

GRAPHIC PRESENTATION

WILLARD C. BRINTON

1939



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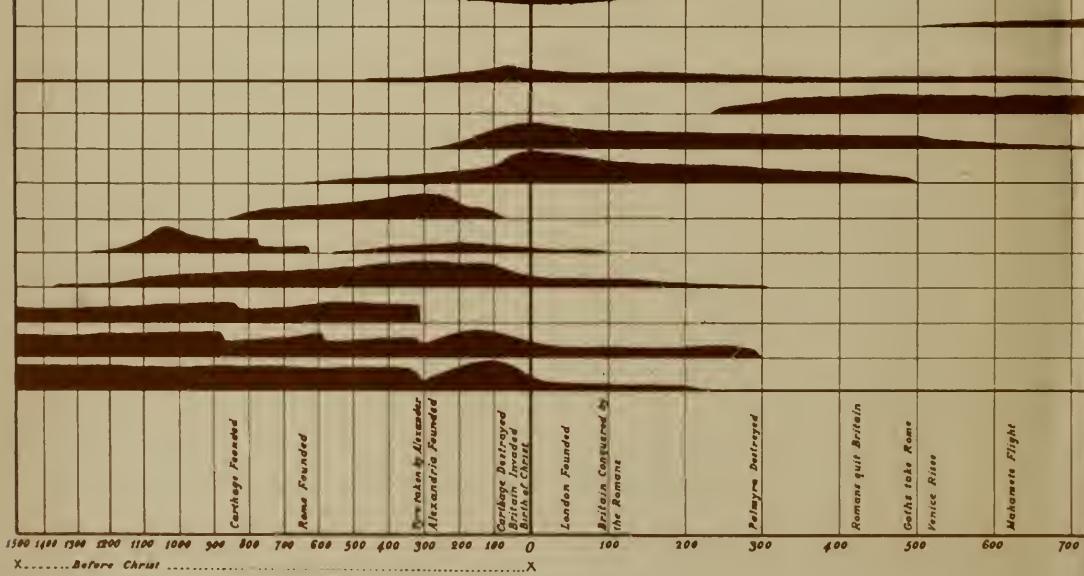
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Chart
of
UNIVERSAL COMMERCIAL HISTORY,
From the Year 1500 before the Christian Era
to the present Year 1805.

being a space of Three Thousand three hundred & four Years.

By
WILLIAM PLAYFAIR.

Inventor of Linear Arithmetic.



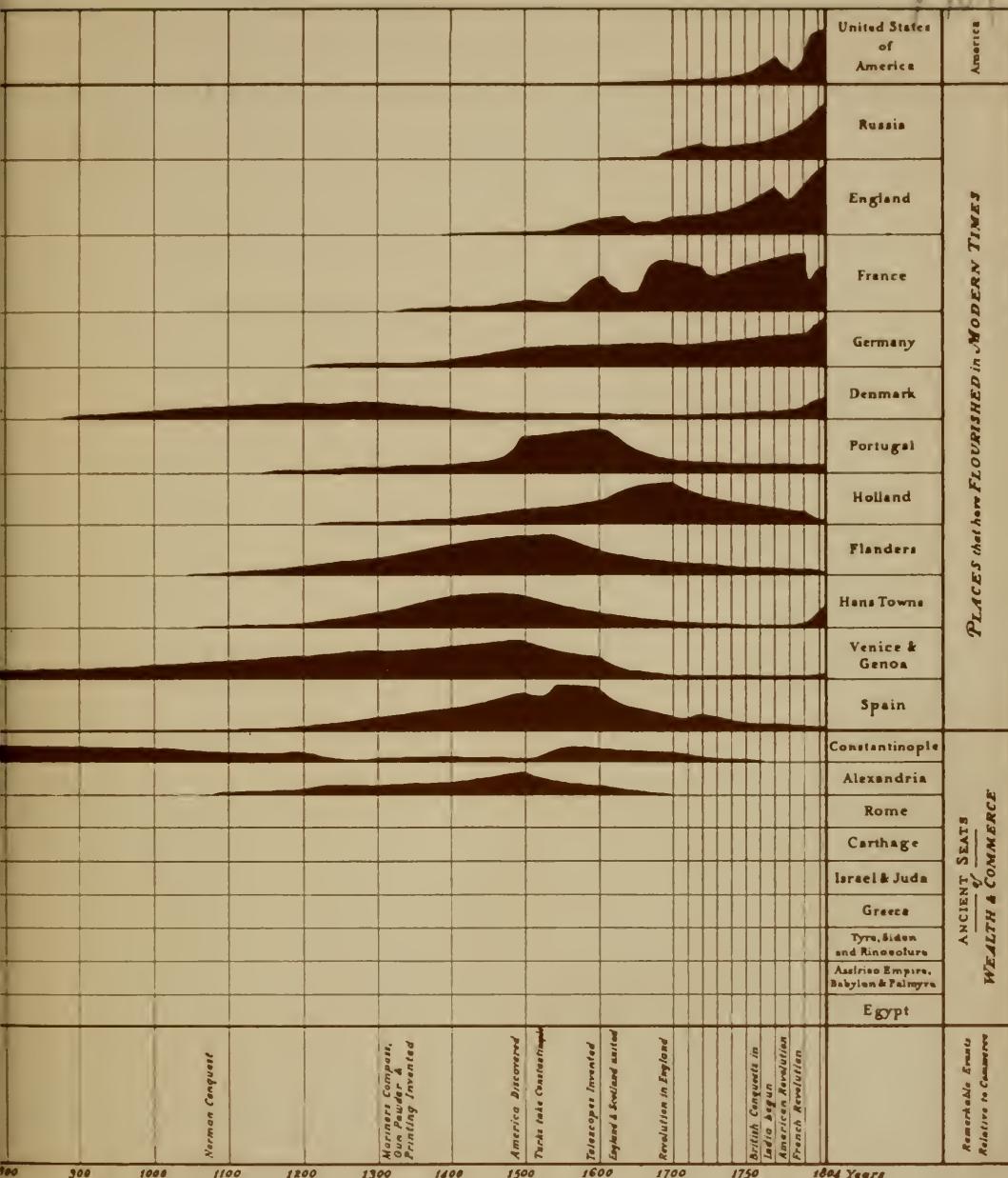
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From Frontispiece of Book by WILLIAM PLAYFAIR, An Inquiry Into the Permanent Causes of the Decline and Fall of Powerful and Wealthy Nations, London, 1805.

Dedicated
IN HONOR
of
WILLIAM PLAYFAIR

FIRST EXPONENT OF GRAPHIC CHARTS
FOR GENERAL USE

Born at Benvie, Scotland, 1759

Died in London, England, 1823

DRAFTSMAN-ENGINEER With James Watt 1780
MANUFACTURER

AUTHOR:

THE COMMERCIAL AND POLITICAL ATLAS, 1st ed., 1786; 2nd ed.,
1787; 3rd ed., 1801

TABLEAUX D'ARITHMETIQUE LINEAIRE DU COMMERCE, 1789
LINEAL ARITHMETIC, 1798

STATISTICAL BREVIARY, 1801

AN INQUIRY INTO THE PERMANENT CAUSES OF THE
DECLINE AND FALL OF POWERFUL AND WEALTHY NATIONS,
1st ed., 1805; 2nd ed., 1807

STATISTICAL ACCOUNT OF THE UNITED STATES OF AMERICA
By D. F. DONNANT. Translated From the French By WILLIAM
PLAYFAIR. Chart and Preface Also By WILLIAM PLAYFAIR. 1805

A LETTER ON OUR AGRICULTURAL DISTRESSES, 1st ed., 1821;
2nd ed., 1822; 3rd ed., 1822

CAN THIS CONTINUE?, 1822

The above titles by William Playfair are all, thus far
located, which contain graphic charts. The total number
of books by William Playfair is perhaps one hundred.

TOPICAL INDEX (1st Half)

1

Place right thumb on triangle, fingers inside back cover.

Spin pages to desired chapter.

9- 15	Preface —————
16- 23	1. Introduction —————
25- 32	2. Graphic Narrative —————
33- 42	3. Tabulation —————
43- 52	4. Classification Charts —————
53- 58	5. Geneology and Genetics Charts —————
59- 67	6. Organization Charts —————
68- 72	7. Relationship Charts —————
73- 80	8. Flow Charts —————
81- 91	9. Sector Charts —————
92- 97	10. 100% Bar Charts —————
98-105	11. Comparison of 100% Bar Charts —————
106-114	12. Multiple Bar Charts —————
115-120	13. Contrasting Bar Charts —————
121-131	14. Pictorial Unit Bar Charts —————
132-141	15. Comparison of Component Bar Charts —————
142-148	16. Bilateral Bar Charts —————
149-152	17. Area Bar Charts —————
153-160	18. General Use of Maps —————
161-169	19. Guide and Route Maps —————
170-177	20. Relief and Aerial Maps —————
178-186	21. Crosshatched and Colored Maps —————
187-193	22. Dot and Pin Maps —————
194-199	23. Maps with Circles and Sector Charts —————
200-207	24. Maps with Bar Charts —————
208-210	25. Maps with Curve Charts —————
211-215	26. Maps with Symbols —————
216-230	27. Flow Maps —————
231-237	28. Contour Maps —————
238-242	29. Distorted Maps —————
243-246	30. Rating Charts —————

(For 2nd Half of TOPICAL INDEX, See Page 247)

MAGIC IN GRAPHS

THERE is a magic in graphs. The profile of a curve reveals in a flash a whole situation —the life history of an epidemic, a panic, or an era of prosperity. The curve informs the mind, awakens the imagination, convinces.

Graphs carry the message home. A universal language, graphs convey information directly to the mind. Without complexity there is imaged to the eye a magnitude to be remembered. Words have wings, but graphs interpret. Graphs are pure quantity, stripped of verbal sham, reduced to dimension, vivid, unescapable.

Graphs are all inclusive. No fact is too slight or too great to plot to a scale suited to the eye. Graphs may record the path of an ion or the orbit of the sun, the rise of a civilization, or the acceleration of a bullet, the climate of a century or the varying pressure of a heart beat, the growth of a business, or the nerve reactions of a child.

The graphic art depicts magnitudes to the eye. It does more. It compels the seeing of relations. We may portray by simple graphic methods whole masses of intricate routine, the organization of an enterprise, or the plan of a campaign. Graphs serve as storm signals for the manager, statesman, engineer; as potent narratives for the actuary, statist, naturalist; and as forceful engines of research for science, technology and industry. They display results. They disclose new facts and laws. They reveal discoveries as the bud unfolds the flower.

The graphic language is modern. We are learning its alphabet. That it will develop a lexicon and a literature marvelous for its vividness and the variety of application is inevitable.

Graphs are dynamic, dramatic. They may epitomize an epoch, each dot a fact, each slope an event, each curve a history. Wherever there are data to record, inferences to draw, or facts to tell, graphs furnish the unrivalled means whose power we are just beginning to realize and to apply.

HENRY D. HUBBARD

National Bureau of Standards
Washington, D. C.

GRAPHIC PRESENTATION

By

WILLARD COPE BRINTON, S. B.
Consulting Engineer

Member, American Society of Mechanical Engineers; Organizer and Chairman, Joint Committee on Standards for Graphic Presentation, Formed 1914 Through Am.Soc.M.E., as Sponsor. Fellow, American Statistical Association; Vice President, 1919. Author *Graphic Methods for Presenting Facts*, 1914, McGraw-Hill Book Company, Inc.



Willard Cope Brinton.
Nov. 6, 1939.

BRINTON ASSOCIATES
New York City
1939

This book was planned with the hope of inspiring more and better factual presentation. If proper credits are given, any reasonable portion of this book may be quoted without further consent. However, to copy any materials here credited to others, care must be exercised to secure permission from the original sources.

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First Edition

Also by Willard C. Brinton

GRAPHIC METHODS FOR PRESENTING FACTS, 1914

Published by McGraw-Hill Book Company, Inc.
New York City

Printed in the United States of America

TABLE OF CONTENTS

When a chapter name or number is given as a reference, turn to the Topical Index, either on Page 1 or Page 247, and spin pages to the desired chapter.

Chapter	Page
PREFACE	9
1. INTRODUCTION	16
Brief History of Development of Graphic Methods.	
2. GRAPHIC NARRATIVE	25
Early Drawings. Picture Comparisons. Sequence Pictures. Procedure Charts. Sports Stories. Basic English.	
3. TABULATION	33
Tallying. Methods of Tabulating. Graphic Tabulation. Machine Tabulation.	
4. CLASSIFICATION CHARTS	43
Use of Arrows and Brackets in Classification. Time-Period Classification. Block Classification.	
5. GENEALOGY AND GENETICS CHARTS	53
Standard Symbols. Trait-Tracing Charts. Family Tree. Pedigree Charts. Genealogical Chart Sheets. Other Uses for Genealogy Charts.	
6. ORGANIZATION CHARTS	59
Geographical Divisions. Government and Business Organization. Functional Charts.	
7. RELATIONSHIP CHARTS	68
Interrelations.	
8. FLOW CHARTS	73
Source and Distribution Chart. Traffic Chart. Activity Chart. Cost-Accounting Chart. Cosmograph.	
9. SECTOR CHARTS	81
Area and Angle Comparisons. Subdivided Sector Charts. Cumulative Charts. Charts Showing Assets and Liabilities.	
10. 100% BAR CHARTS	92
Single Bars. Bar Chart Stamp. Percentage Distributions. Cumulative Charts.	
11. COMPARISON OF 100% BAR CHARTS	98
Groups of Bars. Distribution and Percentage Comparisons.	
12. MULTIPLE BAR CHARTS	106
Value Comparisons. Bars on an Illustration.	

GRAPHIC PRESENTATION

Chapter	Page
13. CONTRASTING BAR CHARTS	115
Variation in Shadings, Crosshatchings, and Colors. Optical Illusion.	
14. PICTORIAL UNIT BAR CHARTS	121
Rows of Figures. Visual Captions.	
15. COMPARISON OF COMPONENT BAR CHARTS	132
Divided Bars Comparing Values. Comparison of 100% Bars and Component Bar Charts. Stair Charts.	
16. BILATERAL BAR CHARTS	142
Profit and Loss Data. Deviations from Normal.	
17. AREA BAR CHARTS	149
Area Comparisons. 100% Square.	
18. GENERAL USE OF MAPS	153
Source of Maps. Base Maps. Map Projection. Borgia Map. Orange-Peel Map.	
19. GUIDE AND ROUTE MAPS	161
Proposed Routes. Transmission Lines. Maps Showing Source of Materials. Geographic Organization Charts. Comparisons of Geographic Areas. Pictorial Maps.	
20. RELIEF AND AERIAL MAPS	170
Oldest Known Map. Bird's-Eye View Maps. Diagram Maps. Statistical Relief Maps. Block Diagrams. Azimuthal Projection.	
21. CROSSHATCHED AND COLORED MAPS	178
Comparison of Ben Day Shadings and Colors. Sampling Maps. Density Maps. Mechanical Intensity Shading Map.	
22. DOT AND PIN MAPS	187
Map Marking Devices. Slave Maps. Bell System Map.	
23. MAPS WITH CIRCLES AND SECTOR CHARTS	194
Scales for Areas of Circles. Census Data. Distribution. Migration.	
24. MAPS WITH BAR CHARTS	200
Traffic Charts. Historical Maps. Map from New York World's Fair, 1939.	
25. MAPS WITH CURVE CHARTS	208
Moving Averages. Precipitation.	
26. MAPS WITH SYMBOLS	211
Quantitative and Qualitative Data. Pictorial Units.	
27. FLOW MAPS	216
Flow of Goods. Traffic Maps. Weather Maps. Hurricane Maps. Traffic Time-Zones Map. Chart by M. Minard.	
28. CONTOUR MAPS	231
Topographic Maps. Weather Maps. Before and After Comparisons.	
29. DISTORTED MAPS	238
Rectangular Maps. Population.	

TABLE OF CONTENTS

Chapter	Page
30. RATING CHARTS	243
Tabulation Form. Mental Development. Safety Records.	
31. CHRONOLOGY CHARTS	248
Time Analysis and Time Studies. Chart for Assigning Vacations.	
32. PROGRESS CHARTS	256
Time Studies. Material Control Board. Production Progress Chart. Gantt Charts.	
33. CURVE CHARTS	263
One Curve on a Grid. Visual Captions. Historical Labels. Stair Charts. Deviation from Normal.	
34. COMPARISON WITH TWO CURVES	275
Cumulative Curves. Causal Relationships. High-Low Curves. Lag.	
35. COMPARISONS WITH CURVES	286
Progressive Average and Moving Average Curves. Normal Trend.	
36. COMPONENT PARTS SHOWN BY CURVES	294
Component Parts in Curve Form. Percentage Charts. Band Charts. Use of Brackets.	
37. INDEX NUMBERS SHOWN BY CURVES	301
Comparison of Index Charts with Numerical Value Charts. Multiple Axis Graph.	
38. FREQUENCY CHARTS	310
Frequency Distribution. Bell-Curve Chart. Distribution in a Circle. Optical Illusion.	
39. CORRELATION CHARTS	320
Relationships Between Variables. Scatter Charts. Standard Deviation. Break-Even Charts.	
40. OGIVE AND LORENZ CHARTS	331
Probability Paper Charts.	
41. RATIO CHARTS	339
Comparison of Ratio and Arithmetic Scale. Key for Selecting Ratio Scale. Method of Ruling Ratio Paper. Index Numbers Curves. Cumulative Curves.	
42. THREE-DIMENSIONAL METHODS	354
Models. Perspective Drawings. Photographs. Isometric Block Diagram. Isometric Protractor. Trilinear Chart.	
43. COMPOSITE CHARTS	360
Methods of Combining Various Types of Charts.	
44. SUGGESTIONS FOR MAKING A CHART	367
Helpful Techniques. Sources of Materials. Methods of Lettering. Ink Colors. Crayons. Colored Papers.	
45. STANDARDS FOR TIME SERIES CHARTS	381
Abstracts from <i>Time Series Charts. A Manual of Design and Construction</i> , 1938, Prepared by Committee on Standards for Graphic Presentation, under Procedure of American Statistical	

GRAPHIC PRESENTATION

Chapter	Page
	Association, with the American Society of Mechanical Engineers as Sponsor Body.
46. THE CAMERA AND ITS USE	397
Photographic Effects. Color Photography. Photomontage.	
47. LANTERN SLIDES	405
Projectors. Slides. Screens. Suggestions for Placing Charts on Slides. Microfilm.	
48. PREPARATION OF ILLUSTRATIONS	410
Types of Illustrations. Preparation of Copy. Reproduction Media for Art Work. Handling Photographs. Shading Mediums and Shading Films. Halftone Screen Tints. Colors Used in This Book.	
49. COLOR AND ITS USE	423
Discussion of Hue, Value, Chroma. Color Top. How Colors Appear to the Color Blind.	
50. METHODS OF REPRODUCING	429
Gelatine Process Duplicating Machines. Blue Prints. Photostats. Mimeograph Process. Fluid Process Duplicator. Lithoprints. Multilith.	
51. METHODS OF PRINTING	435
Relief, Planographic, and Intaglio Printing. Typesetting. Type Sizes and Styles. Photoengraving, Electrotyping, and Line Plates. Proofreaders' Marks.	
52. SELECTION OF PAPER	443
Types of Paper. Considerations in the Selection of Paper. Bulk- ink Table.	
53. BINDING TECHNIQUES	449
Types of Binding. Binding Specifications. Imposition.	
54. GRAPHIC CHARTS IN ADVERTISING	454
Various Types of Graphic Charts in Advertising Material.	
55. QUANTITATIVE CARTOONS	464
Various Types of Graphic Charts in Cartoons.	
56. QUANTITATIVE POSTERS	475
Various Types of Charts in Poster Form. Magazine Covers.	
57. DISPLAYS AND EXHIBITS	486
Mechanical Exhibits. Scale Models. Display Fixtures. Turn- tables. New York World's Fair Exhibits.	
58. DIORAMAS	494
Dioramas in Process of Construction. Dissolving Diorama Exhibit. New York World's Fair Exhibits.	
59. GRAPHIC CHARTS IN CONFERENCE ROOMS	497
Board Rooms. Use of Projectors in Conference Rooms.	
60. GLOSSARY	501
Graphic Methods Vocabulary.	
INDEX	506

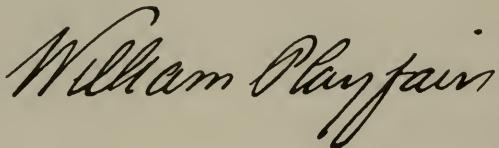
PREFACE

TWENTY-FIVE years have passed since the publication of *Graphic Methods for Presenting Facts* in 1914. The continuing demand for *Graphic Methods* without revisions in a quarter century now incites curiosity as to the causes of that demand. So many excellent works relating to graphic charts or containing chapters on graphic presentation have appeared since 1914 that I had felt the field well covered without another book from me. This, in spite of the fact that I have published nothing regarding activities of my own relating to the 1914-1918 World War period.

Probably the feverish demand for prompt and reliable data during war times did more to stimulate the use of graphic chart technique than anything that has happened since 1920. Without realizing what was happening as the war flared, I found myself advising the executives of large corporations, government departments, etc. World trade was disorganized, and the uncertainty of material supply

required quick analysis of all available data. For instance, in 1916, a New York silk manufacturer and I went to China and back again on the same steamer to determine the feasibility of building a new plant in Shanghai to employ five thousand.

For one of my age at that time, it was a great privilege to have the opportunity to develop some theories and put them in practice day by day with experienced executives whose decisions were so vital in those hectic war years. Establishing, in a Broadway office building, control methods for quicker "turn-arounds" of eighty-five ships chartered by the Belgian Relief Commission had little relation to strategy in the president's office of a steel company with twenty thousand employees in Pittsburgh, or scheduling, at New Haven, Connecticut, two thousand tool makers scattered in shops throughout New England to assist in producing the light Browning machine gun by a company already working twenty-two thousand employees at the New Haven plant. During that period "Z" chart methods and unit card curve records were

A cursive signature of the name "William Playfair" in black ink.

Signature of William Playfair from a Letter to Thomas Jefferson Dated March 20, 1791

GRAPHIC PRESENTATION

developed for use in fields much more specialized than would be of interest here. Also short map pins with spherical heads were created and placed on a quantity production basis. Through all the research of the World War period, the need was constantly evident for standardization so that graphic charts could be made and interpreted without possibility of misunderstanding. For general use, graphic charts must be simple. It is not, however, always easy to determine what is the utmost simplicity. Much depends on the method of approach. A semi-logarithmic chart may not be puzzling if you call it a ratio chart and make no mention of mathematics.

Since the close of the World War, other activities have crowded into the background my interest in graphic charts and human reactions to them. It was impossible, however, to resist tearing from magazines and newspapers thousands of examples of particularly interesting or especially erratic graphic charts. These were added to examples which had come, in what Hollywood would call "fan mail," from readers of *Graphic Methods*. As recently as twenty months ago there was still no expectation of my ever writing another book on the subject.

Although I had been in Los Angeles many times and had passed the Huntington Library on numerous occasions, I had never found time to visit it. Then after months of intensive study



John Playfair, the Brother of William Playfair

In his *Inquiry*, 1805, William Playfair stated that his brother taught him "that whatever can be expressed in numbers, may be expressed by lines." To the "best and most affectionate of brothers," William Playfair owed "the invention of these Charts."

PREFACE

of some problems in Los Angeles in which graphic presentation had proved particularly effective in crystallizing opinion on a complex situation, I visited the Huntington Library on the last day before starting North and East. While observing some unusually fine types of early bookbinding and the repairs made to the bindings on some of the Library's most precious volumes, it occurred to me to ask the Librarian, Dr. Leslie Bliss, what books the library had by William Playfair, to whom this book is dedicated. In a few minutes there was brought to us the only one they had listed under William Playfair:

STATISTICAL ACCOUNT OF THE
UNITED STATES OF AMERICA

by D. F. DONNANT



Translated from the French
by WILLIAM PLAYFAIR

With an Addition on the Trade to America,
For the Use of Commercial Men,
By the Same.

London

1805

As we looked through this book, I exclaimed to Dr. Bliss, "Here is the earliest example of a sector chart," and then noticed beneath the one illustration the inscription, "This Newly invented Method is intended to shew the Proportions between the divisions in a Striking Manner." See Page 81.

I was also much struck by the fact that the subject matter of the book referred to industry, commerce, and finance in the United States, that the preface by William Playfair mentioned conversations between himself and Thomas Jefferson, that the book was inscribed to Jefferson, and that twenty-five copies had been sent to him.

When I wrote *Graphic Methods* in 1914, I had never heard of William Playfair. Two years later a friend in Pittsburgh sent me a marked catalogue of a London bookseller listing a book *Lineal Arithmetic*, 1798, by William

GRAPHIC PRESENTATION

Playfair. Out of curiosity, I wrote asking that the book be reserved and that a price quotation be sent. A few weeks later, upon returning from out of the city, I was astonished to find the English book seller's bill for ten shillings, six pence. Elsewhere in my accumulated mail was the book itself. On the title page the publisher's price is printed, "Price 10s. 6d." Neither the New York Public Library nor the Library of Congress had this book. Each of these libraries has since photostatted my volume for inclusion with the few examples of other Playfair works which they own. About 1916, I had various photostats made from these Playfair books, but had never followed up clues on Playfair, the man. The Playfair search has widened since the chance inquiry made at the Huntington Library a year ago. Questions still continue.

With all that Playfair did to show the effectiveness of graphic chart methods from his first book, published in 1786 at the age of twenty-seven, till his death in 1823, why have not graphic charts become more thoroughly established as a universal language? Another interest was aroused as to the part which engineers have played in the development of the graphic language, since I noted in California that William Playfair was apprenticed in Scotland as a machinist and later became a draftsman for James Watt before writing on a wide variety of subjects. There are about 100 titles by Playfair on record. The story of William Playfair, still developing, may yet have large gaps. Location of those writings relating to graphic charts, however, appears to be fairly well completed.

This book is another contribution from the engineering profession, although written for general use rather than the technical field, on much the same general ideas as expressed in *Graphic Methods* in 1914. The 1914 book was written largely to disclose some of the fallacies that occur when graphic charts are used loosely without the basis of accuracy essentially associated with the work of people with an engineering background.

Until the last decade or so, the use of graphic charts seemed to be progressing sanely and fairly rapidly with no more guidance than resulted from the extremely brief preliminary report of the Joint Committee on Standards for Graphic Presentation, published in 1915. In recent years, some weeds seem to have sprung up to retard the growth of the more cultivated graphics which had been developing strongly with numerous offshoots since the World War stimulus. As in a garden where there is sometimes the policy of deciding in the early stages which are weeds and which are plants that will be productive, it has not been easy to find a method for defining good graphic charts as compared with poor or downright obnoxious charts. What is believed to be a satisfactory method was found in the old story of the blind men who reported on the characteristics of an elephant. Good graphic presentation should be susceptible to only one interpretation.

Recently even official government documents have been using a type of graphics which found its first major use in European countries having a low

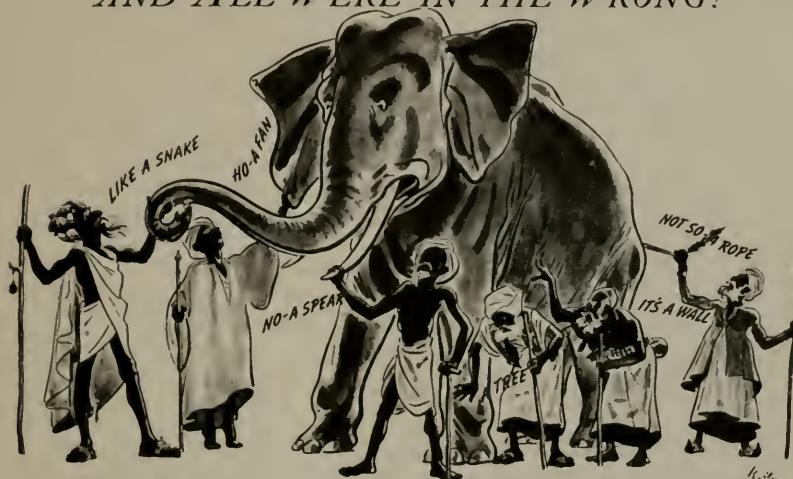
PREFACE

percentage of literacy. When the same European methods have been pushed on a commercialized basis in America, little attempt has been made to follow existing American standards or trends toward the development of an ultimate universal language. The tendency has been to use stock symbols over and over again because they are cheaper to reproduce than special drawings designed for each particular problem of presentation.

The first part of this book up through page 366 deals with "How to Read a Chart." The section from page 366 to page 452 treating the subject "How to Make a Chart," is necessarily condensed, and gives suggestions rather than detailed instructions.

The illustrations in this book have been selected from the standpoint of interesting subject matter as well as to show representative types of graphic

AND ALL WERE IN THE WRONG!



Good Presentation Should Be Susceptible to Only One Interpretation

It was six men of Indostan
To learning much inclined,
Who went to see the Elephant
(Though all of them were blind.)
That each by observation
Might satisfy his mind.

The First (side) "Is very like a wall!"

The Second (tusk) "Is very like a spear!"

The Third (trunk) "Is very like a snake!"

The Fourth (knee) "Is very like a tree!"

The Fifth (ear) "Is mighty like a fan!"

The Sixth (tail) "Is very like a rope!"

And so these men of Indostan
Disputed loud and long,
Each in his own opinion
Exceeding stiff and strong
Though each was partly in the right,
And all were in the wrong!

From John Godfrey Saxe, "The Blind Men and the Elephant", *Clever Stories of Many Nations Rendered in Rhyme*, 1865.

GRAPHIC PRESENTATION

charts. Words are carefully studied before they are qualified for admittance in a dictionary. No one knows how many distinct types of graphic charts are already in established use.

Beneath the majority of the illustrations included here, there is a notation of "SCALE" to indicate the percentage reproduction of the original. In judging the effectiveness of any presentation it should be clearly kept in mind that, as here reduced, the illustration can not be as effective as in the size originally published. Also in the process of photographing, particularly in those charts taken from newsprint paper, the illustration is less clear. Halftones which here appear too black have been photographed from previously printed halftones rather than from original photographs.

If the subject matter of any illustration is of special interest to the user of this book, a reading glass may be used to enlarge the detail.

Because a frame around the chart may be interpreted falsely as a zero line, or base line, the liberty has been taken to remove frames from many illustrations. Changes have also been made in lettering or other details, when necessary, for reproduction in reduced sizes.

It should be clearly understood that this book would not have been feasible except for the photo offset process of reproduction and color printing.

The use of color has been a gamble—many of the charts here shown in color were originally black and white. It was impossible to foresee results obtained from hundreds of lay-outs sent to the printer. Changes may seem obvious in the final printed form.

Designs at the top and bottom of color pages may appear incongruous with some of the color combinations in the body of the page. Varied color designs were inserted with the thought that the user of this book might gain from our experiments and select certain effects appropriate for his own particular problem.

In order to test whether color is worth while in graphic presentation, color has here been literally splashed on. In folding printed sheets for sewing into bookbinders' signatures, every other pair of pages evolve from one side of the printed sheet of paper. Thus, if color is printed on only one side, a reader finds color on every other pair of pages in the book. In this way it is possible for the reader of this book to judge the effect of color on the varied types of charts shown in the 60 chapters simply by turning the pages two at a time. It is believed the evidence is conclusive that to get maximum results in graphic presentation the question is not "Can one afford to use color?" but "Can one afford to omit color?"

This book *Graphic Presentation* results from the work of many people. It would not have been possible except for the charts produced by the individuals and organizations to whom credit is given under many of the 676 illustrations. The illustrations were selected from thousands of clippings

PREFACE

which I could not resist saving during the 25 years that have elapsed since publication of *Graphic Methods for Presenting Facts* in 1914.

The chapter on selection of paper was prepared by Mr. W. B. Gibson, of the Mead Sales Corporation, in consultation with officers of various trade associations. My wife, Laura M. Brinton, did practically all the work in preparation of Chapter 46, "The Camera and Its Use"; Chapter 47, "Lantern Slides," and Chapter 49, "Color and Its Use." Miss Audrey W. Zeigler, of Newburgh, New York, made all the drawings used as the headings of chapters. Mr. R. R. Lutz, of the National Industrial Conference Board, made valuable suggestions in the early stages of planning the book, particularly regarding the possibilities for the use of color. Mr. Roy S. McElwee, and numerous others read manuscript and contributed suggestions as the book progressed. In planning the printing, many helpful ideas were given by Mr. Edward N. Mayer, Jr., of Gray Photo Offset Corporation. The cooperation of the entire staff of that organization is appreciated. Personally I regret that frequent absences from the city have prevented that close contact which I should have preferred to give to such fascinating subject matter.

Methods of graphic presentation and new types of charts will continue to evolve through processes of human ingenuity as need arises. There is need for classification and comparison of types noting the advantage of each type and making all types available for general use internationally. Nomenclature alone is deserving of careful attention far beyond the range of any one individual.

In the discussion of these matters in Washington, D. C., during the past year the Honorable Kent E. Keller, member of the House of Representatives from Illinois, and Chairman of the House Committee on the Library of Congress, has been of great assistance in exploring the possibilities. Mr. Keller's unusual range of knowledge and experience in education, medicine, law, engineering, publishing, and mining, coupled with residence in Europe and Mexico, served in determining potentialities for not only a central file of graphic charts by types, but also a comprehensive file of graphic material arranged for quick reference and classified according to subject matter.

William Playfair, from his first book in 1786 throughout his writings to his death in 1823, mentioned the possibility that a graphic language could be an international language assisting in better relations between nations of different tongues. As this is written, with international conditions throughout the world unsettled and getting worse, there seems more than ever before a need for such a common graphic language as William Playfair envisioned.

WILLARD COPE BRINTON.

New York City
Sept. 6, 1939

Chapter 1

INTRODUCTION

Why have graphic methods been so tardy in developing? Three things in combination are necessary before visual methods of presentation can be adequately used.

1. Accurate factual data readily available.
2. Competent drafting talent to chart the data on a standardized basis.
3. Equipment and organization for reproducing the charted data at a cost not too high compared to the printed word.

Until mankind developed reasonably cheap paper, there was no convenient method for preserving quantitative data. The study

百聞不如一見

"One hundred rumors are not comparable to one look."

An Old Chinese Inscription

of statistical records and the developing of policies from facts had to wait until records gradually accumulated. The making of paper and the preserving of records developed rapidly after the invention of loose-type printing about 1450.

At the time William Playfair wrote his first book on graphics in 1786, the word "statistics" had not come into general use. The word itself is derived from "state." The state first had to keep records of tax rolls, collections, and various government activities. Playfair lamented the inadequacy of historical data in a number of his writings; for instance, in *Commercial and Political Atlas* of 1801:

"Had our ancestors represented the gradual increase of their commerce and expenditures, if it had not been an object of utility, it would

INTRODUCTION

at least have been one of curiosity; but had records, written in this sort of shape [plotted curves] and speaking a language that all the world understands, existed at this day, of the commerce and revenue of ancient nations, what a real acquisition would it not have been to our stock of knowledge! In place of which, a few detached facts are collected and brought forward as the only criterion from which we can judge of the manners and wealth of the ancient world.

"It is not only of importance that this species of information should be handed down, but also that it should go down in such a form and manner as that any person might, even though a native of another country, understand the nature of the business delineated.

". . . If we could have a copy of the custom-house books of Carthage or Tyre for a hundred years, what value might not be set on them! These charts [Playfair's] will be for future nations the same thing that the ancient records we so much desire would be for us now. . . ."

If we search into the past for factual data, we naturally think of libraries. If we could now examine the libraries as they existed at intervals of one hundred years, say one, two, three or four centuries back, what would we find? Probably very little factual



Courtesy of American Chicle Company—Makers of Dentyne Gum

The First Agricultural Report

GRAPHIC PRESENTATION

information. Even books in our grandfathers' attics, if classified, would be short on factual material and long on abstruse discussion of theories, most of which were of a religious nature or perhaps vaguely astronomic or otherwise theoretical considerations of the universe.

The development of printing and the gradual cheapening of paper resulted in people of Europe and this country being exposed not to pictures but to more and more words, words not only from the printed page but from ministers of the gospel who, being of the educated class and able to read, obtained their inspiration from the printed material which came to them.

Let us consider bookmaking in the early days from the standpoint of cost. There would seem to be little reason why illustrations should not be generally used. Books were made from wooden blocks even before the use of movable metal type. Illuminated manuscripts and early books of similar pattern used illustrative methods which today we would think prohibitive from the cost standpoint. Labor must have been relatively cheap, especially in monasteries or other religious institutions which in those days produced so much of the literary output. Probably there was nothing whatever to prevent the development of illuminated graph charts long before the days of William Playfair except lack of reliable factual data from which to make the charts. People of those days must have found out, just as we find out so often now, that if we start to chart our facts, we are frequently stopped by the startling insufficiency of the data, the annoyance that the data may have a single gap in its continuity, or that the data have not been kept on a uniform basis over the period of time under consideration.

Organization of data on a rectangular field would appear to be so obvious that it might have been done fairly early by scholars in different countries, if they had had much data to study. The printed page with its lines of words proceeding from left to right is in itself a coordinate field, the lay-out of which required careful thought from those who produced the illuminated manuscripts or books which are so fascinating to us now. Descartes in 1637 published his works on geometry which firmly established the method of rectangular coordinates when used for mathematical formulas. Those who are interested in the history of graphic presentation will find the sequences well brought out in a paper of one hundred and thirty-five pages by H. Gray Funkhouser, published in *Osiris*, Volume Three, Part One, 1937, available through the Carnegie Institution of Washington, D. C. Funkhouser dates the use of the coordinate field to astronomers and surveyors as far back as 140

INTRODUCTION

B.C. when points in the earth's surface were located by means of their longitudes and latitudes. Oresme in 1350 in his *Tractitus de Latitudinibus Formarum* endeavored to represent graphically how an empirical curve might behave. As Funkhouser states, "If a pioneering contemporary had collected some data and presented Oresme with some facts to work on, we might have had statistical graphs four hundred years before Playfair."

Leonardo da Vinci antedated Descartes 77 years. Leonardo's genius in the natural sciences and as an engineer was so far in advance of his time that it would seem that he might have been familiar with rectangular coordinates. Recent examinations of his

notebooks, though not very conclusive, seem to indicate that in his experiments regarding gravitation, his records of the velocity of falling bodies were analyzed on a rectangular coordinate basis. See Volume M, Verso 40, Manuscripts of the Institute of France. He used horizontal distances to express time and vertical distances to show the space covered by falling balls when two were dropped together or one following the other. Leonardo, however, left no group to carry on his engineering works, which were little understood by his immediate contemporaries and successors.



Early Work on Books Was Done in Monasteries

The American Statistical Association, formed in 1839, now celebrating its one hundredth anniversary, is the earliest specialized scientific organization in this country. The American Philosophical Society, organized by Benjamin Franklin in Philadelphia, was, of course, earlier but its activities cover such a wide field as to put it in a different class. The American Society of Civil Engineers founded in 1876, was followed by the American Society of Mechanical Engineers in 1880 and then by numerous other engineering and scientific societies. The presentation of their papers in edited transactions has resulted in rapid advance in varied chart techniques.

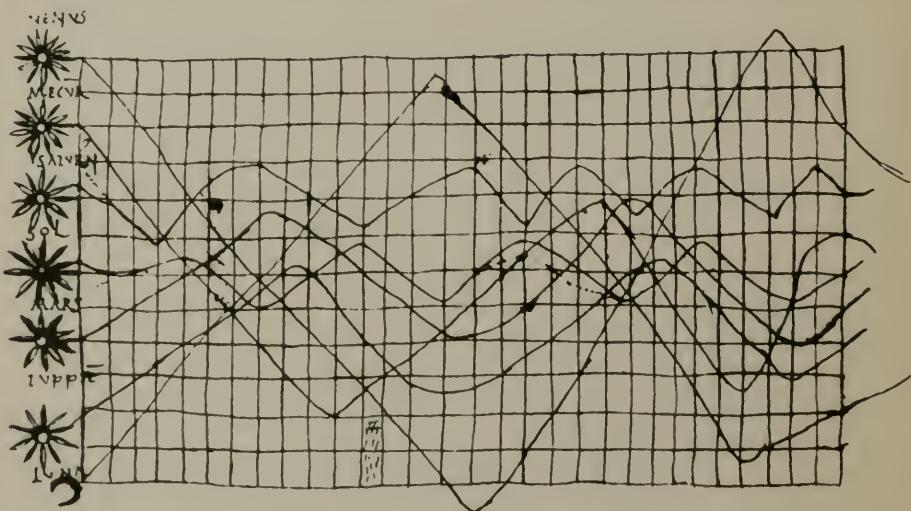
In spite of all that Playfair pointed out a century and a half ago, and the interest shown by a few college instructors during recent years, there is still insignificant use of graphic presentation

GRAPHIC PRESENTATION

methods in the field of education. Educators themselves do relatively little to analyze the methods for transmitting facts and ideas.

At present most educators are graphically illiterate. An educator, or person with a message to give is referred to as: lecturer, speaker, orator, preacher, narrator, reciter, etc. These words generally imply the conveyance of a message through the ear without reference to the eye. Until the cinema was equipped with sound there was a move to use the word "optience" instead of "audience." Although the moving picture now combines perception through both the eye and the ear, the messages generally conveyed today by the motion picture are descriptive rather than quantitative. The moving picture projector has not thus far been a great influence for introducing the type of graphic presentation indicated in this book. Lantern slides, and more recently, slide films, have been important factors.

There are interesting possibilities if educational institutions would seriously study the methods for presenting ideas and facts, and then, as their instructors qualified in the new technique, designate each by the term "Presentor." In a similar way, a student might be called a "Perceivor." Each of these terms implies re-



H. Gray Funkhouser, "A Note on a Tenth Century Graph," OSIRIS, Vol. I, 1936.

A Tenth Century Graph That Forms a Part of a Manuscript Discovered by Sigmund Gunther in 1877

According to the article by Dr. Funkhouser, from which this illustration was taken, the graph was meant to represent a plot of the inclinations of the planetary orbits as a function of the time.

INTRODUCTION

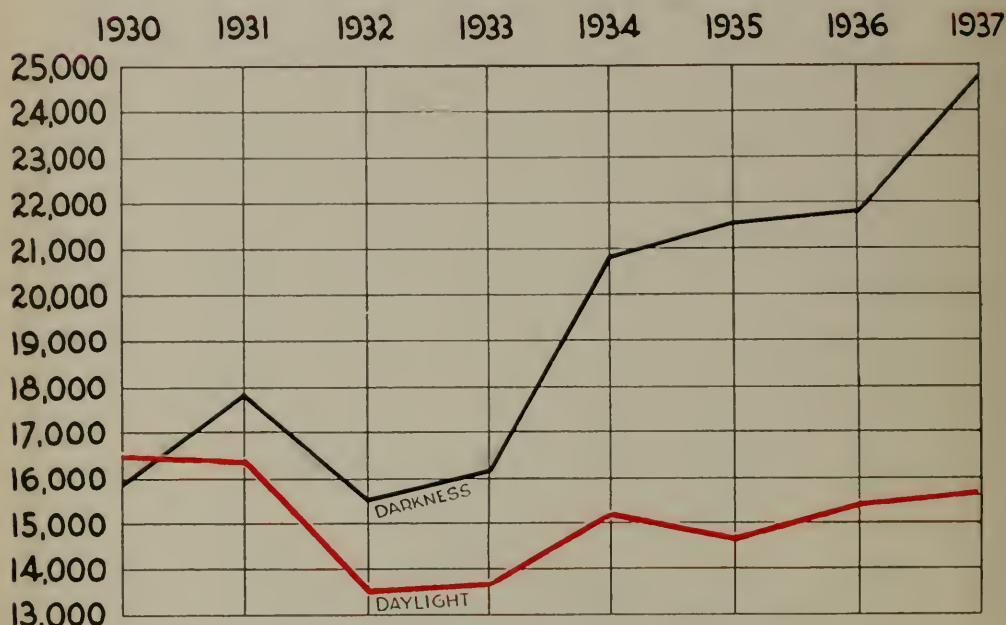
sponsibility for results. These terms are not limited in their scope to the field of education. Anyone planning a conference, convention, committee, discussion, assembly, council, etc., might do well to consider the method for presenting the subject matter. How many of these meetings today are just talk? If each participant would consider himself as a Presentor of data or ideas that he is especially qualified to contribute to the group, there would be less misunderstanding and more conclusive action.

We are still expressing ourselves in meetings by the traditional methods the old patriarchs used to pass on the folklore of the tribe —by word of mouth. While the newspaper, the movie and the radio are being used to present descriptive material to secure public approval, quantitative presentations are relatively rare in publicity campaigns. The introduction of quantitative expression in every phase of life can lend itself to great future progress. There has been some discussion of the effectiveness of graphic methods to convey facts and ideas, but no comprehensive analysis has thus



Rene Descartes, 1596-1650

DEATH AFTER DARK



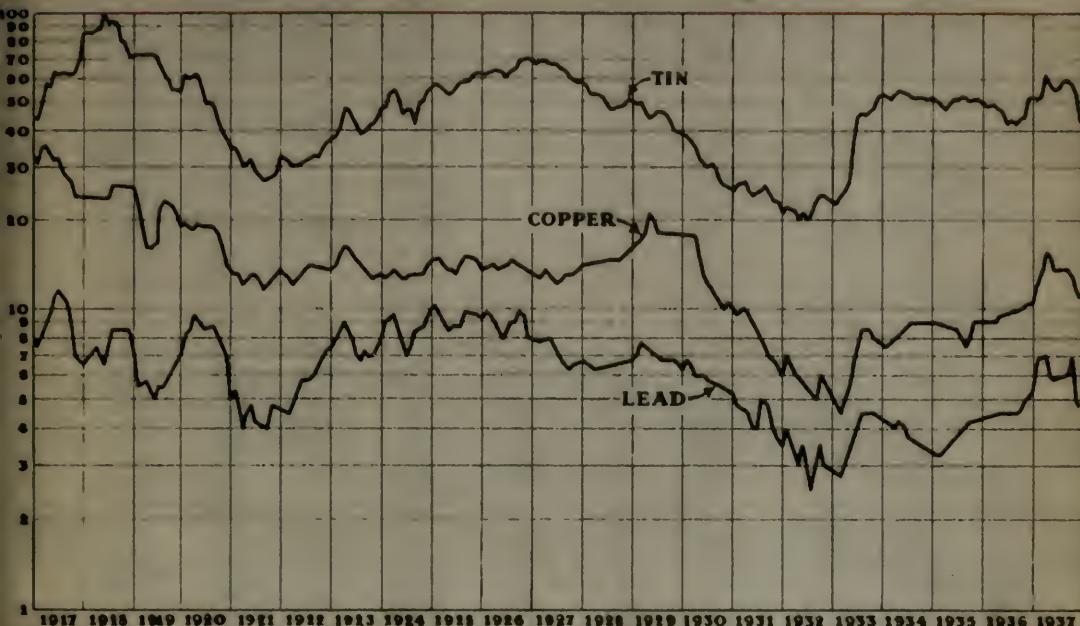
How Charts Ought Not to Be Made

The omission of the zero line in this chart gives a false impression of the relative values of the number of accidents during the hours of darkness and during daylight.

far been made measuring results from organized material carefully prepared and presented graphically.

The question is sometimes raised as to how you can present in graphic chart form, abstruse ideas which have not yet been reduced to words. Engineers and other people who are accustomed to using graphic methods are likely to approach the problem thinking graphically. They are apt to list the factors involved and then try different types of organization charts, etc., to work out the relations and size of the different factors.

INTRODUCTION



Ratio Chart Showing Prices of Non-Ferrous Metals in the United States from 1917 to 1937.

The above chart was reduced from one transmitted by Western Union automatic telegraph, showing that, as machines are installed, graphic charts may be sent from one city to another. Service is now available only in New York, Buffalo, and Chicago. Other cities will be added.

Graphic charts present unusually comprehensive data in condensed form for analysis and interpretation. Major libraries should contain a division of graphic charts. Filing most of the material could be easily done by placing material in the usual letter vertical files. Provision should, of course, be made for cross references. Probably it would be desirable to have two sections, one for scientific and technical data, the other to contain all other material. To aid those studying graphic presentations, larger libraries would do well to have a separate file classified according to types of graphic charts, irrespective of the subject matter.

