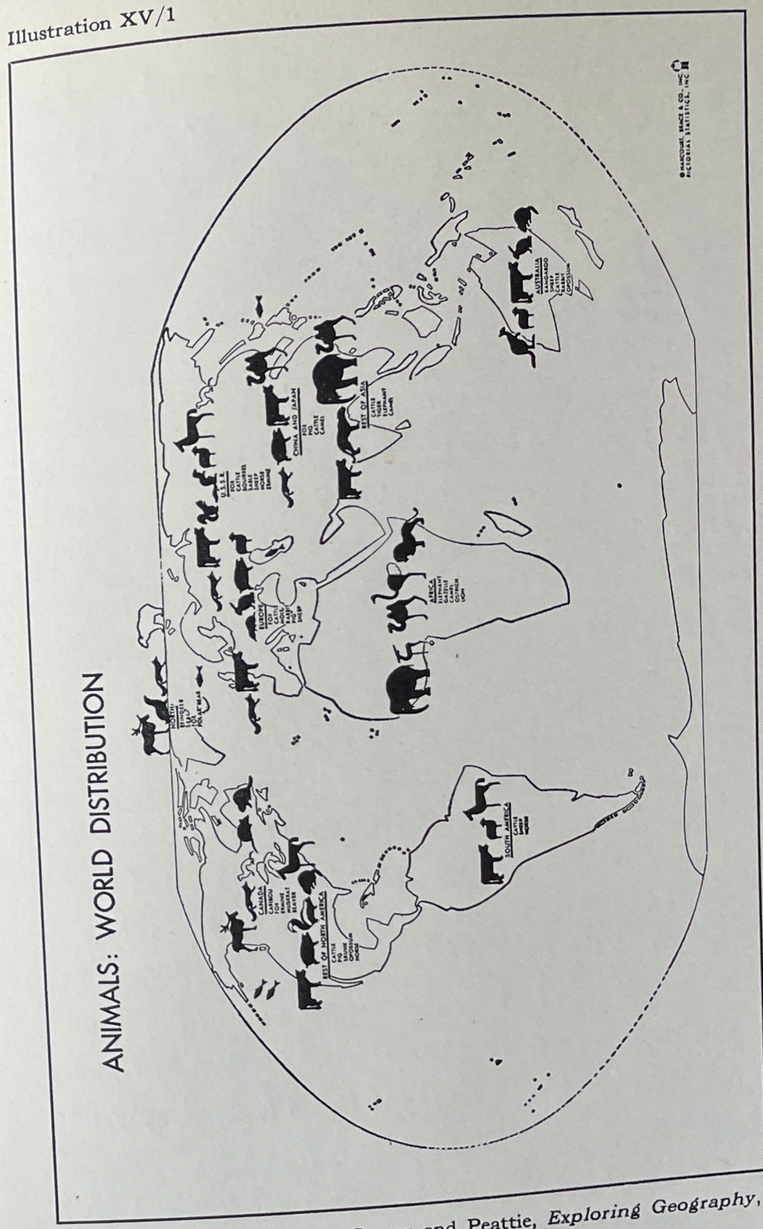
Let us consider in which way pictorial charts may aid the teacher.

Shortly, there will be at her disposal wall charts to illustrate her stories; the pupils will find charts in their textbooks, in magazines and newspapers. In the near future, statistical fact-films will be available, outlining in dramatic motion the flow of foreign trade, the growth of our population and many other things.

But pictorial statistics can provide more than ready-made material for the teachers' use. They offer a wide field for student activity in the classroom, workshop, and at home.

Think of a class which is studying the problems of oil. One group of pupils may take it upon itself to show where the world's oil is produced. With the help of the *World Almanac* they will find out the statistics on which to base their work. Then they will draw a map of the world. And then the inter-