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Selvage, James P., and Morris M. Lee, *Making the Annual Report Speak for Industry*, Compiled by National Association of Manufacturers, McGraw-Hill Book Company, Inc., New York City, December 1938.

Chapter 2

GRAPHIC NARRATIVE

Synonyms for graphic narrative are: ideographic drawings, pictograms, figurative symbols, pictographic charts, and hieroglyphs. Graphic narrative may involve the keeping of records, quality of materials, time, or quantities.



Walker Engraving Corporation, New York.

SCALE .7

A Stone Age Man's Painting of a Bison.

1. Long before a written language had evolved, man recorded his actions and accomplishments in stone carvings and paintings.
2. Although it is not certain that the picture above is one of a bison which the painter has slain, it is probable.
3. This early recognition of the value of a painting in preference to a verbal description is the forerunner of the use of illustrations in modern textbooks.

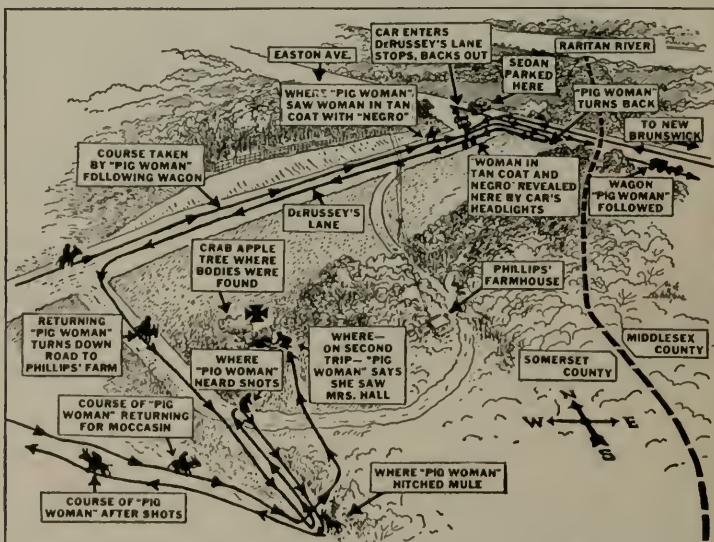
GRAPHIC PRESENTATION

CHARACTERISTICS OF GRAPHIC NARRATIVE CHARTS

1. A picture is more universally understood than a word description.
2. Graphic narrative is adaptable for poster use and has a great deal of popular appeal.
3. There are few rules for, or restrictions on, the use of graphic narratives.
4. Quantitative data may be shown or suggested in graphic narrative form. The picture may stand alone or may be accompanied by comments of explanation.

BASIC ENGLISH

Basic English is a system of 850 words and five simple rules for putting them together, which was the invention of Mr. C. K. Ogden of the Orthological Institute, Cambridge, England. It will do the work of 20,000 words of English for the normal purposes of trade, science, and everyday living. Special lists for general science and for any special science put the number of words up to 1,000, with



Liberty Magazine, April 13, 1929.

SCALE .9

The Pig Woman's Story of Her Movements and Observations on the Night of the Hall-Mills Murder.

This form of graphic narrative may be used to accompany fiction as well as fact. It is very simple in idea—it gives the story in time sequence.

GRAPHIC NARRATIVE

the addition of which the international signs of chemistry, for example, may be made to do their work at the expert level. Its interest for the writer of this book is that graphics—the international language of the eye—may be made completely international if Basic English is used where any words are necessary.

Basic may be learned in a month by a quick learner, working privately, or in a year or less in school. To the eye and ear it is not different from normal English, and it takes only a very short time to get the trick of writing and talking in it.

Of 1,500 living languages, only seven are used by more than sixty million persons. Of these seven, English is by far the commonest. It is the natural, or government language of six hundred million, it has for a long time been the second language of the Far East, and is now learned in schools in all parts of the earth. It is the language of the seas, of trade, to a great degree of science, of the moving pictures and radio. Basic English is an international form of this most international of living tongues.

This account of the system is in Basic English.

Further facts about Basic English may be had from the Payne Fund, 1 Madison Avenue, New York City, or the Orthological Institute, Cambridge, England.

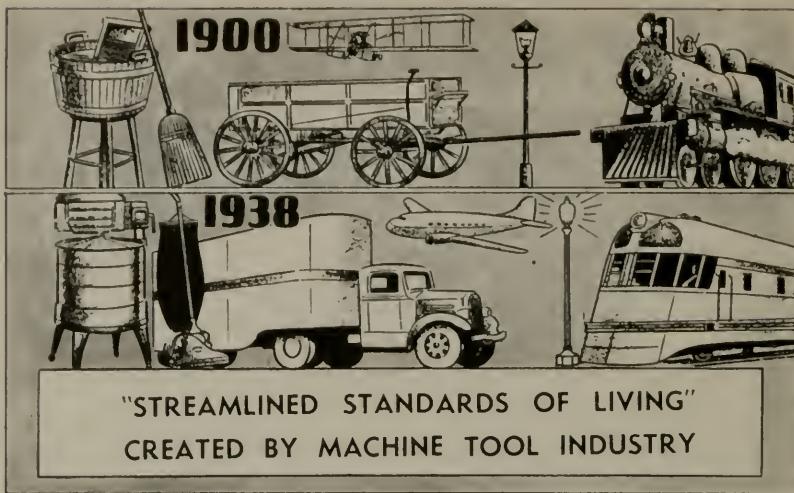


Textile World, October 1938, Part of an Editorial on Public Relations Entitled "Textiles a Source of Purchasing Power."

An Analysis of the Textile Community.

Without representing the pictorial items quantitatively, this form of graphic picture gives a concise analysis of the textile community. It was used effectively as an illustration for a public relations editorial.

GRAPHIC PRESENTATION



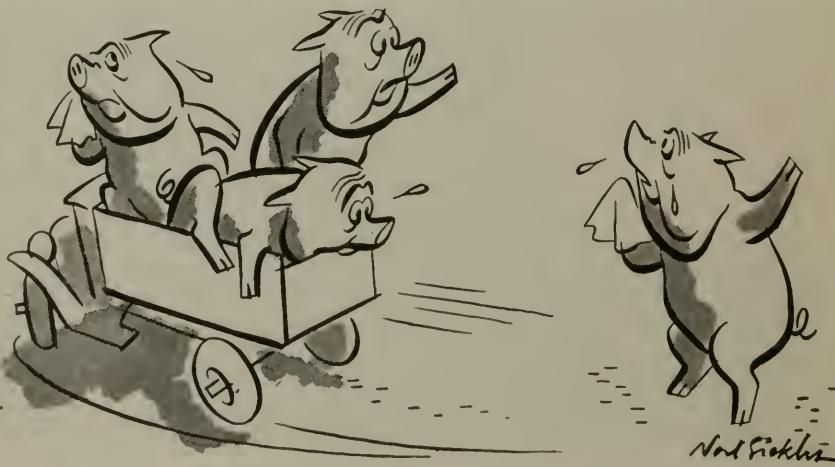
United States News, Washington, D. C., June 20, 1938.

SCALE .6

A. The Story of American Efficiency in the Machine Tool Industry.

Here is a vivid story of the changes that have taken place in history. It is purely a qualitative analysis:—the wagon has been replaced by the truck; the broom by the vacuum cleaner.

THREE-FOURTHS OF PIGS GO TO MARKET BY TRUCK

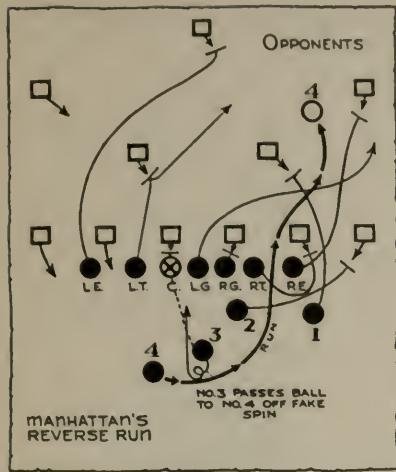


Automobile Manufacturers Association, "Automobile Facts," September 1938

B. A Graphic Presentation of the Fact That Three-Fourths of the Pigs in the United States Go to Market by Truck.

The use of pictures to represent 3 out of 4 or 7 out of 10 or 4 out of 5 has been used for many years. It is still an effective method of presenting percentage analysis.

GRAPHIC NARRATIVE



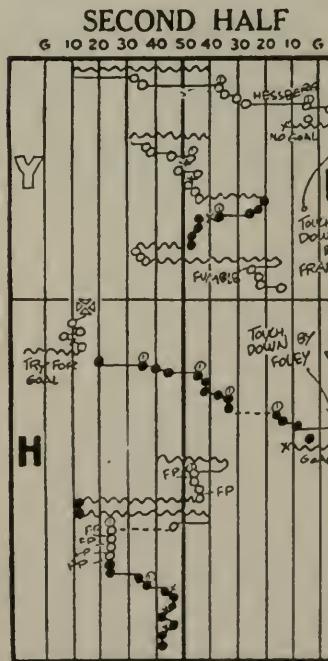
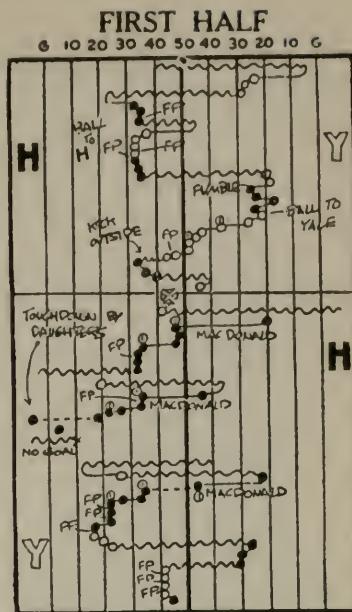
New York Journal and American. SCALE .5

A. Famous Football Plays: Manhattan College Reverse Run.

An explanation of a football play, either before a game or after a game, is a well-known form of graphic narrative. Players on each side are indicated by squares, circles, or other distinctive symbols, and the movements of the various players are indicated by arrows.

B. The Harvard-Yale Game of 1937. The Score Was 13 to 6 in Favor of Harvard.

1. After the "game," spectators often would like to have a picture of the various plays before them so that any confusion as to what actually did occur may be seen at a glance.
2. The work sheets from which the above chart was made were of heavy cardboard and easy to handle at the game. It may be possible that standards for this type of chart will evolve in the future.

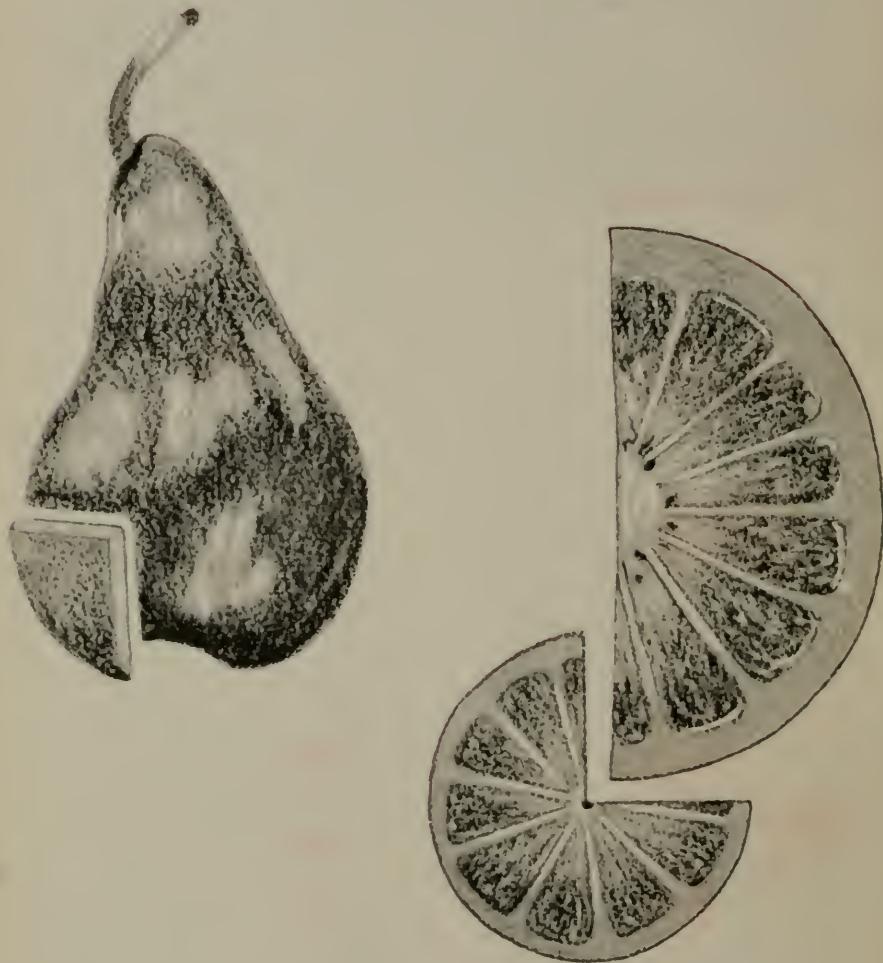


● HARVARD ○ YALE ⚪ DOWNS
— RUSH ~~~ RUSH, X PENALTY
--- FP FORWARD PASS □ PLAY RESUMED

Victor O. Jones, Sports Editor, Boston Globe.

GRAPHIC PRESENTATION

Compare the charts in this chapter with those in "Pictorial Unit Bar Charts," pages 121-131.



Redrawn from Fortune Magazine, February 1932.

The Use of Segments of Fruit to Represent Quantities.

With the modern emphasis on novelty, the use of segments of fruit to represent quantities should be an effective one. A quarter segment of a lemon to represent the production by the United States of a fourth of the world's lemons, or a half segment of grapefruit to represent the production by the United States of half the world's grapefruit, would be much more vivid than the same information presented in verbal form or even bar-chart form.

GRAPHIC NARRATIVE



You choose the plot and plan you want; you seek a loan... The lender turns to F.H.A., they study and approve... The lender, insured, provides the money.

F.H.A. approval is given if your income is sufficient and steady, your credit good. Your house must conform to essential F.H.A. requirements, as illustrated below:



The design must be architecturally sound, readily salable.



The construction must be good, resisting weather and use.



The plan must be practical (left), not inconvenient.



Equipment must be appropriate to house and neighborhood.

House and Garden, June 1938.

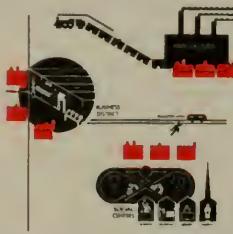
The Procedure for Securing a Federal Housing Administration-Insured Mortgage in the United States in 1938.

Stories have been told by pictures since prehistoric times. Here the story was told graphically but the verbal narrative was also included. The pictures attract attention; the words make sure that the picture is understood; and the combination of the two results in the reader remembering the procedure for securing an F.H.A.-insured mortgage.

How to get an F.H.A.-insured mortgage—graphically told in words, pictures and charts



F.H.A. loans against new houses in a neighborhood.



Here are the three components of a town plan as they affect the homebuyer: first, buildings on the part of business and industry; second, buildings on the part of residential, educational, cultural, and other civic centers; and third, transportation, schools and other civic centers.



First, express the location (in red) because the kind of house where it rests becomes the kind of house where it rests and the design is homogeneous.



The house is representative of the location because rough values are used; the new design breaks fixed city trends.



An appropriate house in an appropriate neighborhood, or next house is economically around lower value.

SCALE .6

GRAPHIC PRESENTATION

Transparent material on which pictures and words may be printed has made possible a new type of book. It is literally a book, but a book that builds up a given idea, subject, or problem step by step as the pages are turned. By the use of transparent pages and an ingenious pictorial scheme, a *complete* story is spread out before the individual as a *complete whole*. The book is planned so that it can be read from front to back or back to front with the story differing according to which way the book is read. After the subject is built up, it may be reversed from the other angle. Since the page is transparent, the subject matter is carried through the page, presenting the other side of the same material.

Educators, advertisers, science, and industry may use this new tool to unfold an object, lesson, or product in a practical, pictorial manner where the spoken or written word is often misinterpreted or misunderstood. It greatly simplifies the presentation of any object, and produces a vivid mental picture which is easily retained.

Sources:

*Offset Gravure Corporation, Long Island City, New York
S. Theo Jonas, 10 West Jackson Boulevard, Chicago, Illinois*

**When You're ROLLING ALONG
Think About 'ROLLING OVER!'**



25 Miles an Hour



50 Miles an Hour



75 Miles an Hour

Travelers Insurance Co., Hartford, Conn.

Graphic Presentation of the "Turnability" of an Automobile Traveling at Three Rates of Speed.

Chapter 3

TABULATION

ATTRACTIVENESS can be a characteristic of statistical tables. Adherence to certain simple suggestions will improve their appearance. Designing is an integral part of every table and should be carefully planned. The actual form which any table takes depends upon the data to be presented.

For suggestions relative to setting up tabulation for reproduction, see the Vari-typer in Chapter 44 and the material about type-setting in Chapter 51.

CLASSIFICATION		TOTAL COUNT
Engines	//	2
Coal Cars	//	2
Mail Cars	///	3
Baggage Cars	///	4
Coaches	### //	7
Diners	///	3
Pullmans	### /	6
Observations	///	3

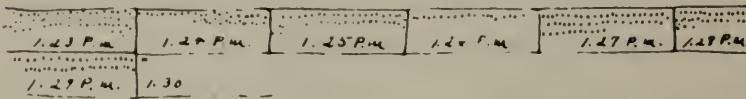
A Simple Method of Tallying.

1. The above method of tallying, while simple, lends itself to practically all counting procedures.
2. Often, rather than count everything there is to count, one "sample" count or several are taken. The average of the total of these samples, if chosen according to a logical plan, will give the same result as would be obtained if all were counted.

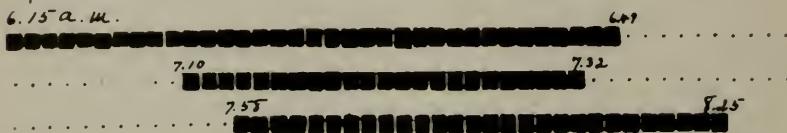
REFERENCES

Day, E. E., "Standardization of the Construction of Statistical Tables," *Journal of the American Statistical Association*, Vol. 17, March 1920. This issue of the *Journal* is so limited that the American Statistical Association cannot sell it. However, it is available in most libraries.

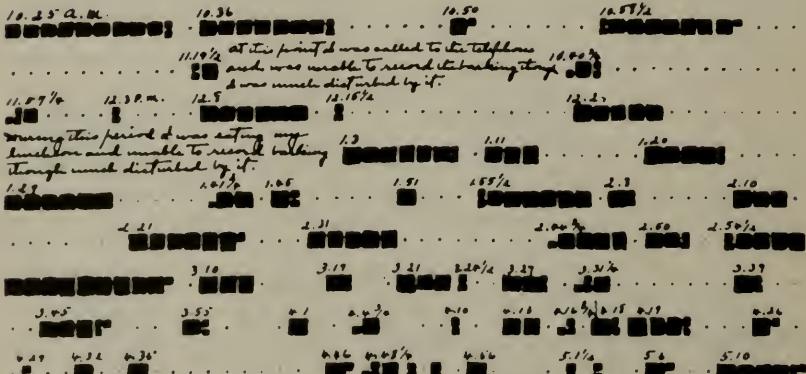
Each dot represents
a bark, each ablong, minute. The specimens shown
are typical of the whole period.



Each black square represents 1 minute of barking. Each dot represents 1 minute of quiet.



August 14, 1930. Record of periods of barking. Large black squares represent 1 minute of barking by from 1 to upwards of 20 dogs. Small black squares represent ½ minute of barking. Small white squares represent ½ minute of quiet. Dots represent 1 minute of quiet.



Three Methods of Tallying the Barking of Dogs. Data for Use in a Lawsuit. SCALE .5
Since intelligent planning preceded the tallying of this information, there was no need to record it in the form of tables.

TABULATION

Mudgett, Bruce D., *Statistical Tables and Graphs*, Houghton Mifflin Company, Boston, Mass., 1930

U. S. Department of Agriculture, Bureau of Agricultural Economics, *The Preparation of Statistical Tables*, 1937. A pamphlet distributed free of charge.

Walker, Helen and Walter Durost, *Statistical Tables: Their Structure and Use* (Bureau of Publications), Teachers College, Columbia University, New York City, 1936

	Population
Washington, D. C.	486,869
Chevy Chase, Md.	8,000
Takoma Park, Md.	6,415
Silver Spring, Md.	5,000
Hyattsville, Md.	4,264
Mt. Rainier, Md.	3,832

	Kilowatt-hours ¹
1929.	354,932,330
1930.	400,208,431
1931.	438,360,381
1932.	464,108,604
1933.	495,013,756
1934.	662,832,609

¹ Energy generated for the Washington Railway & Electric Company is not included in these figures.

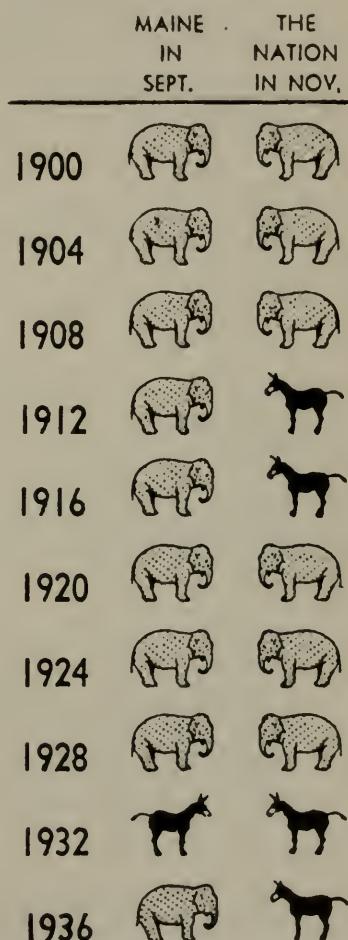
Federal Power Commission, National Power Survey, Cost of Distribution of Electricity 1936.
SCALE .7

A. Population of the Principal Cities Served by the Potomac Electric Power Company in 1934, and Trend of Service Growth from 1929 to 1934.

These are simple tables arranged according to magnitudes and chronologically. Note that the arrangement is from the top down.

B. As Maine Goes So Goes the Nation?

This diagram shows that Maine, the state which had its election first, forecasted the result of the presidential election with approximate accuracy. The forecast has been "wrong" three times up through 1936. In 1940, however, Maine will hold its election at the same time as the other states.



Adapted from The Philadelphia Evening Bulletin.

GRAPHIC PRESENTATION

MANUFACTURES.

TABLE 53.—DETAILED STATEMENT FOR THE UNITED STATES.

DIVISION AND STATE.	Number of establish- ments	Total	PARSONS ENGAGED IN MANUFACTURING INDUSTRIES.											
			Proprietors and officials.				Clerks, etc.		Average number of wage earners.				Wage earners employed 15th day of—	
			Total	Male	Female	Propri- etary and from members	Sale- rial offi- cers of cor- porations	Super- in- ten- dents and man- agers	Male	Fe- male	Total	Male	Fe- male	Male

GENERAL TABLES.

BY GEOGRAPHIC DIVISIONS AND STATES: 1919.

Capital.	EXPENSE.												Value of products	Value added by manufacture	Primary horse-power
	Salaries and wages.			For contract work	Rent and taxes.		For materials.			Total	Principal materials	Fuel and rent of power			
	Officials	Clerks, etc.	Wage earners		Rent of factory	Taxes, Federal, State, county, and local	Total	Principal materials	Fuel and rent of power						

TABLE 53.—DETAILED STATEMENT FOR THE UNITED STATES

DIVISION AND STATE	NUM- BER OF ESTAB- LISH- MENTS	Total	PARSONS ENGAGED IN MANUFACTURING INDUSTRIES											
			Proprietors and Officials				Clerks, etc.		Average Number of Wage Earners				Wage Earners Employed 15th Day of—	
			Total	Male	Female	Propri- etary and from members	Sale- rial offi- cers of cor- porations	Super- in- ten- dents and man- agers	Male	Fe- male	Total	Male	Fe- male	Male

BY GEOGRAPHIC DIVISIONS AND STATES: 1919.

CAPITAL	EXPENSE												Value of Products	Value Added by Manufacture	Primary Horse- Power
	Salaries and Wages			For Contract Work	Rent and Taxes		For Materials			Total	Principal Materials	Fuel and Rent of Power			
	Officials	Clerks, etc.	Wage Earners		Rent of factory	Taxes, Federal, State, County, and Local	Total	Principal Materials	Fuel and Rent of Power						

Bruce D. Mudgett, "Statistical Tables & Graphs," Houghton Mifflin Co., 1930.

SCALE .7

Two Methods of Boxing to Show Coordinate and Subordinate Relationships.

1. The use of single and double lines, as shown in the two upper tables, fails to maintain coordinate and subordinate distinctions. The width of line in the lower two tables reinforces the boxing arrangement to show coordinate and subordinate relationships.
2. The caption headings have also been changed to aid reading.

TABULATION

-Value of Public-Building and Highway-Construction Awards Financed Wholly From State Funds¹

Geographic division	Value of awards for public building ¹			Value of awards for highway construction		
	June 1938	May 1938	June 1937	June 1938	May 1938	June 1937
	\$1,708,748	\$938,211	\$1,502,167	\$12,230,069	\$13,571,996	\$8,621,883
All divisions.....	103,811	4,375	974	669,455	423,571	614,837
New England.....	939,977	431,637	45,573	1,656,663	3,754,975	1,821,320
Middle Atlantic.....	431,472	291,032	384,428	2,304,213	2,936,768	2,470,513
East North Central.....	38,985	1,680	377,461	727,251	671,612	1,008,710
West North Central.....	29,150	168,472	3,919	2,084,882	926,816	388,732
South Atlantic.....						
East South Central.....			402,000	1,027,581	1,004,135	191,222
West South Central.....	159,853	23,000	109,060	2,547,350	1,363,384	876,543
Mountain.....	5,500	18,025	97,312	677,725	4,147	161,123
Pacific.....			83,800	535,573	2,483,148	1,079,853

¹ Preliminary, subject to revision.

² Data for building projects which were located in the cities reporting to the Bureau are included also in tables 1, 2, 3, 5, 7, 9, and 11.

U. S. Department of Labor, Bureau of Labor Statistics.

A. A Tabulation Showing the Total for All Divisions as the First Item Rather Than As the Last.

1. The total of a column may be put at the top of a table, as shown here, instead of at the bottom.
2. The use of notes to clarify box headings should be encouraged.

SUMMARY OF MEN DISPATCHED FROM CENTRAL HALL

YEAR	REGISTERED MEN DISPATCHED			NON-REGISTERED MEN DISPATCHED									
	Long-shoremen	Truckers	Total	Per Cent		Longshoremen		Truckers		Casuals	Floaters	Casuals	Floaters
				Longsh.	Truck.	No.	Per Cent of Longsh.	No.	Per Cent of Longsh.				
1922	55,070	25,210	80,280 ²	69	31								
1923	70,663	29,702	100,365	70	30								
1924	74,724	31,248	105,972	71	29								
1925	74,992	33,044	108,036	69	31								
1926	84,705	34,467	119,172	71	29								
1927	87,304	32,033	119,337	73	27								
1928	89,425	39,442	128,867	69	31	2,886	3.2	492	.55	4,894	12.6	2,976	7.5
1929	96,496	39,424	135,920	71	29	5,912	6.1	472	.49	5,746	14.6	1,955	5.0
1930	85,475	31,146	116,621	73	27	2,743	3.3	160	.19	1,785	5.7	708	2.5
1931	80,271	24,798	105,069	76	24	1,237	1.5	35	.04	602	2.4	50	.2
1932	60,965	21,505	82,470	74	26	339	.6	6	.01	469	2.2	27	.1
1933	72,508	22,289	94,797	76	24	1,075	1.5	62	.09	929	4.2	255	1.1
6 Year Average	80,856	29,767	110,623	73	27	2,365	2.9	204	.25	2,404	8.1	995	3.3

F. P. Foisie, "Decasualizing Longshore Labor and The Seattle Experience," Waterfront Employers of Seattle, Feb. 1, 1934.

SCALE .7

B. A Tabulation Showing the Summary of Longshore Labor Dispatched from the Central Hiring Hall in Seattle from 1922 Through 1933.

1. The good points of this tabulation are that the lettering is clear and easy to read, and the figures are distinct.
2. It might have been better to use wide lines to maintain the various divisions rather than the double lines. See 36.

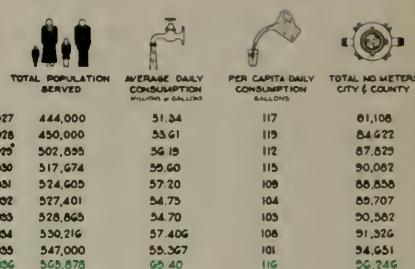
GRAPHIC PRESENTATION

	At their Average Hourly Wages			
	AMERICAN 83½¢	BELGIAN 16¢	GERMAN 29¢	ENGLISH 34¢
	Minutes	Minutes	Minutes	Minutes
Bacon-1 lb	18	156	89	45
Beef-1 lb	12	116	38	20
Bread-1 lb	5	20	27	7
Butter-1 lb	26	244	116	51
Eggs-1 Doz	18	236	120	75
Milk-1 Qt	9	37	8	21
Potatoes-1 lb	2	7	3	3
Sugar-1 lb	4	42	29	8
Total Above	94	858	430	230

American Iron and Steel Institute, "Steel Facts," May 1937.

SCALE .7

A. A Tabulation of the Length of Time American and Foreign Steel Employees Must Work to Buy the Same Amount of Typical Foods.



"IN 1925 THE CITY BEGAN TO SERVE SOME OF THE AREA OF HAMILTON COUNTY

City of Cincinnati, "Municipal Activities," 1936.
SCALE .5

B. Water Consumption of the City of Cincinnati from 1927 through 1936.

The only difference between this and straight tabulation is that the stub headings are presented pictorially as well as verbally.

	CONSUMER BUYING HABITS AT BEAVER DAM, WISCONSIN													
	Of This % This Is Where They Go		This Is Where Farmers Go		This Is Where "White Collar" Go									
	% Buying Out of Town	Other Towns	Mail Order	Post Office	% Farmers Buying Out of Town	Other Towns	Mail Order	Post Office	% Buyers Buying Out of Town	Other Towns	Mail Order	Post Office		
AUTO SUPPLIES	18.0	40.3	43.0	46.3	48.3	44.8	48.6	49.6	26.0	71.6	96.5	80.7	82.8	78.0
GROCERIES	4.9	20.0	18.0	19.3	6.0	40.0	50.0	52.0	62.0	100.0	—	19.6	—	100.0
LUMBER	5.0	85.0	18.0	46.0	7.0	78.0	55.0	19.7	10.0	100.0	—	19.7	100.0	—
DRUGS	14.0	27.0	6.0	14.0	57.0	50.0	62.0	52.0	100.0	—	14.0	—	100.0	—
HARDWARE	11.0	30.0	6.0	8.0	8.0	50.0	70.0	10.0	50.0	40.0	56.0	45.0	57.0	—
DRY GOODS	0.0	70.0	50.0	90.0	37.0	37.0	86.7	28.0	77.0	92.0	25.0	60.0	60.0	0.0
JEWELRY	4.0	87.0	18.0	30.0	78.0	0.0	87.0	100.0	10.0	100.0	—	18.0	100.0	—
ELECTRICAL GOODS	11.0	36.0	6.0	9.0	47.0	33.0	86.7	10.0	100.0	—	48.0	85.0	78.0	—
REFRIGERATORS	0.0	100.0	—	75.0	100.0	—	100.0	—	50.0	50.0	—	50.0	42.0	70.0
RAILROADS	0.0	80.0	70.0	0.0	60.0	75.0	86.0	50.0	50.0	50.0	—	42.0	48.0	40.0
MAN'S CLOTHING	60.0	74.0	66.0	50.0	75.0	88.0	50.0	50.0	50.0	50.0	—	47.0	61.0	26.0
CHILD'S CLOTHING	65.0	69.0	51.0	18.0	60.0	60.0	64.0	64.0	13.0	13.0	—	56.0	70.0	29.0
WOMEN'S CLOTHING	82.7	85.5	18.7	80.7	78.0	97.7	41.0	84.0	8.5	8.5	—	56.0	70.0	29.0
SHOES	82.0	81.5	18.0	80.0	81.0	18.1	46.0	90.0	100.0	—	51.0	70.0	38.0	—
HIGHWAY	10.0	28.0	61.0	5.0	20.0	80.0	50.0	61.1	77.0	14.0	14.0	68.0	30.0	80.0
NOVELTIES	12.7	62.5	9.0	8.7	8.8	100.0	—	57.0	55.0	10.7	—	58.0	65.0	14.0
SKINS AND FURS	7.0	60.0	6.5	7.0	75.0	83.0	44.0	10.7	100.0	—	9.0	100.0	—	—
FURNITURE	16.0	81.1	60.0	55.0	50.0	50.0	50.0	52.5	90.0	30.0	—	52.5	64.0	50.0

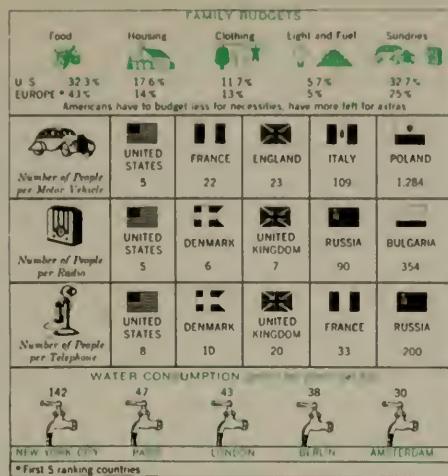
American Business, May 1938.

SCALE .6

C. An Analysis of Consumer Buying Habits at Beaver Dam, Wisconsin, in 1937.

The wide lines between the boxes emphasize the relationships among the various columns.

TABULATION



Literary Digest, August 29, 1936.

SCALE .5

A. A Comparison of Living Standards of the United States and Foreign Nations in 1936.

The use of visual titles in tabulating material to be read by all nations is an almost sure guarantee that the tabulation will be understood. Although this graph was published in an American magazine, it would be equally comprehensible to people of other nations.

Table 1: Temperatures

Temp. Fahr. t	Pressure lbs. atmos p	Sp. Vol. v or s	Density cu. ft. lbs. per lb. cu. ft. 1/y	Heat of the liquid h or q	Latent heat of evap. L or r	Total heat of steam H	Internal Energy			Entropy			Temp. Fahr. t
							B. t. u. l or p	Evap. Steam E	Water n or θ L/Torr/T	Evap. Steam n or φ L/Torr/T	Steam n or φ L/Torr/T		
280°	49.18	3.347	8.64	0.1157	249.0	924.3	1173.3	845.9	1094.8	0.4098	1.2496	1.6594	280°
281	49.97	3.401	8.51	0.1174	250.1	923.5	1173.6	845.1	1095.0	0.4112	1.2470	1.6582	281
282	50.77	3.455	8.38	0.1192	251.1	922.8	1173.9	844.3	1095.2	0.4126	1.2443	1.6569	282
283	51.58	3.510	8.26	0.1210	252.1	922.1	1174.2	843.5	1095.4	0.4140	1.2416	1.6556	283
284	52.40	3.566	8.14	0.1228	253.1	921.3	1174.4	842.7	1095.6	0.4154	1.2389	1.6543	284
285°	53.24	3.623	8.02	0.1246	254.2	920.5	1174.7	841.9	1095.9	0.4168	1.2363	1.6531	285°
286	54.08	3.680	7.90	0.1264	255.2	919.8	1175.0	841.1	1096.1	0.4181	1.2337	1.6518	286
287	54.93	3.738	7.79	0.1283	256.2	919.1	1175.3	840.3	1096.3	0.4195	1.2311	1.6506	287
288	55.79	3.797	7.68	0.1302	257.2	918.4	1175.6	839.5	1096.5	0.4209	1.2284	1.6493	288
289	56.67	3.856	7.57	0.1322	258.3	917.6	1175.9	838.6	1096.7	0.4222	1.2258	1.6480	289
290°	57.55	3.916	7.46	0.1341	259.3	916.9	1176.2	837.8	1097.0	0.4235	1.2232	1.6467	290°
291	58.44	3.977	7.35	0.1360	260.3	916.2	1176.5	837.0	1097.2	0.4249	1.2205	1.6454	291
292	59.34	4.038	7.24	0.1380	261.3	915.4	1176.8	836.2	1097.4	0.4262	1.2179	1.6441	292
293	60.26	4.100	7.14	0.1400	262.4	914.7	1177.1	835.4	1097.6	0.4276	1.2153	1.6429	293
294	61.19	4.163	7.04	0.1421	263.4	914.0	1177.4	834.6	1097.8	0.4290	1.2127	1.6417	294

Lionel S. Marks and Harvey N. Davis, "Tables and Diagrams of the Thermal Properties of Saturated and Superheated Steam," Longmans, Green and Co., 1909.

B. A Tabular Arrangement.

Note the grouping of the rows of figures into fives. The type was selected to aid the reading of the figures. These two improvements have, according to the authors, made the tables much more legible than they were in previous editions.

GRAPHIC PRESENTATION

MACHINE TABULATION

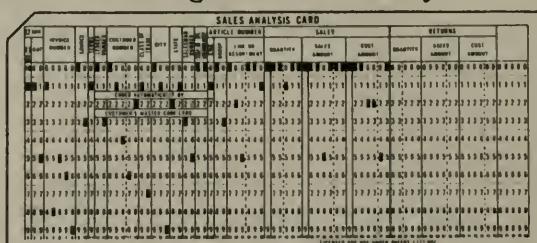
Punched card tabulating machines have proved a great aid in sorting and accumulating data. The information need not be purely statistical. Cards such as the one shown below are the basis of the punched card plan. Each card is a general-purpose record for one item, one customer, one salesman, or one person, etc.

Holes are first punched in pre-determined positions on the cards according to the data registered.

A sorting machine is used to group the cards according to the information punched in them. The cards are guided automatically into receiving pockets according to the position of the punched holes in the vertical columns. The automatic sorting is made on one column at a time. It is apparent, therefore, that to arrange a group of cards in numerical sequence according to the data punched in a three-column field, the group of cards is passed through the sorting machine three times.

The third step in mechanical tabulation is the automatic compilation of the punched data. This is done in the tabulator. In a non-printing tabulator, the information is merely accumulated in dials. In another type of machine, the data may be automatically added and printed.

Machines for mechanical tabulation are built by International Business Machines Company, New York City, and Remington Rand, Inc., New York City. Tabulating work is done on a service basis in various cities throughout the country.



International Business Machine Co., New York City.

Punched Card for Use in Machine Tabulation.

1. Tabulating cards are made of paper stock carefully processed to permit of extremely rapid actuation of all three machines—the punch, the sorter, and the tabulator. The card size is $7\frac{3}{8}$ " x $3\frac{1}{4}$ ".
 2. Cards may be punched for each item or classification on a customer's invoice showing, for example, customer number, salesman, district or territory, trade class, complete item identification, and amount.
 3. All cards may be balanced to a control and at any time can be sorted and tabulated to prepare various analyses.

GRAPHIC PRESENTATION

MILES PER HOUR. + D.U.'s	25 MILES PER HOUR (1 D.U.)	35 MILES PER HOUR (2 D.U.)	45 MILES PER HOUR (3 D.U.)	55 MILES PER HOUR (5 D.U.)	65 MILES PER HOUR (7 D.U.)
 OIL	½ QT. .13¢	1 QT. .25¢	1¾ QT's .43¢	3 QT's .75¢	4½ QT's \$1.13
 GASOLINE	50 GALS. \$8.75	55 GALS. \$9.63	60 GALS. \$10.50	69 GALS. \$12.08	80 GALS. \$14.00
 TIRES	\$1.50	\$3.00	\$4.50	\$7.50	\$10.50
 MAINTENANCE	\$4.00	\$5.00	\$6.60	\$10.00	\$13.00
TOTAL COST	\$14.38	\$17.88	\$22.03	\$30.33	\$38.63
COST PER MILE	1.44¢	1.79¢	2.2¢	3.03¢	3.86¢

Speed Increase	Cost per 1000 Miles	Time Saved	Cost per Hour Saved
35 to 45	\$4.15	6.4 Hours	\$.65
35 to 55	\$12.45	10.4 Hours	\$1.20
35 to 65	\$20.75	13.2 Hours	\$1.57
45 to 55	\$8.30	4.0 Hours	\$2.08
45 to 65	\$16.60	6.8 Hours	\$2.44
55 to 65	\$8.30	2.8 Hours	\$2.96

The Travelers Insurance Company, Hartford, Connecticut, "Lest We Regret," 1939.

SCALE .9

Graphic Tabulation Showing the High Cost of Speeding in the United States.

This table is based on a 1000-mile journey, with an average car, average roads, and an average driver. It does not include the economic cost of accidents, which rises in proportion to the speed at which the car is traveling.

Chapter 4

CLASSIFICATION CHARTS

IN a Classification chart the facts, data, etc., are arranged so that the place of each in relation to all others is readily seen. Quantities need not be given, although a quantitative analysis adds to the value of a classification chart. Brackets and arrows are effective tools to use in a classification chart.

REFERENCES

Karsten, Karl G., *Charts and Graphs*, Prentice-Hall, Inc., New York City, 1923.

Riggleman, John R., and Ira N. Frisbee, *Business Statistics*, 2nd edition, 1938, McGraw-Hill Book Co., Inc., New York City.

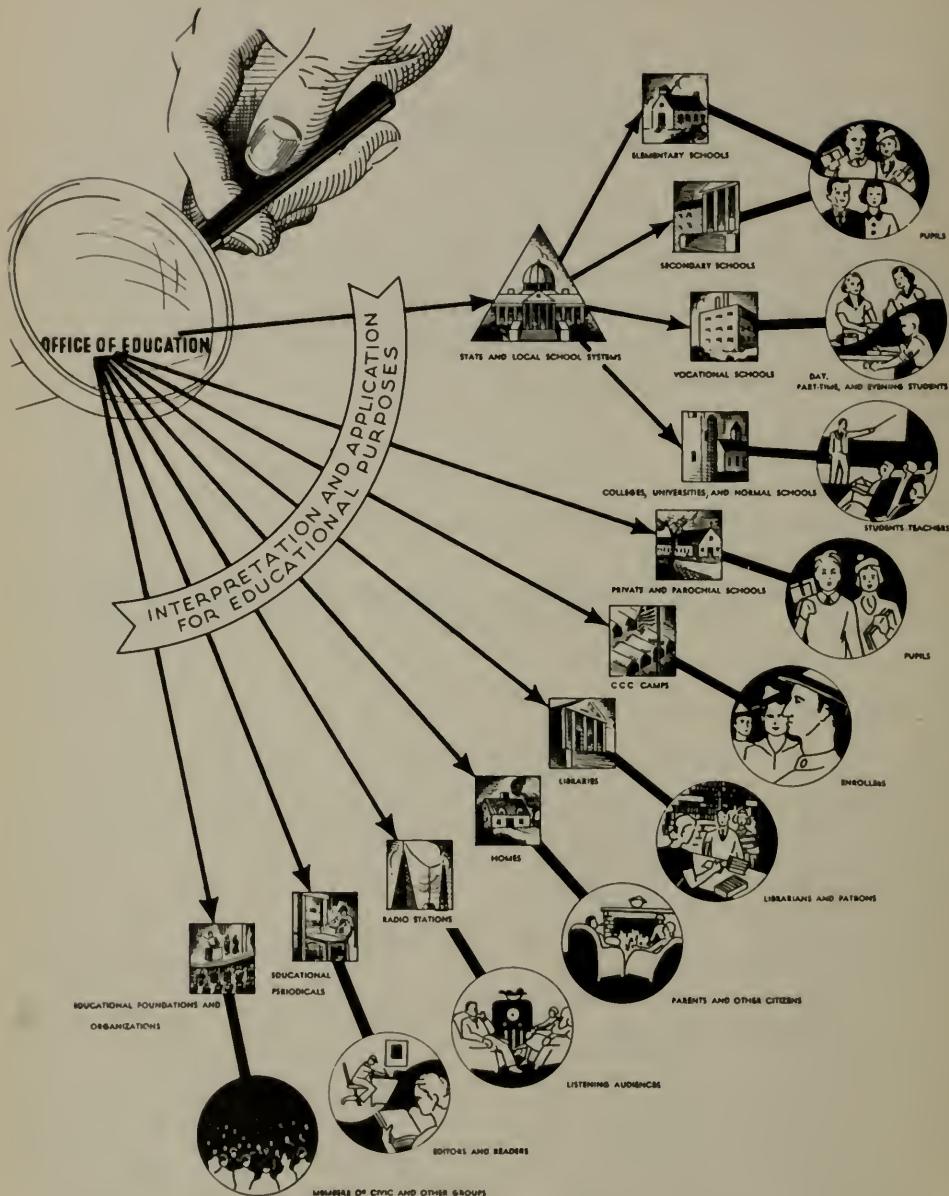
	WAR ADMIRAL, br. c. 1934
Man o' War	{ Fair Play { Hastings Mahubah { * Fairy Gold { Rock Sand { * Merry Token
Brushup	{ Sweep { Ben Brush { Annette K { Pink Domino { Harry of Hereford { * Bathing Girl
	SEABISCUIT, b.c. 1933
Hard Tack	{ Man o' War { Fair Play { Mahubah { Tea Biscuit { Rock Sand { Teas Over
Swing On	{ Wiskbroom { Broomstick { 2d { Audience { Balance { Rabelais { * Balancoire

* Imported.
War Admiral bred by S. D. Riddle.
Seabiscuit bred by Wheatley Stable,
(Mrs. H. C. Phipps).

The Pedigrees of the Race Horses War Admiral and Seabiscuit.

1. This chart shows the use of brackets in classification of data. The original was in newsprint.
2. The subject matter of this chart is the genealogy of two race horses. (The pedigrees of War Admiral and Seabiscuit show that they are both descendants of Fair Play and also of Rock Sand.)

GRAPHIC PRESENTATION



U. S. Department of Interior, Office of Education, "School Life," February, 1938.

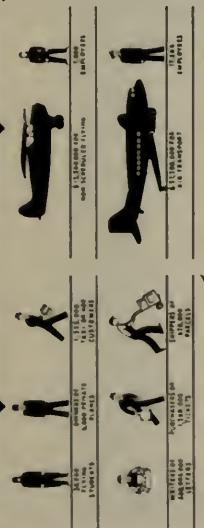
SCALE .6

The Office of Education in the United States and Its Relationships.

This chart is especially interesting because it shows graphically that to study one section of the myriad of groups in the government of the United States, that area must be "magnified."

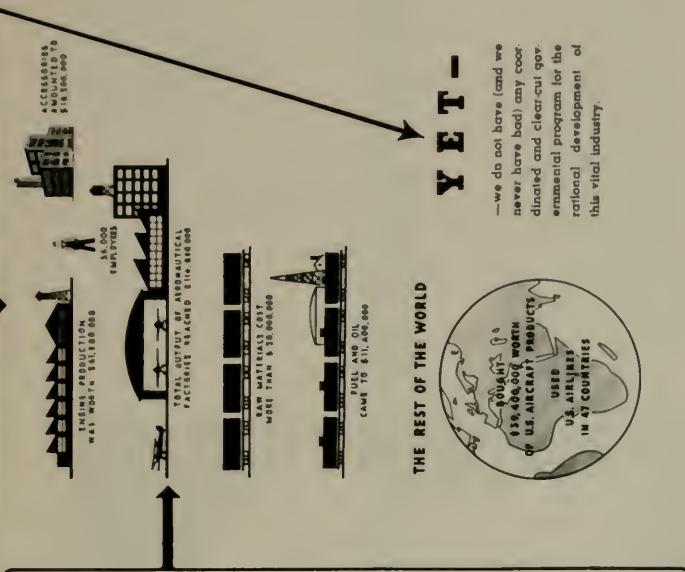
THIS COUNTRY'S AVIATION

PAID OUT \$304,600,000 FOR -



WHICH IN TURN SUPPORTED THESE ESSENTIAL INDUSTRIES

11



- 1 -

—we do not have (and we never have had) any coordinated and clear-cut government program for the rational development of this vital industry.