Illustration XV/1



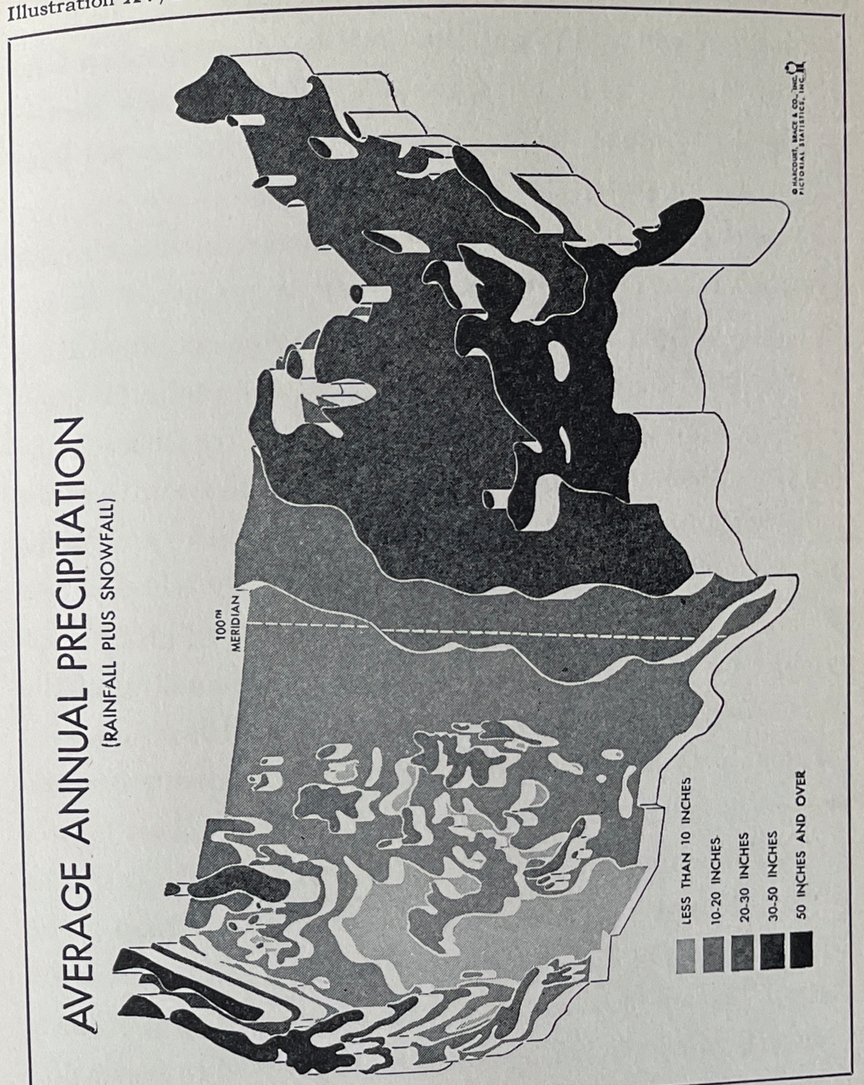
The map of animals is from Casner and Peattie, *Exploring Geography*, Harcourt, Brace & Co., Inc., New York, 1937.

esting part of the work begins. How can they show oil? Should they show barrels or tank-cars or tanks? Should they use tankers, maybe? And how do these things look? After a long discussion and some study the group may decide to use barrels to represent oil. The decision may be based on the fact that barrels are the units in which oil is measured or that they are simpler to draw or that most of the children have seen barrels oftener than other oil containers.

Having decided on suitable symbols the problem arises where they have to be put and how many of them have to be used. Iran and Roumania and other little known countries have to be located. After this problem in geography will come one in arithmetic. The children will learn soon that any attempt to show too much detail will spoil the looks of the map and they will begin to limit themselves to the larger aspects. If about 1500 million barrels of oil were produced in 1934 they will probably do best with showing only 15 barrels of 100 million each. Distributing them on the map they will see that the Americas produce more than two-thirds of this total and the United States far more than one-half. When this group finally is ready to present its work to the class it will have a good knowledge of what oil is shipped in, of where it is found, and of the importance of the various producing centers. And, what is equally important, it will be able to transmit these facts simply and easily to the other children in the class.

In the meantime, another group may have worked on a chart on oil production since 1900. It will be able to show that

Illustration XV/2



● Another illustration from Casner and Peattie, *Exploring Geography*, Harcourt, Brace & Co., Inc., New York, 1937.

during this period production has increased from one and a half symbols (each of 100 million barrels, again) to 15. This fast increase will lead to questions and to further studies into the development of oil users, the automobile, the navies and merchant marines of the world, aviation—all of them subjects for fascinating pictorial charts and maps.

In lower grades, the teacher may want to begin with simpler facts: how many children are in the class; how many of them are boys, how many girls. Does our class have more children than the class next door? All this, the children will easily portray; they may want to draw the symbols or to cut them with scissors and paste them up; in doing this, they will still want to make one symbol for each child; their minds will still be unable to grasp the abstractions by which later only they will come to recognize a dot on a map as "New York." By grouping 5 symbols we will gradually introduce an understanding of the fact that one symbol may stand for 5, 10, even 100 children.

From the earlier symbols drawn by the pupils themselves the class may pass to the paste-up of ready-made symbols (available at cost from Pictorial Statistics, Inc., New York). The children can paste the population of their state on a map of the United States and put in the population of a few neighboring states for comparison. In this way they can get their first ideas of density of population, a subject that may lead to many discussions in arithmetic or economic geography.

Pictorial charts lend themselves easily to work in many fields. Textbooks on government, history, economics, and

geography have already been illustrated.

Of great help to the class may be sets of magnetized symbols on sheet-iron boards on which maps may be painted. The symbols can be made to represent almost anything from people to factories, can be placed on the board, will stick to it easily, and can be removed without effort and without leaving any marks. Such magneto maps have been used successfully by the Social Museum in Vienna.

The field of education is the only one in which self-made charts are definitely advised as a help. In all other fields it is better to rely upon the specialists to produce the most effective material.

CHAPTER • XVI

Exhibitions and Museums[1]

Through pictorial statistics fairs and exhibitions will be able to perform a much more useful service to the visitor and to the exhibitors, than was formerly possible. To realize just how much of the vital aspects of an industry had to be left untold because of the lack of a proper technique let us compare what a large exhibition usually shows on the automobile industry—and what it does not show.