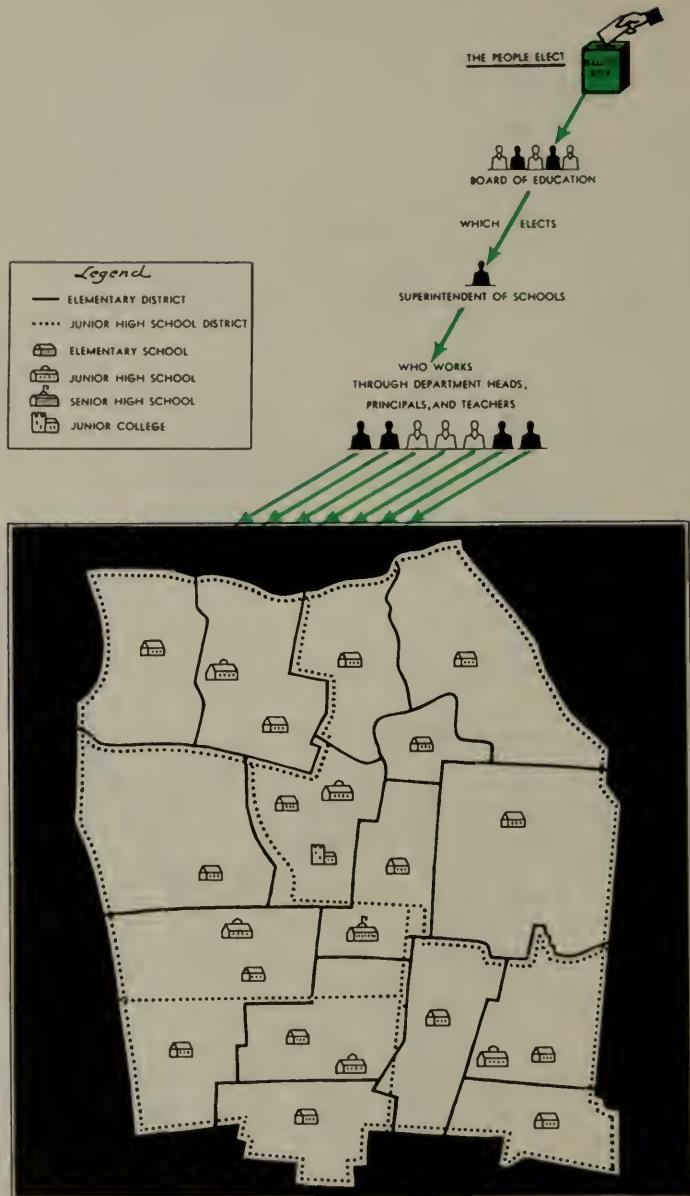
Aviation April 1938

The Relation Between Aviation and "Everybody" in the United States in 1937

The use of facts alone in an attempt to convince would be formidable. The combination of facts, illustrations, and arrows to present the amount of information given here simplifies as well as vivifies.

SCALE : 6

GRAPHIC PRESENTATION

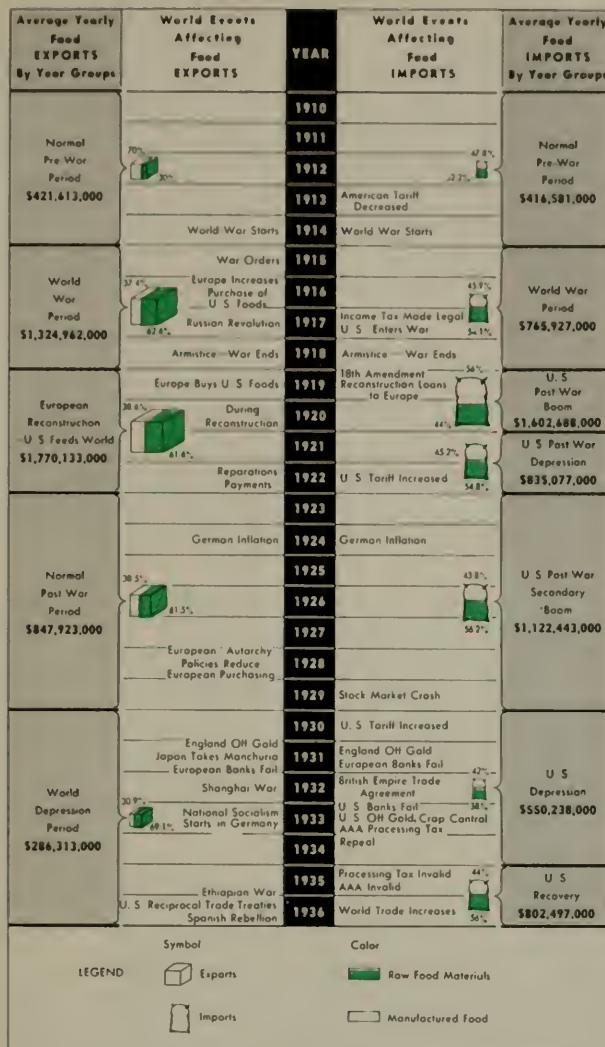


U. S. Department of Interior, Office of Education, "School Life," February, 1938.

An Organized City or County School System in the United States in 1937.

Arrows emphasize and here show the relationship between the "people" and the school system.

CLASSIFICATION CHARTS

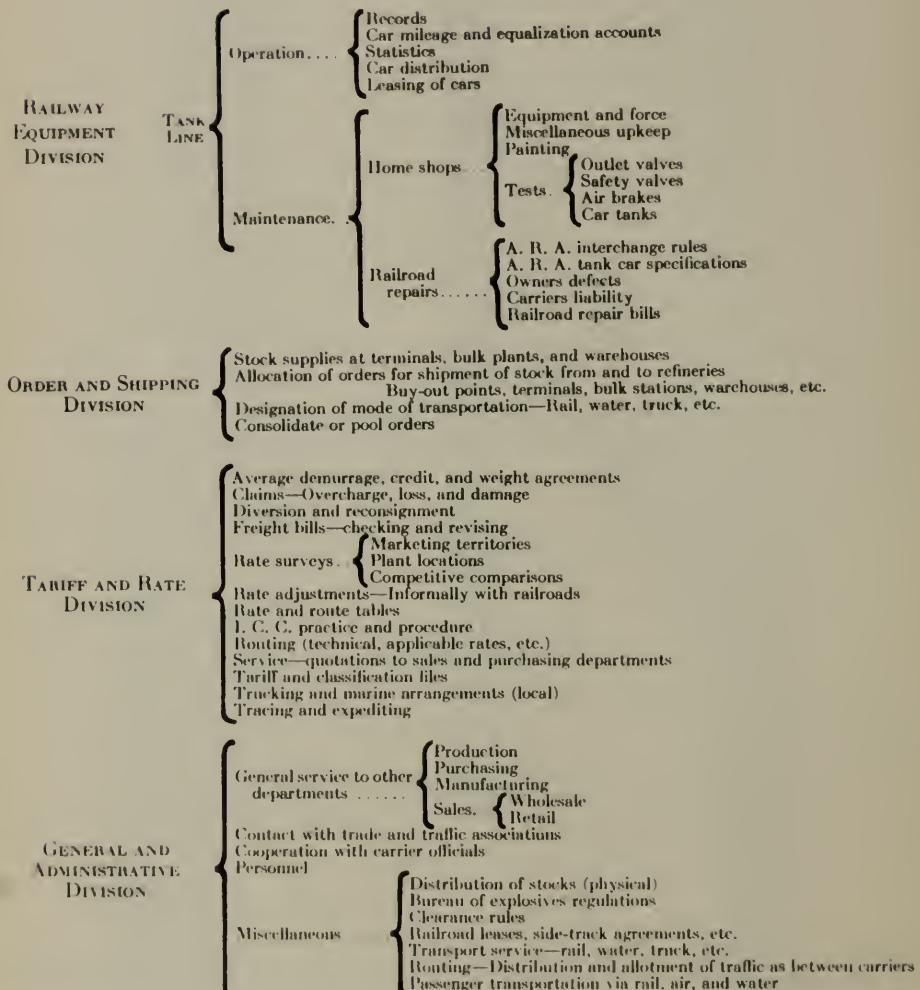


Food Industries, October, 1938, Part of an Editorial on Public Relations Entitled, "World Trade Makes Food Prices." SCALE .6

Analysis of Food Exports and Imports of the United States from 1910 to 1936.

- The years presented in this chart are divided into 5 world time-periods and 7 United States time-periods with notations of historical events.
- The analysis of exports and imports shows a comparison of our exports and imports for any one time-period, the percentage distribution of the imports for any one time-period into raw food materials and manufactured food products, and the same for total exports for any one time-period.
- In the original copy the sections labelled "raw food materials" were orange in color.

GRAPHIC PRESENTATION



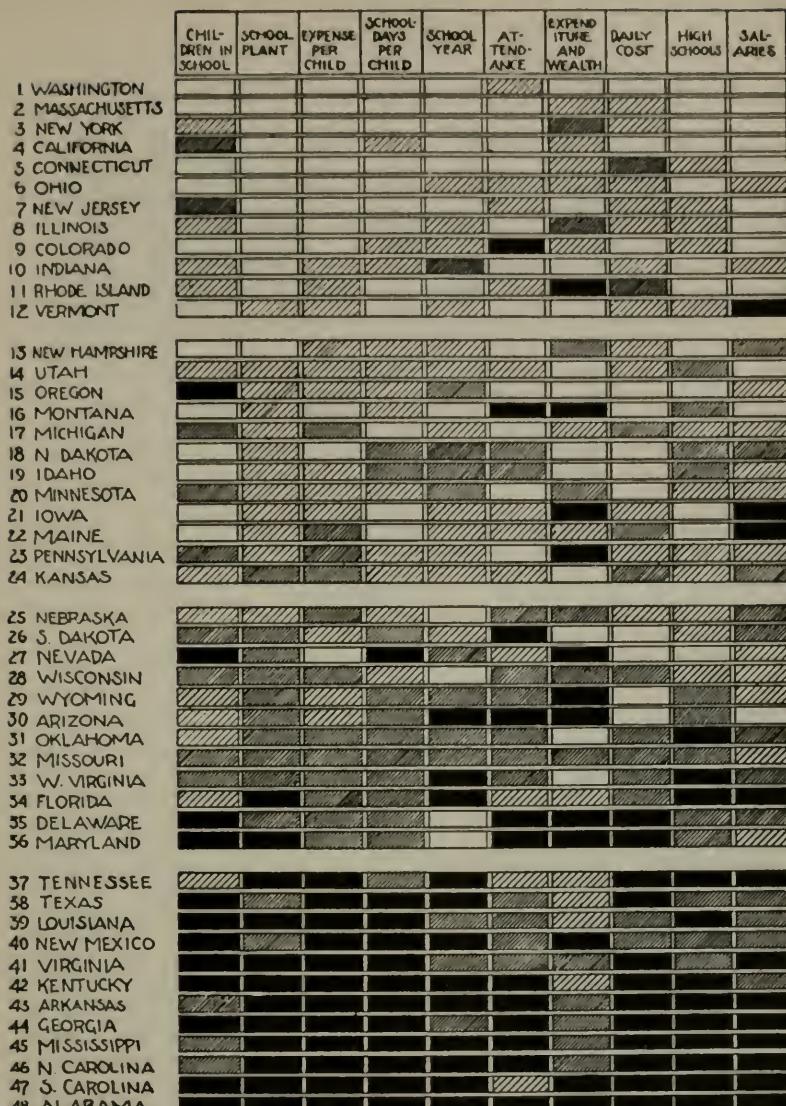
Metropolitan Life Insurance Company, "Functions of the Traffic Manager," 1937.

SCALE .6

Traffic Department of a Large Company.

The brackets in this classification were retouched. Since the important thing in such a presentation is to show relationships, the tool used, that is, the brackets, should be emphasized. Otherwise, the purpose is lost.

CLASSIFICATION CHARTS



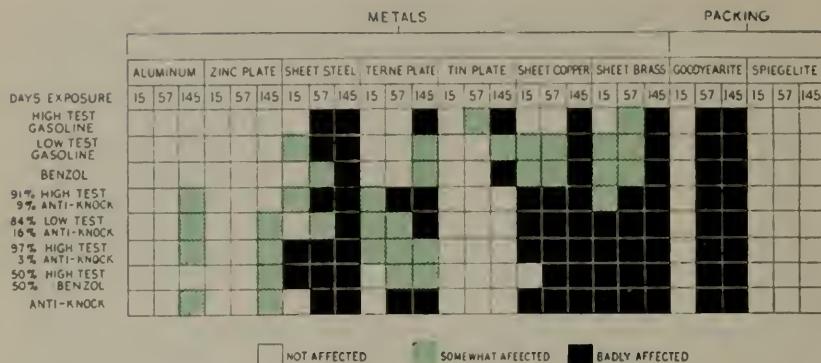
Brinton, "Graphic Methods," McGraw-Hill, 1914.

SCALE .9

Rank of Each of the United States in Ten Educational Features in 1910.

1. In making a block classification chart it is important that shadings ranging from white (or light) to black are chosen to correspond to correct gradations of value.
2. The states are arranged according to their total ranking in all twelve educational features; thus Washington State which ranked among the first 12 states in all but one feature is listed first, and Alabama which ranked among the lowest 12 states in all 12 features is listed last.

GRAPHIC PRESENTATION

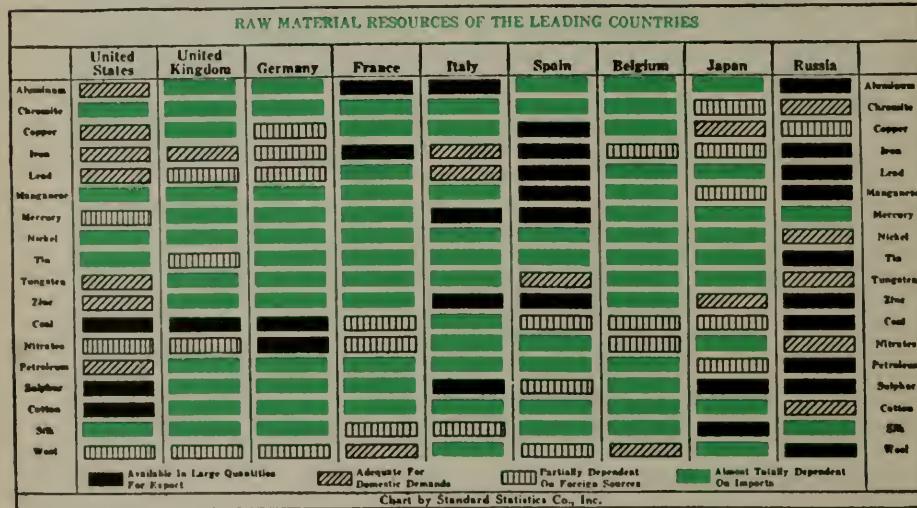


Automotive Industries, March 23, 1922.

SCALE .8

A. The Effect of "Doped Fuels" Upon the Fuel System of an Engine in the Presence of Moisture.

Here again a block chart is used to present a gradation classification. It is based on the results of an investigation made by the Material Section of the Engineering Division, War Department, Air Service, McCook Field in Dayton, Ohio. It may be observed that the metals which stood up better than the others are aluminum and zinc plate.



Standard Statistics, Inc., N. Y. C.

SCALE .9

B. Raw Material Resources of the Leading Countries of the World in 1936.

- The value of this type of chart is that a quantitative analysis which is not actually shown on the chart can be compared with other analyses. That such an analysis was made is shown in the titles of the four classifications at the bottom.
- Compare this chart with 51.

CLASSIFICATION CHARTS

51

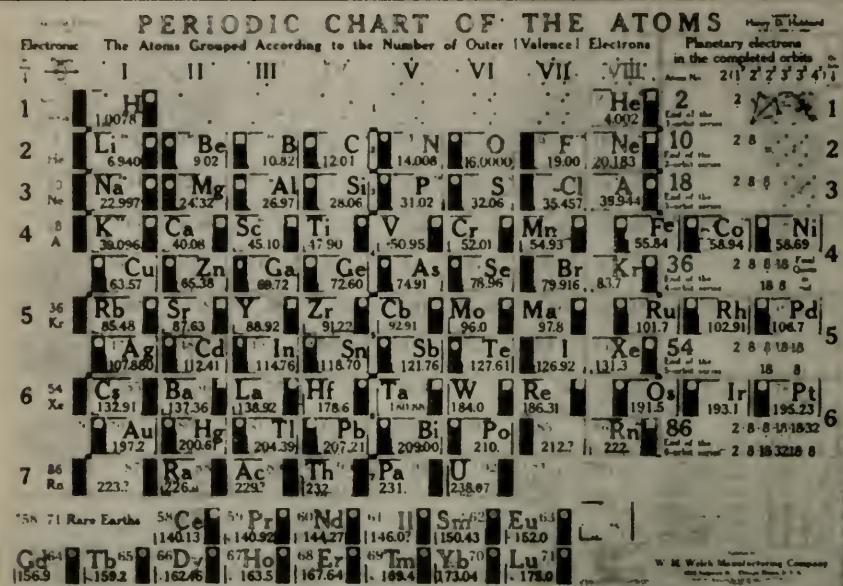


Taken from "The Strategy of Raw Materials," by Brooks Emeny (Macmillan, 1934), with the permission of the author and the Bureau of International Research of Harvard University and Radcliffe College.

National Self-Sufficiency of the Great Powers in 1934 in Essential Industrial Raw Materials, Expressed in Percentages of Domestic Production and Net Imports to Consumption.

1. In reality this chart is a series of 100% bar charts and might be classified as such.
2. Each nation is analyzed on the basis of percentage self-sufficiency in 22 raw materials. Synthetic materials are not included.
3. According to this chart, the United States and Russia have relatively greater self-sufficiency than Germany, Great Britain, France, Italy, or Japan.

GRAPHIC PRESENTATION



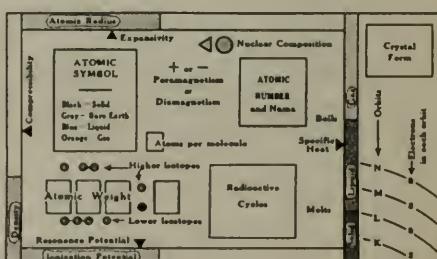
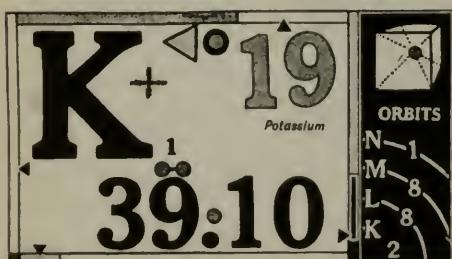
Compiled by Henry D. Hubbard of the U. S. Bureau of Standards; Published by W. M. Welch Manufacturing Company, Chicago.

W. M. Welch Manufacturing Company
600 Superior St., Chicago, Ill.

SCALE: Greatly Reduced

A. Chart of the Atoms.

Concise information on atomic structure as well as 40 different characteristics of the atoms is given in this chart. The original is lithographed in six colors, and all routine information is printed in large type. It can be obtained in two sizes, 42" x 64" and 22" x 30".



Compiled by Henry D. Hubbard of the U. S. Bureau of Standards; Published by W. M. Welch Manufacturing Company, Chicago.

B. A Reproduction of One Unit of the Chart of the Atoms, and the Key Used to Interpret All of the Graphic Illustrations on 52A.

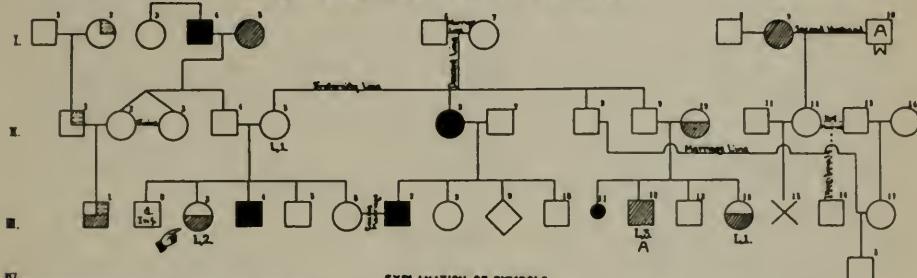
The right side is a reproduction, in one color only, of the unit which represents the element Potassium. The left side appears as a key at the lower right of each chart.

Chapter 5

GENEOLOGY AND GENETICS CHARTS

Genealogy and Genetics Charts are known chiefly as means for tracing ancestors. Synonyms for genealogy and genetics charts are: pedigree charts, genealogical charts, ancestral charts.

SAMPLE PEDIGREE CHART SHOWING THE MANNER OF CONSTRUCTION, AND THE USE OF STANDARD AND SPECIAL SYMBOLS.



EXPLANATION OF SYMBOLS

(a) Standard for all Pedigree Charts:

- Male; ○ Female; △ Sex unknown; ⚡ Still-birth or Miscarriage; X Children — number and sex unknown; ○ Twins;
- d. Inf. Died in Infancy; ↗ Points to the Propositus or central figure in the pedigree.
- Parents.

□ ○ ○ Children.

Roman figures to the left indicate generations, Arabic figures locate individuals, (thus III, 7 is the young man in the third generation, who married his cousin).

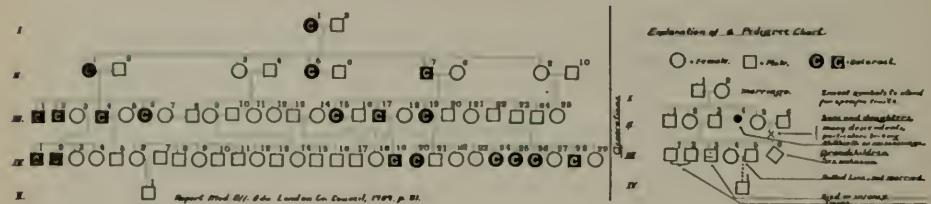
The following letters, placed in or around the individual's pedigree symbol, are standard for certain traits: A, alcoholic; B, blind; D, deaf; E, epileptic; F, feeble-minded; I, insane; M, migraineous; N, normal in reference to traits under consideration; Ne, neuretic; P, paralytic; Sr, sexually immoral; S, syphilitic; T, tuberculous; W, wanderer.

(b) Especially devised or selected for this particular pedigree-chart:

- • Successful leaders in politics. ■ ○ Extra thumb on right hand. L.1 = Highly successful author. L.3 = Little or no ability in literary efforts.
- ● Superior in vocal music. ■ □ Medium attainment in vocal music.

So fit the particular family and traits (whether physical, mental or temperamental; good or bad) under consideration, invent special symbols, or select special letters (in addition to those standardized under (a) above) to be placed within or near the particular individual's pedigree symbol, to indicate particular traits and their degree of development.

GRAPHIC PRESENTATION

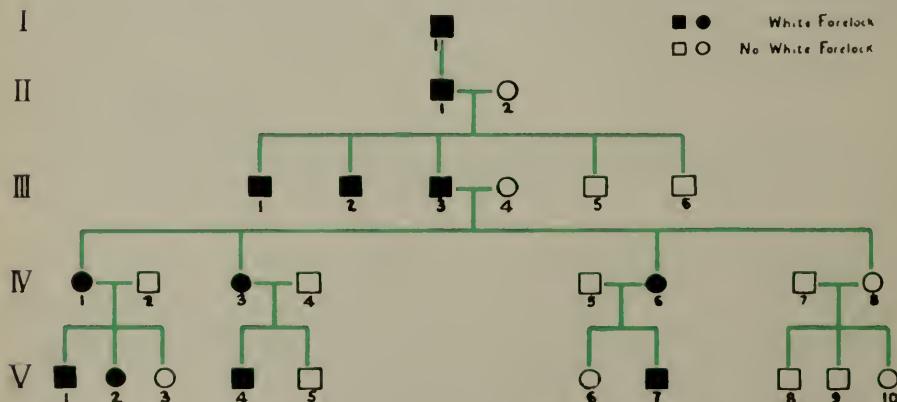


Eugenics Record Office, Cold Spring Harbor, Long Island, N. Y.

SCALE .7

A. A Genealogy Chart Showing the Actual Pedigree of Pre-Senile Lamellar Cataract.

1. Following the practice of tracing only one trait on one pedigree chart, this chart traces the trait of pre-senile lamellar cataract. All individuals of the family tree are plotted even though all do not show the trait.
2. It would be fairly easy to construct a chart tracing the family distribution of a trait by following the principles exemplified in the above diagram.



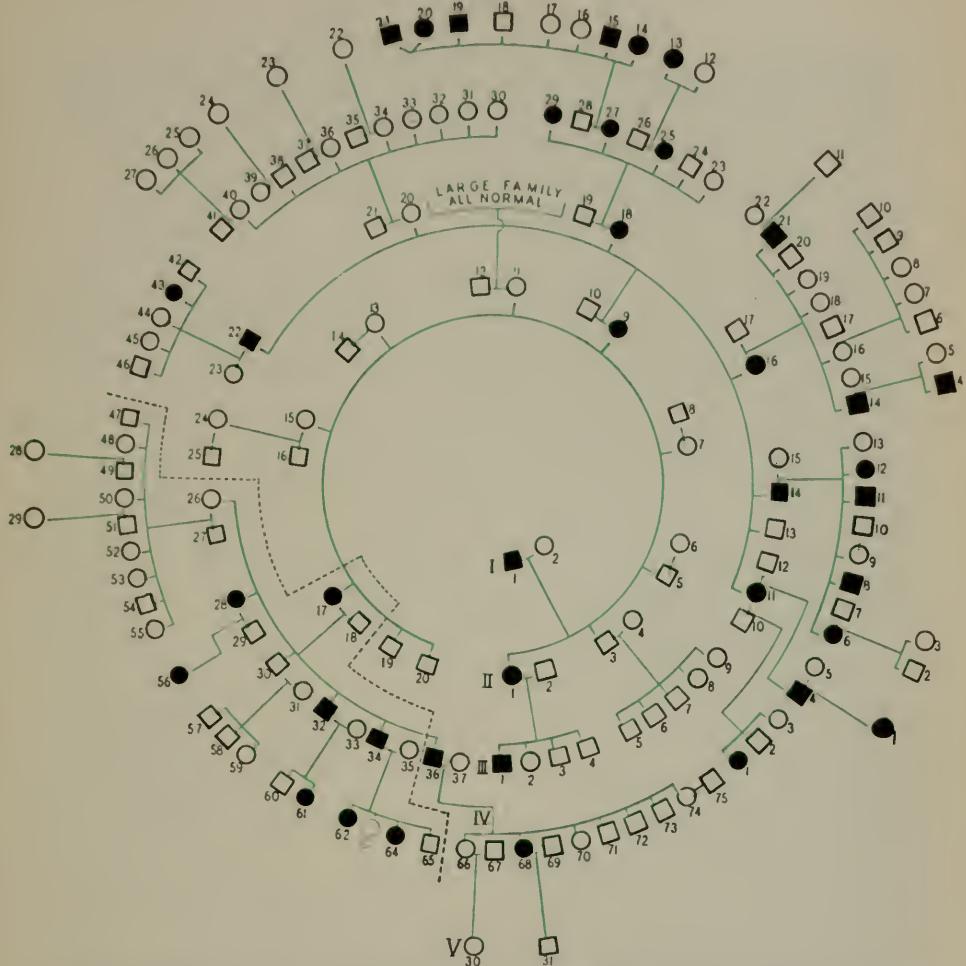
I-1, the first recorded ancestor having a white forelock. II-1, his son inherited the white forelock and married a woman without it. III-1, of their five sons three inherited the white forelock and two did not. IV, showing the four daughters of one son, III-3, three daughters having inherited the white forelock and one has not. V, showing the children of these four daughters who married men without a white forelock; some of the children of each of the three mothers possessing the white forelock have inherited it but none of the children of the other mother not possessing it have the white forelock.

Lyle Fitch "Inheritance of a White Forelock," The Journal of Heredity, November, 1937, American Genetic Association, Washington, D. C.

SCALE .9

B. Five Successive Generations Showing Dominant Inheritance of a White Forelock in the Logsdon Family.

Explanations below a genealogy chart are helpful and should be used frequently.



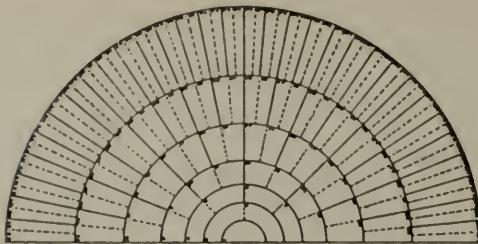
In several places in this chart the inheritance simulates that of a sex-linked dominant character, but the pedigree as a whole proves that the apparent association with sex is purely fortuitous. The largest sector in which sex-linked inheritance is suggested is bracketed with a dotted line.

Mable R. Walter, "Five Generations of Short Digits," *The Journal of Heredity*, April, 1938, American Genetics Association, Washington, D. C.

Pedigree Chart Showing Five Generations of Short Digits.

1. Deformed individuals are represented by solid symbols.
2. The use of a circular heredity chart is helpful when the number of persons in the fourth or fifth generation would necessitate too long a chart.

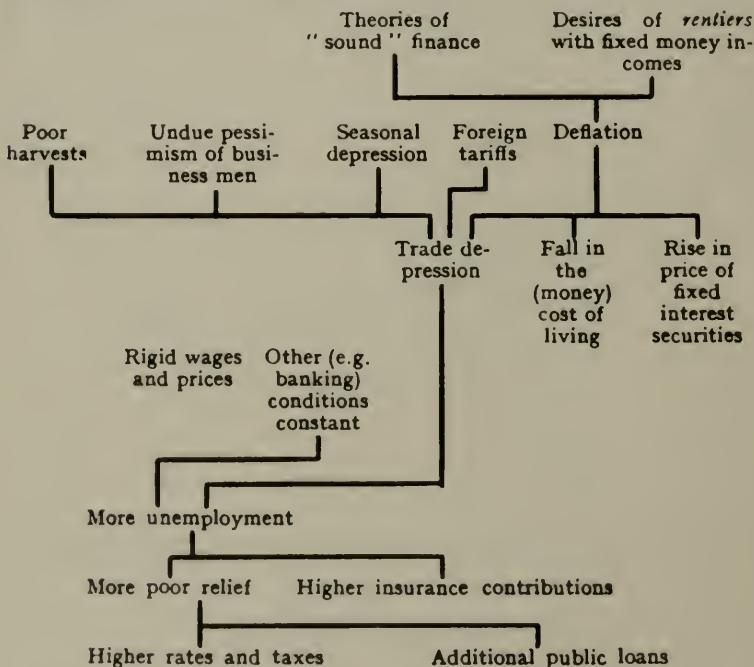
GRAPHIC PRESENTATION



Codex Book Co., Inc., Norwood, Mass.

A. A Genealogical Chart Sheet.

1. This sheet is 8½" x 11" and its purpose is to show graphically the genealogy of a person or the pedigree of an animal. In the central space numbered "1," the name of the individual is written. In the spaces of the concentric bands, the names of the ancestors are placed, each band representing a generation. The figures in the spaces may be used as reference numbers.
2. The fan-shaped pedigree chart, while it eliminates the difficulty of spreading over too much space, is less easy to read than 57.

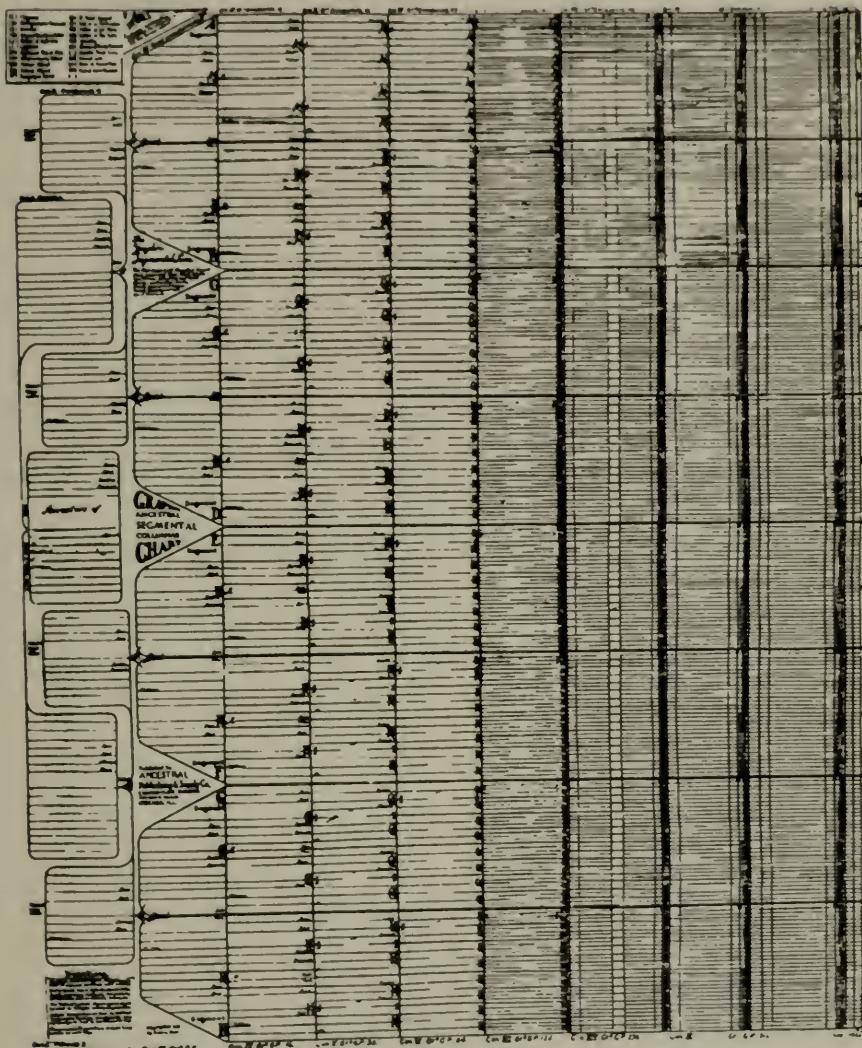


P. Sargent Florence, "The Statistical Method in Economics and Political Science," 1929, Kegan Paul & Co., London.

B. Genealogical Presentation of the Theory of Unemployment.

1. The lines in the original of this chart were undoubtedly set in type, not drawn. The lines have been retouched and thickened.
2. This chart illustrates the point that there is more than one reason for unemployment.

GENEOLOGY AND GENETICS CHARTS

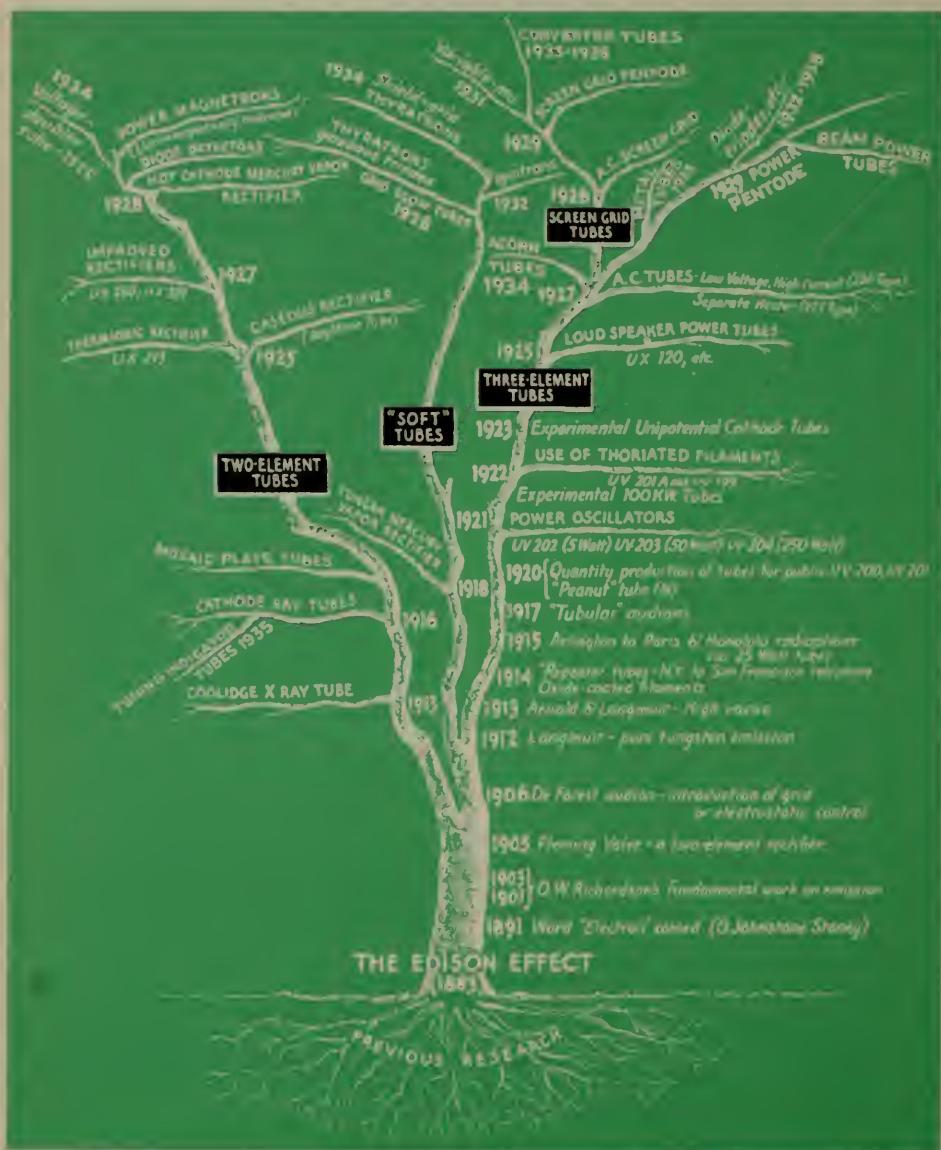


Ancestral Publishing & Supply Co., Chicago, Ill.

A Columnar Ancestral Chart.

The left to right rather than top to bottom arrangement makes it possible to get in a great deal of information. The horizontal rather than circular arrangement makes the chart easy to read. Compare this form with 56 A

GRAPHIC PRESENTATION



Electronics, October, 1938, Part of an Editorial on Public Relations for Industry.

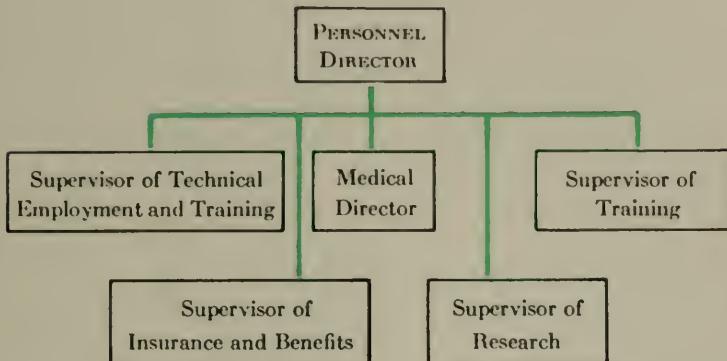
SCALE .7

The Family Tree of the Thermionic Tubes.

Although the term "family tree" does not necessarily mean a "tree," the "tree" form of heredity or family chart is a well-known one. The "tree" here presented is in reality a chronological statement of events, all of which have contributed to the existence of the "thermionic tubes."

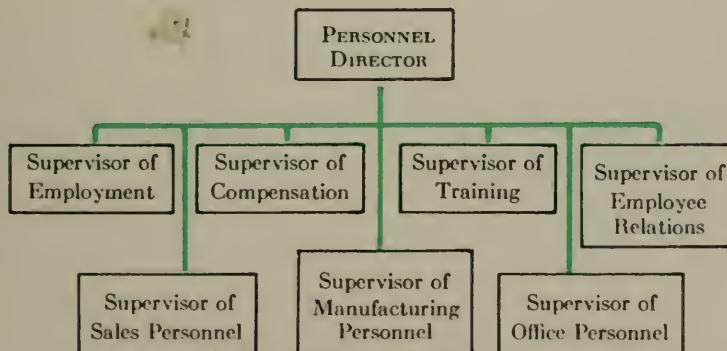
Chapter 6

ORGANIZATION CHARTS



Metropolitan Life Insurance Company, "Functions of the Personnel Director," 1937.

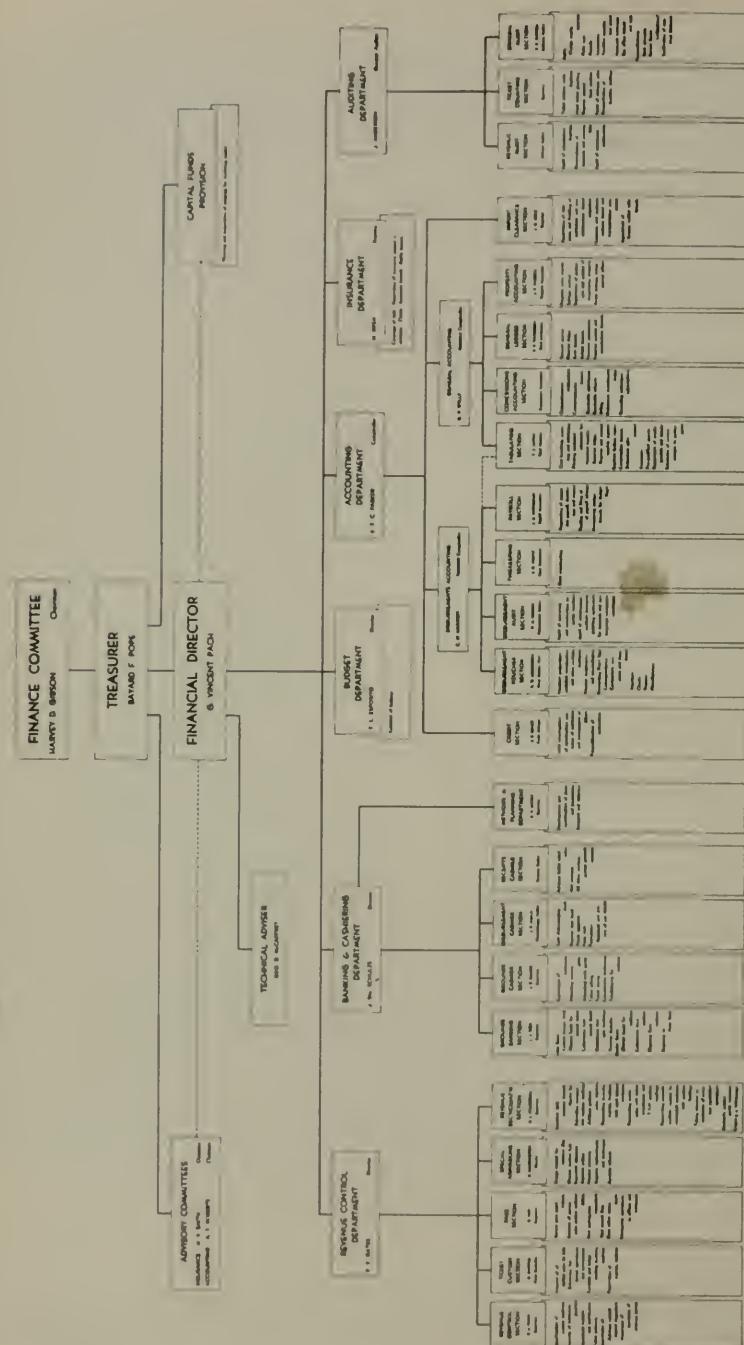
- A. Organization Chart of the Headquarters Staff of a Personnel Director Whose Company Has Units in Various Parts of the Country.



Metropolitan Life Insurance Company, "Functions of the Personnel Director," 1937.

- B. An Organization Chart Showing That an Organization Which is Engaged in Manufacturing Also Has Special Staff Men for Both Functional and Departmental Problems.

GRAPHIC PRESENTATION



New York World's Fair, 1939, Treasury Division, Methods and Planning Department.

Functional Organization Chart of the Treasury Division of the New York World's Fair, 1939, Inc.

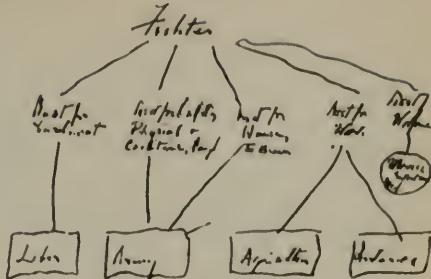
1. Note how the size of the lettering becomes smaller as each step is taken downward.
2. The use of the names within each division makes this chart helpful to new members of the division.

SCALE .8

ORGANIZATION CHARTS

A. Diagram of the Organization of the CCC made by President Roosevelt in 1933.

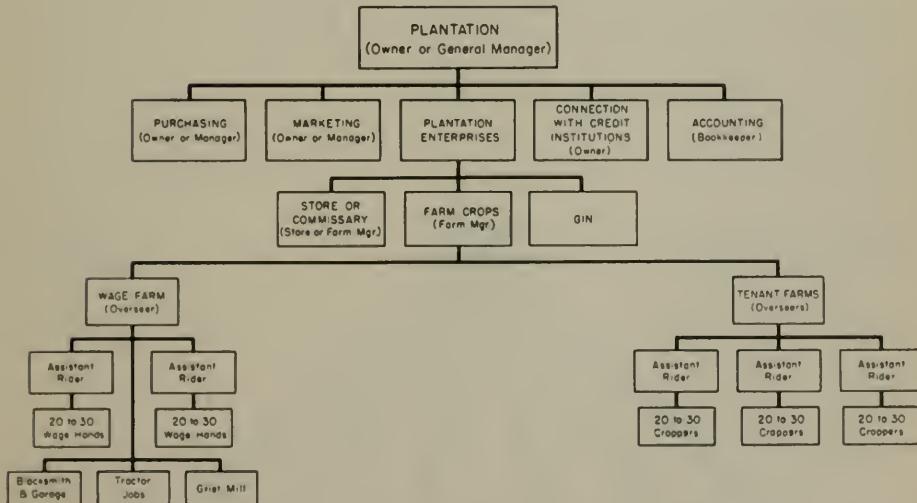
The most complex and widespread organizations may begin from just such crude drawings as this one.



I want personally to check on
the location, scope, etc. of the camps,
pigs, and other things etc.

FDR

Newspaper of the Civilian Conservation Corps,
"Happy Days," April 2, 1938. SCALE .4

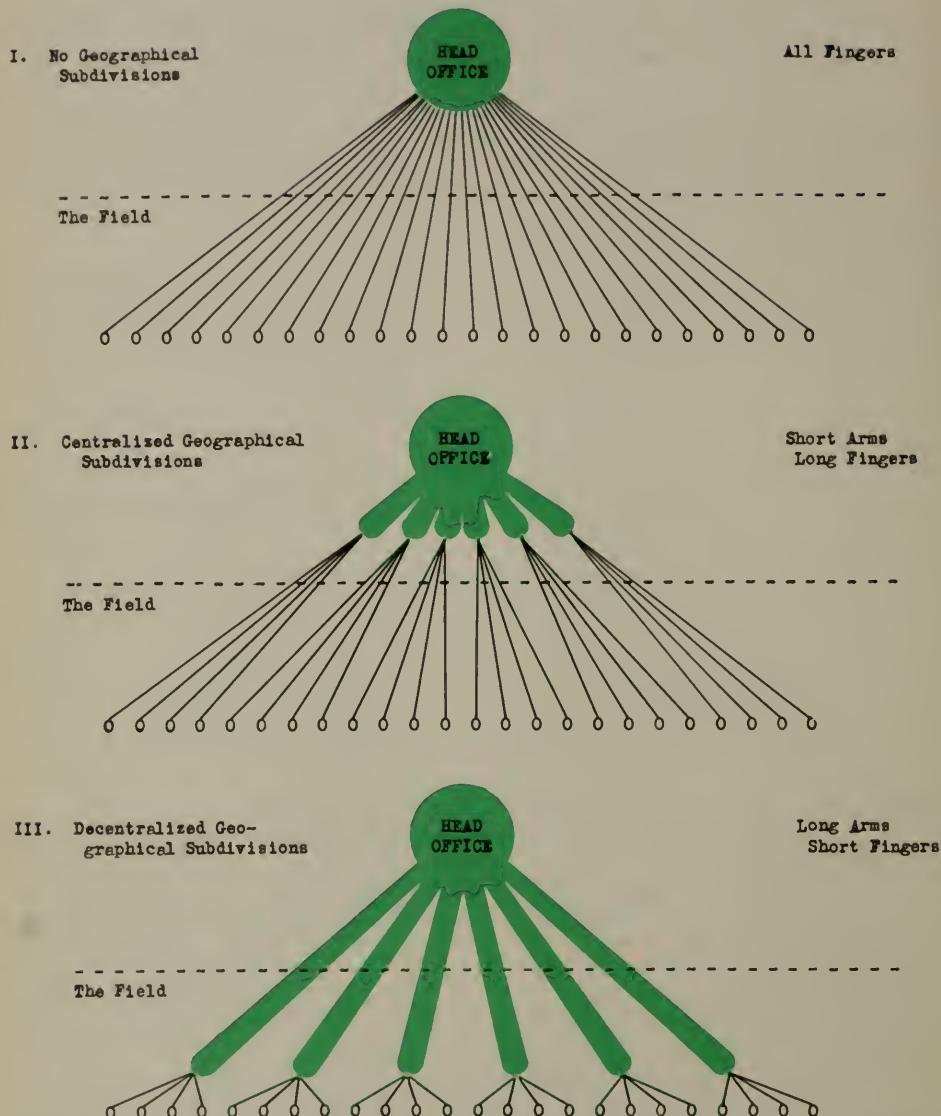


WPA, Division of Social Research, "Landlord and Tenant on the Cotton Plantation," 1936. SCALE .6

B. Organization of Enterprises on the Large and Closely Supervised Cotton Plantation in the United States.

The organization chart starting with the top and then branching downward to small division at the bottom is perhaps the best known form of organization chart. How the branching will be done depends a great deal upon the organization.