It usually shows one thing excellently: the technical accomplishments of the industry. Before the eye of the visitor there is reproduced a perfect replica of the assembly-line at work. Parts move with precision to their predestined places, are jointed together, move on. Around the assembly-line may be arranged smaller—and mostly still—exhibits of various parts of the car, small models of out-of-date cars which arouse the interest of the crowd because of their quaint appearance and the memories they stir. There may also be the very latest motor cut right through the middle to show the accuracy and beauty of its construction. The technical part of the exhibit is perfect;

[1] The ideas outlined in this chapter follow closely a pamphlet *Now It Can Be Shown*, by Pictorial Statistics, Inc., and "Museums of the Future" by Dr. Otto Neurath (*Survey Graphic*, September, 1933).

no money has been spared to make it so; motion and size and color have been combined to create a lasting impression in the visitor that the automobile industry—and that particular manufacturer—are doing a good job.

And yet—have you ever stopped to think what a thrilling and vital part of the story has been left untold? That part which deals with the growth of the industry, shows its position today, indicates the changes it has wrought in the lives of thousands of people. Nowhere in the exhibition can we find the production record of the automobile industry dramatically portrayed; nowhere do we find a striking exhibit which shows us how the price of a car has been climbing down and down and how the standards of living have been climbing up and up until one out of every five people has a car. Nowhere do we see how this tremendous industry is organized, where the products it uses come from and where it ships its own product to. There is no place where we can get simple and clear information about the problems the industry faces—taxation, highway construction, accidents. There is no place where the student can see what the automobile has meant to the railroads and to the buying habits in small towns. All this and a hundred more things—they have not been shown. And the reason for this is not that people are not interested. Quite to the contrary—some of these things are closer to their lives than the technical parts of the car. They simply have been left unshown because there was no way of showing them attractively and interestingly enough to the average man or woman visitor.

All this has changed. With less money than is necessary to build an assembly line we can produce animated social exhibits of considerable strength. The history and the position of any industry—or a particular manufacturer—can now be described in graphic form just as dramatically as the making of his product can be described through the motions of the machines. A well-planned exhibit at a future World's Fair will present to the visitor a coordinated balance of technical and factual information. To the central technical theme there will be added a social theme of equal vividness in motion, size, and color. Around these central themes will be placed supplementary exhibits prepared in simpler and less costly techniques.

The combination of technical and social exhibits in each part of the Fair will give the visitor a better understanding of how all these things concern him, how they affect his life and change his surroundings. The different parts of the Fair, related to each other through the method of presentation will be quickly understood and easily remembered.

For anyone who has followed us up to this point it will not be difficult to guess what we are going to say about museums. They have neglected the social side of history, natural history, art, and science even more than the fairs and exhibitions. Let us give one example of what a Natural History Museum could add to its exhibits of the horse to indicate what we have in mind. To the modern child in a big metropolis a horse is a sad remnant of the past. And yet it had a brilliant history as man's helper—it carried the warrior in hundreds of

battles, it pumped the water from early mines, it pulled the plow for the farmer and heavy loads for the merchant. Charts and pictures may well describe this history. It has not been for long that we have known much about the number of horses in this country. But would it not be of great importance to show how the number of horses has increased from decade to decade until it suddenly reached its peak and declined? Would it not be interesting to know that it was the automobile and the tractor which caused this change? And how many people know that the decrease in the number of horses and the lesser need for fodder implies that we have at our disposal more land for human food?

And how about the situation in other countries? Do the Chinese have horses; do they have more or less than we? Is there any other animal which replaces the horse in some part of the world: and why? We could even go further; and try to give the reasons why the automobile replaced the horse. We could give comparisons of speed, of cost, of upkeep, of mortality between horses and internal combustion engines.

We could, shortly, give a clear description of what the horse meant and means to mankind. And then we would feel satisfied to go ahead and describe the development of the horse family from the early four-toed eohippus to the one-toed equus of today.

From this one example it will be possible to infer how many additions might be possible and useful in the numerous other fields in which the museums of today work. But not only should

there be additions and changes in the existent museums; there should be a realization that the time has come to assemble in Social Museums the story of the growth of our civilization. These museums would tell where people live and what they do. They would show the growth of social organization, of cities and countries. They would portray the story of the machine as written in the changing lives of the villages, towns, and cities. They would show the shrinkage of the globe with the ever-increasing speed of the means of transportation. They would show the conquest of some diseases and the fight against others. They would show what each part of the world contributes to our present day life; how tin comes from Malaya and silk from Japan, coffee from Brazil and diamonds from Africa.

In these museums would be presented what hundreds of books have shown but few people have read. It would be presented in attractive form so that it would appeal to the man on the street as well as to the child in school. It would be presented clearly so that it could be grasped at a glance and easily remembered. Museums of this kind will be necessary counterparts of the industrial museums which have increased so rapidly in popularity in the last decade.

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