GRAPHIC PRESENTATION



Luther Gulick and L. Urwick, "Papers on the Science of Administration," Institute of Public Administration, N. Y. C., 1937.

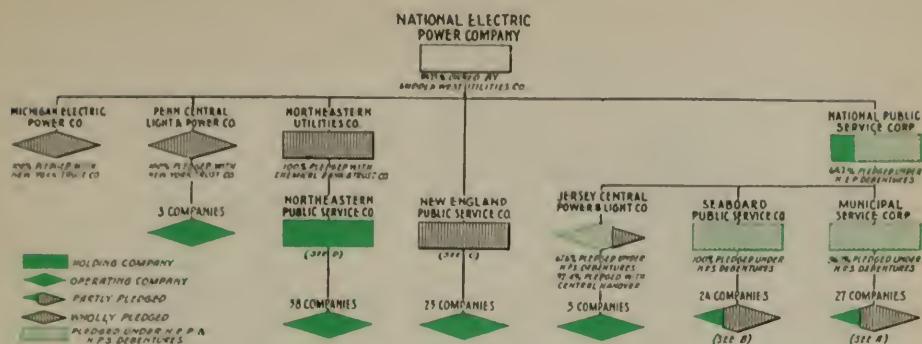
SCALE .6

Three Types of Geographical Division of Work.

The practical application of these forms of organization may be found in government.

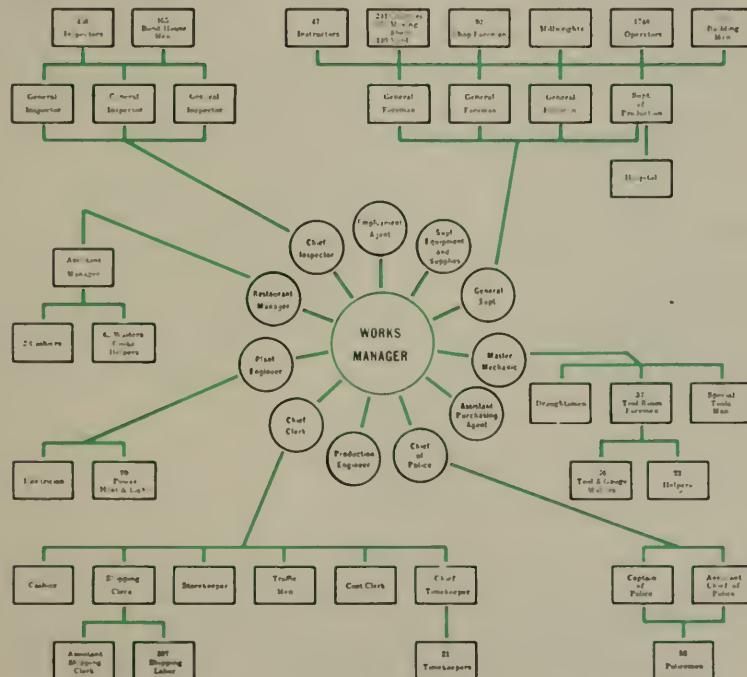
A detailed explanation of each is in the book from which this chart was taken.

ORGANIZATION CHARTS



A. An Organization Chart Showing How Holdings of the Eastern Insull Utilities Were Pledged.

In order to differentiate, cross hatchings and shadings may be used effectively in an organization chart. A variety of shapes as well as shadings distinguishes the divisions.



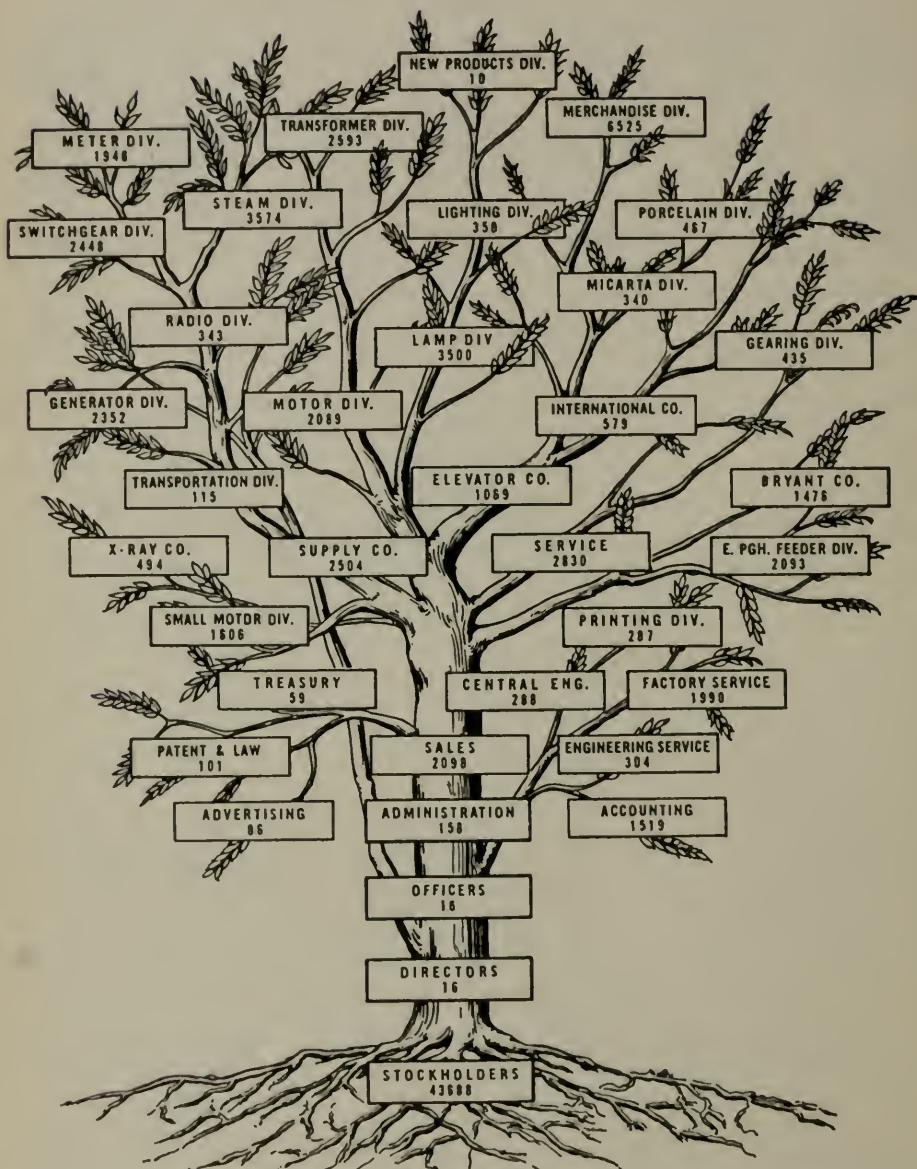
Industrial Management, June, 1917.

SCALE .7

B. Organization Chart of the Shell Plant in Erie, Pennsylvania, of the American Brake Shoe and Foundry Company.

A circular form is seldom used in organization hierarchy, probably because it is difficult to indicate hierarchy in a circle.

GRAPHIC PRESENTATION

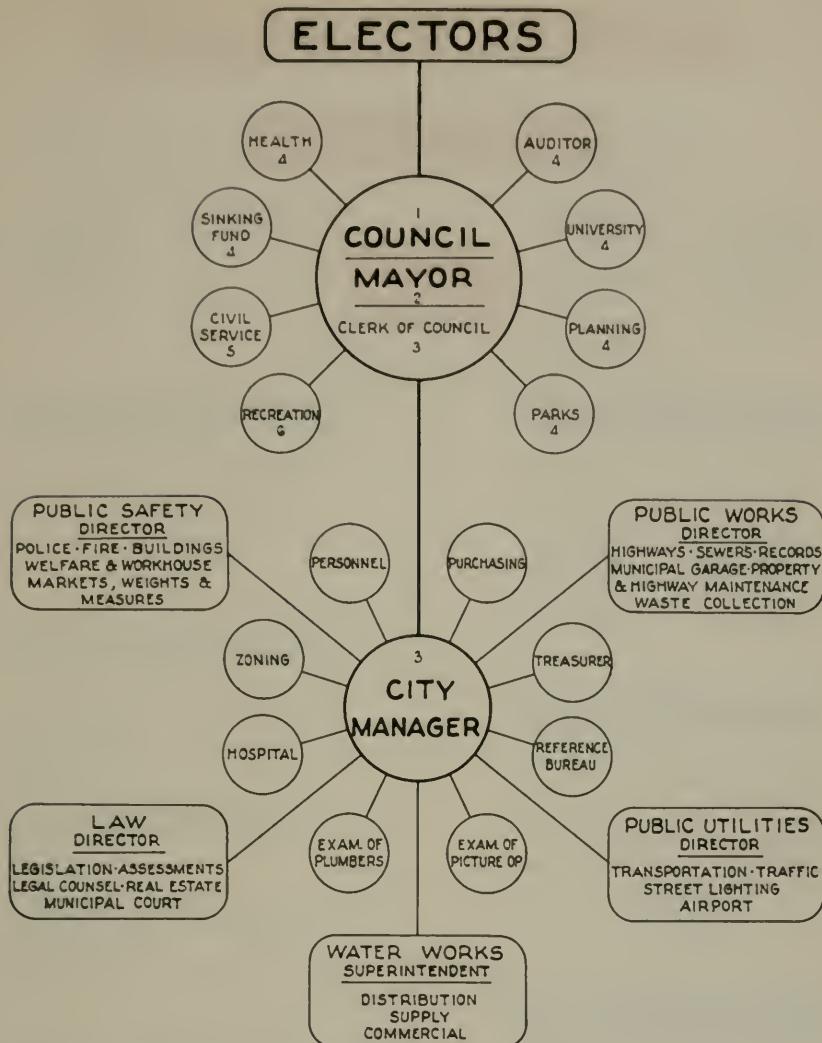


Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa., "Westinghouse Industrial Relations," 1937.

The Westinghouse Family Tree in 1937.

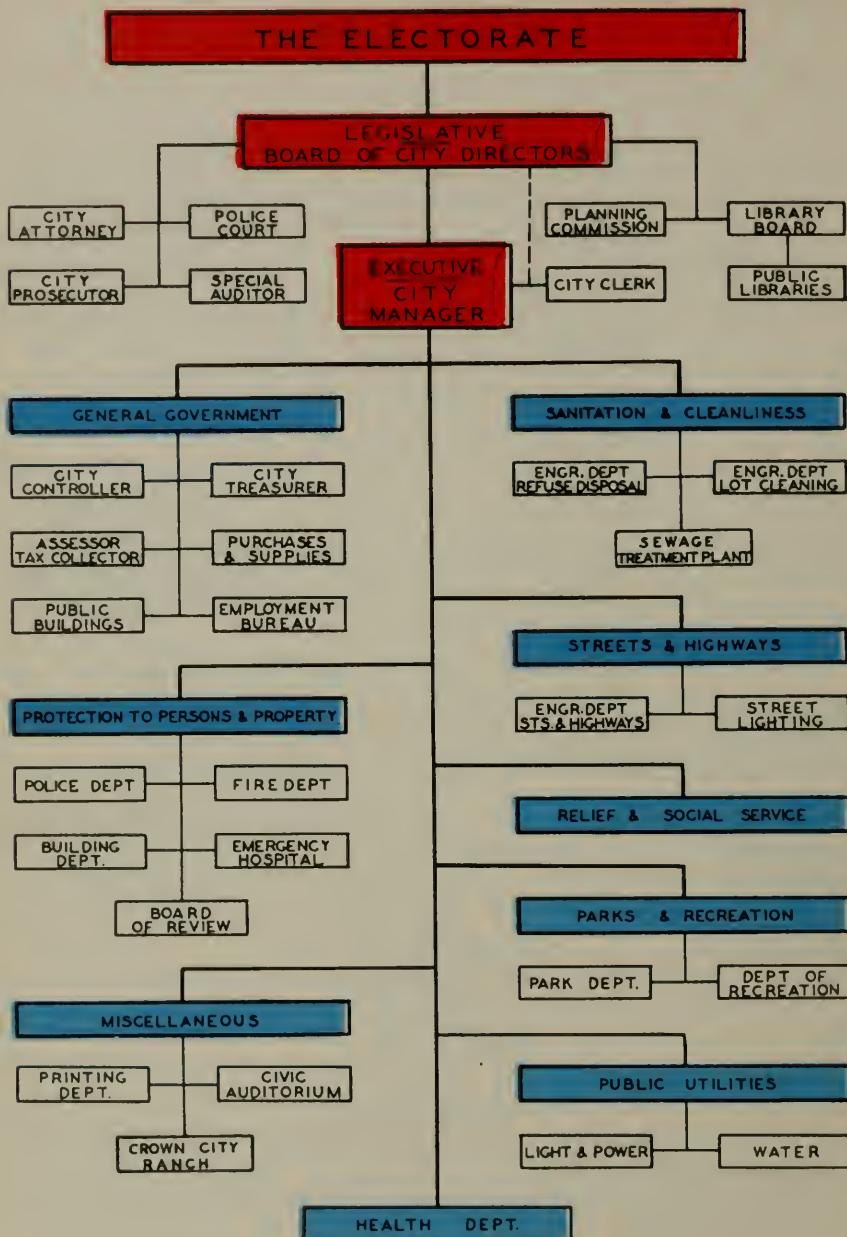
This is an effective and legitimate use of the structure of a tree. It is an organization chart superimposed upon a "family tree." Compare this form with 58.

ORGANIZATION CHARTS



1. Nine members elected bi-annually.
2. Selected by Council from its membership.
3. Appointed by Council.
4. Appointed by the Mayor.
5. Three members—1 each appointed by the Mayor, Board of Education, and University Directors.
6. Five members—3 appointed by the Mayor, and 1 each by the Board of Education and the Park Board.

GRAPHIC PRESENTATION

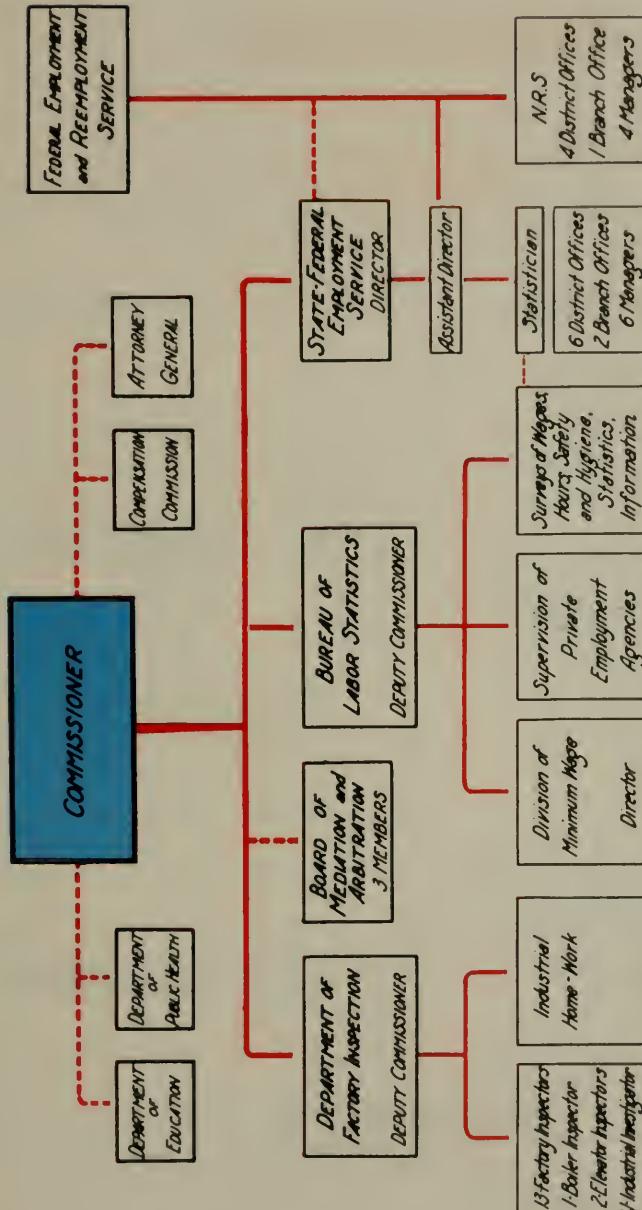


Annual Report of the City Manager, Pasadena, California, 1937.

Organization Chart of the City of Pasadena.

Compare this type of organization chart of a city-manager form of government with 65.

ORGANIZATION CHARTS



U. S. Department of Labor, Bureau of Labor Statistics, "Labor Information Bulletin," March, 1936.

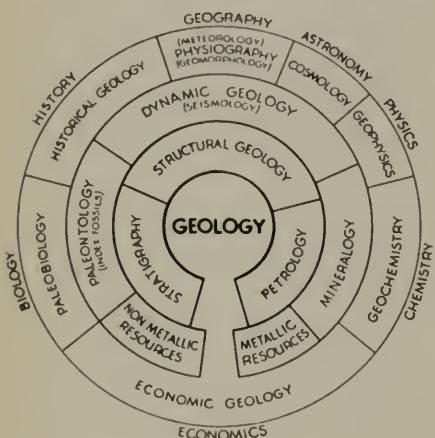
SCALE .8

Organization of the Connecticut Department of Labor and Factory Inspection.

Chapter 7

RELATIONSHIP CHARTS

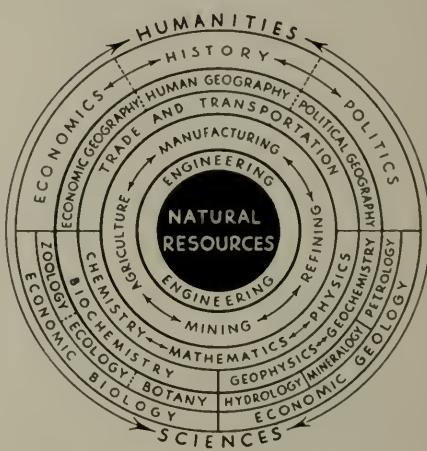
A "RELATIONSHIP CHART" is a diagram in which facts, information, etc., are arranged to emphasize their relation. It differs from a classification chart in that relationships may be shown without any classification of the material used.



From "An Outline of the Principles of Geology" by R. M. Field, Copyright 1938. Used by Permission of the Publishers, Barnes & Noble, Inc. SCALE .6

A. The Relations of Geology To and Its Interrelations With Other Divisions of Knowledge.

1. This diagram suggests that geology is not an isolated thing, but is bound up with many branches of study.
2. The divisions immediately adjacent to the center of this chart are the ones most closely related to the science of geology. Those divisions on the outer edges are related to geology through the intermediate subjects.



From "An Outline of the Natural Resources of the United States" by R. M. Field, Copyright 1936. Used by Permission of the Publishers, Barnes & Noble, Inc. SCALE .6

B. Relation of Natural Resources to Human Activities and Interrelations With Other Branches of Study.

Although similar to the preceding chart, this diagram differs in that relationships around the circle are indicated as well as from the center outward.

RELATIONSHIP CHARTS

SPECIAL WAR WORK ON—

MILITARY MAPPING

Making progressive military index map of United States

SURVEY OF SITES.

Balloon fields

Ordnance proving grounds

Artillery sites

Areas near cantonments

Aviation fields

ROUTE MAPS.

Airplane routes

Motor truck routes

ENGINEER REGIMENTS.

Contributing 110 officers

Contributing 164 men

Training officers and enlisted men

Training school for topographers

PURCHASE AND SHIPMENT OF INSTRUMENTS.

NEW AIRPLANE CAMERA

CONFIDENTIAL MILITARY DATA

Orientation manual

GENERAL TOPOGRAPHIC INFORMATION.

TOPOGRAPHIC DRAFTING.

Artillery instruction maps

Danger poster for hydroplane

French conventional signs

Base maps to scale for miscellaneous surveys

CONTRIBUTED TO—
WAR DEPARTMENT.

General Staff

Corps of Engineers

Ordnance

Artillery

Quartermaster

Signal Corps

Aviation

Surgeon General's Office

Departmental commanders

Any officers requesting

NAVY DEPARTMENT

Marine Corps

COUNCIL OF NATIONAL DEFENSE

FRENCH MISSION

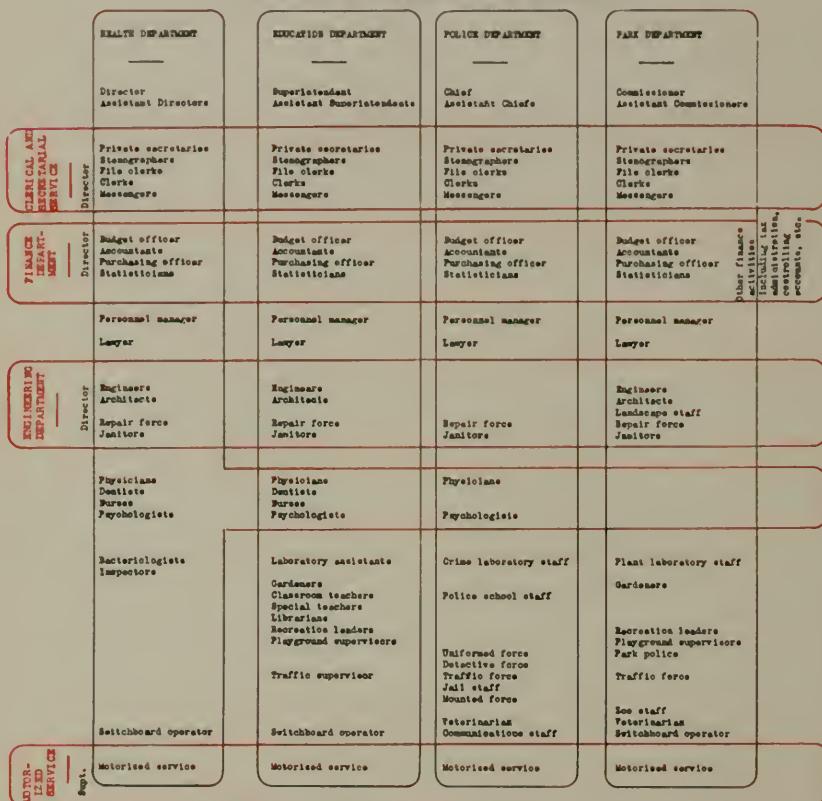
U. S. Department of Interior, "Thirty-ninth Annual Report of the U. S. Geological Survey," 1918.
SCALE .8

Relationship Chart Showing the Contributions to War Service by the Topographic Branch of the U. S. Geological Survey.

1. In this chart, the fact that one government department cooperates extensively with others is brought out with force.
2. It would not be wise to use this form to show too many interrelationships, however, as all detail would be lost.

GRAPHIC PRESENTATION

PURPOSE AND PROCESS SUBDIVISIONS IN ORGANIZATION



Luther Gulick and L. Urwick, "Papers on the Science of Administration," Institute of Public Administration, N. Y. C., 1937.

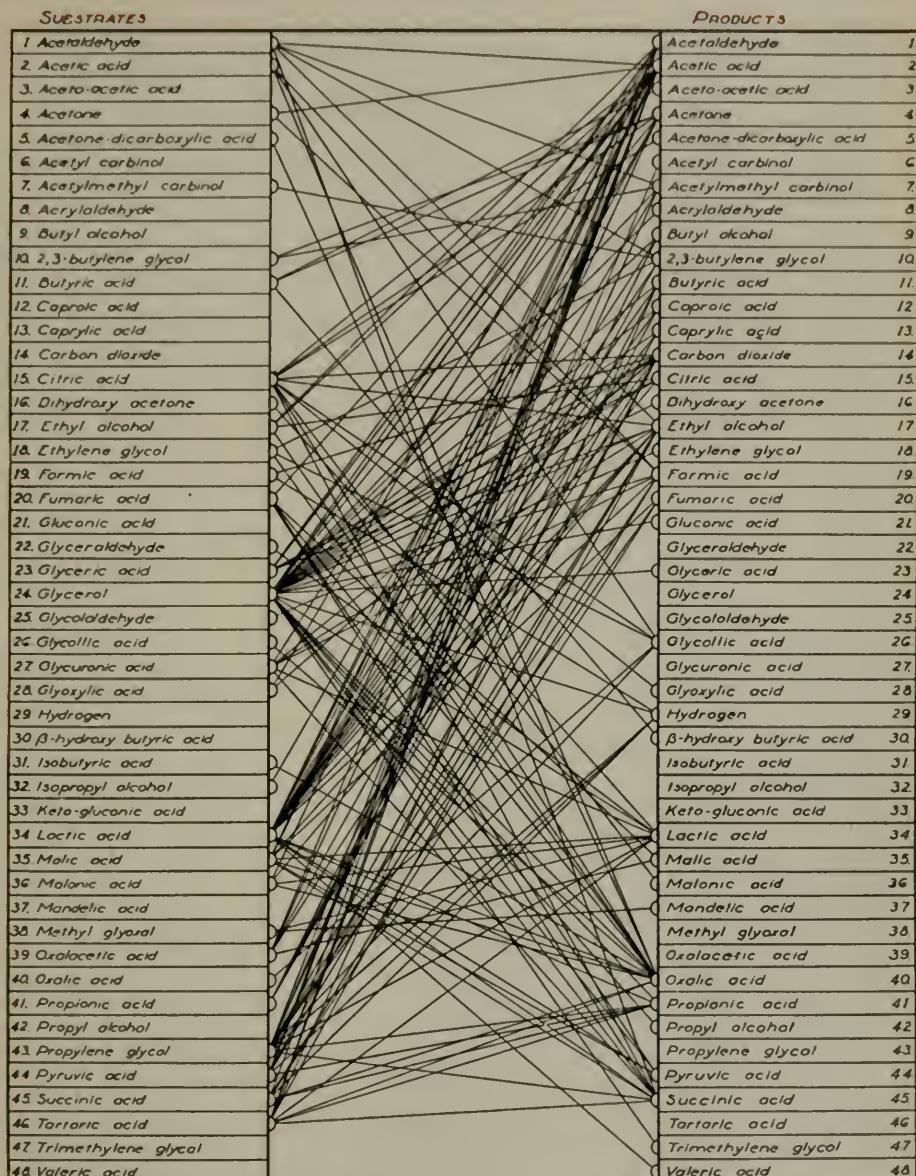
SCALE .6

The Interrelationships of the Purpose and Process Subdivisions in Organization.

Four sample city departments are presented vertically, each divided into its functions and workers. A considerable number of workers are common to all or to several departments. These are indicated by the horizontal red network. Thus when an organization has both purpose and process departments, interrelationships are essential, in fact, impossible to escape.

RELATIONSHIP CHARTS

71

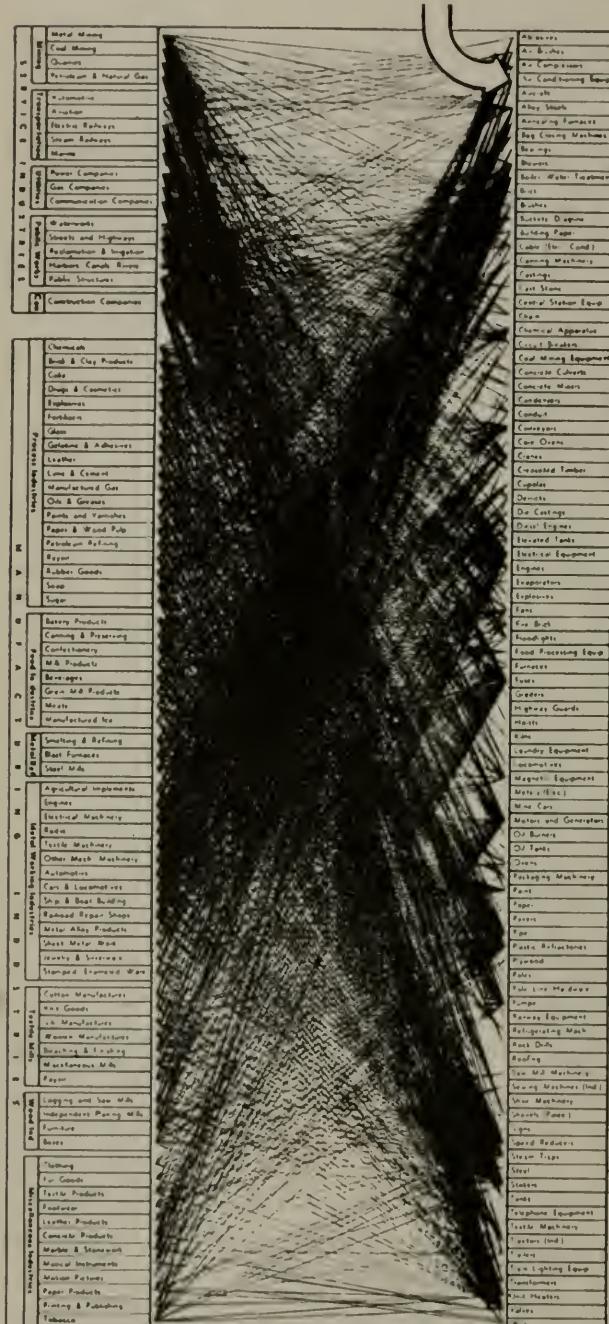


Industrial and Engineering Chemistry, November, 1930.

SCALE .8

The Fermentative Interrelationships of the Micro-Biological Dissimilation Products of the Carbohydrates.

GRAPHIC PRESENTATION



Russell T. Gray, Inc., Chicago.

Relationship Chart Which Connects the Products Advertised During the Eighteen Year Period from 1917 to 1935 with an Industrial Market in Which Each Product Was Promoted.

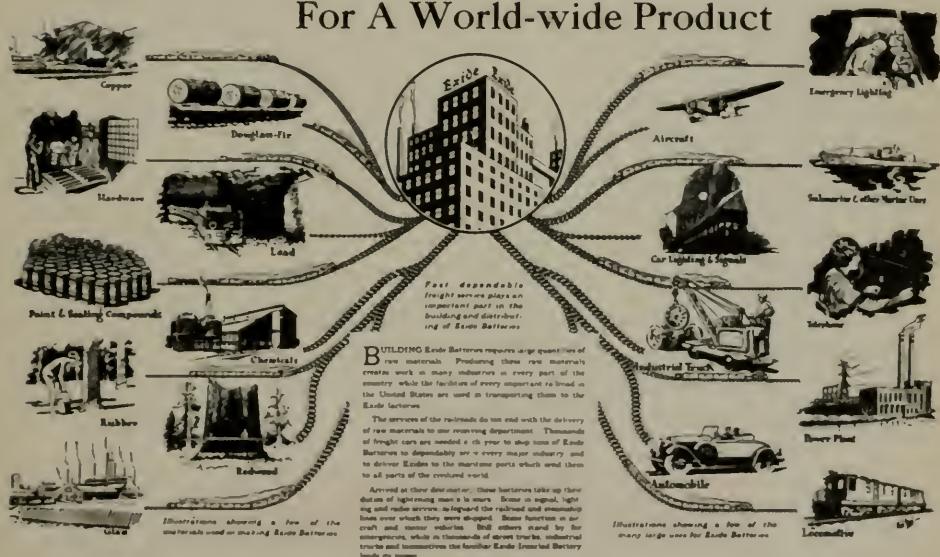
While no specific or detailed impression is possible because of the conglomeration of lines, a general idea is obtained that the products advertised by this particular firm had a widespread influence in the industrial market.

Chapter 8

FLOW CHARTS

Flow charts present a graphic explanation of the movement of materials, printed forms, etc., through an organization or structure. "Cosmograph" is the trade name for a type of flow chart presenting numerical information or percentages by means of black and white strips of paper, showing source contrasted with destination.

Materials From the Wide-world For A World-wide Product



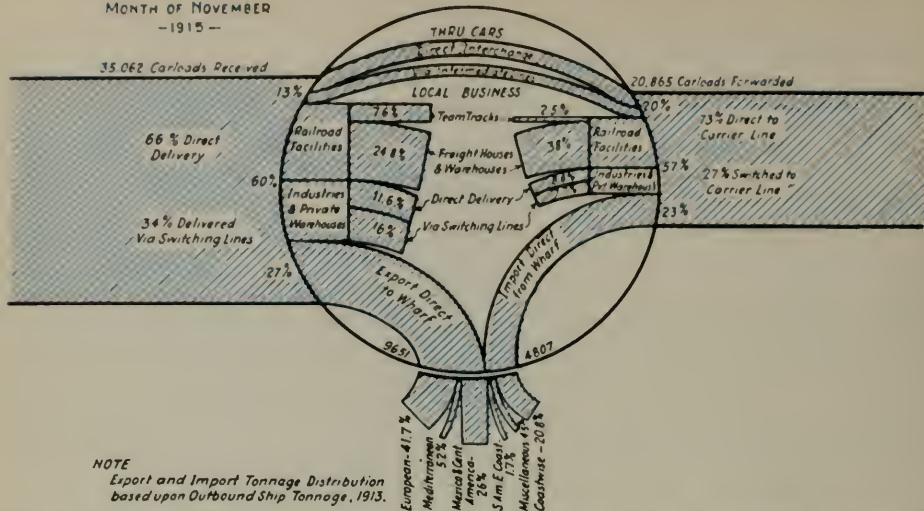
Electric Storage Battery Co. Philadelphia, "Exide-Ironclad Topics," May, 1933.

SCALE .5

Flow Chart Showing Source of Materials for Manufacture and Distribution of the Completed Product.

GRAPHIC PRESENTATION

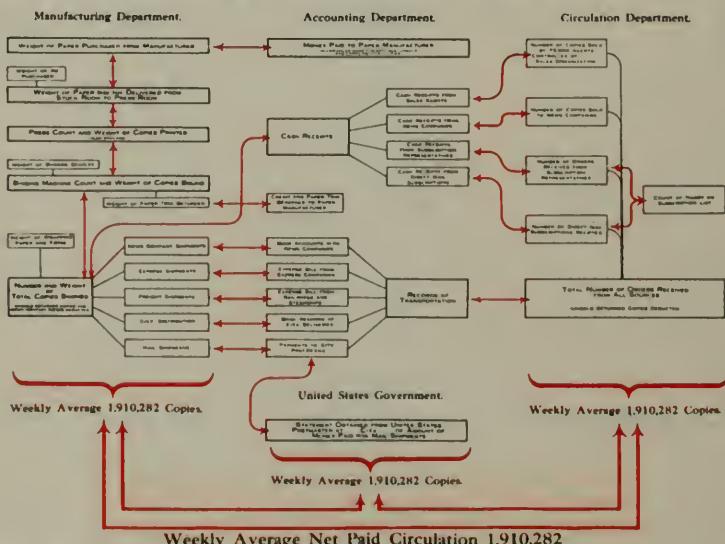
MONTH OF NOVEMBER
—1915—



James R. Bibbins and Bion J. Arnold, "Our National Transportation System," Proceedings of New York Railroad Club, April, 1923.
SCALE .9

A. Railroad Traffic Flow Diagram.

The similarity between this flow chart and a simple balance sheet with "amounts received" and "amounts paid out" is quite pronounced. Compare with 79.



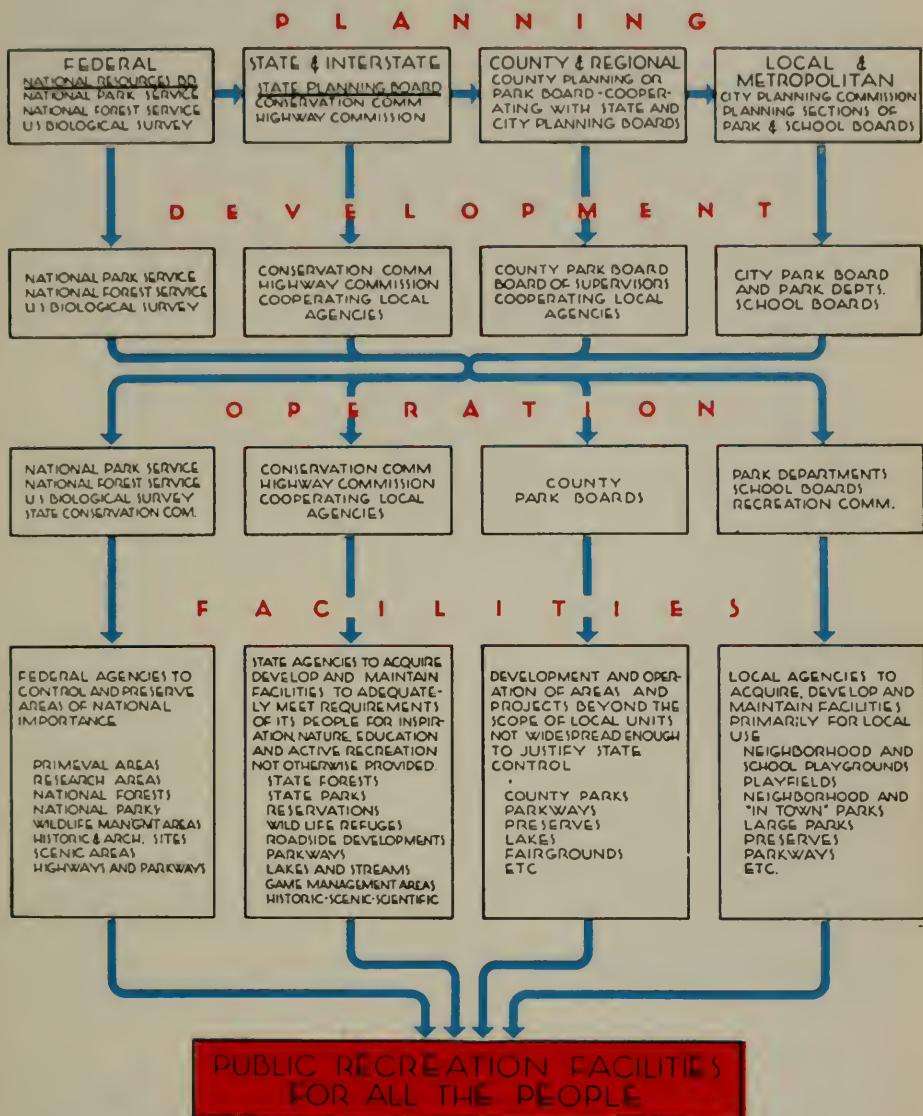
Drawn Under the Direction of Willard C. Brinton in Consultation with a Firm of Certified Public Accountants.
SCALE .5

B. Method of Displaying Proof of the Circulation for a Weekly Magazine.

This chart resulted from a survey made by a firm of certified public accountants. Since the formation of the Audit Bureau of Circulations in Chicago, any survey like this would not be necessary.

FLOW CHARTS

COOPERATING AGENCIES



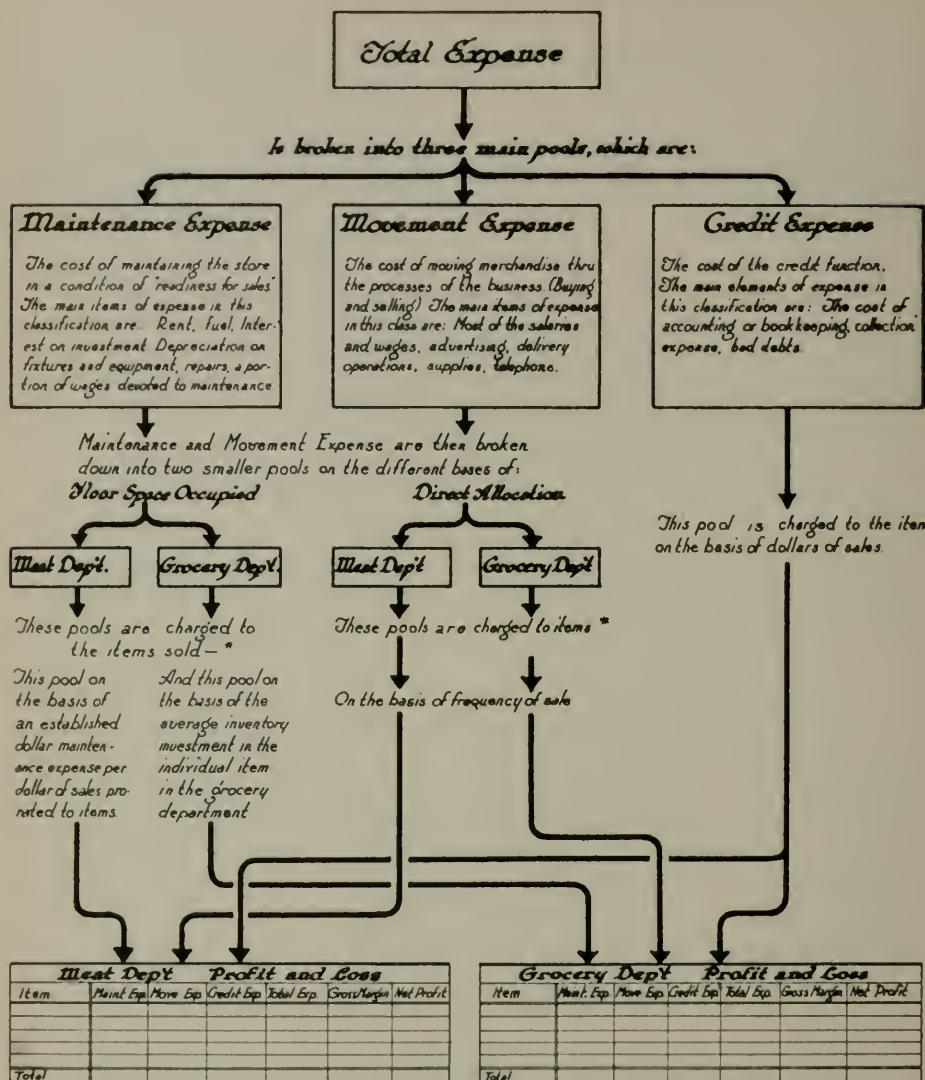
National Resources Board, "State Planning," 1935.

SCALE .8

A Plan for Public Recreation in Iowa.

The arrows indicate the "flow" of activity from four groups of cooperating agencies towards the attainment of public recreation facilities for "all the people."

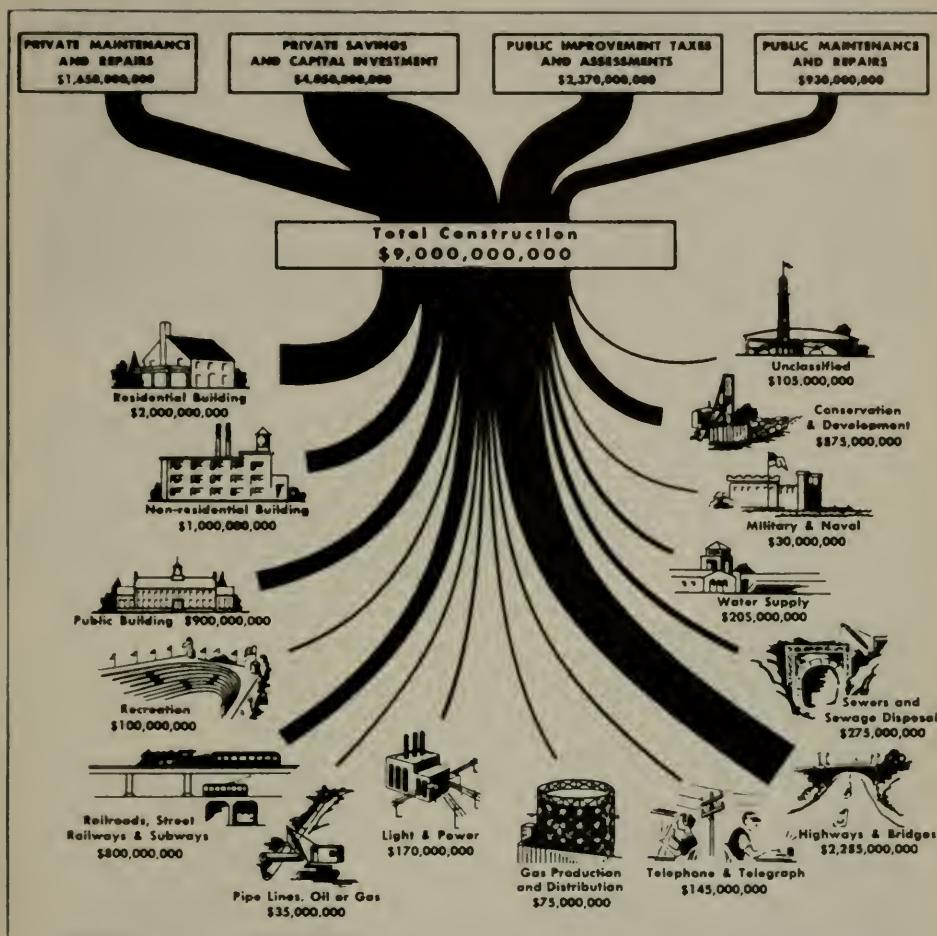
GRAPHIC PRESENTATION



U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce, March, 1934. SCALE .9

The Commodity Cost Accounting Method Employed in a Survey Made by the Domestic Commerce Division of the U. S. Bureau of Foreign and Domestic Commerce.

1. Flow charts to indicate accounting methods are well known.
2. Similar charts are used to indicate terminology to be applied to certain classifications.
For example, in a foreign trade chart of this type, it could be indicated by means of boxes and arrows that the term "domestic imports" applies to those products which are exported by us in raw material form and then imported in another form.



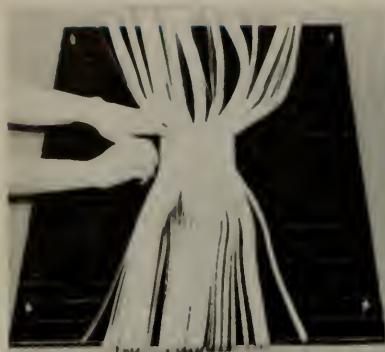
CONSTRUCTION converts private savings into productive structures and with public savings raises community standards of living. It produces the structures that provide our shelter, transportation, communication, defense, power, light, heat, water, waste disposal, recreation, conservation and development of our national resources.

Engineering News Record, October, 1938, Part of an Editorial on "The Construction Industry, What It Is—What It Does." SCALE .7

The Wide Range of Construction in the United States.

Here again is a simple balance sheet, with the emphasis on the places from which the money for construction came, and the places to which it went.

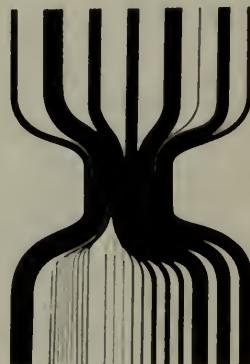
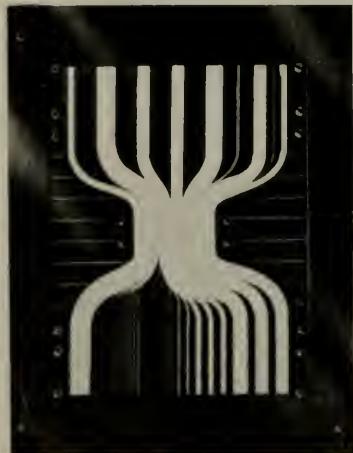
GRAPHIC PRESENTATION



International Business Machines Corp., N. Y. C.

A. The Use of a Cosmograph to Make a Flow Chart.

1. The "Cosmograph" is a flow chart made by using the device shown above. One thousand strips of paper are set on edge to represent 100%, and are separated into component parts of 100%.
2. These two illustrations give two steps in making a "Cosmograph." The first shows the process of locating and firmly clamping the strips of paper into position. The second shows wedge spacers and bar spacers being inserted between groups of strips of paper.



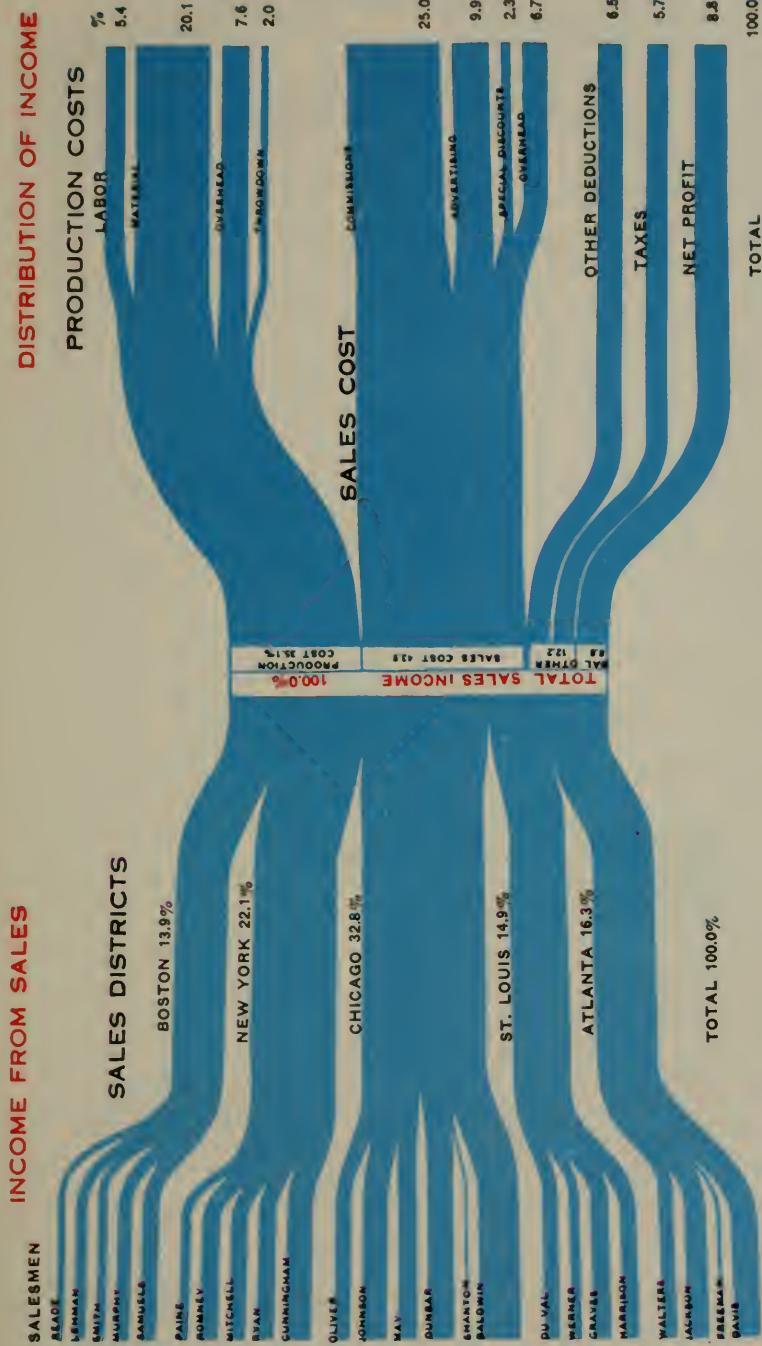
The first or negative photostatic print of the Cosmograph set-up at the left

International Business Machines Corp., N. Y. C.

B. The Completed Cosmograph.

1. Border guides are placed in position to block out excess ends of the paper strips and the Cosmograph is ready for photostatting.
2. The negative photostatic print appears at the right. Note that all black portions of the device fail to reproduce. Of the one thousand strips of paper, twenty are red and are set at each 5% mark. In the negative photostat, these red strips of paper reproduce as white.

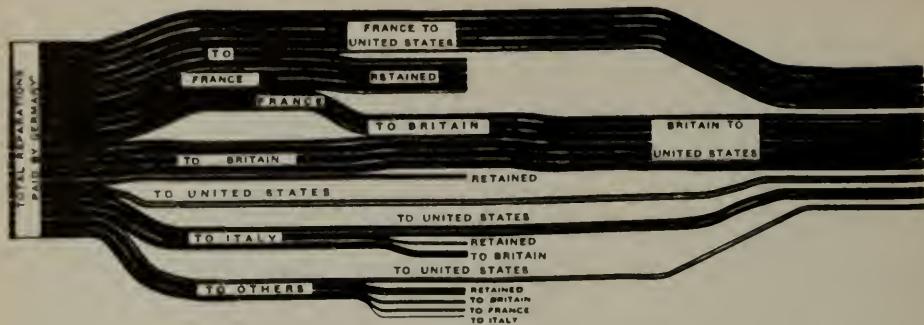
FLOW CHARTS



A Cosmograph Showing Distribution of Income From Sales.

The right side of the chart shows the distribution of the income on the left. It shows not only the major channels of distribution—production cost, sales cost, etc.—but also the factors of which these major costs are composed.

GRAPHIC PRESENTATION

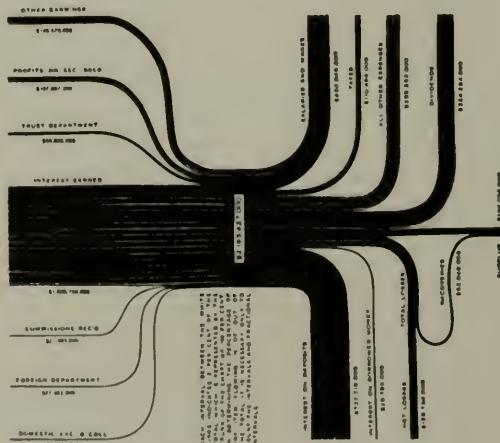


International Business Machines Corp., N. Y. C.

SCALE .6

A. Cosmograph Showing Distribution of German Reparation Payments.

1. The left side of the chart shows the total amount of reparations, and the countries by which they were received. The center of the chart shows the amounts retained by each country, indicated by the broken portions of the branches. The right side of the chart shows the amounts paid in turn by the several countries to the United States. The extreme right shows the total amount received by the United States.
2. The effect of the broken branches is obtained by sliding the paper strips backward until their ends lie at the center of the chart. The remaining strips are held in position at the center by the insertion of wedges.



International Business Machines Corp., N. Y. C.

SCALE .6

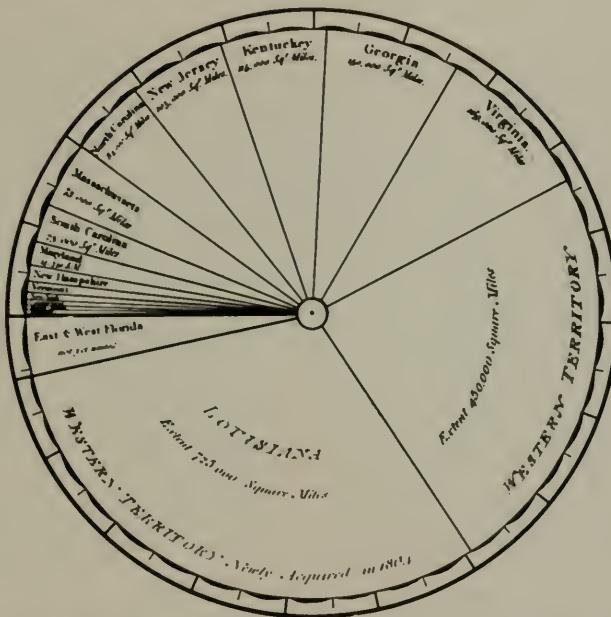
B. Cosmograph Showing Simple Income and Outgo.

1. In setting up such a chart, the center trunk is clamped in the usual manner. The income side of the chart is set up and clamped, the board is turned and the expenditure side is arranged and clamped.
2. A short strip of black paper is pasted across the trunk to provide a white block on the negative photostatic print. The total money value is noted in type on this white block.

Chapter 9

SECTOR CHARTS

A SECTOR chart presents data in the form of a circle. The circle is divided along its radii so that the angle of each section is proportional to the factual data it represents. Other terms used for sector chart are: pie chart, divided circle. In practically every instance in which material is presented in a sector chart, the same information might also be presented in bar charts. See Chapters 10 and 12.



From D. F. Donnart, "Statistical Account of the United States of America," 1805, Greenland & Norris, London. The Chart Was Made by William Playfair. SCALE .5

Statistical Representation of the United States of America in 1805.

1. This, so far as is known, was one of the first sector charts. William Playfair, the man who invented the method, called it a "divided circle."
2. In *Statistical Breviary*, 1801, William Playfair presented a group of circles whose areas were equal to the areas of the countries they represented. The circle representing the Turkish Empire was divided into 3 sections. Since this preceded the illustration above in point of time, it may have been the first sector chart.

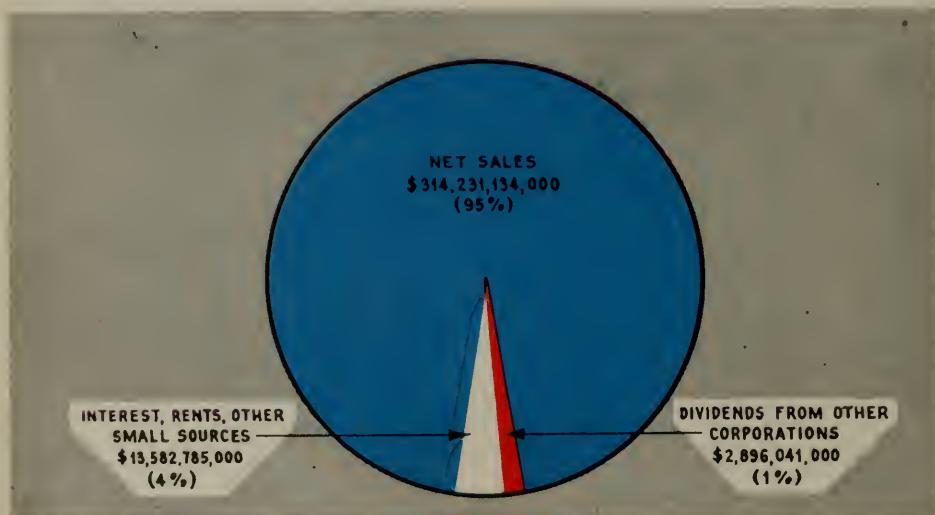
GRAPHIC PRESENTATION



Works Progress Administration, National Research Project, "Summary of Findings to Date," March, 1938.

- A. Employment and Unemployment Experience of 129 Displaced Hand Cigar Makers in Manchester, N. Y., as Recorded Five Years After the Lay-off.

1. Divisions within divisions are possible in the sector chart. Here two categories, employed and unemployed, are further divided so that the circle is in reality divided into four parts.
2. Shading pieces of the sector chart makes the chart easier to read.

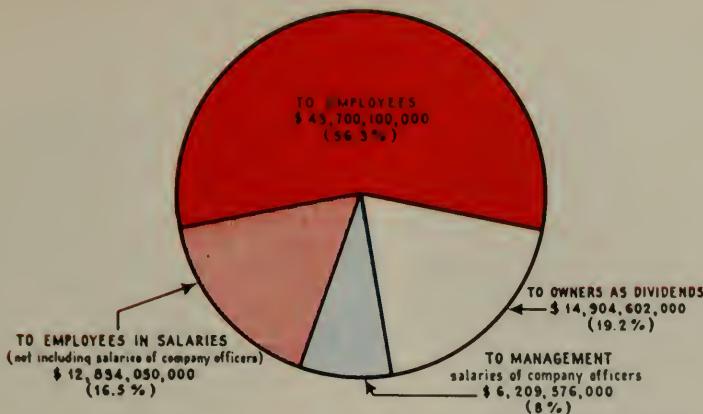


Factory Management and Maintenance, October, 1938, Part of an Editorial on Public Relations Entitled, "How a Company Can Make Simple Reports to Its Employees."

- B. Sources of the Total Income of Manufacturing Industries for the Period 1929-1935. Total \$330,709,960,000.

The sector chart gives an angle and area comparison. The relative merits of the sector chart and the 100% bar chart in presenting the same facts are disputed.

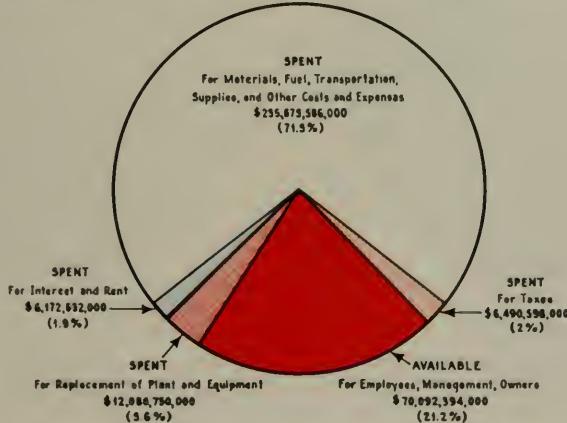
SECTOR CHARTS



Factory Management and Maintenance, October, 1938, Part of an Editorial on Public Relations Entitled,
"How Much Employees, Management, and Owners Got." SCALE .6

A. Total Paid Employees, Management, and Owners for the Period 1929-1935 in Manufacturing Industries.

1. In all three of the sector charts presented , the largest component part has been placed on the top section of the circle. For artistic balance and eye appeal this may be the preferred practice. But to aid in making comparisons between any two of these, it probably would have been better to arrange the sections as shown in 88B.
2. Expenditures and income of the manufacturing industries are shown in this chart and 83B.



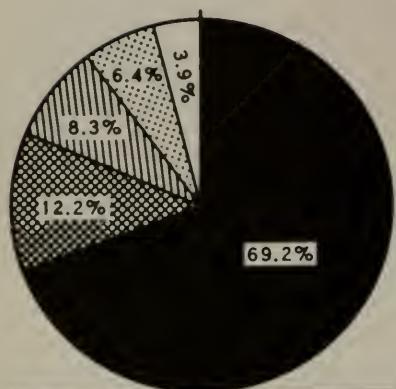
Factory Management and Maintenance, October, 1938, Part of an Editorial on Public Relations Entitled,
"How a Company Can Make Simple Reports to Its Employees." SCALE .6

B. Disposition of Total Income of Manufacturing Industries for the Period 1929-1935. Total \$330,709,960,000.

1. When it is impossible to place the titles for the component parts of a sector chart in a horizontal position within the section, the above method exemplifies good practice.
2. Expenditures and income of the manufacturing industries are shown in this chart and 83A.

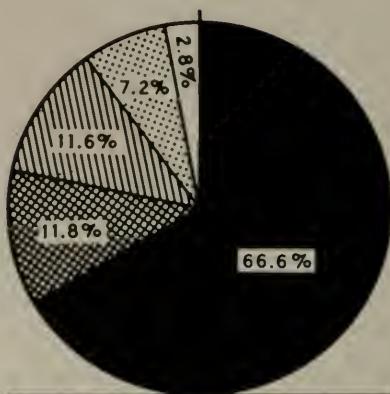
GRAPHIC PRESENTATION

1927



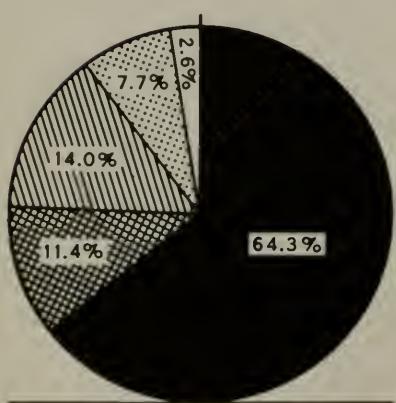
\$ 787,000,000

1930



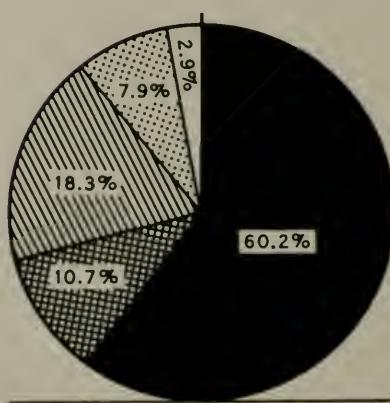
\$ 850,000,000

1932



\$ 699,000,000

1934



\$ 608,000,000



U. S. Department of Agriculture, Bureau of Agricultural Economics.

Sources of the Farm-Tax Dollar in the United States for the Years 1927, 1930, 1932, and 1934.

The general rule regarding the arrangement of the component parts of a sector chart is that the divisions should be arranged according to magnitudes clockwise with the 12 o'clock mark as the starting point. This rule, however, is a flexible one. It should be noted that the 1927 circle follows the general rule and establishes the arrangement of shadings which is adhered to in the other circles.

SECTOR CHARTS

A. Comparison of Crimes Against Persons By Time Periods in Cincinnati in 1937.

This is a comparison of areas rather than angles as can easily be seen by comparing the section labelled 18.3% with 9.9%, a ratio of about 2 to 1. The distance along the radius for each does not appear to be as 2 is to 1.

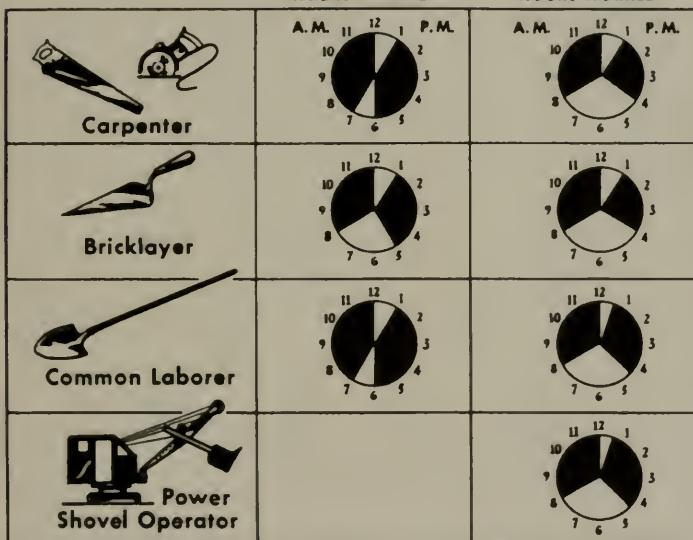


Cincinnati, Ohio, "Municipal Activities," 1937.
SCALE .5

1888 1938

HOURS WORKED

HOURS WORKED

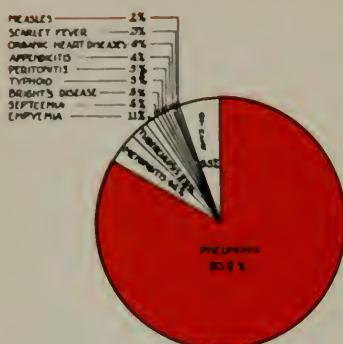


Engineering News Record, October, 1938, Part of an Editorial on Public Relations Entitled, "The Construction Industry, What It Is—What It Does."

B. A Comparison of the Hours Worked in New York City on Various Construction Jobs in 1888 and 1938.

The average number of hours worked in each of the two years, 1888 and 1938, is actually plotted on a clock so that not only the number of hours but the time of day involved can be seen. For instance, in 1888, an hour was allotted for lunch. In two categories in 1938 only half an hour is allotted for lunch.

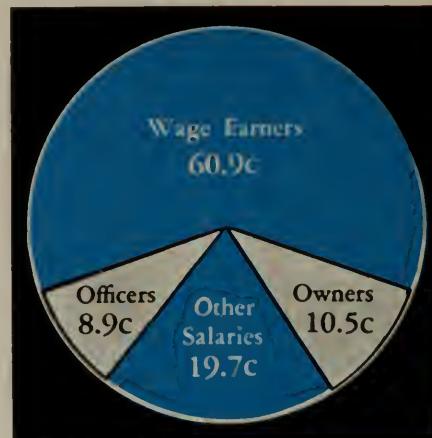
GRAPHIC PRESENTATION



Leonard P. Ayres, "The War With Germany," Government Printing Office, 1919.

A. Deaths of American Soldiers by Principal Diseases in the World War.

This chart illustrates the position of a miscellaneous item when component parts are presented. Although the percentage of soldiers who died from diseases other than those listed is second to the percentage of those who died from pneumonia, it is placed last in the clockwise arrangement.



Power, October, 1938, Part of an Editorial on Public Relations Entitled "Man's Power Partner."

B. Distribution of Industry's Dollar in 1937.

- One distinctive feature about this chart is the use of a black background which emphasizes both the grey and blue sections.
- By alternating light and dark, it is possible to make two colors do the work of four.



U. S. Department of Labor, Bureau of Labor Statistics, "Labor Information Bulletin," October, 1936.
SCALE .4

C. Total Cost of Direct Labor and Materials on PWA Construction Projects, 1933-1936.

- The use of many circles and the arrangement of each one makes this an interesting group of charts.
- In order to aid in comparing one circle with another, it might have been better to have a common starting point, that is, to have the black section of each circle start at the top center as in 84.
- Note that the numbers beneath the circle give the amount of money spent for each purpose, but have no bearing on the size of the circles.



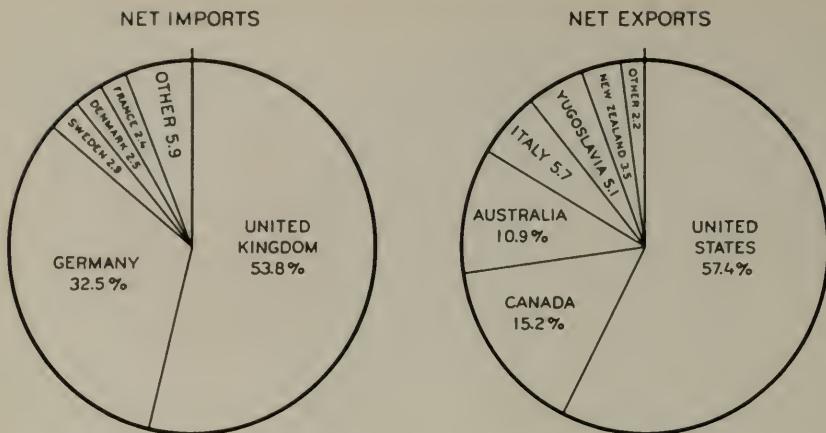
During the period 1923-1934 (latest figures available) the average profit in the manufacturing industries was equal to 4.2¢ for each sales dollar, or 4.3¢ for each invested dollar.

Factory Management and Maintenance, October, 1938, Part of an Editorial on Public Relations Entitled, "A Program for Public Relations."

Percentage of Profit from a Sales Dollar and an Invested Dollar.

1. The use of a dollar or other coin in place of a circle adds to the effectiveness of a sector chart.
2. It might have been better to place the section labelled "Profit" at the 12 o'clock mark. The difference between 4.2 and 4.3 is so slight that the eye has difficulty in noting it. Because the sections are centered on the 6 o'clock mark, it is even more difficult to see the difference.

GRAPHIC PRESENTATION

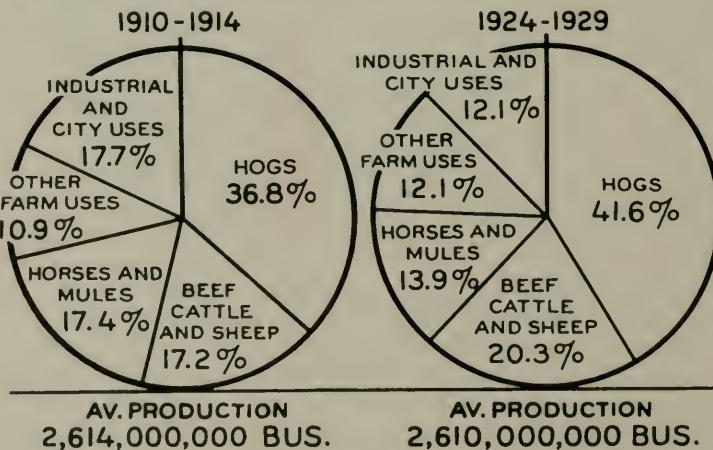


U. S. Department of Agriculture, Bureau of Agricultural Economics.

SCALE .7

A. Average World Trade in Apples by Countries for the Five Year Period from 1928 to 1932.

1. The lettering on this chart, the method of division, and the arrangement of the sections should be commended. Although labels usually are kept on a horizontal plane, the small size of the sections may make it impossible to follow this method even by the use of arrows.
2. These data might be more clearly shown by a 100% bar chart.



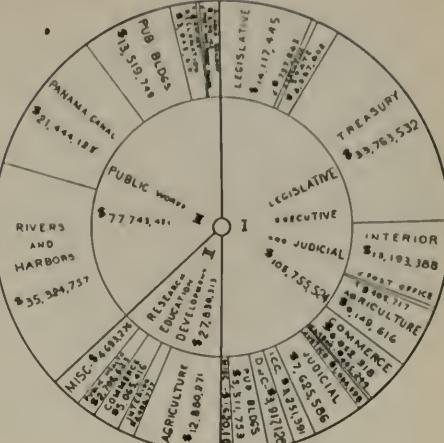
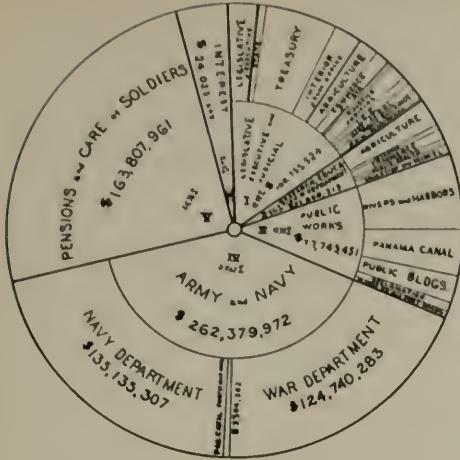
U. S. Department of Agriculture, Bureau of Agricultural Economics.

SCALE .7

B. Distribution of Corn in the United States for the Two Periods 1910-1914 and 1924-1929.

1. This chart presents the best method of dividing the circle and labelling its parts.
2. The chart is marked clockwise in magnitudes with the first line beginning at 12 o'clock.
3. The lettering of the sections is on a horizontal plane so that it is not necessary to turn the chart to read the labels.

SECTOR CHARTS

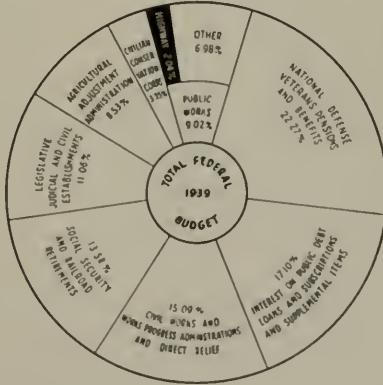
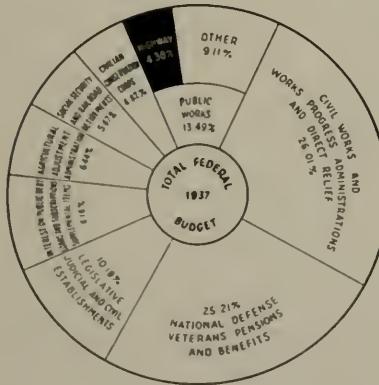


American Society of Mechanical Engineers, N. Y. C., "Mechanical Engineering," February, 1921.

SCALE .5

A. Average Annual Net Expenditure of the Federal Government During the Period 1910 to 1919, and for the Same Period Exclusive of War Cost.

1. If you think of this type of chart as two sector charts, one larger than the other with the smaller on top, it is much easier to understand.
 2. It would have been impossible to put the titles of the segments on a horizontal plane in this sector chart. Care has been taken, however, to make the lettering clear.



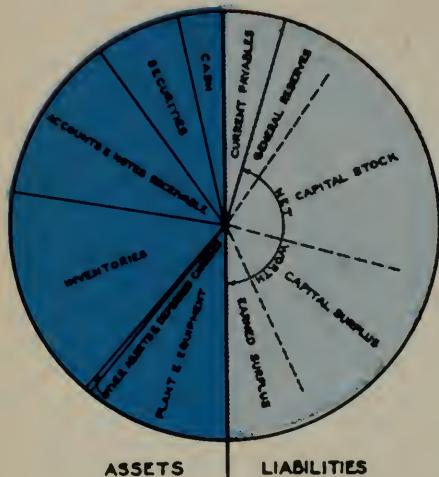
American Association of State Highway Officials, "American Highways," April, 1938.

SCALE .5

B. Distribution of the Total Federal Budget for 1937 and 1939.

Since the budget for highways was the point of emphasis, public works, of which it is a part, was placed at the center top. Note that public works only was subdivided to allow for this emphasis.

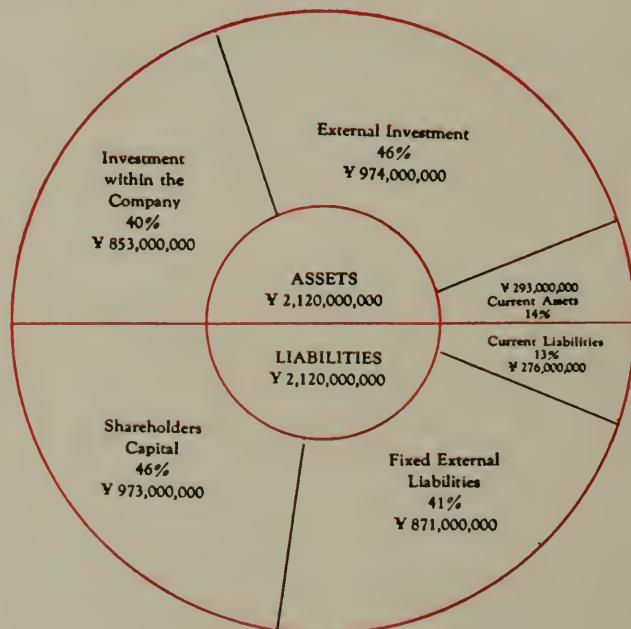
GRAPHIC PRESENTATION



Elgin National Watch Co., Elgin, Illinois, "Let's Look at the Record of 1937."

A. Assets and Liabilities of the Elgin National Watch Company in 1937.

This differs from the sector chart below in that the dividing line between the assets and liabilities is a vertical one rather than a horizontal one.

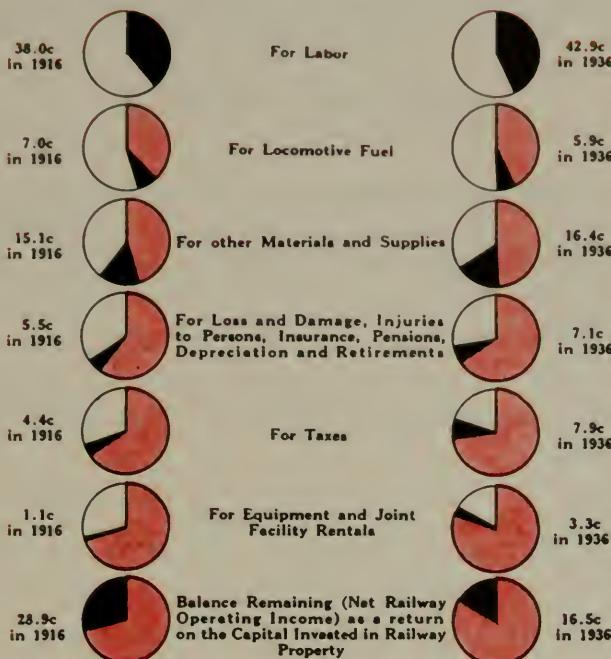


South Manchuria Railway Co., "Contemporary Manchuria," a Bimonthly Magazine, Japan, September, 1938.

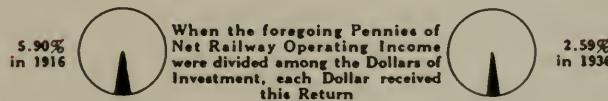
B. Distribution of Assets and Liabilities of the South Manchuria Railway Company in 1938.

Half of this circle represents the assets of the South Manchuria Railway Company and the other half the liabilities. Each half equals 100%.

SECTOR CHARTS



For each Dollar of Operating Revenues Received, the Railways had \$4.90 Invested in their Properties in 1916 and \$6.37 in 1936.



Committee on Public Relations of the Eastern Railroads, N. Y. C., "A Yearbook of Railroad Information," 1937.

A Comparison of the Distribution of the Average Dollar of Operating Revenues Received by Class I Railways in 1916 and 1936.

This might be called a cumulative sector chart. Note that in each circle the total of all that has been presented above it is represented by a shaded section, while the part to be added is in black.

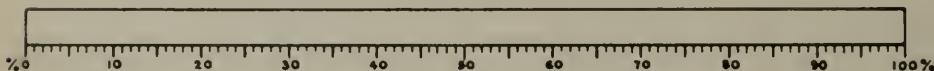
Chapter 10

100% BAR CHARTS

A one hundred per cent bar chart is one in which a single bar represents 100% and the divisions of the bar represent percentages of the whole. Synonyms for 100% bar chart are: percentage bar chart, relative bar chart, component parts bar chart.

CHARACTERISTICS OF A 100% BAR CHART:

1. A straight bar is easy to divide into parts representing approximate percentages, and is more convenient to use than a sector chart.
2. The sections may be shaded or colored for contrast.
3. Groupings of the parts are possible by using brackets or engineering dimension lines.
4. A percentage scale outside the bar is more easily read.
5. To aid in using the chart for reference purposes, the actual value of the bar and its component parts should be given.
6. To eliminate any need for turning the bar, the labels should read from left to right horizontally wherever possible.
7. The bar should be wide enough to allow for differentiation, and yet not so wide that the facts presented are distorted.

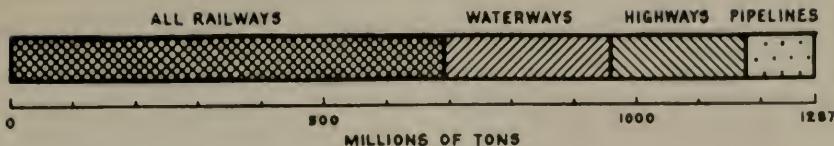


A 100% Bar Chart Stamp.

SCALE .8

1. A rubber stamp in the form of a 100% bar chart with the percentages marked may be secured from stores handling graphic chart material or from makers of rubber stamps.
2. When a bar chart is wanted in a report, all that is necessary is to allow two inches height and six inches length in the manuscript. The chart may then be placed in this space.
3. These rubber stamps may be secured in other sizes, but they are usually six inches long. Paper on which five 100% bars have been printed is also available. This illustration may be used as copy for making a rubber stamp.

100% BAR CHARTS

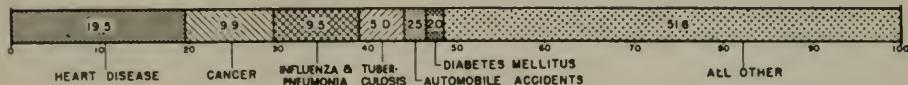


"The Federal Chart Book," Prepared by the Central Statistical Board and National Resources Committee, January, 1938.

SCALE .8

A. Estimated Tonnage in the United States Originated by Principal Types of Carriers in 1932.

1. In this chart a comparison of weights is given rather than amounts or percentages, and the scale is separated from the 100% bar.
2. The value of this chart would have been increased if the tonnage for each of the four divisions had been given.
3. The choice of shadings was unfortunate, since at the point where the two sections, "waterways" and "highways," meet, the bar seems to sag.
4. *The Federal Chart Book* is an experimental publication and does not stand as a document for general use. As a result, the illustrations are in a tentative and not necessarily final form.



"The Federal Chart Book," Prepared by the Central Statistical Board and National Resources Committee, January, 1938.

SCALE .6

B. Percentage Distribution by Selected Causes of Deaths in the United States in 1935.

1. The 100% bar chart is a classification chart with percentages graphically presented. It gives the component parts of the total along a straight line. By making the line a bar, the component parts are more easily identified and compared.
2. Note that the percentage for each of the seven divisions is given within each section.
3. The use of connecting lines to identify small sections of a 100% bar chart with its title is here demonstrated.



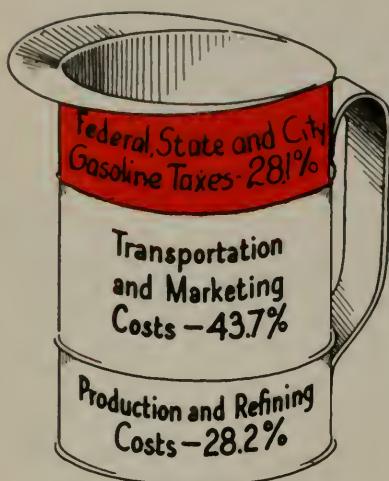
"The Federal Chart Book," Prepared by the Central Statistical Board and National Resources Committee, January, 1938.

SCALE .7

C. Distribution of Sales by Types of Retailers in the United States in 1935.

1. The use of brackets or engineering dimension lines to show groupings of the parts of a 100% bar chart is often useful. In this chart the titles of the individual sections are given above the bar, while the titles of the groupings indicated by brackets are given below the chart.
2. The inclusion of the percentages within each section is a decided advantage.

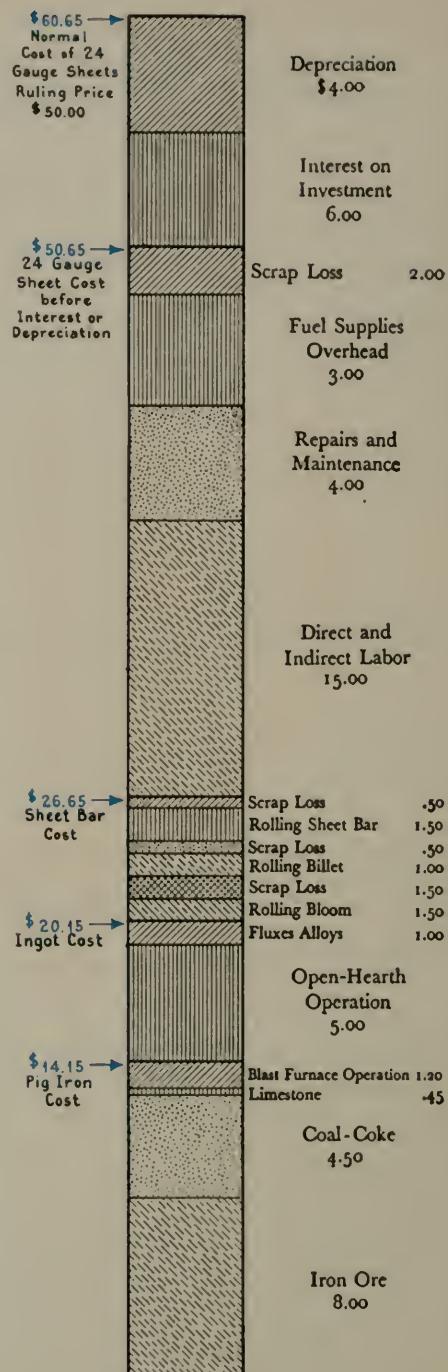
GRAPHIC PRESENTATION



Automobile Manufacturers Association, "Automobile Facts and Figures," 1938.

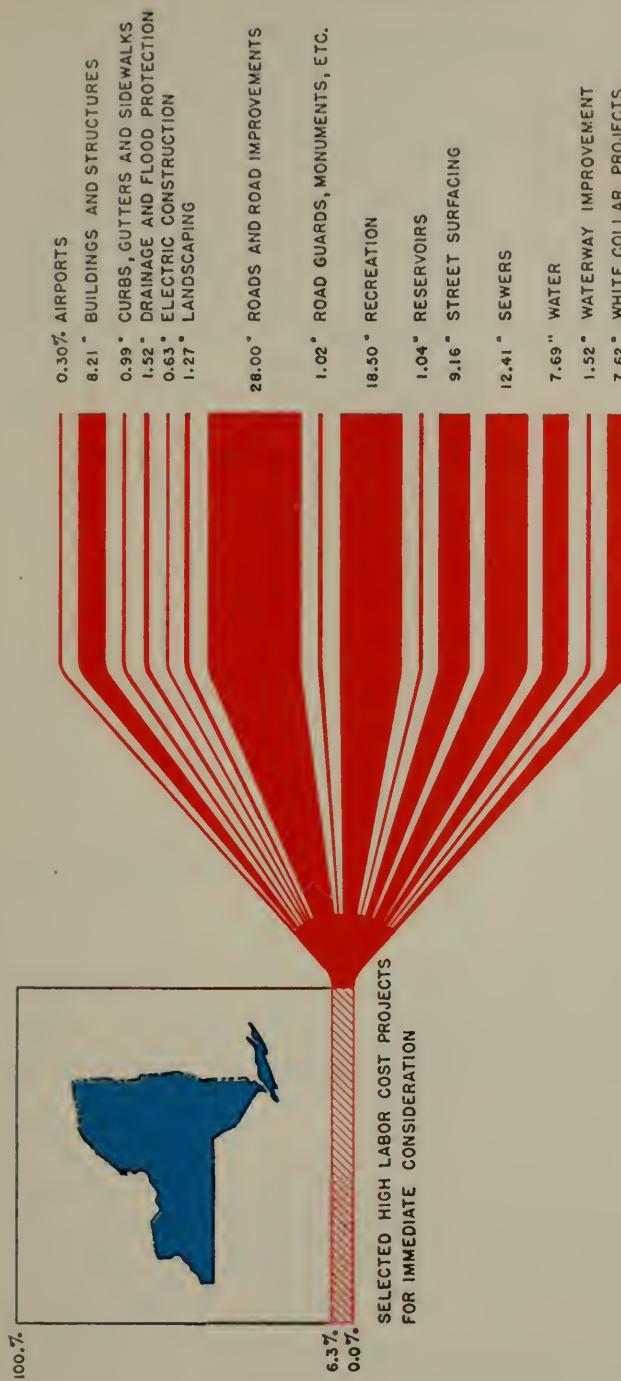
A. Distribution of the Cost of Gasoline in the United States in 1936.

The use of objects which can be divided into percentages is a common practice. In this chart, a gallon can is very appropriate to illustrate the distribution of the cost of gasoline.



B. Cost of a Ton of Finished Sheet Steel at a Lake Port in the United States in 1931.

1. The amounts to the left of the bar are cumulative: each one is a total of all those below it on the right hand side.
2. It might have been better to include either a percentage scale or percentages within each division. As it is now, percentages of the total may be computed, though they are not given.



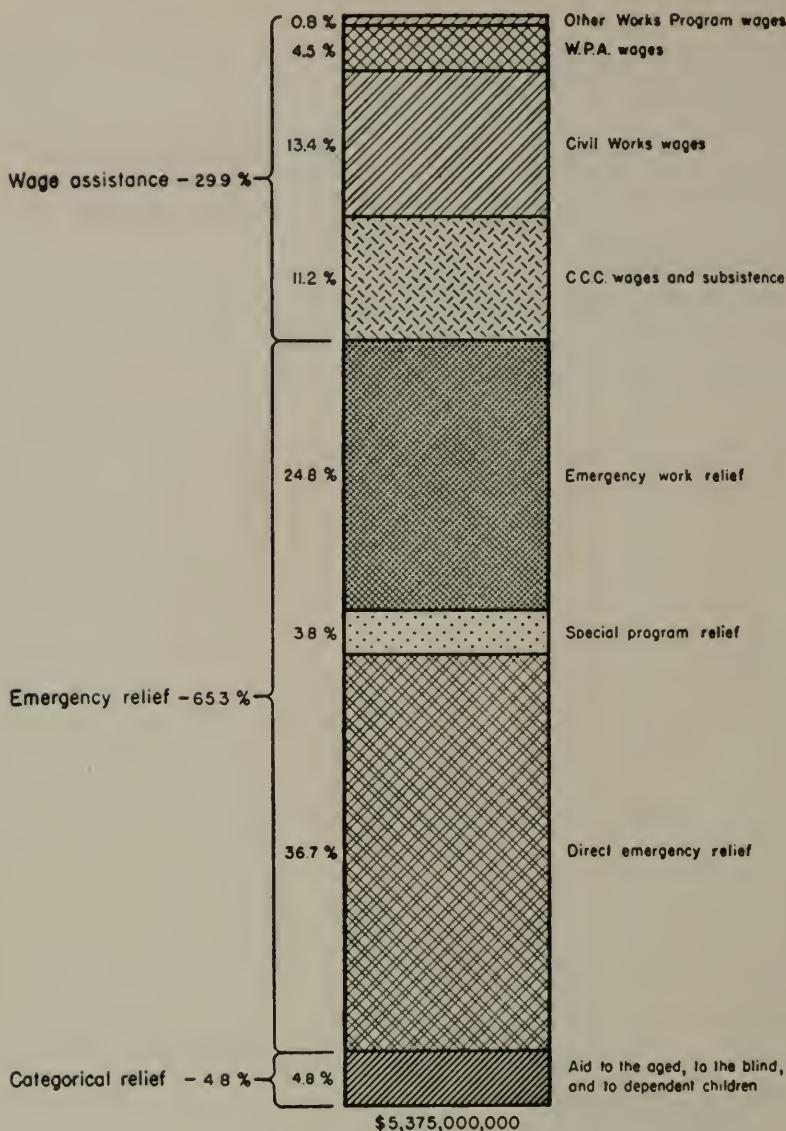
National Resources Board, "State Planning," 1935.

Analysis of Works Projects of Comparatively High Labor Cost for New York State.

In this chart two important facts are presented. First the fact that only 6.3% of total labor costs in New York is being considered is given at the left. The separation of this 6.3% into its various categories presents the other important fact.

SCALE .8

GRAPHIC PRESENTATION

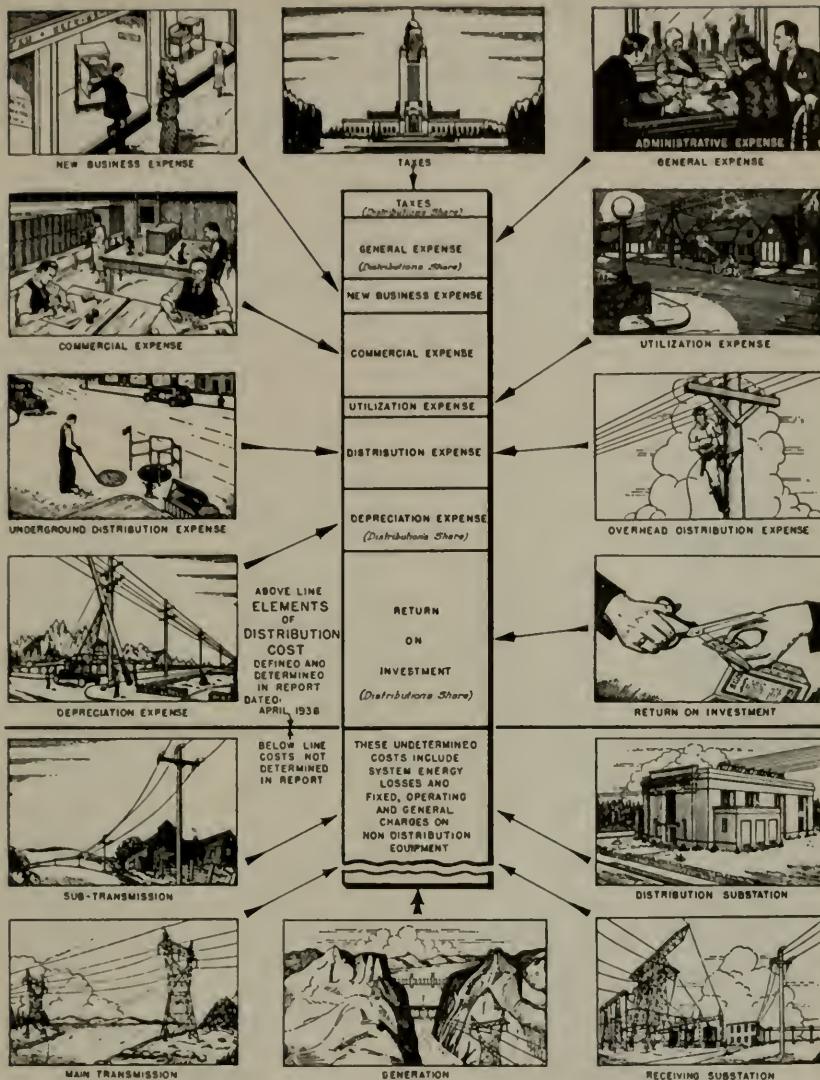


WPA, Division of Social Research, "Trends in Relief Expenditure," 1937.

A. Percentage Distribution of Total Expenditures for Public Relief and Wage Assistance in the United States for the Years 1933-35.

1. The vertical 100% bar when divided into small sections is much easier to label than if it were horizontal.
2. It also lends itself readily to grouping by sets of brackets to show such items as total fixed charges, total operating expenses, etc.

100% BAR CHARTS



Federal Power Commission, "National Power Survey," 1936.

SCALE .7

Elements of Costs in the Supply of Electricity to Residential Customers in the United States in 1935.

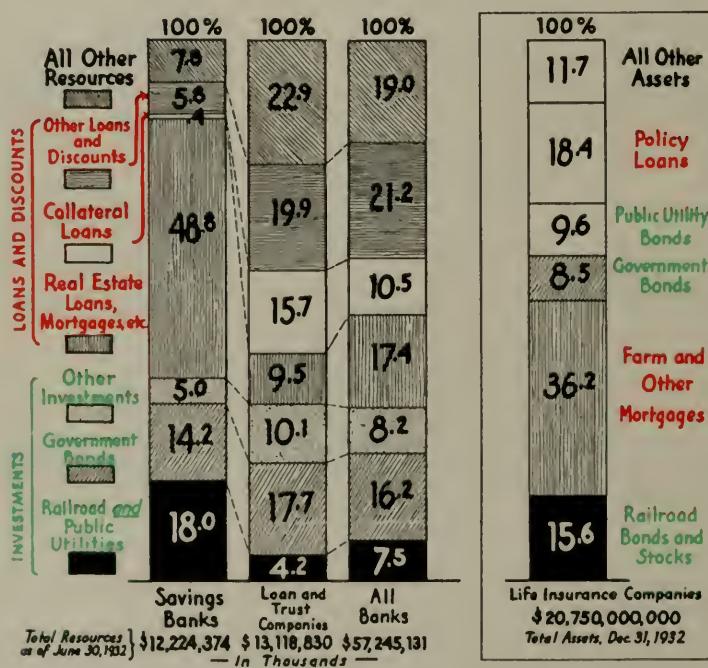
1. By illustrating each of the elements of cost in the supply of electricity to residential customers in the United States, meaning is given to such terms as "utilization expense" and "return on investment." This form of chart would be appropriate for an annual report.
2. In this illustration, no figures are shown. When a chart is to be used in a report, figures should be given and correct relative proportions maintained.

Chapter 11

COMPARISON OF 100% BAR CHARTS

THE CHARTS in this chapter are the same type as those shown in the preceding chapter. The 100% bars are grouped for comparison purposes.

1. Since it is difficult to determine the approximate height or length of any one of the sections of a bar, it might be better to put the percentage scale at both left and right, or top and bottom.
2. The shadings should follow the general rule that when no one thing is to be emphasized, the darker shadings should be next



American Association of Automobile Manufacturers, New York City.

SCALE .8

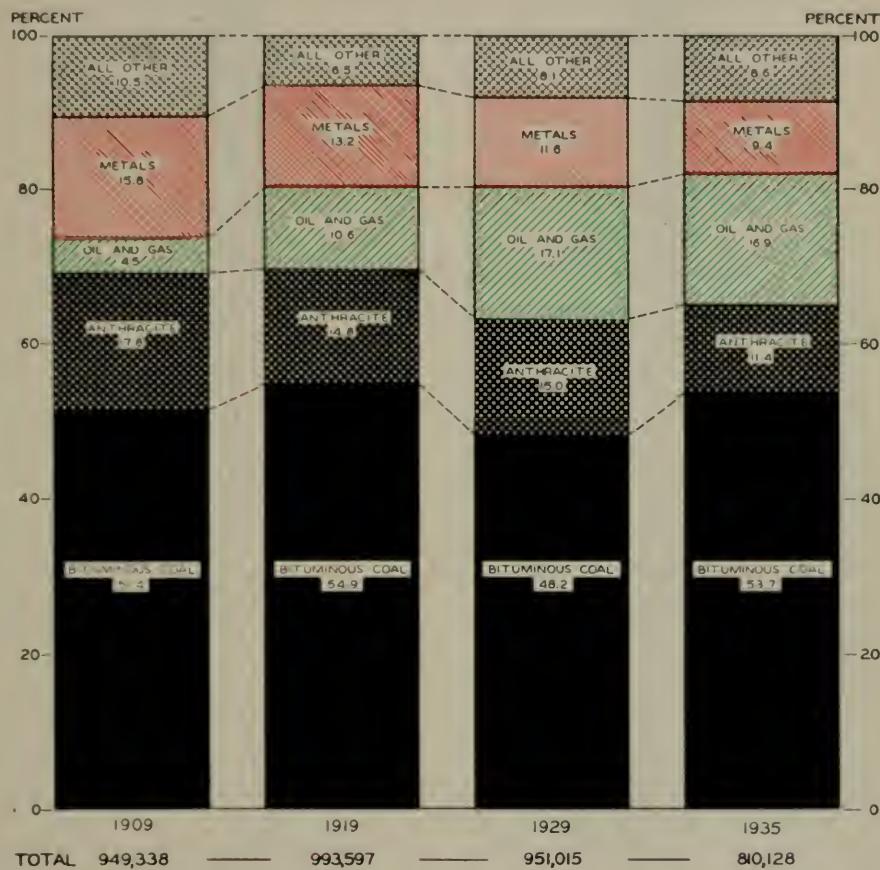
Percentage of Total Resources or Assets of Banks and Life Insurance Companies in the United States Invested in Various Types of Securities, Loans, or Other Assets in 1932.

COMPARISON OF 100% BAR CHARTS

99

to the zero line. A section to be emphasized should be the darkest shade.

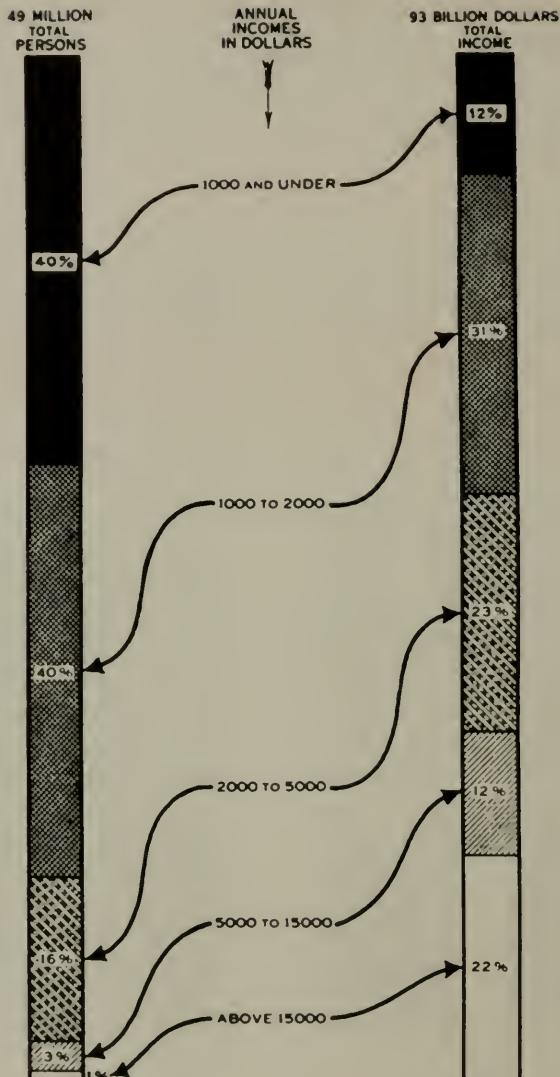
3. Connecting lines from one bar to the next aid the reader.



WPA, National Research Project, "Summary of Findings to Date," March, 1938.

Percentage Distribution of Wage Earners Employed in the Mineral Industries in the United States in 1909, 1919, 1929, and 1935.

GRAPHIC PRESENTATION



S. S. Wyer, "Living Together in a Power Age," Association Press, New York, 1936.

SCALE .9

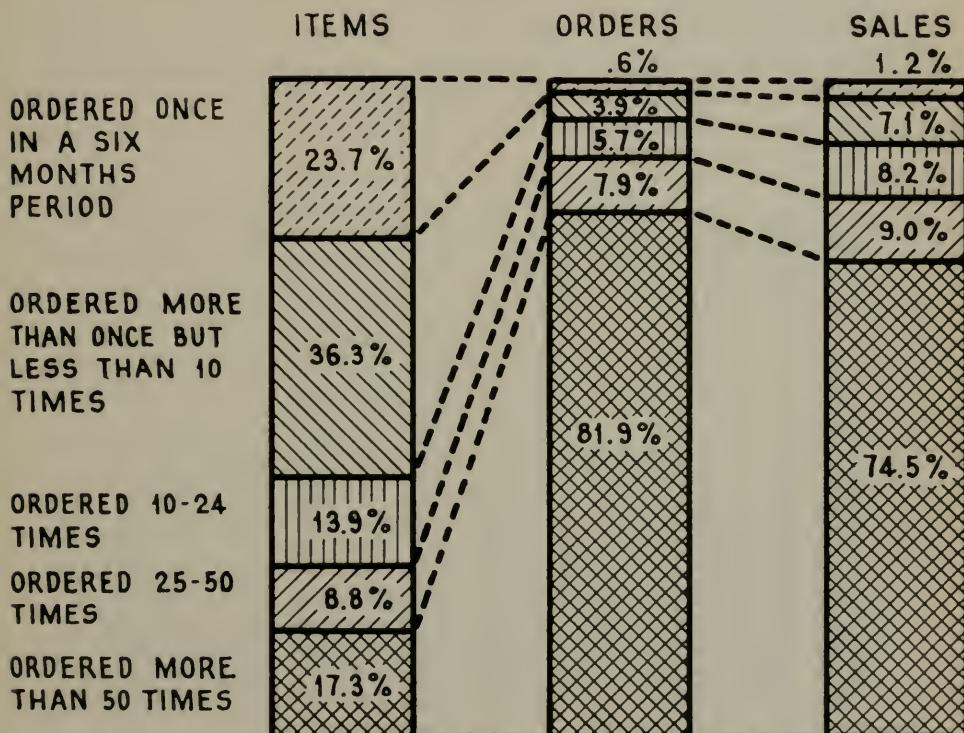
Distribution of the Income of the People in the United States in 1929.

1. The method of reading this chart is as follows: the people in the United States whose incomes are \$1000 or under comprised 40% of the population and contributed 12% of the total national income in 1929; the people in the United States whose incomes are from \$1000 to \$2000 comprised 40% of the population and contributed 31% of the total national income in 1929.
2. The use of arrows and distinctive gradations aid in reading this chart.

COMPARISON OF 100% BAR CHARTS

CHARACTERISTICS OF BAR CHARTS:

1. Bar charts may be adapted to fit almost any application.
2. The height of each bar is easily compared.
3. There should be some order for arrangement:
 - a. Time-series
 - b. Magnitudes
 - c. Geographical
 - d. Alphabetical
4. The actual amount which each bar represents should be given.

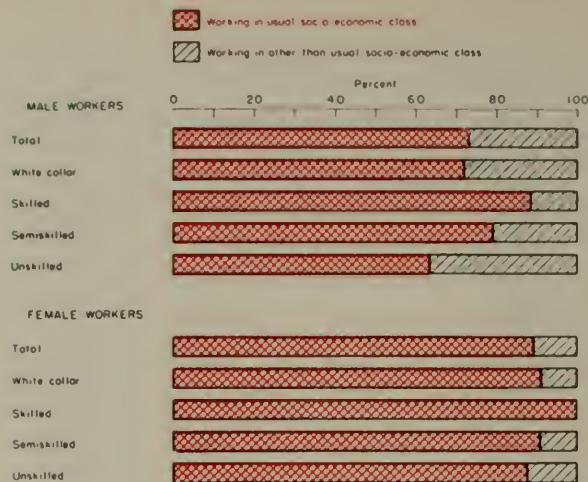


Redrawn from a Chart by U. S. Department of Agriculture, Bureau of Agricultural Economics.

Frequency of Orders of Ten Selected Candy Plants in the United States in 1930.

When none of the various shading films are available to provide cross hatchings on a chart, rulings such as these may easily be put in by hand. Care should be taken not to create weird effects such as those in 93A and 115A.

GRAPHIC PRESENTATION

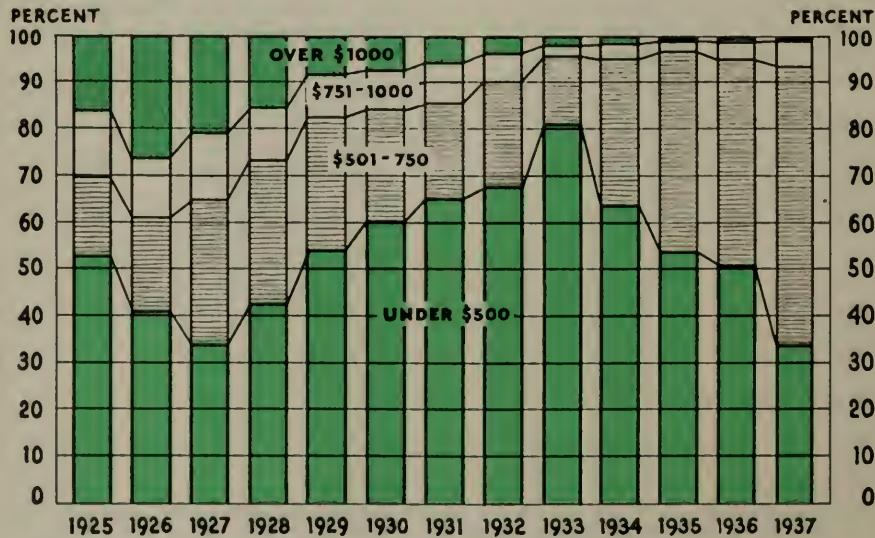


WPA, Division of Social Research, "Urban Workers on Relief," 1936.

SCALE .6

A. Proportion of Employed Workers on Relief in Jobs of Their Usual Socio-Economic Class in the United States in May, 1934.

The inclusion of the "total" bar in each of the two classifications adds to the value of this chart.

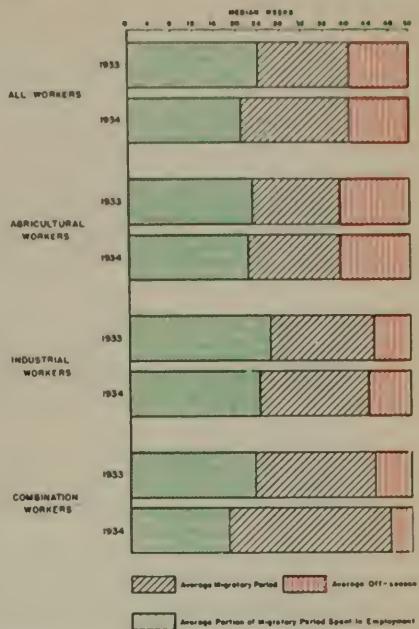


Automobile Manufacturers Association, "Automobile Facts and Figures," 1938.

B. Percentage Distribution of the Wholesale Price of Cars in the United States from 1925 to 1937.

1. Connecting lines facilitate the reading of this chart.
2. When percentages for each section of each bar are not given, it is better to put the percentage scale on both sides of the series.

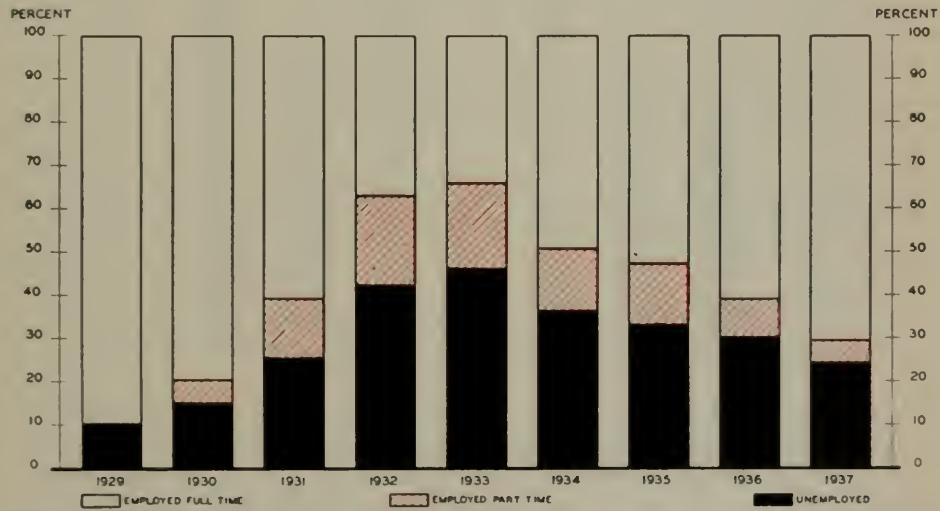
COMPARISON OF 100% BAR CHARTS



A. Average Migratory, Employment, and Off-Season Periods of 500 Migratory-Casual Workers in the United States for 1933 and 1934.

Each of these bars represents one year or 52 weeks. As a result, "weeks" are used for the scale, rather than percentages.

WPA, Division of Social Research, "The Migratory-Casual Worker," 1937. SCALE .6

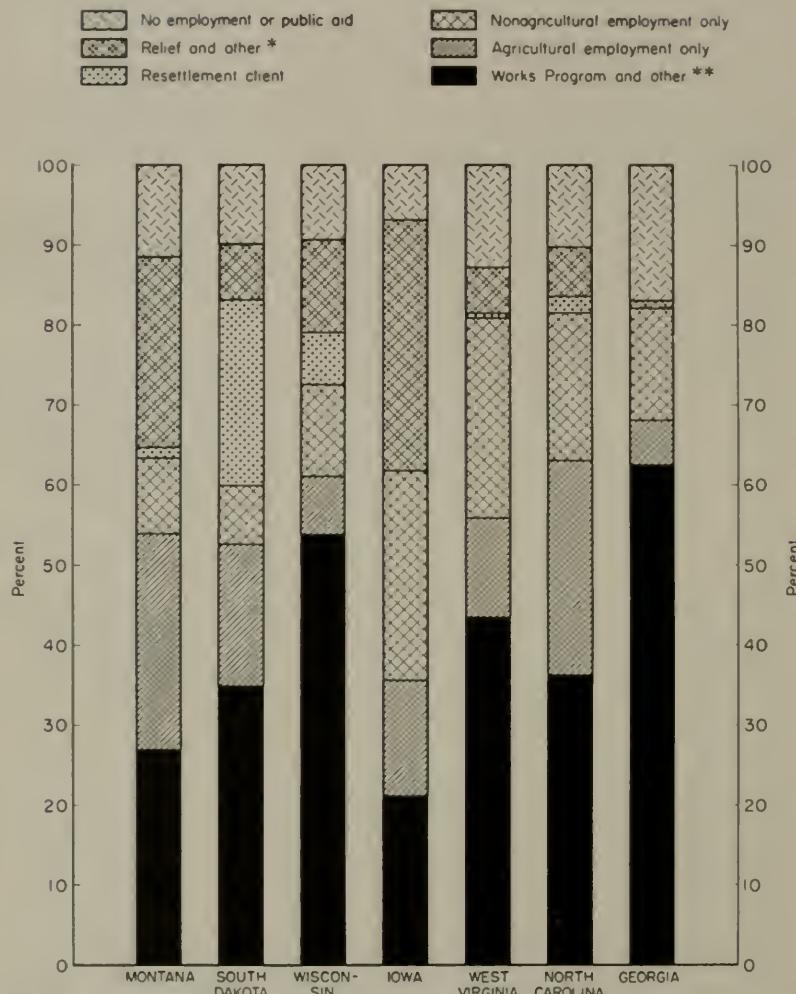


WPA, National Research Project, "Recent Trends in Employment and Unemployment," December, 1937. SCALE .7

B. Employment Status of Employable Persons As Revealed in the Philadelphia Unemployment Sample for the Years 1929-1937.

Notice that the hachures are arranged according to relative darkness. See Chapter 9.

GRAPHIC PRESENTATION



* Including those who had relief only and relief combined with private employment, but not including those with relief and Works Program employment.

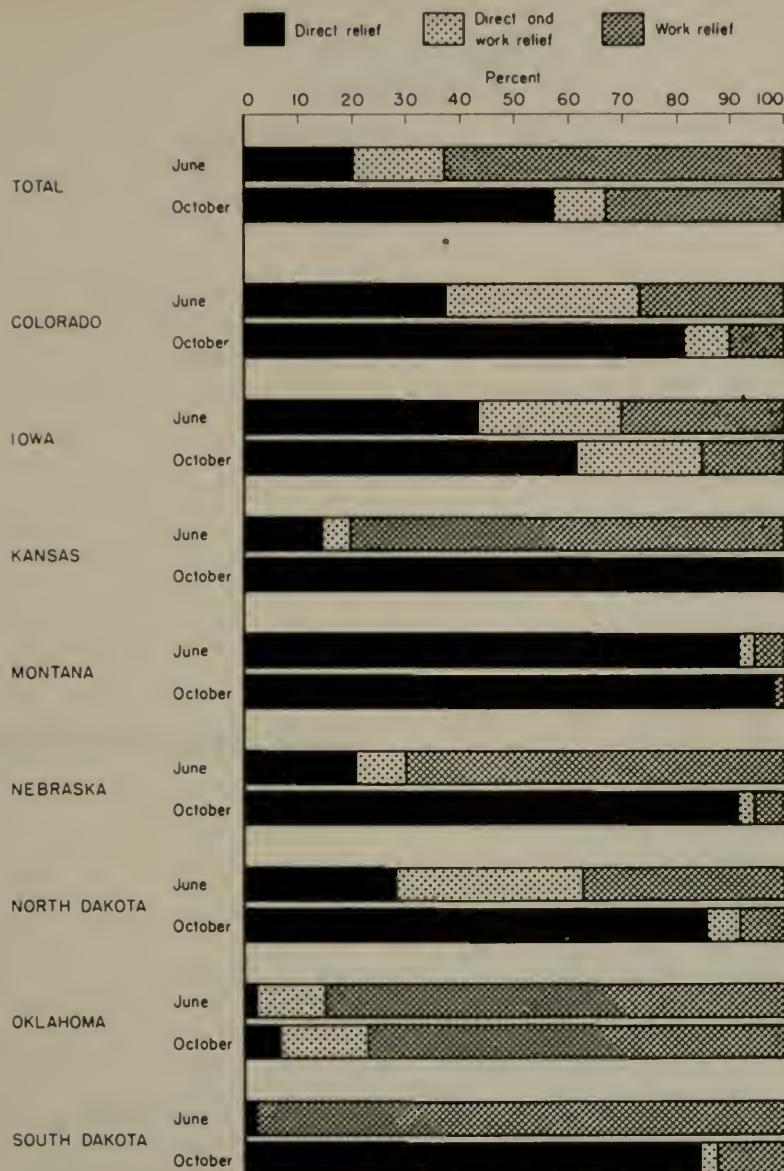
** Including those with Works Program employment only, Works Program and private employment, and Works Program and relief.

WPA, Division of Social Research, "Effects of the Works Program on Rural Relief," 1938.

Relief and Employment Status of Heads of Rural Households in the United States, in December, 1935.

When it is not possible to give complete information within the chart itself, footnotes similar to these may be utilized. The footnotes here give a great deal more detail than would have been possible in the legend itself.

COMPARISON OF 100% BAR CHARTS



WPA, Division of Social Research, Relief and Rehabilitation in the Drought Area, 1937.

SCALE .9

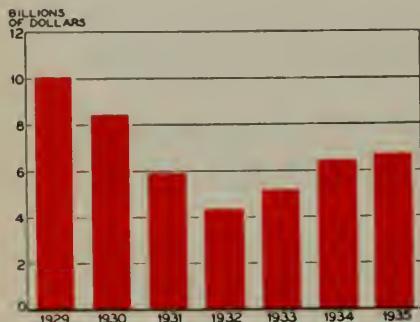
Types of Relief Granted by the Federal Emergency Relief Administration in Eight Drought States in June and October, 1935.

Here again is the application of the 100% bar chart to periods of time. Compare this with 103A.

Chapter 12

MULTIPLE BAR CHARTS

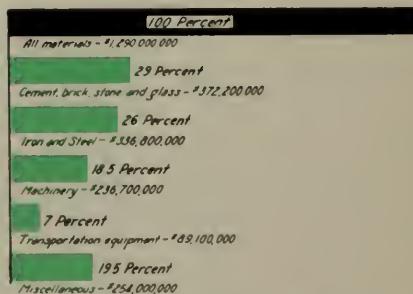
Each of the bars in the charts shown in the two preceding chapters represent 100%. Another use of the bar form is to have the length of the bars indicate values. The following are synonyms for bar charts when they are in a vertical position: column chart, "pipe-organ" chart, "pipe-of-Pan" chart, "flute-of-Pan" chart.



Federal Reserve Agent, New York, "Monthly Review," Sept. 1, 1935. SCALE .6

A. Estimated Total Cash Income of Farmers in the United States from Agricultural Marketings Including Payments by the Agricultural Adjustment Administration, for the Years 1929-1935.

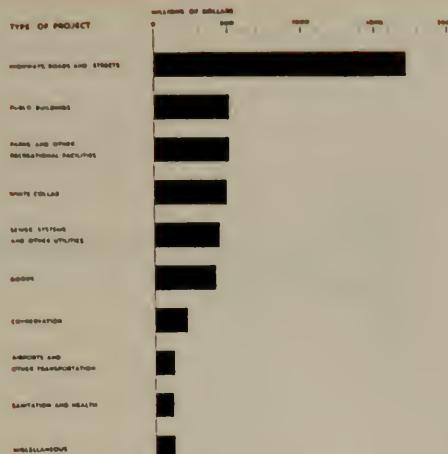
- Simple comparisons are easily represented in bar form. The yearly comparison is best when presented in vertical form, the bars forming a curve.
- The addition of the actual amounts which each bar represents would facilitate the reading of the chart and aid in its use for reference purposes.



U. S. Department of Labor, Bureau of Labor Statistics, "Labor Information Bulletin," October, 1936. SCALE .8

B. Value of Orders Placed for Materials Used on PWA Projects for the Period 1933-1936.

- The total of the lengths of all the bars beneath the first one is equal to its length.
- It should be noted that there is no difference between the width of the "total" bar and the others.

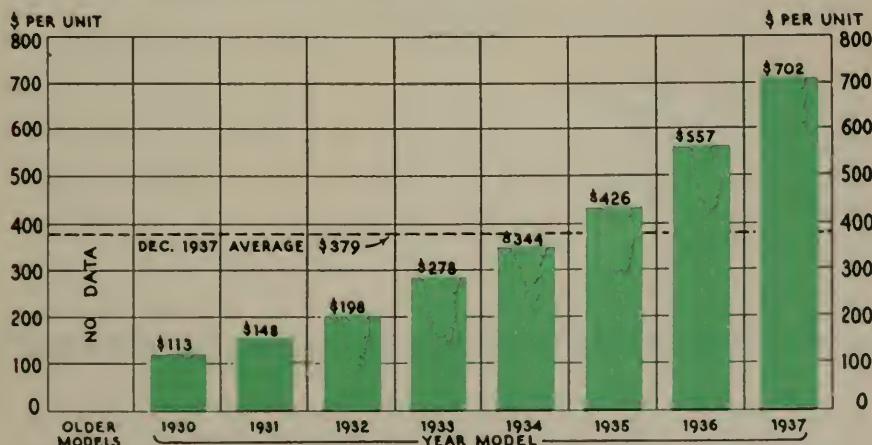


WPA, "Report on Progress of the Works Program," December, 1937.

SCALE .7

A. Estimated Total Cost of Works Progress Administration Projects Placed in Operation from May 6, 1935, Through September 30, 1937.

1. The material here is arranged according to the magnitude of the bars.
2. Its presentation horizontally eliminates the possibility of the eye seeing a curve which would be undesirable.
3. Since stubs only are used in the vertical rulings, it might have been better to include actual figures to facilitate reading the chart.

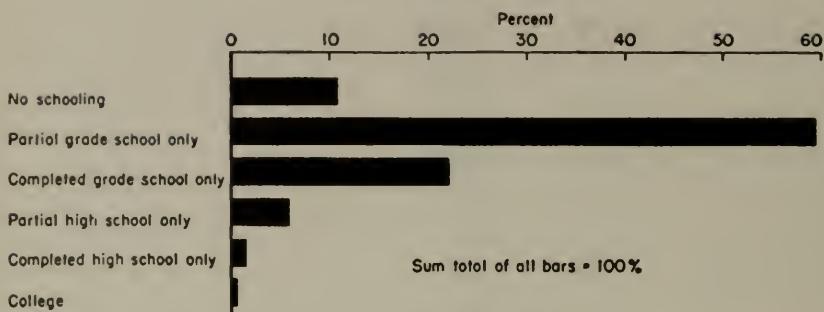


Automobile Manufacturers Association, "Automobile Facts and Figures," 1938.

B. The Average Used Car Price in the United States in 1937.

The method of reading this chart is as follows: the selling price of a used car, 1930 model, in December 1937 was \$113, while the selling price of a used car, 1935 model, was \$426. The average price of all used cars in December 1937 was \$379.

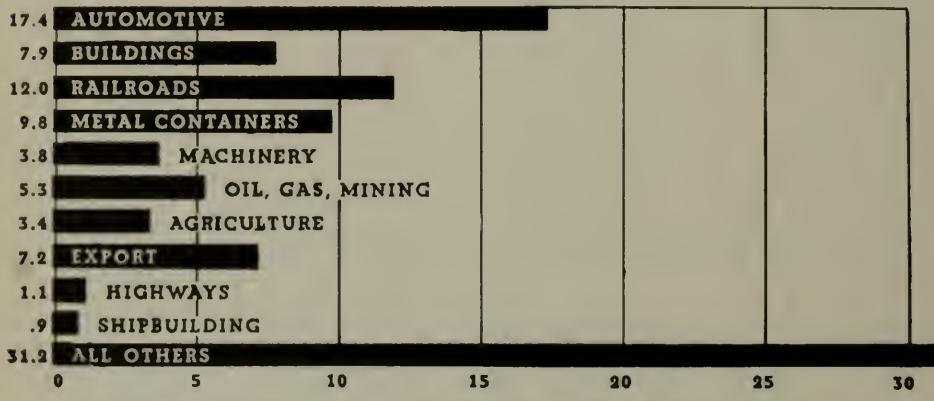
GRAPHIC PRESENTATION



WPA, Division of Social Research, "Farmers on Relief and Rehabilitation," 1937.

A. Grade Attainment of Heads of Open Country Households on Relief in the United States, October, 1935.

As is indicated, the total of all the bars in this chart equals 100%. Compare this chart with 106A and 108B.



1937 DISTRIBUTION OF FINISHED STEEL PRODUCED IN THE U. S., BY CONSUMING GROUPS

The American Rolling Mill Company, Middletown, Ohio, "37th Annual Report," 1937.

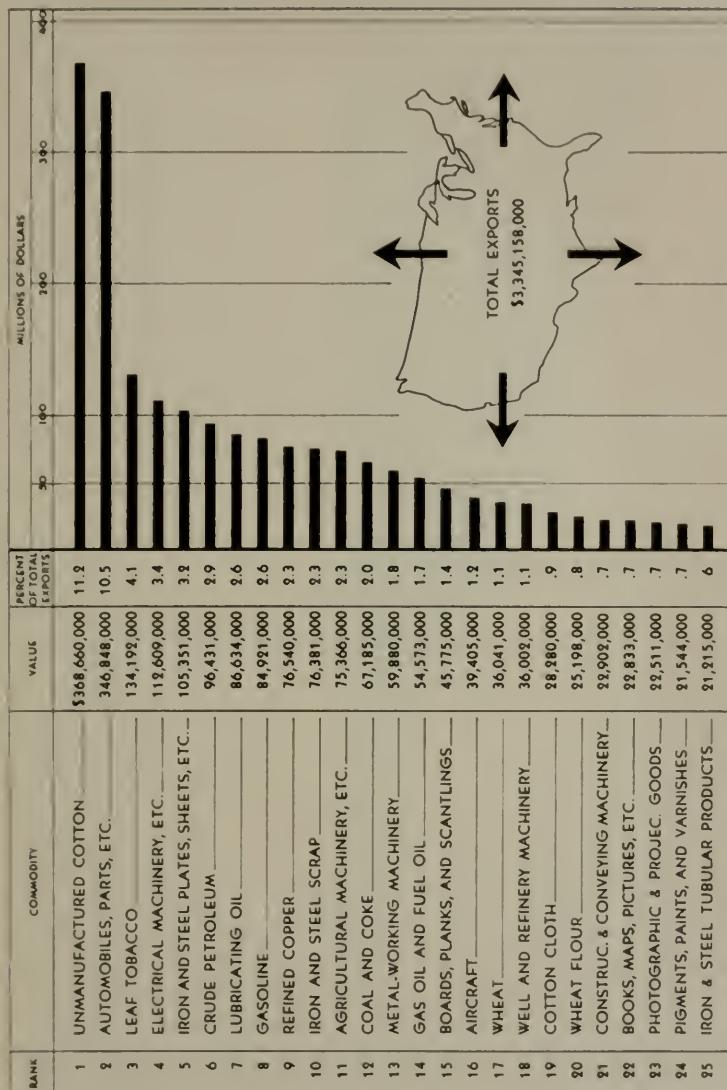
SCALE .8

B. Distribution by Consuming Groups of Finished Steel Produced in the United States in 1937.

Probably for variety, the titles of these bars were placed within the bars and the percentages were placed to the left. This arrangement aids in ascertaining whether or not the total was 100%.

MULTIPLE BAR CHARTS

109



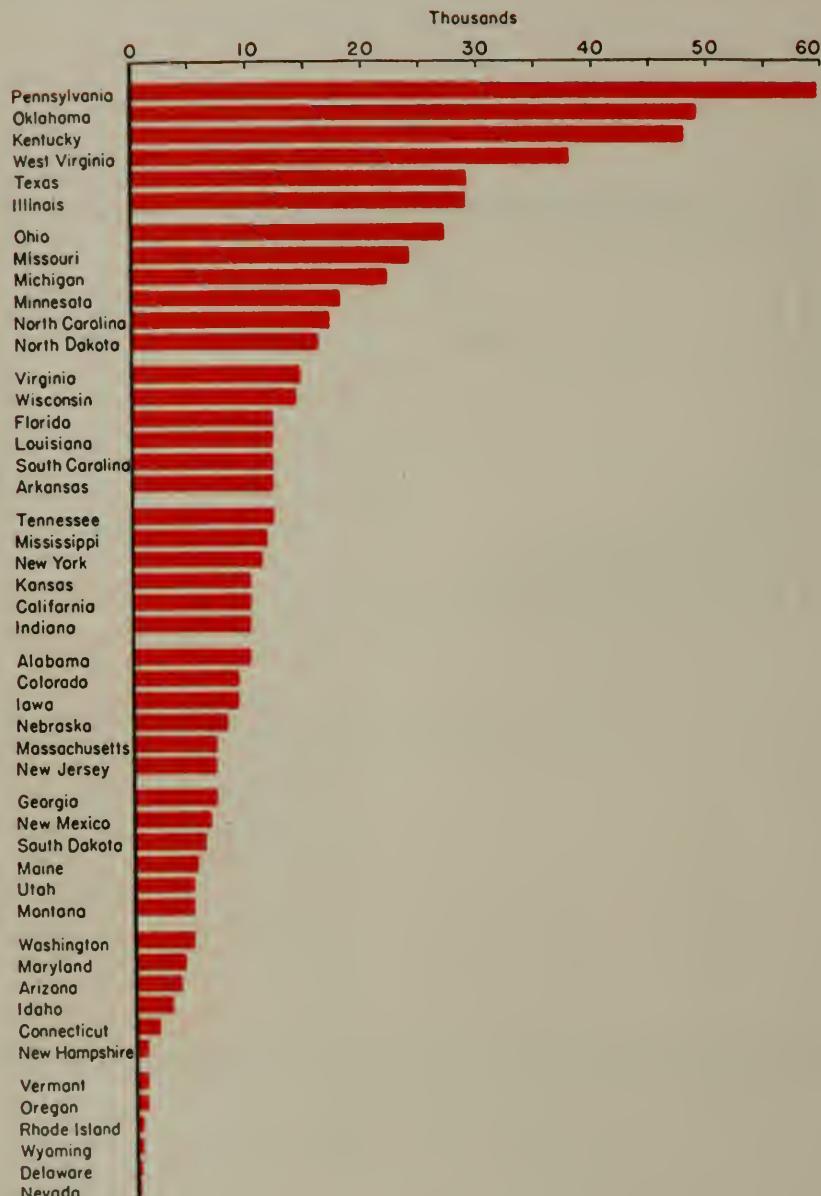
Chamber of Commerce of the USA, Foreign Commerce Department.

The Chief Exports of the United States in 1937.

All the salient points relative to the material presented are given in this chart. First, the commodities are arranged in the order of their values. Second, the numerical value for each is presented in a separate column. Third, the percent of total exports for each is included. Fourth, the amount of total exports is given.

SCALE .7

GRAPHIC PRESENTATION

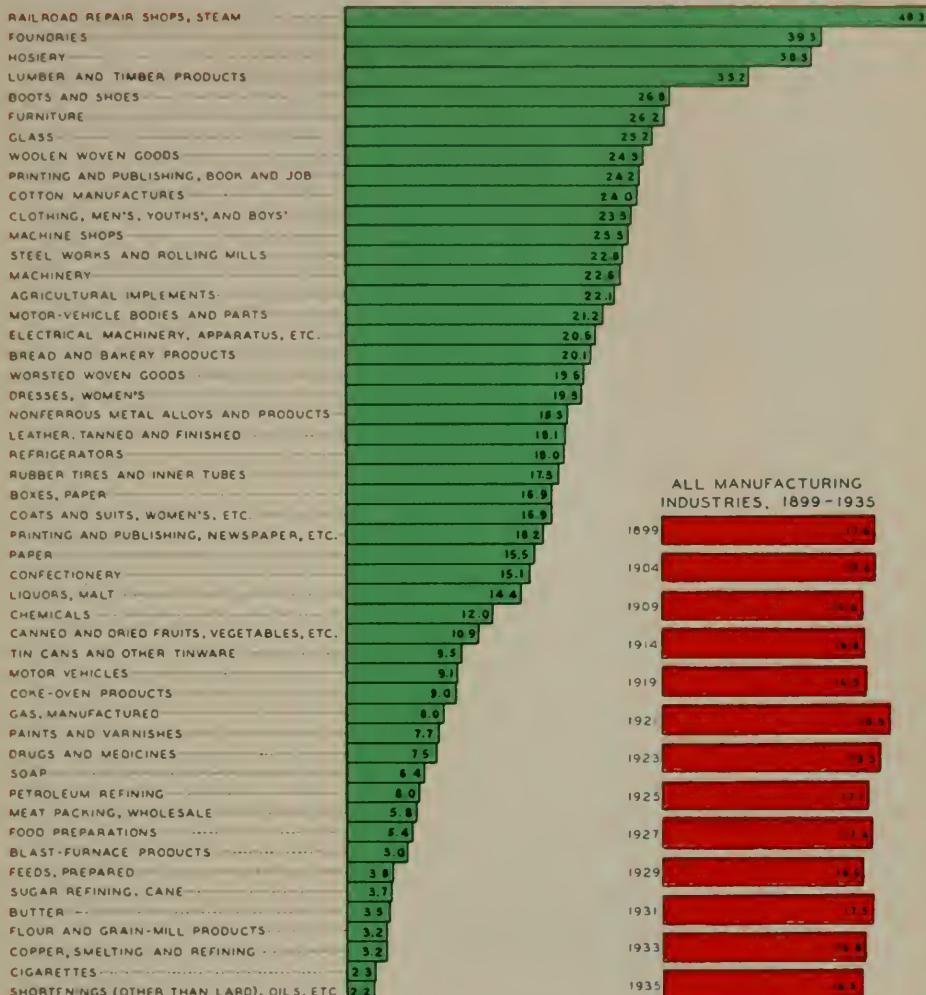


WPA, Division of Social Research, "Rural Youth on Relief," 1937.

Estimated Number of Rural Youth on Relief in the United States in October, 1935.

Compare with 109.

WAGES AS PER CENT OF VALUE OF PRODUCTS



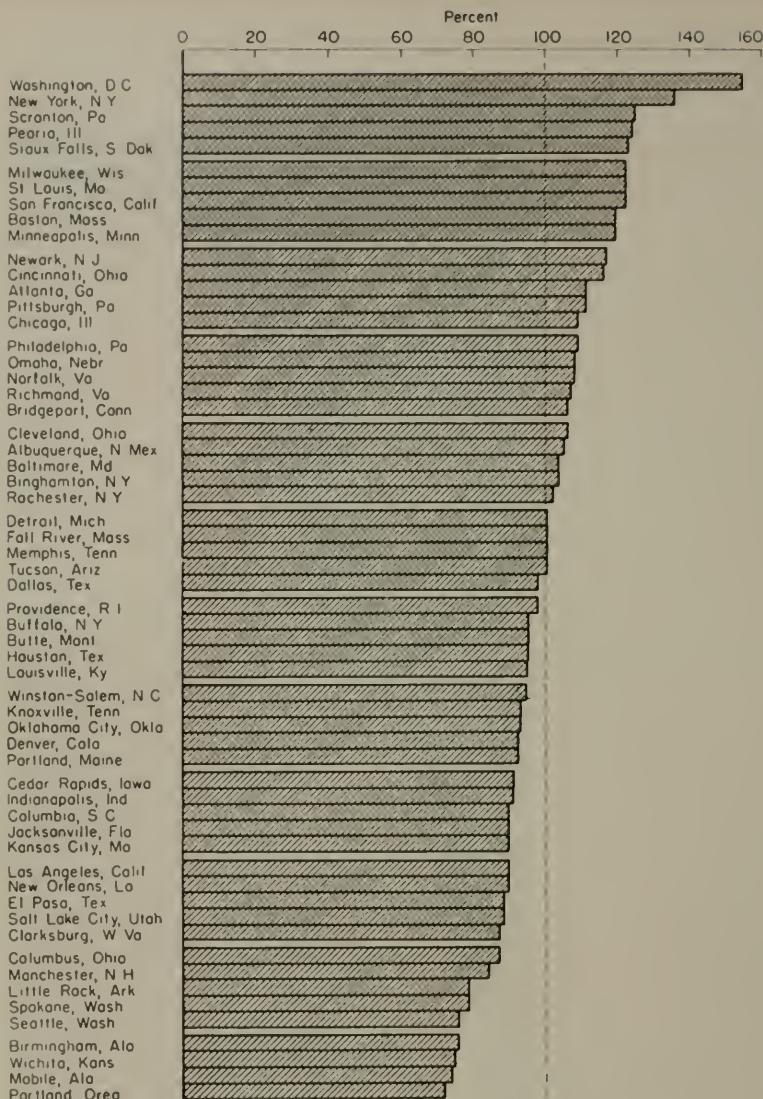
National Industrial Conference Board, Inc., February 18, 1938.

SCALE .7

The Percentage of Value of Products Which Is Expended for Labor in Wages in Fifty Leading Manufacturing Industries in the United States in 1935.

The inclusion of the value at the end of each bar, while it eliminates the necessity for two eye movements, visually decreases the length of the bars. It might have been better to put the values in a column on the left.

GRAPHIC PRESENTATION



WPA, Division of Social Research, "Intercity Differences in Cost of Living—59 Cities," March, 1935.

Relative Rents for a 4-Person Manual Worker's Family in Each of 59 Cities in the United States, March, 1935.

1. The 100% line here gives a good measuring rod for comparisons.
2. The chart would be read as follows: the four cities, Detroit, Michigan, Fall River, Massachusetts, Memphis, Tennessee, and Tucson, Arizona, may be described as average cities so far as rent for a 4-person manual worker's family is concerned. Rents are relatively much higher in Washington, D. C., and New York City, and relatively much lower in Mobile, Alabama, and Portland, Oregon.

MULTIPLE BAR CHARTS

Abstracts from *Time Series Charts. A Manual of Design and Construction*, 1938, prepared by Committee on Standards for Graphic Presentation, under procedure of American Standards Association, with The American Society of Mechanical Engineers as sponsor body.

TIME-SERIES COLUMN CHARTS

A. DEFINITION Column charts are graphic presentations wherein numerical values are represented by the length of vertical bars or columns.

B. THE COLUMN CHART IS PARTICULARLY EFFECTIVE:

1. To emphasize comparisons of amounts in a single time series.
2. For popular presentation.
3. To show components for a relatively few totals.
4. To picture "period" data as against "point" data.
5. For showing a range of values or deviations from a normal or bogey.

C. THE COLUMN CHART IS NOT THE BEST FORM:

1. For comparing several time series
2. For time series over an extended period with many plottings

Note. The column chart, while simple to read, is relatively difficult to design effectively. The proper layout of columns requires special care and good judgment.

Construction

1. LAYOUT AND DESIGN A chart consisting of a few columns should generally be higher than wide, for more than a few columns a wider-than-high chart is preferable.

2. GRIDS. The field or grid used for column charts may be a completely ruled coordinate surface. Usually, however, it is not necessary to indicate all the rulings which would normally be shown on a line chart. A complete grid outline is usually not required. The columns themselves generally make vertical rulings unnecessary. Moreover, fewer horizontal rulings may be needed since column charts are more generally used for popular presentation than are line charts. Often horizontal rulings may be incomplete, being extended through only that portion of the field occupied by the columns.

3. SCALE SELECTION In column charts the interest is generally in a comparison between amounts as of different dates. These amounts are proportionate to the height of the columns. This means that the zero line, when it is the principal line of reference, should always be included in a column chart. It follows, too, that the amount scales should not be broken, but made continuous from the reference line. While normally the full length of the column should be shown, when it represents an abnormally large value the column may be broken at the top and the amount indicated.

Columns should be spaced according to their proper position on the time scale. When time intervals between values are not equal, columns should be spaced accordingly.

4. SCALE DESIGNATIONS. Placing of scale numerals and captions on column charts is less conventionalized than on line charts. As the grid rulings are often incomplete, the vertical scale values generally are placed on the side where the rulings are complete. [For example, if the tallest columns are at the right, the scale designations may be shown on the right-hand side only.]

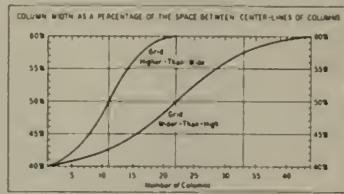
Time Scale Designations are normally centered under the columns, reading horizontally, in column charts for popular presentation either or both amount and time designations may be placed above the columns.

5. COLUMNS The effective appearance of a column chart requires special care in the design of the columns. When there are only a few columns they should be narrower than the white space between; when there are many columns the reverse should be true.

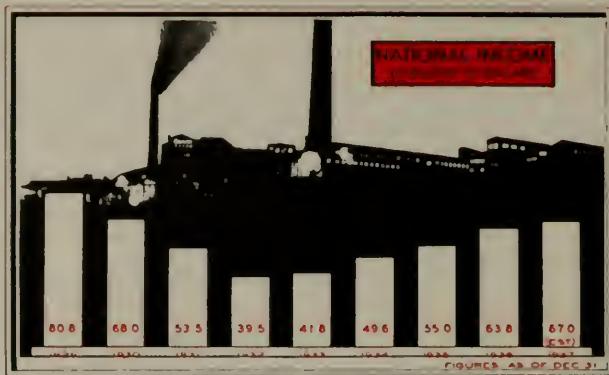
6. COLUMN DESIGNATIONS It is generally more difficult to label segmented or grouped columns than curves because the columns themselves take up so much more of the space. Segment labels should be placed across several columns if practicable. However, the space about labels should be reduced as much as possible and too much contrast with the tone of the column avoided so as not to distort the impression of the relative lengths of the columns and segments. Where labels cannot be placed on the columns, arrows may be used. A key or legend should be used only when impracticable to label directly.

7. COLUMN CHART DESIGNATIONS Column chart titles can often be placed most effectively according to the distribution of the columns rather than in a fixed position at the top (the usual case with line charts).

Note. An empirical relationship between column and space is presented in the chart below, based on an actual test of charts of root two proportions and various numbers of columns, one set wider than high and another higher than wide.



To space columns equally along the time scale, divide the available horizontal space into twice as many spaces as there are to be columns. Then center the columns on every other division mark beginning with the first from either end.

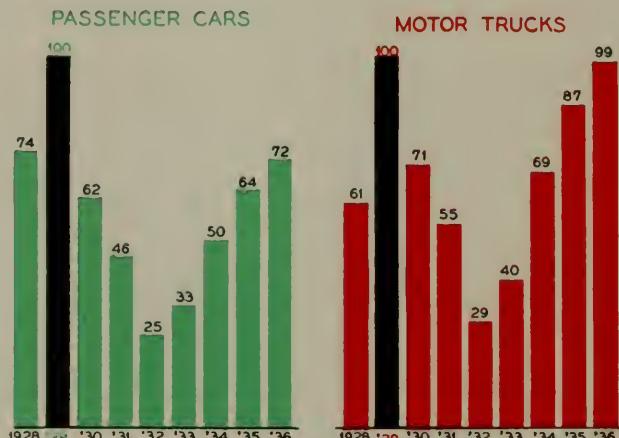


Magazine of Wall Street, January 29, 1938.

SCALE .5

A. National Income of the United States in Billions of Dollars from 1929 Through 1937.

When superimposing a bar chart upon a picture, care should be taken to choose a picture which does not have smokestacks or other such buildings which take on the appearance of a bar. The eye automatically compares heights. Superimposing when done correctly is very effective.



Federal Reserve Agent, New York, "Monthly Review," October 1, 1936.

A. Production of Passenger Cars and Motor Trucks in the United States During the First Eight Months of 1928-1936. The First Eight Months of 1929 Equal One Hundred Per Cent.

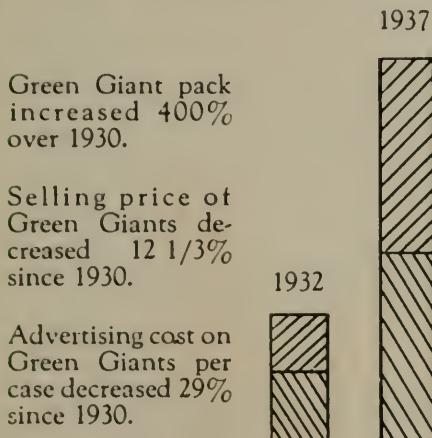
1. The time series comparison of index numbers in bar form is here supplemented by actual figures. Thus anyone consulting it is able to quote figures without computing the various heights.
2. However, the figures placed at the top of each bar add to its visual length, resulting in a false visual comparison. A better position for the figures would be between the date and the bottom of the bar, or in the form of a data table below the chart.
3. For explanation of index numbers, see 301 A

Chapter 13

CONTRASTING BAR CHARTS

ONE VARIATION of the type of bar chart shown in Chapter 12 is to differentiate the bars by using hachures, or shadings. Charts in which this technique is used are called contrasting bar charts.

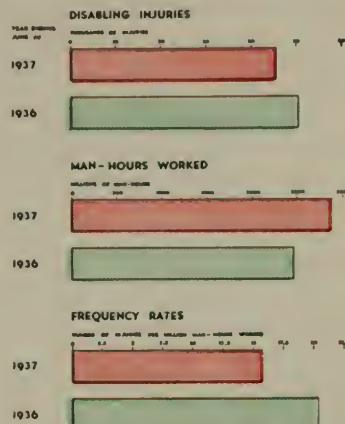
-  Green Giant brand peas
-  Other Peas



Minnesota Valley Canning Company, Beaver Dam, Wis., "Annual Report for the Fiscal Year Ended March 31, 1938."

A. A Comparison of the Shipment of One Brand of Peas and the Shipment of All Others by the Minnesota Valley Canning Company in the Years 1932 and 1937.

The reason for including this chart is to illustrate an optical illusion which is seldom seen and which should be avoided. Note how the bars are distorted to the left because of the cross hatchings.



WPA, "Report on Progress of The Works Program," December, 1937. SCALE .5

B. Relation of Man-hours Worked to Disabling Injuries Incurred in Works Progress Administration Project Work for 1936 and 1937.

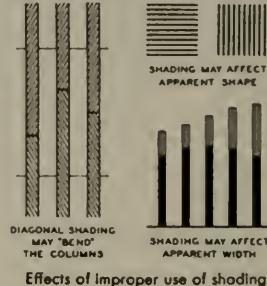
1. Bar charts with contrasting units are used chiefly to differentiate various bars. Here one type of hachure is used for the year 1937 in each of three charts and another for 1936.
2. Since neither complete vertical rulings nor numerous stubs are used, it might have been better to include the actual figures.
3. Note that in horizontal bars the latest year is usually at the bottom so that the reader looks down from the top rather than up from the bottom.

GRAPHIC PRESENTATION

Abstracts from *Time Series Charts. A Manual of Design and Construction*, 1938, prepared by Committee on Standards for Graphic Presentation, under procedure of American Standards Association, with The American Society of Mechanical Engineers as sponsor body.

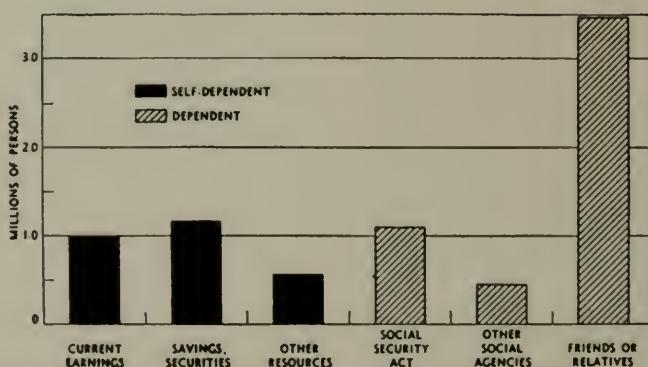
Specific column designs or shadings are recommended as follows:

- (a) Block (solid) for general use for narrow columns. However, a series of long narrow columns filled in solid may cause an unpleasant optical effect. In segmented column charts, black is good for the bottom segments if they are not too large.
- (b) Vertical Line Shading is recommended for general use as pleasing in appearance and easy to construct.
- (c) Diagonal Line Shading is useful only in small segments as optical illusion results if any appreciable length of column is shaded with this design, as illustrated at the right.
- (d) Horizontal Line Shading has limited usefulness and is not generally recommended.
- (e) Crosshatch Shading (diagonal) is recommended in place of black for wide columns. Crosshatch shading made by crossing vertical and horizontal lines is not recommended.
- (f) Dotted Shading (pebbled or stippled) is sometimes effective for columns of medium width and particularly for small segments for charts in which a third or fourth distinguishing shading is needed.
- (g) Hollow columns, if distinctly wider or narrower than the space between and outlined with a heavy line.



Effects of improper use of shading

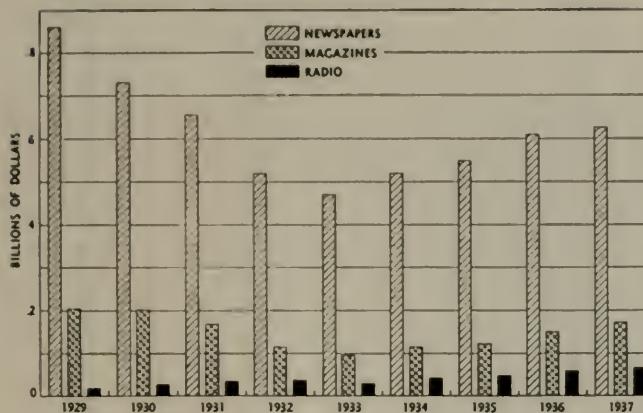
Columns may present undesirable optical illusions unless slight correctives are applied. A white or lightly shaded segment on top of a column may appear to spread unless the column outline is tapered about the width of a line; a black segment may appear more narrow than the rest of the column unless it is widened about the width of a line; a tall column may appear to be thinner in the middle unless the lines are bowed out slightly.



Dun's Review, June, 1938.

A. Means of Support of Persons 65 Years of Age or Older Living in the United States in April, 1937.

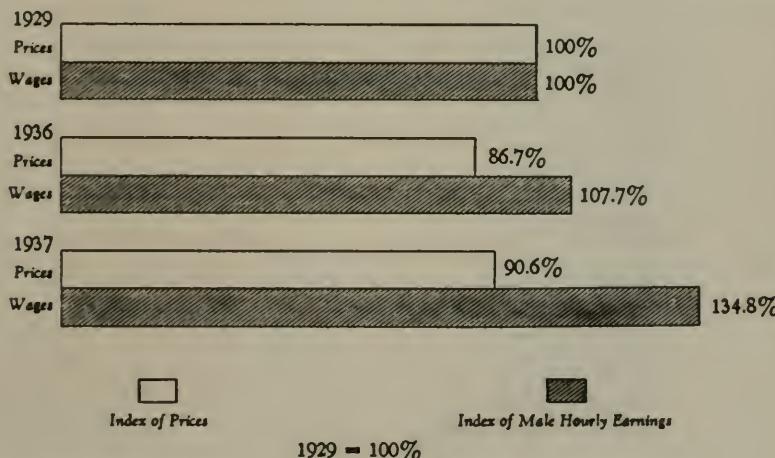
CONTRASTING BAR CHARTS



Dun's Review, April, 1938.

A. Advertising Expenditures for Newspapers, Magazines, and Radio in the United States from 1929 to 1937.

1. It might have been better to include actual figures in this chart.
2. Note the groupings, the spacing between groupings, and the narrowness of the bars.



Armstrong Cork Company, Lancaster, Pa., "Annual Report," December 31, 1937.

B. A Comparison of Weighted Average Selling Prices of All Armstrong Cork Company Products and Average Male Hourly Earnings in the Company for the Years 1929, 1936, and 1937.

Rather than merely state that the year 1929 was equal to 100%, this chart visually represents both index of prices and index of male hourly earnings as 100% bars.

GRAPHIC PRESENTATION



Engineering and Mining Journal, October, 1938, Part of an Editorial on Public Relations Entitled, "What Mining Means to the United States."

SCALE .7

Frequency Rates and Severity Rates of Industrial Accidents in the United States with Special Reference to Certain Ones.

The bars in blue are the "special reference" industries. The magazine in which this chart appeared was interested chiefly in those bars colored blue, and used the simple method of color for emphasis.

CONTRASTING BAR CHARTS

119



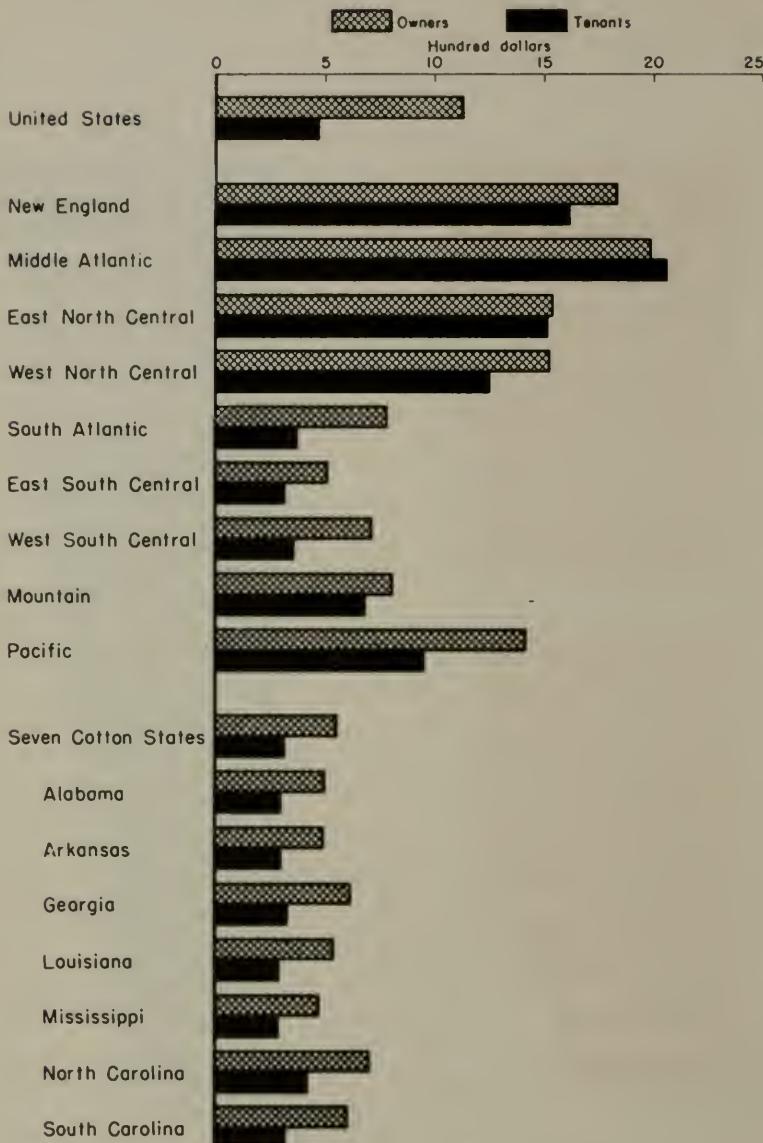
National Industrial Conference Board, Inc., October 23, 1936.

SCALE .8

Cost of Living and Wholesale Prices in the United States and Specified Foreign Countries for 1929 and 1936.

Compare this method of presenting two groups of facts with 144A.

GRAPHIC PRESENTATION



WPA, Division of Social Research, "Landlord and Tenant on the Cotton Plantation," 1936. SCALE .9

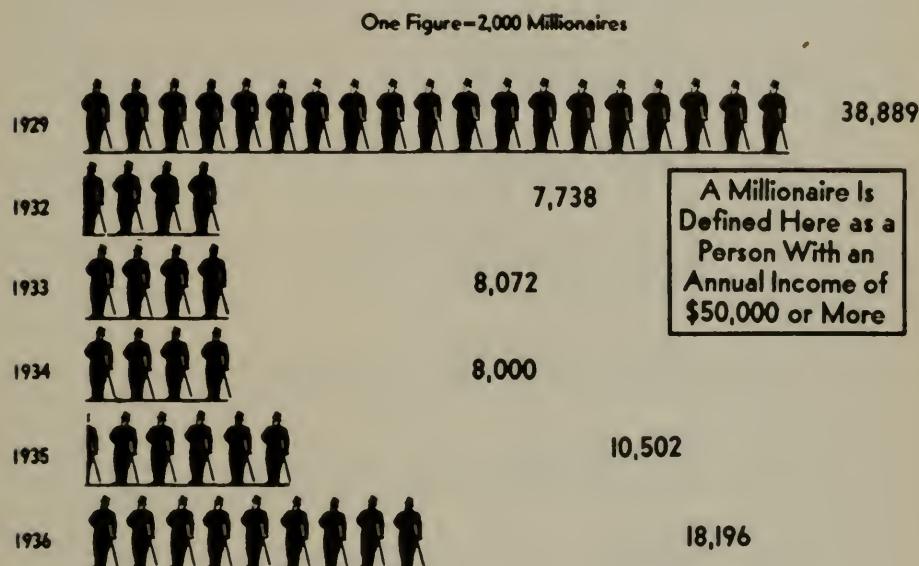
Median Value of Farm Dwellings by Tenure in the United States in 1930.

Divisions and subdivisions are possible in the bar chart as demonstrated in this one. The median value for the United States as a whole is first given, then for each of nine geographical divisions, and finally a separation of the "Seven Cotton States" is made.

Chapter 14

PICTORIAL UNIT BAR CHARTS

IN A pictorial unit bar chart comparisons are made by using a number of symbols, each of which represents a specific value. Synonyms for pictorial unit bar charts are pictogram, pictograph. The advantage of the pictorial unit chart over a chart in which large and small units are used is that there is a variation in one dimension only.



Chicago Tribune, "The 1938 Chart Book."

Number of Millionaires in the United States in Selected Years.

1. The reason for classifying this as a bar chart is readily seen. The rows of men create bars.
2. Since fractions are difficult to present in this form, the numerical value of each row of figures is given.
3. It might have been better to leave more space between the 1929 row and the 1932 row, since all the others are consecutive years.
4. As it appeared in the original, the 1936 row was at the top and the 1929 row at the bottom. Because it is general practice to read years from the top down, the rows were reversed.

GRAPHIC PRESENTATION



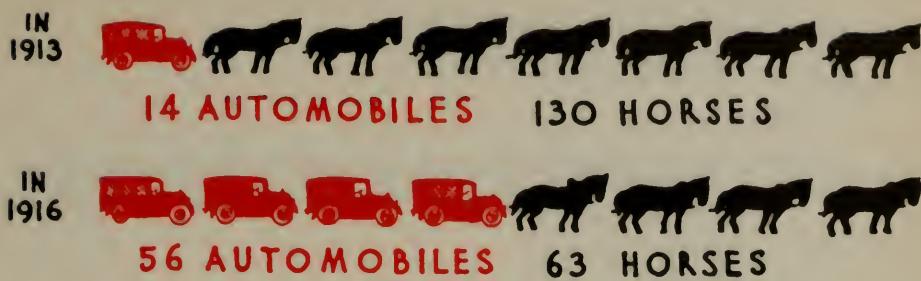
W. Sanford Evans, "Statistical Examination—Georgian Bay Canal," Ottawa, Canada, 1916.

SCALE .9

Maximum Number of Trainmen and Yardmen Employed on Grain Trains on the Manitoba, Saskatchewan and Alberta Divisions of the Canadian Pacific Railway in Each Month of the Crop Year 1913-1914.

1. This was one of the first pictorial unit bar charts to appear.
2. Note that the numerical value of each row is given directly beneath the month. Compare this form with 121, 123B, and 124A.

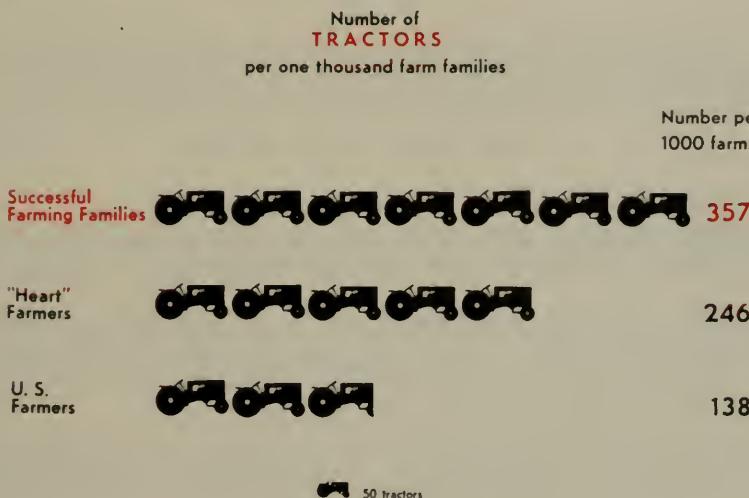
PICTORIAL UNIT BAR CHARTS



From "Humanizing the Greater City's Charity" by Bertrand Brown, Department of Public Charities, City of New York, 1917.

A. Comparison of the Means of Transportation Used in the Department of Public Charities of New York City in 1913 with 1916.

1. The distinctive feature of this chart is that it is a 100% bar chart. Each row represents 100% and each figure represents $12\frac{1}{2}\%$.
2. It would be read as follows: in 1913 one out of eight, or $12\frac{1}{2}\%$, of the transportation used in the Department of Public Charities in New York City, was by automobile and the rest by horses. In 1916, four out of eight, or 50% of the transportation, was by automobile and 50% was by horses.



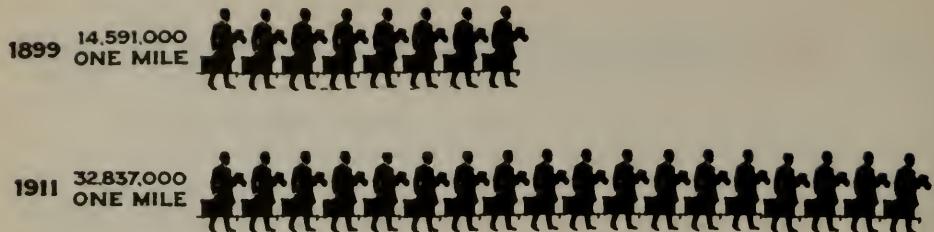
Meredith Publishing Co., Des Moines, Iowa, "Successful Farming."

SCALE 5

B. A Comparison of the Number of Tractors Per One Thousand Farm Families in Three Groups of Farmers in the United States.

1. The "heart" referred to in this chart means a group of states that form the heart of the farming industry, as estimated by the Meredith Publishing Company.
2. The date to which this comparison applies is not definite: the sources listed for the information given were dated 1930 and 1935.

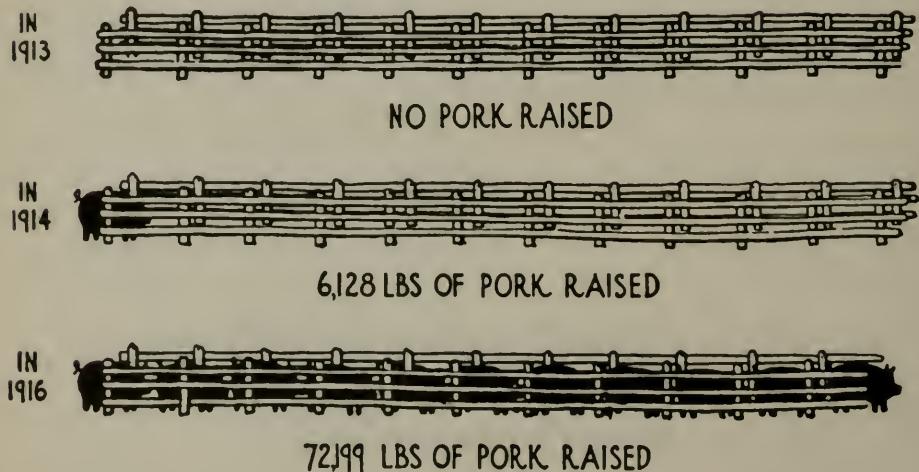
GRAPHIC PRESENTATION



Brinton, "Graphic Methods," McGraw-Hill, 1914.

A. Comparison of the Average Number of Passengers Carried Per Mile on United States Railroads in 1899 and 1911.

1. The theory behind pictorial unit bar charts is that there are more or less units rather than larger or smaller units. A pictorial unit bar chart consists of rows of symbols rather than large and small symbols.
2. In this chart, each figure represents 2000 passengers.



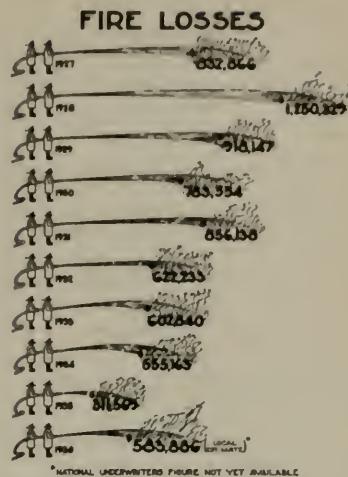
From "Humanizing the Greater City's Charity" by Bertrand Brown, Department of Public Charities, City of New York, 1917.

B. Increase in Pork Production at the Sea View Farms (The New York City Farm Colony) from 1913 to 1916.

Apparently the basis on which the pigs were placed inside the fences was this: one pig was added for each 6000 pounds of pork raised.

CHARACTERISTICS OF PICTORIAL UNIT BAR CHARTS:

1. They are effective for popular presentation of educational matter.
2. They are effective to attract attention, and for publicity, advertising, and propaganda.



City of Cincinnati, "Municipal Activities," 1936.
SCALE .6

If Our People - And Theirs - Should Pack Up And Move By Motor Car, Tomorrow —
How Many Would Have To Walk?

ITALY
1 RIDES, 20 WALK



GERMANY
1 RIDES, 10 WALK



U.S.S.R.
1 RIDES, 150 WALK



U.S.
ALL RIDE



Each Man Afoot = 10 People Walking.

The Figures Include Buses & Trucks.

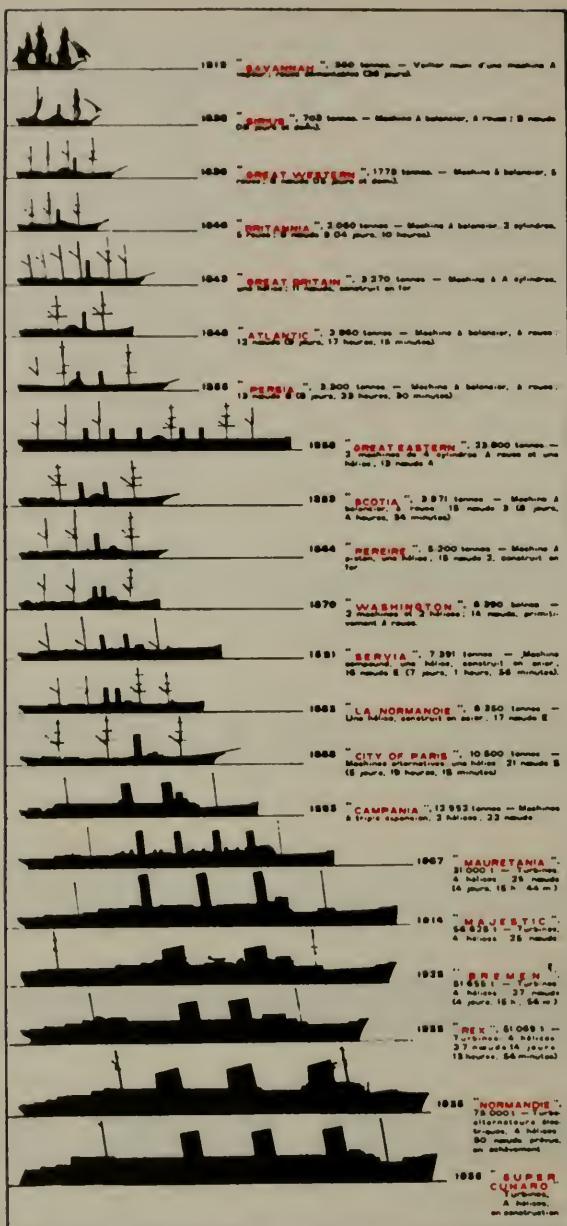
From "Our Country, Our People, and Theirs" by M. E. Tracy, 1938. By Permission of The Macmillan Company, Publishers, N. Y. C.

SCALE .5

B. A Picture of Automotive Transport Facilities in Italy, Germany, Russia, and the United States in 1935 and 1936.

It should be noted that although each man afoot represents ten people walking, each figure in the automobile represents one person.

GRAPHIC PRESENTATION



Relative Size of Oceangoing Vessels from the "Savannah" in 1819 to the "Super Cunard" in 1935.

1. The universality of the graphic chart language is here illustrated. This chart was taken from a French magazine.
2. Compare with 131B.

FASTER TURNOVER BRINGS MORE PROFIT ON ADVERTISED BRANDS

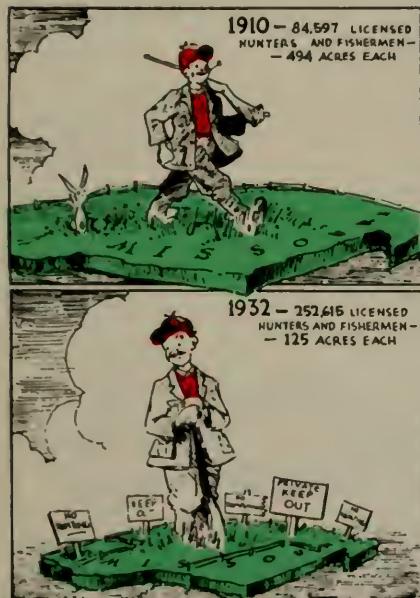


Sales Management, Oct. 1, 1937.

SCALE .6

A. Comparison of Stock Turnover for Advertised and Unadvertised Brands of Goods in the United States in 1936.

According to this chart, people in the United States are influenced more by advertisements for headache cures than they are by food advertisements, and are influenced by advertising in proportion to the unfamiliarity of the product advertised.

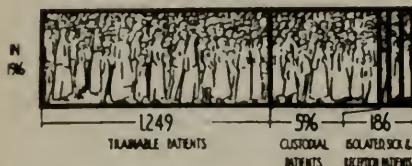
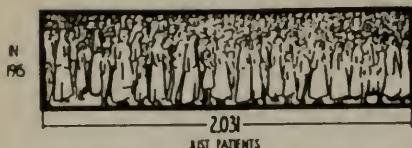


National Resources Board, "State Planning," 1935.

SCALE .7

B. The Growth in Number of Hunters and Fishermen in Missouri from 1910 to 1934.

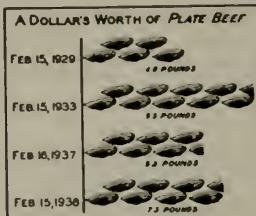
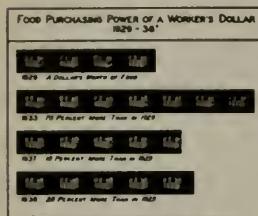
1. Although the height of the man and the size of the state may not represent the exact numerical value of each, the fact that there were too many hunters and fishermen in 1934 for the size of Missouri is quite apparent.
2. This chart illustrates the point made in 124A1 relative to larger units or more units.



From "Humanizing the Greater City's Charity"
by Bertrand Brown, Department of Public
Charities, City of New York, 1917.

**A. Adaptability to Training of 2,031
Patients Examined at the New
York City Children's Hospital
and School in October 1916.**

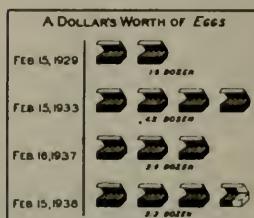
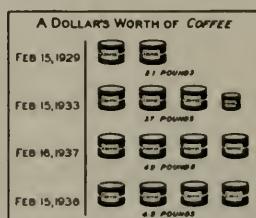
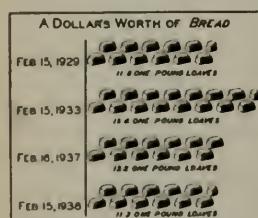
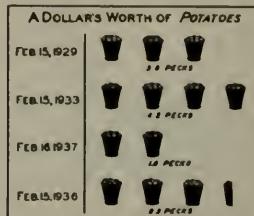
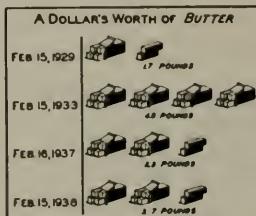
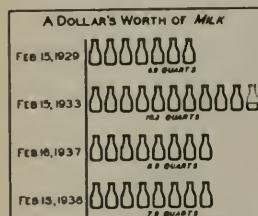
This is not a true pictorial unit bar chart, but is rather two 100% bar charts filled in with drawings of people.



RETAIL FOOD PRICES, 1929 - 38

STELLA STEWART
DEALER IN LADIES' FASHIONS

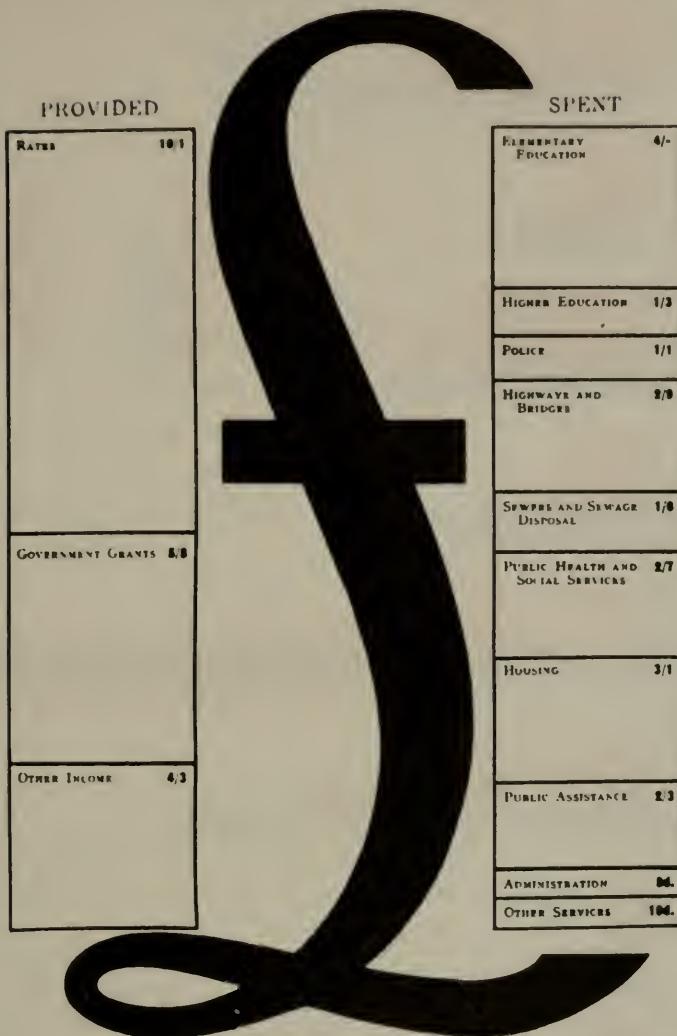
BUREAU OF LABOR STATISTICS



U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce, "Domestic Commerce," June
10, 1938. SCALE .6

B. A Comparison of How Much a Dollar Will Buy in Terms of Retail Food Prices in the United States for the Years 1929, 1933, 1937, and 1938.

1. The pictorial unit bar chart is of particular value for popular appeal. It attracts attention even when it does not convey facts.
 2. The inclusion of the actual amounts below each row of items in this series of charts makes it valuable not only as a poster but also for research and reference purposes.



County Borough of Reading, England, Borough Accountant's Dept., "General Statistics and Epitome of the Corporation's Accounts," 1935.

How Each Pound Was Provided and Spent in the British Government During the Year Ended March 31, 1935.

1. Bar charts with visual captions may be our salvation from the preponderance of "little men" charts.
2. The pictorial caption aids in making them universally understood.
3. They have a popular appeal, and yet present facts as clearly and accurately as possible.

GRAPHIC PRESENTATION

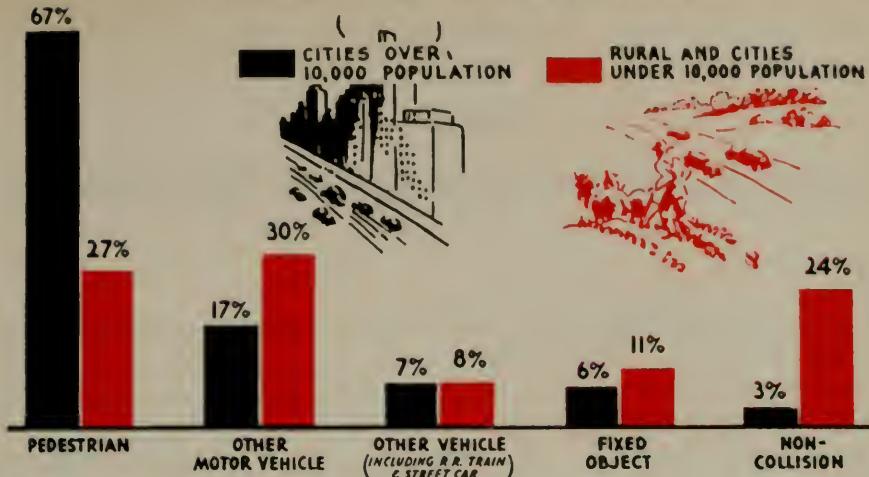


U. S. Department of Labor, Bureau of Labor Statistics, "Labor Information Bulletin," July 1938.

Food Expenditures of Wage Earners and Lower-Salaried Clerical Workers at Successive Economic Levels in New York City for the Winter Quarter of 1934-1936.

This would be much more informative if the total annual income at each economic level had been given.

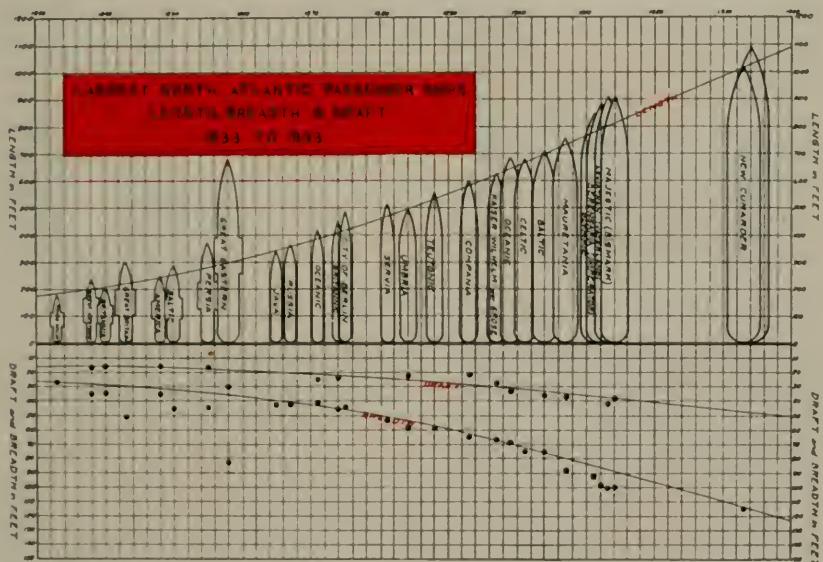
PICTORIAL UNIT BAR CHARTS



Automobile Manufacturers Association, "Automobile Facts and Figures," 1938.

A. Types of Motor Vehicle Deaths in the United States in 1937.

Pictures representing rural and urban districts are fairly well understood. The few strokes of the pen which were necessary to create these two captions were well worth the time.



MacElwee & Crandall, Inc., N. Y. C.

B. The Trend in Length, Breadth, and Draft of North Atlantic Passenger Ships from 1830 to 1940.

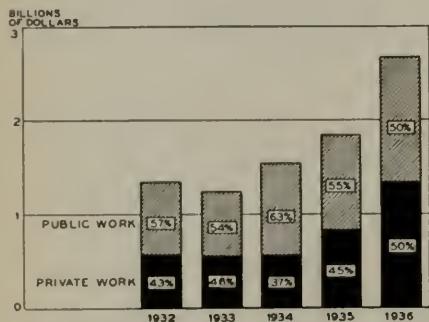
1. The purpose of this chart was to determine the trend in length, breadth, and draft of passenger ships so that docking facilities might be planned for the future.
2. As the newer ships were placed upon the chart, it was found that the calculation of the trend was unbelievably accurate.

Chapter 15

COMPARISON OF COMPONENT BAR CHARTS

T

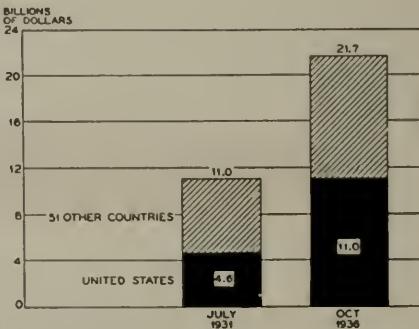
he term "component bar" may refer to any bar which has been divided into parts. The charts in Chapters 10 and 11 are component bars in which each bar represents 100%, and the comparison of the component parts is the important item. In this chapter, divisions of the bars are made without reducing all bars to the same length.



Federal Reserve Agent, New York, "Monthly Review," Feb. 1, 1937. SCALE .7

A. Total Value of Building and Engineering Contracts in Thirty-seven of the United States, Showing the Proportion of Private and Public Construction from 1932 to 1936.

1. Here the component parts are labelled in percentages, facilitating the reading of the chart.
2. Since there are so few horizontal rulings, it might have been better to give the numerical values of each bar.

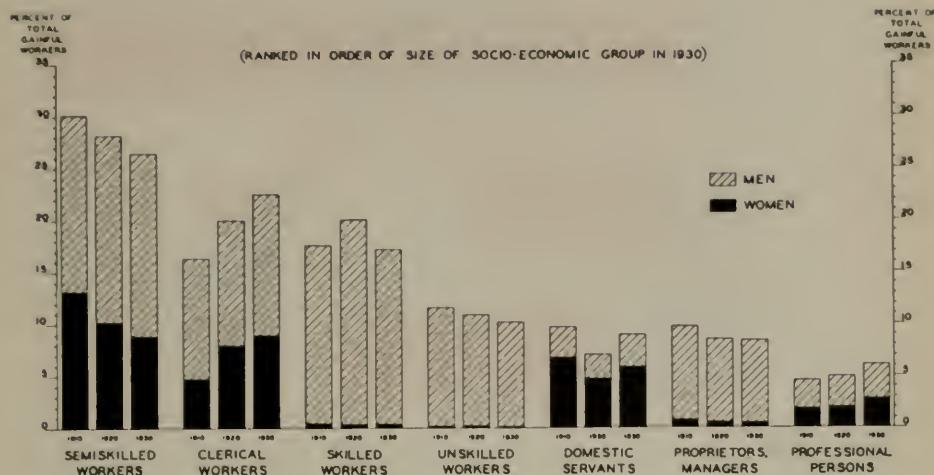


Federal Reserve Agent, New York, "Monthly Review," Nov. 1, 1936. SCALE .8

B. Comparison of the Gold Holdings of the Central Banks and Governments of 51 Other Countries and the United States in July 1931, and October 1936.

1. To prevent the reading of the top figures as the items for the 51 other countries, there should be a third set of figures placed in a position similar to the item for the United States.
2. Since both the vertical scale and the labels are put to the left of the bars, it may be more difficult to read the chart than if one or the other were placed to the right.

COMPARISON OF COMPONENT BAR CHARTS

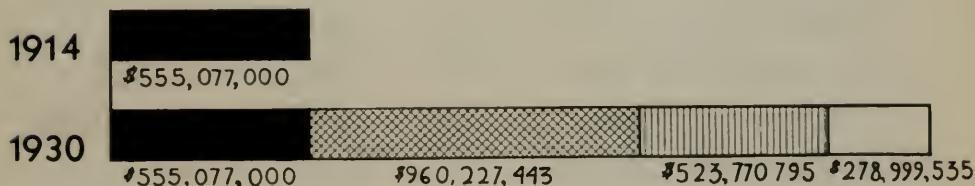


WPA, National Research Project, "Recent Trends in Employment and Unemployment in Philadelphia," December 1937.

SCALE .7

A. Extent and Character of Changes in the Types of Employment in Philadelphia for the Years 1910, 1920, and 1930.

Since there are no horizontal rulings, it might have been better to include the value of each bar as well as percentages of each component part.



[Solid black bar] Expenditure for public schools in 1914.

[Hatched bar] Increase over 1914 chargeable to decrease in purchasing power of dollar.

[Horizontal striped bar] Increase over 1914 chargeable to increased attendance.

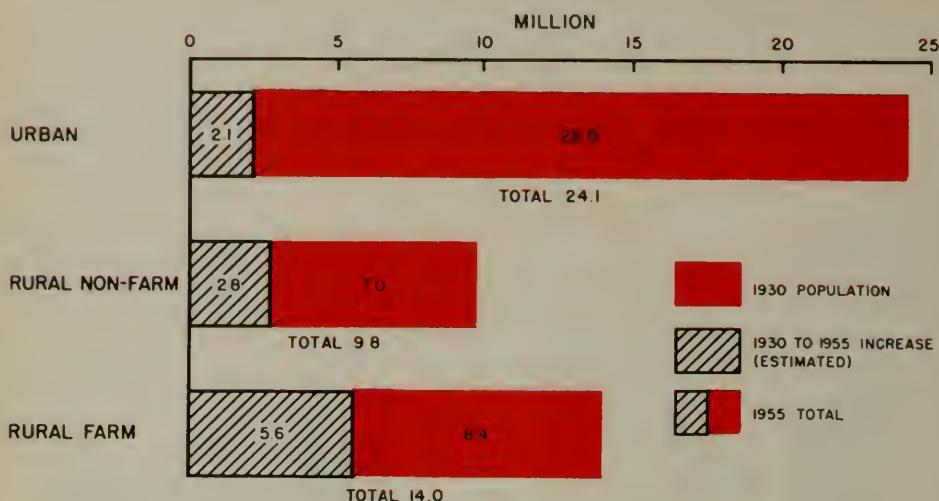
[White bar] Increase over 1914 chargeable to increased services.

National Education Association, Washington, D. C., "Research Bulletin," May 1938.

B. Estimated Causes of Increase in School Costs in the United States from 1914 to 1930.

This simple classification of reasons for the increase in school costs shows a great deal of study and forethought. A verbal statement would not have been half so effective.

GRAPHIC PRESENTATION



WPA and U. S. Bureau of Agricultural Economics, "Rural Poverty," February 1938.

SCALE .7

A. Estimated Increase in Male Population from 18 to 65 Years of Age by 1955 in the United States.

The inclusion of practically all the data in the chart makes it useful for research and reference purposes.

	WAGES AND SALARIES	COMPANY OFFICERS' SALARIES	DIVIDENDS	SURPLUS
1929	67.8	6.6	17.8	7.8
1930	70.6	7.6	21.8	11.7*
1931	71.1	8.4	20.5	25.2*
1932	72.9	9.7	17.4	36.7*
1933	74.9	9.4	15.7	12.8*
1934	75.1	7.9	17.0	4.7*
1935	72.8	7.4	19.8	0.7*

*Shows percentage of total expended for wages, salaries, and dividends that had to be withdrawn from surplus

Factory Management and Maintenance, October 1938, Part of an Editorial on Public Relations Entitled "A Program for Public Relations." SCALE .9

B. Distribution of Income of the Manufacturing Industries in the United States from 1929 to 1935.

1. The chief significance of this chart lies in the arrangement of component parts of the bars so that there is a common starting point for each classification.
2. The omission of a scale or some indication of the numerical value of each row of bars was unfortunate.

COMPARISON OF COMPONENT BAR CHARTS

FOR EVERY \$1.00 SPENT BY FAMILIES IN THE MEDIAN
(\$1,250-\$1,499) INCOME GROUP, OTHER GROUPS SPEND:

INCOME GROUP

\$500 - \$749 PER YEAR

750 - 999

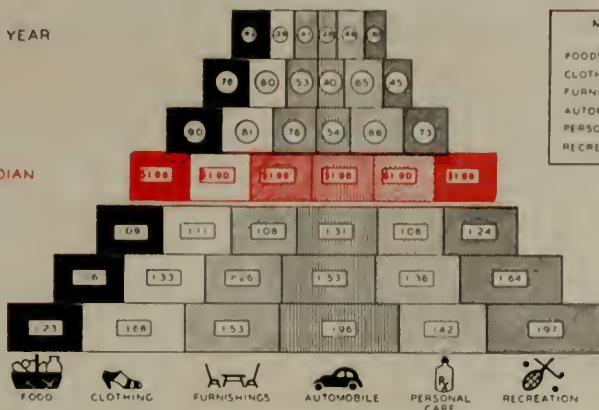
1,000 - 1,249

1,250 - 1,499 MEDIAN

1,500 - 1,749

1,750 - 1,999

2,000 - 2,499



MEDIAN BASE

PER YEAR

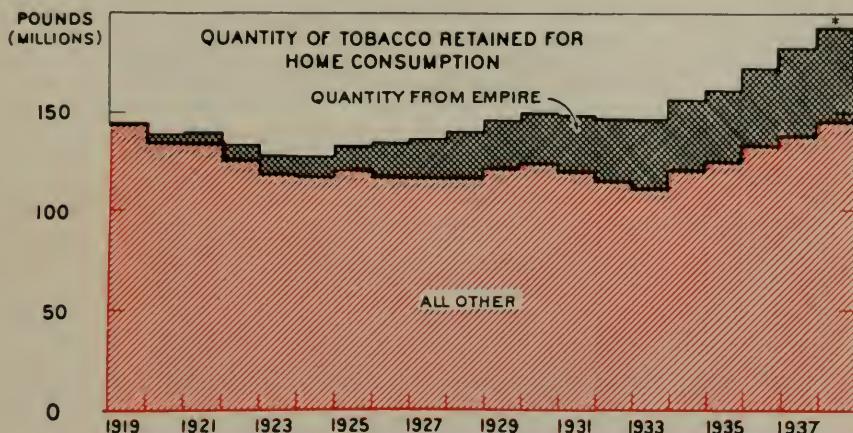
FOODS	\$ 4.8
CLOTHING	121
FURNISHINGS	51
AUTOMOBILE	137
PERSONAL CARE	26
RECREATION	33

Sales Management, Feb. 1, 1938.

SCALE .6

A. Comparison of the Distribution of the Income of People in the United States on Seven Income Levels in 1936.

This chart should be read as follows: while the median group spends one dollar for food, the income group receiving from \$500 to \$749 per year spends sixty-two cents, and the \$2000 to \$2400 group spends \$1.23.



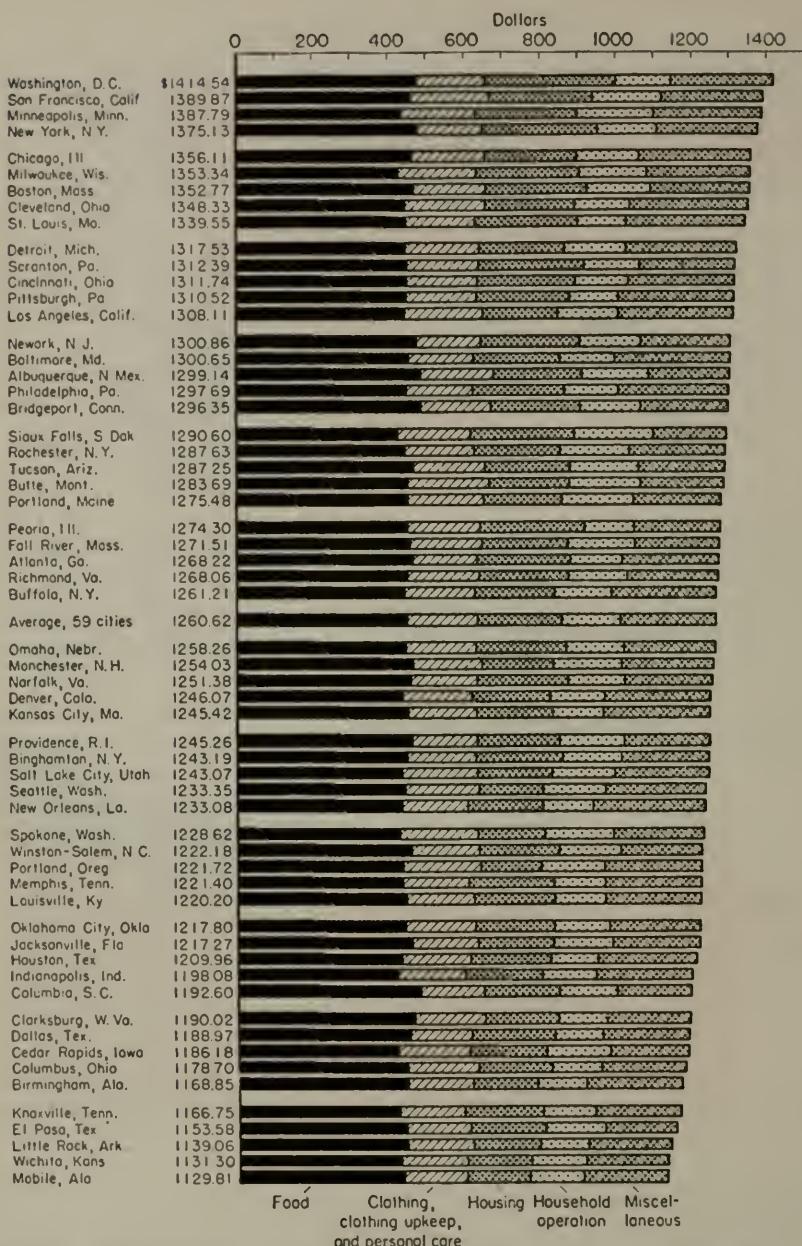
U. S. Department of Agriculture, Bureau of Agricultural Economics.

SCALE .5

B. A Comparison by Sources of the Amount of Tobacco Consumed in the United Kingdom from 1919 to 1937.

- Because basically this chart seems to be a series of bar charts whose vertical rulings have been eliminated, it can present slight differences which would not have been apparent had the "staircase" been plotted as a curve.
- Charts of this type are occasionally useful to give variety.

GRAPHIC PRESENTATION

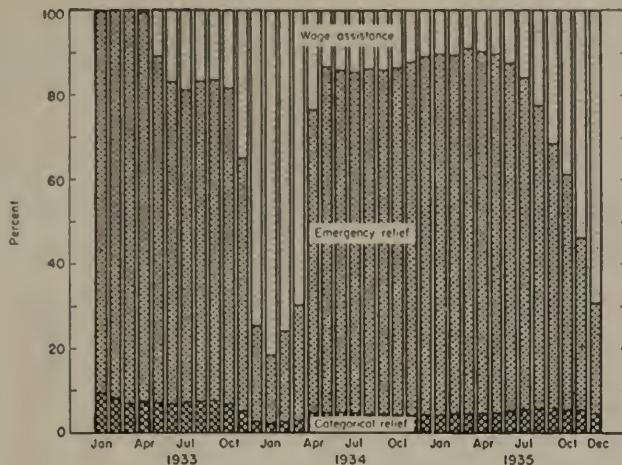


WPA, Division of Social Research, "Intercity Differences in Costs of Living—59 Cities," March 1935.

Annual Costs of Living, by Major Budget Groups, of a 4-Person Manual Worker's Family in Each of 59 Cities in the United States in March 1935.

Note the inclusion of the numerical values of the bars in the column at the left and the inclusion of the average for the 59 cities enumerated in this chart.

COMPARISON OF COMPONENT BAR CHARTS

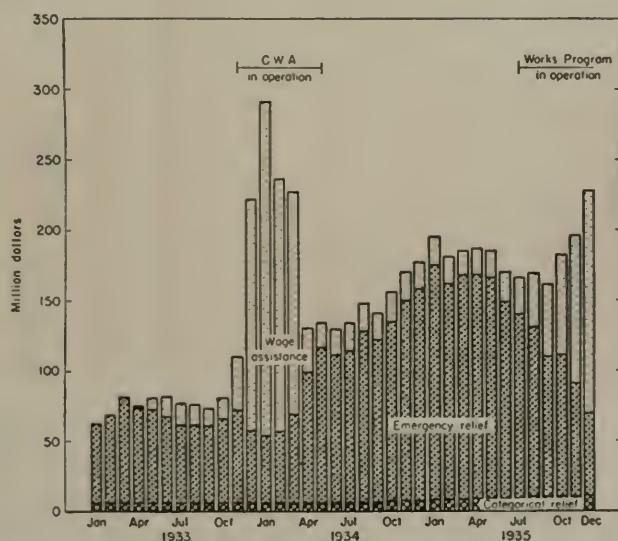


WPA, Division of Social Research, "Trends in Relief Expenditures," 1937.

SCALE .7

A. Percentage Distribution of Monthly Expenditures for Public Relief and Wage Assistance in the United States for the Period from January 1933 to December 1935.

1. This chart and 137B present the same information, except that this gives percentages while 137B gives numerical values.
2. When component parts are given in a chart, the information should be presented in both these forms if possible.

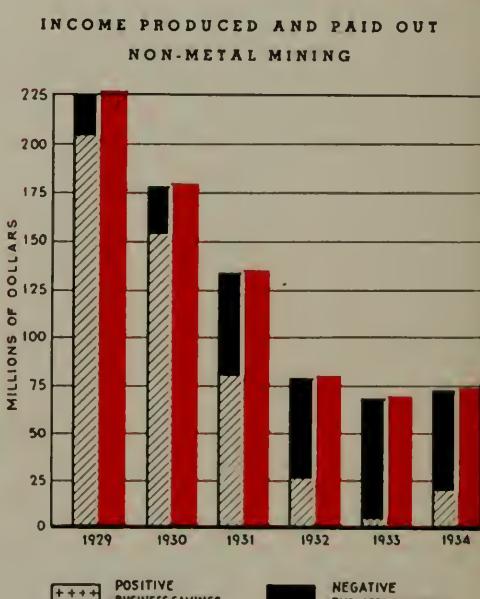
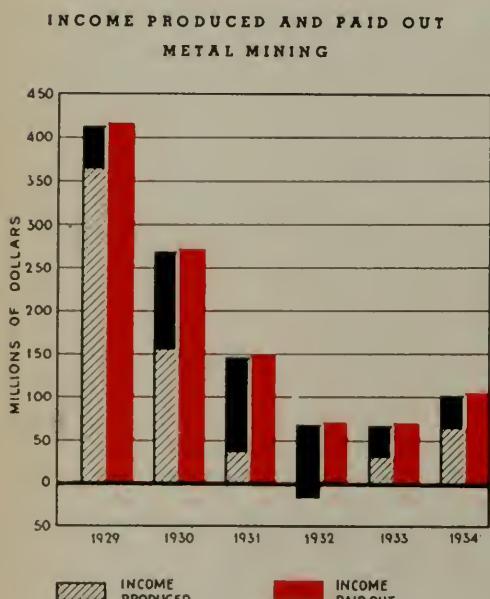
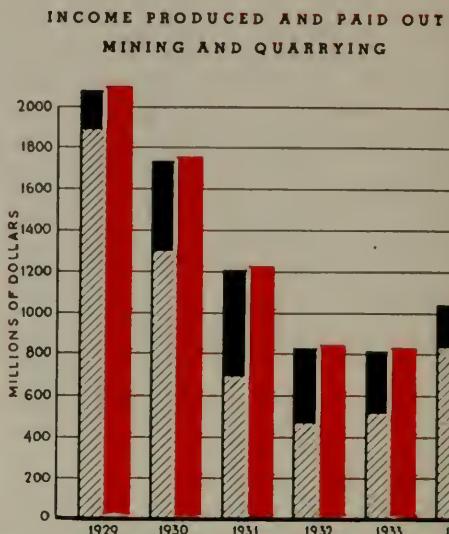
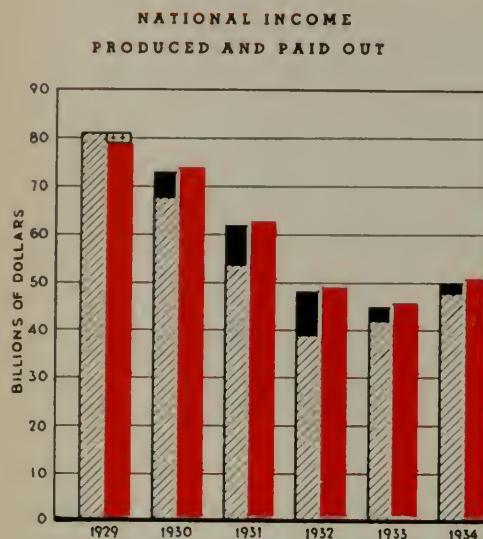


WPA, Division of Social Research, "Trends in Relief Expenditures," 1937.

SCALE .7

B. Trend of Monthly Expenditures for Public Relief and Wage Assistance in the United States for the Period from January 1933 to December 1935.

GRAPHIC PRESENTATION



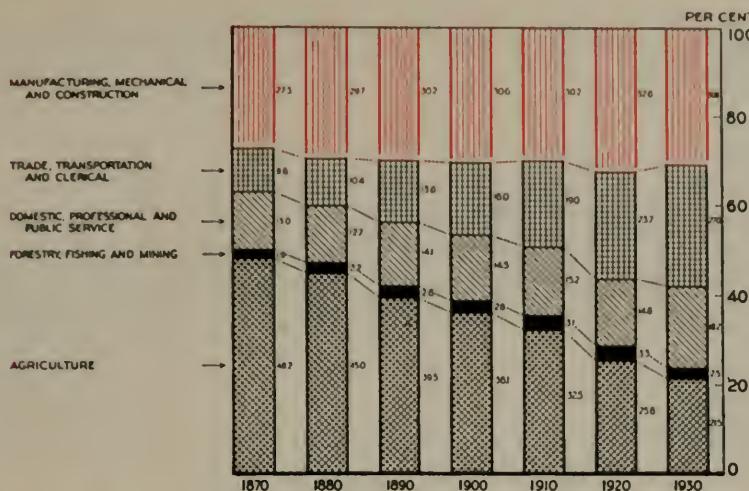
Engineering and Mining Journal, October 1938, Part of an Editorial on Public Relations Entitled "What Mining Means to the United States."

SCALE .8

Income Produced and Paid Out in the United States with Special Reference to Certain Industries from 1929 to 1934.

The classification "negative business savings" means, no doubt, "losses."

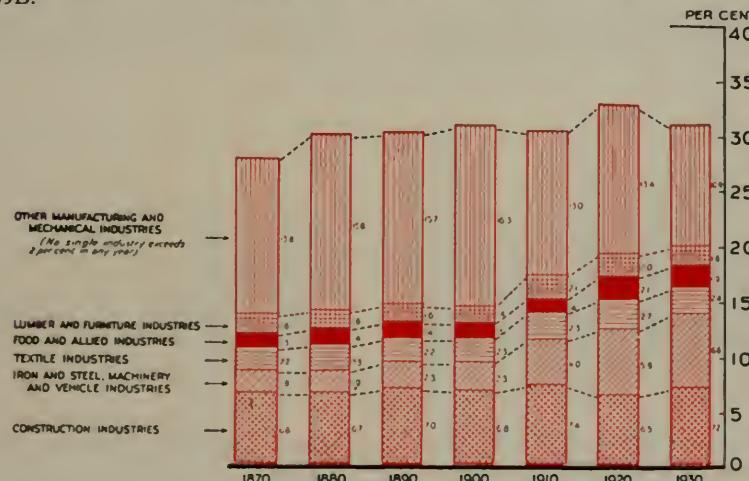
COMPARISON OF COMPONENT BAR CHARTS



U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce, "Construction Activity in the United States 1915-1937," 1938.

A. Percentage Distribution of Gainful Workers in the United States by Occupations from 1870 to 1930.

This chart is a series of 100% bar charts, but is included here because of its relation to 139B.

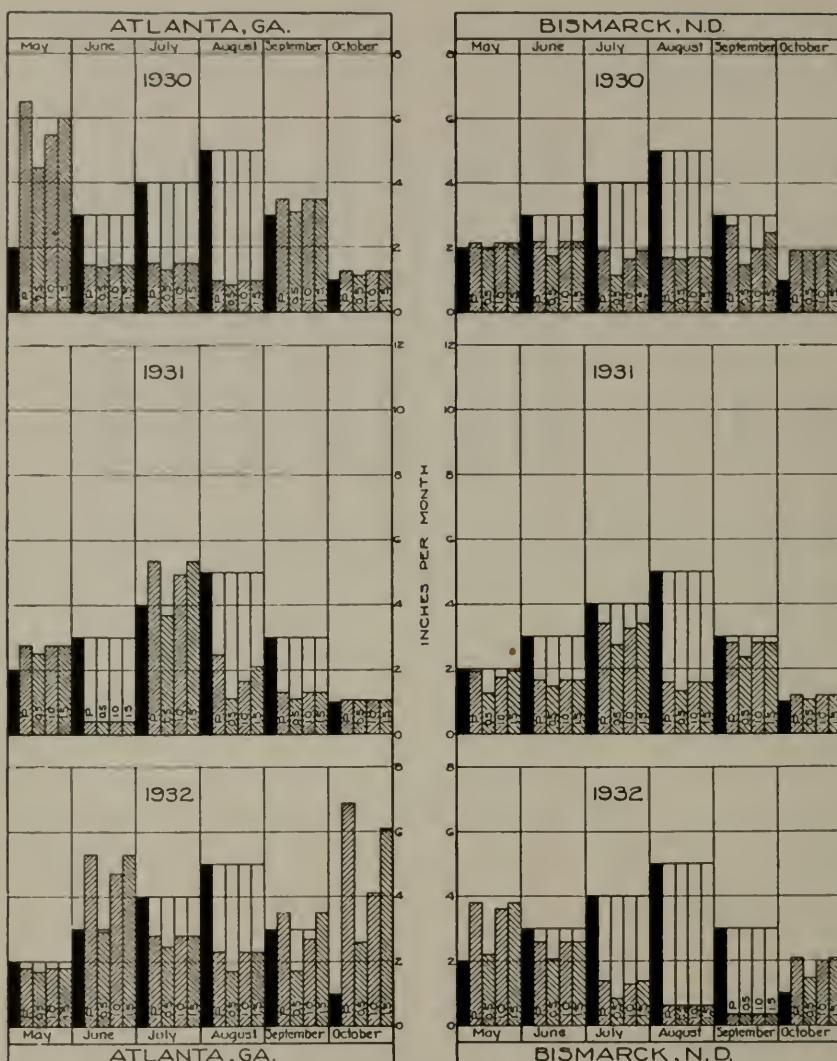


U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce, "Construction Activity in the United States 1915-1937," 1938.

B. Percentage Distribution of Gainful Workers in Manufacturing, Mechanical, and Construction Industries in the United States from 1870 to 1930.

Note that in 139A above, the division at the very top is labelled "Manufacturing, Mechanical and Construction." This chart is a further break-down of that one component. In the same way each of the component parts of 139A could be divided.

GRAPHIC PRESENTATION



~ LEGEND ~

[White Box] Unshaded areas show supplemental water required
 [Black Box] Water required - Inches per month.
 [Hatched Box] Actual rainfall

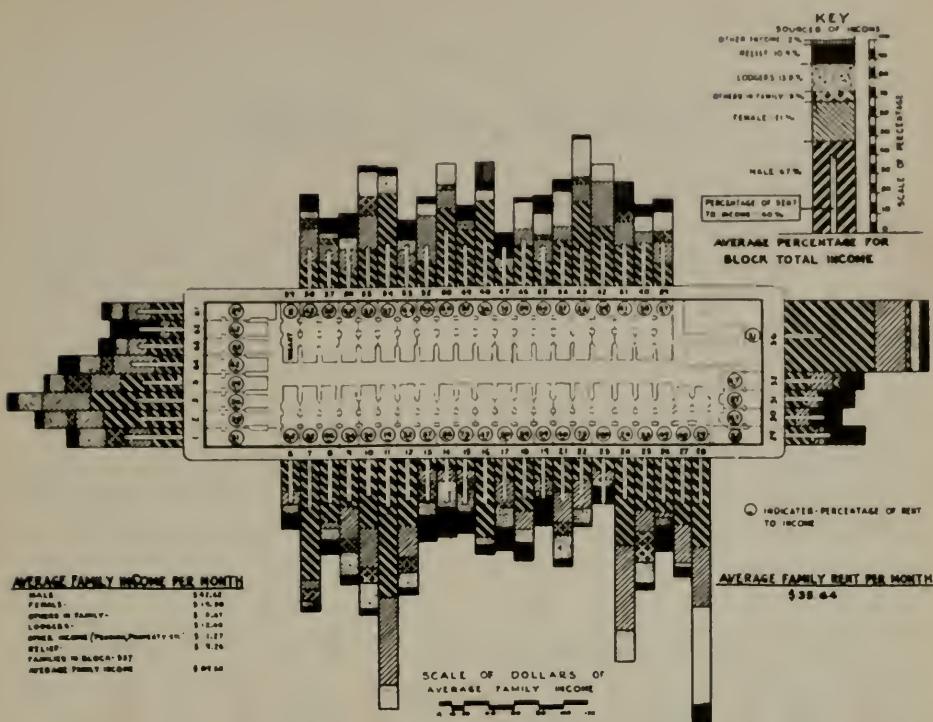
[Hatched Box] Available water for soil having infiltration capacity of 0.5 inch per day
 [Hatched Box] Do 1 inch per day
 [Hatched Box] Do 15 inches per day

National Resources Board, "Report of Water Planning Committee, Part III," 1934.

SCALE .7

Supplemental Water Required to Provide 18 Inches Total Water for Crop Use Per Day from May to October on Soils Having Various Infiltration Capacities in Atlanta, Georgia, and Bismarck, North Dakota, from 1930 to 1932.

1. These cities were only two of several for which this analysis was made.
2. The necessity for reservoirs and dams is clearly shown in an effective form.



Land Utilization Committee, New York Building Congress, Arthur C. Holden, Chairman. SCALE .8

Sources of Income and Ratio of Rent to Income for Families in Block 2007 in New York City in 1936.

1. Seldom does one find a chart in which so much information is given. While it may seem formidable at first glance, the key at the right simplifies it.
2. This amount of information in words and figures only would require many pages of text and could not make evident the interrelations clearly shown in chart form.

CHARACTERISTICS

1. Both actual amounts and percentages should be given.
2. When there is one bar to represent the total of all the others, it should be the same width as the others.
3. The amount scale may be placed at both the left and the right of the chart, or it may be placed on the side of greater significance.

Chapter 16

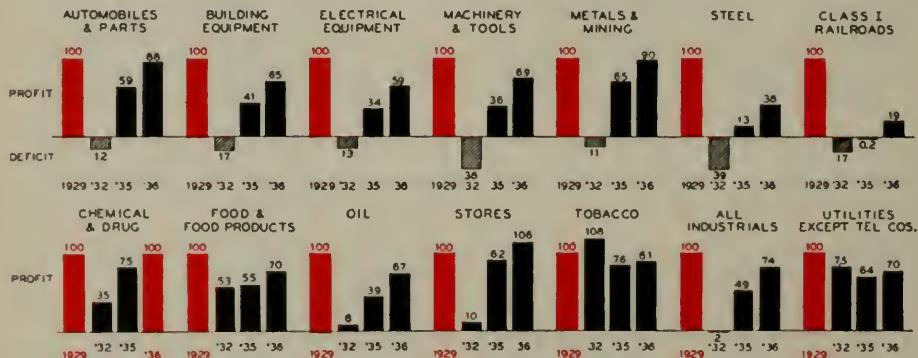
BILATERAL BAR CHARTS

THE TERM bilateral may refer to a curve or line chart as well as to a bar chart. In a bilateral bar chart the bars extend both up and down or both to the left and to the right of a common line.

This results in a comparison of the distances from the line to the ends of the bars rather than from the bottom or line at the left.

Bilateral bar charts are especially adapted to the presentation of profit and loss data or of deviations from normal.

The following are synonyms for bilateral bar charts: two-way bar chart, two-directional bar chart.

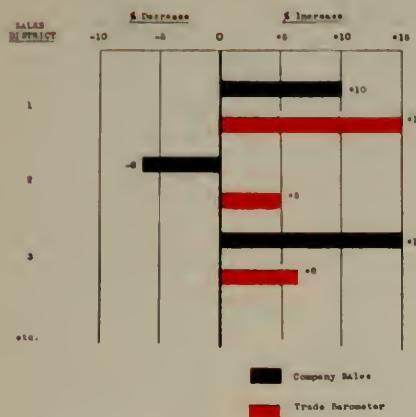


Federal Reserve Agent at New York, "Monthly Review," April 1, 1937.

SCALE .7

Annual Net Profits or Deficits of 727 United States Industrial and Mercantile Concerns, Class I Railroads, and 62 Public Utility Companies Other Than Telephone Companies, During 1929, 1932, 1935, and 1936. 1929 Equals 100%.

1. In a bilateral bar chart, the zero line while still a base line is not the bottom line.
2. In this chart the bars below the zero line are a minus quantity and those above are a plus quantity.
3. It should be noted that in each group of bars, the 100% bar is always the same height.
4. It might have been better not to have the numbers at the end of each bar, since the bar is lengthened and the visual differences are decreased.



Dun's Review, April 1938.

SCALE .5

A. Hypothetical Use of the Regional Trade Barometer of Dun's Review in a Comparison of Increases or Decreases of a Company's Sales from Month to Month in Each Sales District.

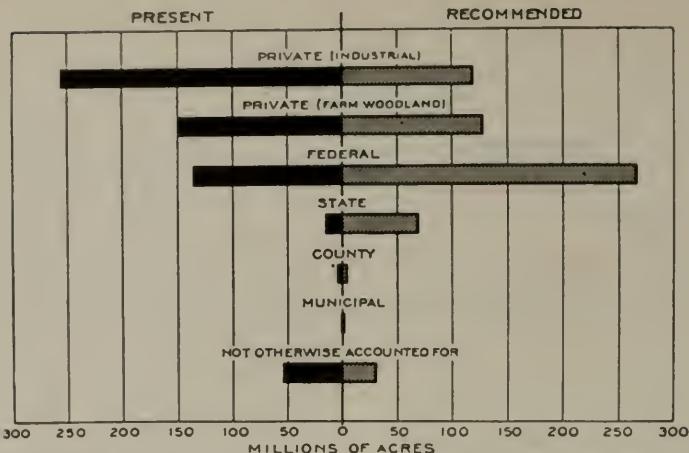
B. Trade Barometers for 29 Regions in the United States in Which the Indexes of November 1938 Are Compared With the Indexes of November 1937 in Percentage Reductions or Increases.

REGION	NOVEMBER 1938 REGIONAL INDEX	NOV. 1938 COMPARED WITH NOV. 1937 (%)	RATIO OF 1935 SALES %
U. S.	89.4	-3.6	100.0
1. NEW ENGLAND	81.8	+12	78
2. NEW YORK CITY	76.7	-25	103
3. ALBANY AND SYRACUSE	88.9	-43	26
4. BUFFALO AND ROCHESTER	79.0	-44	1.9
5. NORTHERN NEW JERSEY	80.8	-23	2.9
6. PHILADELPHIA	82.3	-49	6.2
7. PITTSBURGH	82.2	-92	3.7
8. CLEVELAND	85.3	-26	2.9
9. CINCINNATI AND COLUMBUS	95.0	-35	3.1
10. INDIANAPOLIS AND LOUISVILLE	99.8	-32	2.6
11. CHICAGO	85.1	-53	6.4
12. DETROIT	83.5	-92	4.0
13. MILWAUKEE	92.7	-63	2.2
14. MINNEAPOLIS AND ST. PAUL	97.7	-1.0	4.5
15. IOWA AND NEBRASKA	75.9	-07	3.0
16. ST. LOUIS	87.8	-28	2.5
17. KANSAS CITY	87.7	-52	3.6
18. MARYLAND AND VIRGINIA	103.3	-18	3.8
19. NORTH AND SOUTH CAROLINA	96.5	+0.6	2.1
20. ATLANTA AND BIRMINGHAM	110.0	+8.3	3.5
21. FLORIDA	112.2	+0.1	1.3
22. MEMPHIS	90.2	+3.8	1.5
23. NEW ORLEANS	100.4	+5.1	1.0
24. TEXAS	108.1	-1.7	4.5
25. DENVER	101.5	-58	1.3
26. SALT LAKE CITY	88.7	-88	.8
27. PORTLAND AND SEATTLE	87.7	-29	2.7
28. SAN FRANCISCO	97.3	-33	3.4
29. LOS ANGELES	97.8	-16	3.9

Dun's Review, February 1939.

SCALE .7

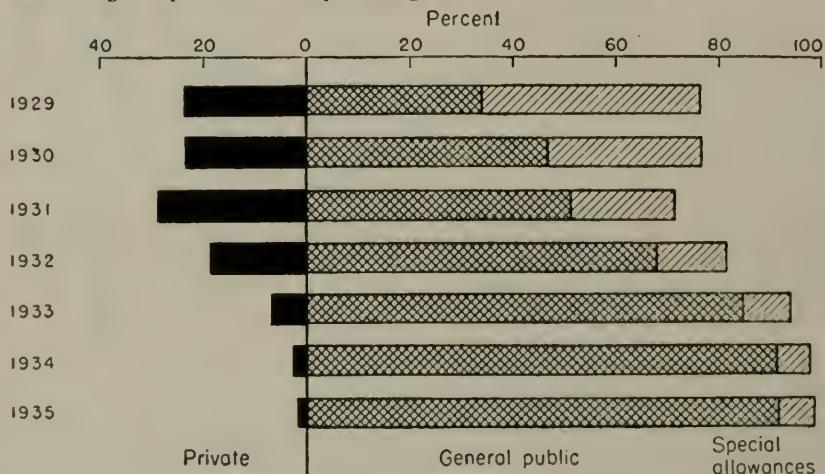
GRAPHIC PRESENTATION



From "An Outline of the Natural Resources of the United States" by R. M. Field, Copyright 1936.
Used by the Permission of the Publishers, Barnes & Noble, Inc., N. Y. C.

A. Ownership of Forest Land in the United States in 1934 and as Recommended by the National Resources Board.

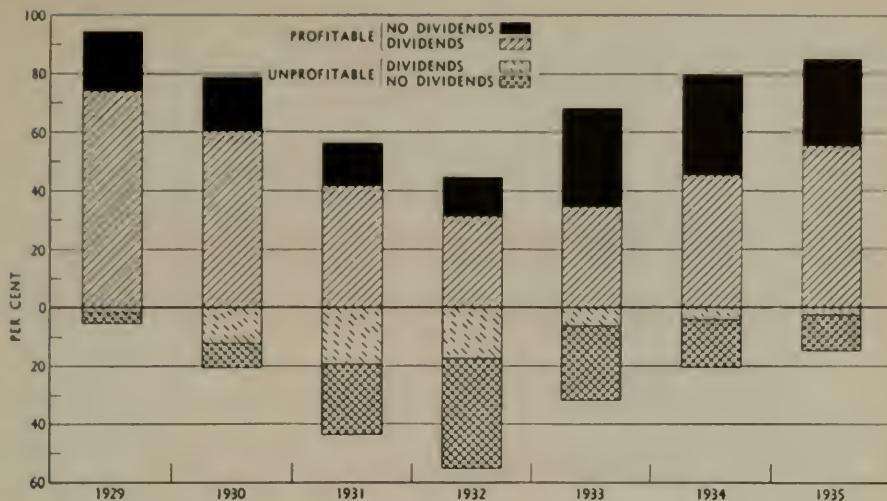
1. This chart does not present plus and minus quantities, but is, however, in bilateral bar chart form.
2. It should be noted that the sum of the lengths of the bars on one side of the zero line is equal to the sum of the lengths of the bars on the other side. As a result, the scale might represent either percentages or "millions of acres."



WPA, Division of Social Research, "Trends in Relief Expenditures," 1937.

B. Percentage Distribution of Relief Expenditures from Public and Private Funds in 120 Urban Areas in the United States from 1929 to 1935.

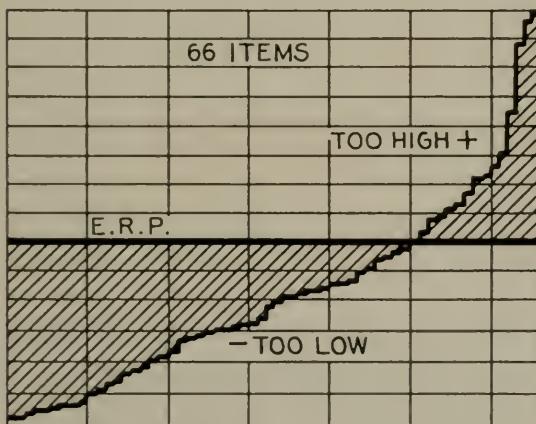
The total length of each bar if measured on the per cent scale would be 100%. Thus this chart is merely a rearrangement of 100% bar charts. The reason for presenting it in this way was to emphasize the relation between public and private relief. Compare with 102A and 145A.



Dun's Review, April 1938.

A. Profit-and-Dividend Status of 348 Corporations in the United States for the Period from 1929 to 1935.

1. Here again is a group of 100% bar charts.
2. Note that the two types of crosshatchings below the zero line are in the classification "unprofitable" while the two above the zero line are in the classification "profitable."
3. The zero line might well be heavier to emphasize this division.



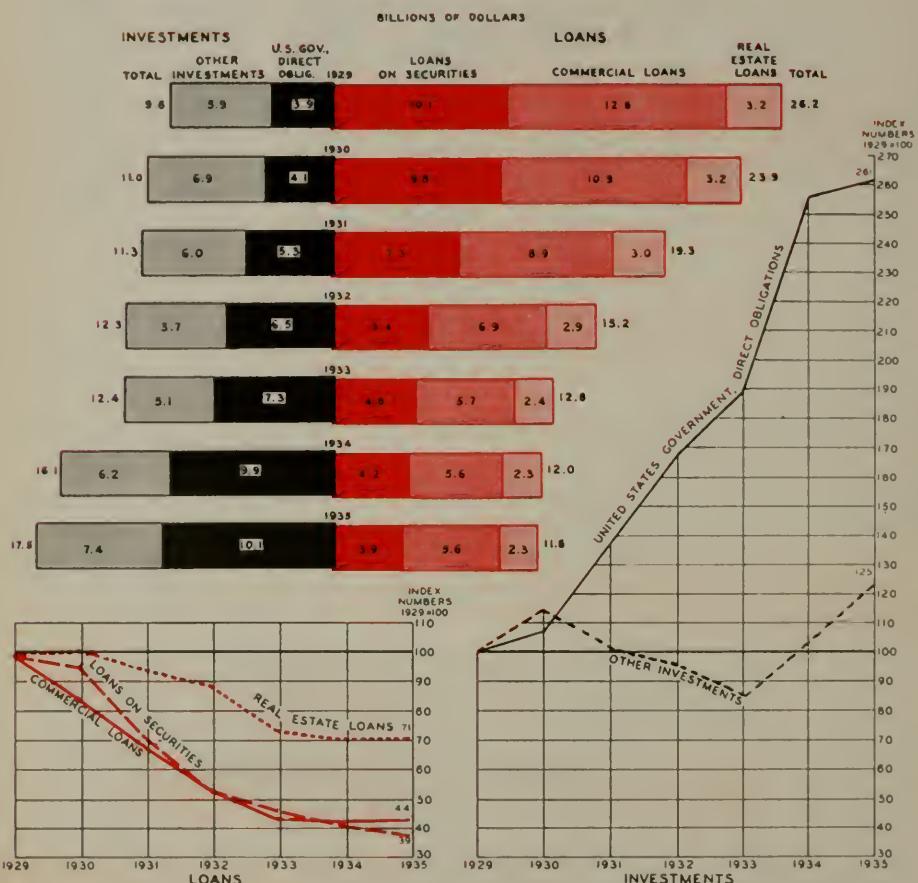
- Typical
1. Paring knives priced at \$ 0.72 per doz. Right Price was \$ 2.10
 2. Carving sets: \$ 7.50 each. Right Price was \$ 5.00

Churchill Engineering Corporation, N. Y. C.

B. The Distortion in Prevailing Prices of Sixty-Six Items of Cutlery Manufactured by One Company as Determined by the Churchill Engineering Corporation.

E.R.P. in this chart means "Economic Right Prices." Fifty of sixty-six items analyzed, according to this corporation, were below E.R.P., while sixteen were above.

GRAPHIC PRESENTATION



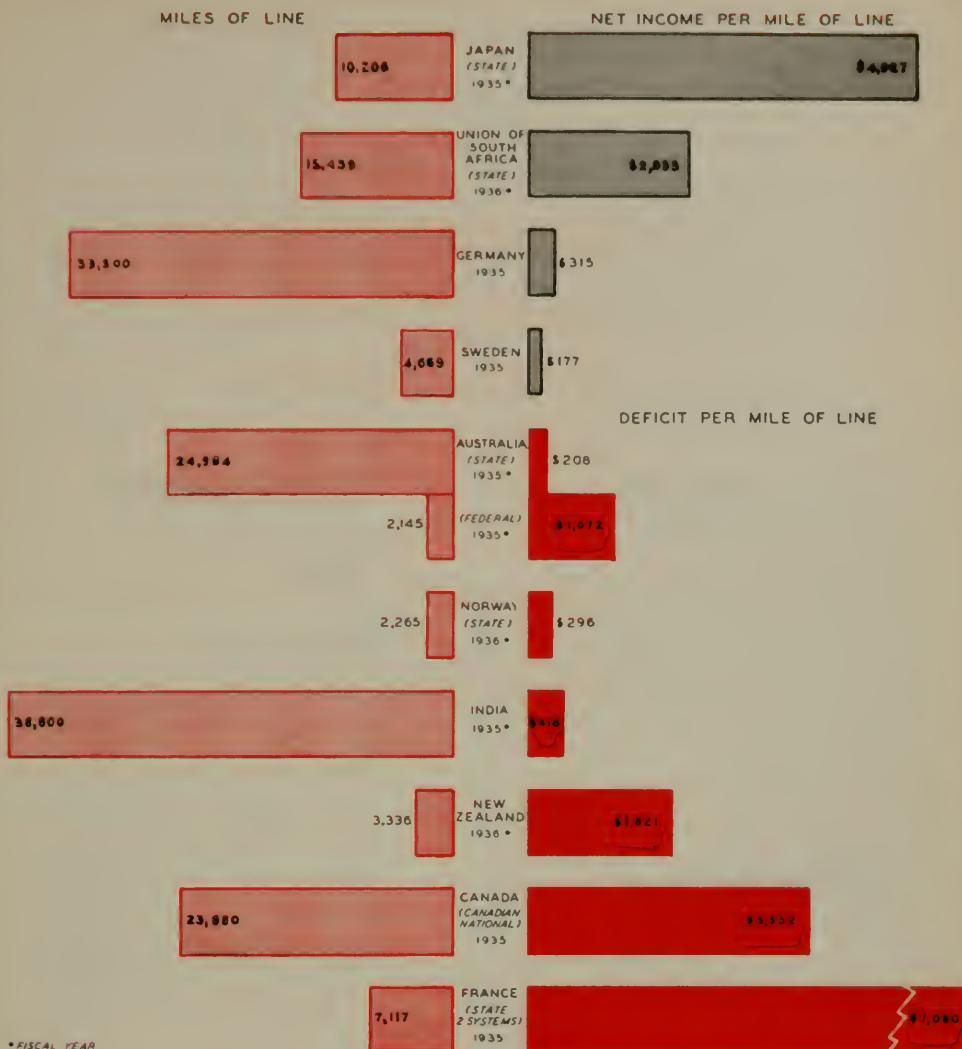
National Industrial Conference Board, Inc., N. Y. C., February 7, 1936.

SCALE .7

Loans and Investments of the Member Banks of the Federal Reserve System from 1929 to 1935.

1. The insertion of figures in each of the component parts facilitates the reading of the chart.
2. The curves which supplement the chart give a great deal more detail than could be given in one form of chart alone.

BILATERAL BAR CHARTS



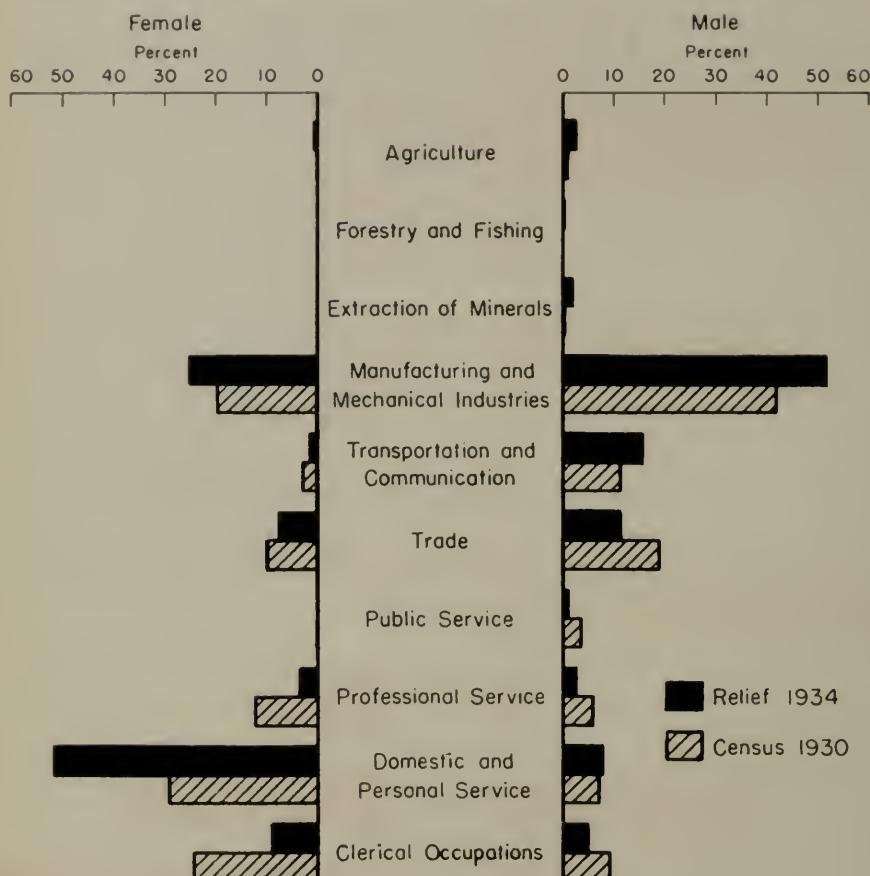
National Industrial Conference Board, Inc., N. Y. C., April 22, 1938.

SCALE .7

Net Income or Deficit of Governmentally Owned or Operated Railways for Various Foreign Countries in 1935 or 1936.

1. The point of interest in this chart is the net income or deficit of the various railroads. The number of miles of line were probably included to show that there is no evident relationship between the length of the railroad and profit or loss.
2. The dividing line between the two groups of bars in this chart is not a zero line with plus and minus quantities to right and left, since miles are the quantity on one side and dollars the quantity on the other.
3. Thus the arrangement of the bars alone makes this a bilateral bar chart.

GRAPHIC PRESENTATION



WPA, Division of Social Research, "Urban Workers on Relief," 1936.

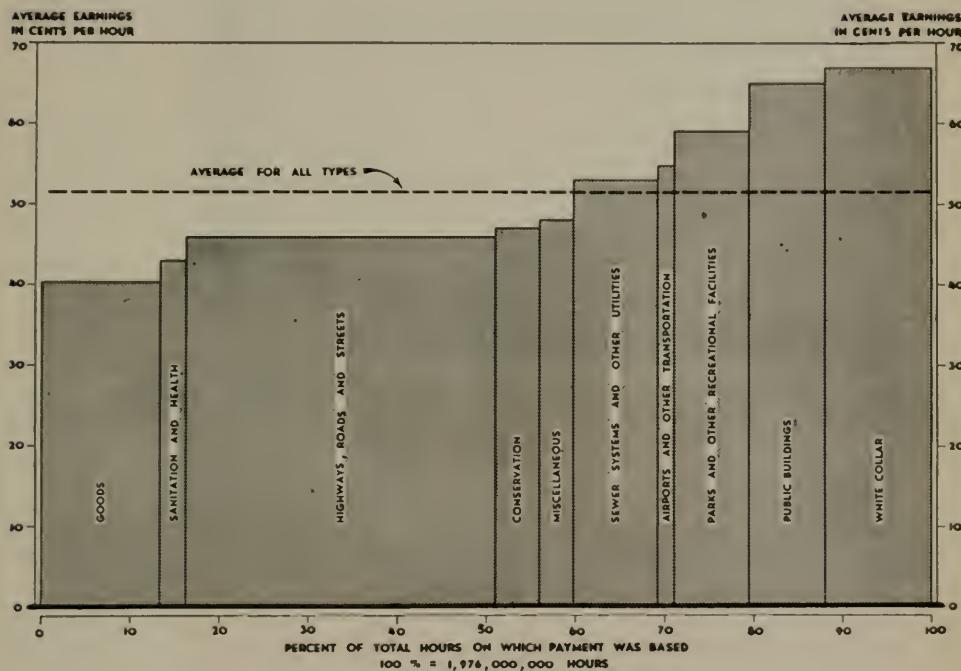
Usual Occupation of Unemployed Workers on Relief in 1934 and Gainful Workers in 1930 in the United States.

The method of reading this chart is as follows: according to the 1930 census about 42% of male gainful workers were in the manufacturing and mechanical industries. In 1934 about 52% of the men on relief designated manufacturing and mechanical industries as their former place of employment. This latter fact does not seem so startling in view of the first statement.

Chapter 17

AREA BAR CHARTS

THE BASIS of comparison in an area bar chart is the area of the bar rather than the length of the bar. Other terms applied to this type of chart are, 100% square; 100% block.

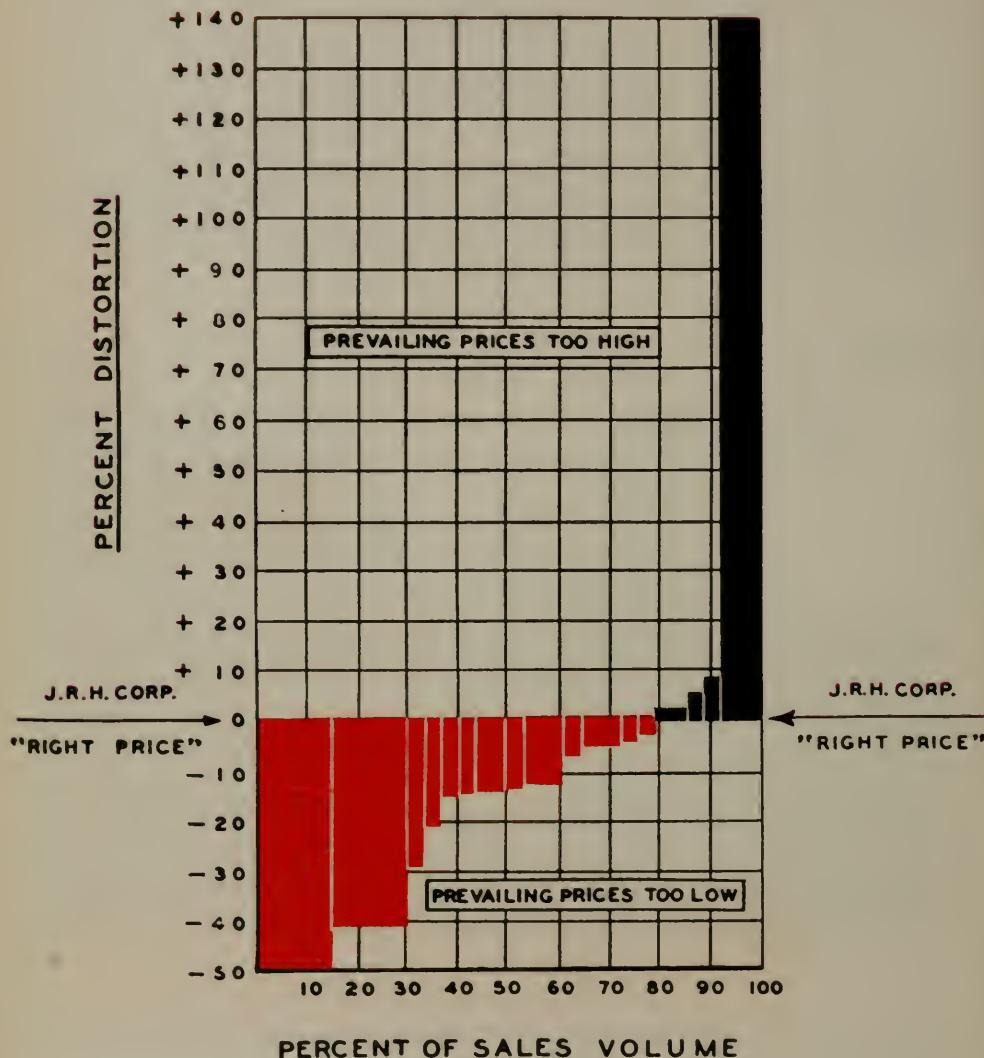


WPA, "Report on Progress of the Works Program," December 1937.

Average Hourly Earnings of Persons Employed on Works Progress Administration Projects, by Types of Projects for the Period from January through October 1937.

- As both the percentage of the total number of hours and the earnings per hour are given, it is possible to compute from this chart the actual amount of expenditure for each type of project.
- The chart indicates without computation in which projects earnings are above the average and which ones fall below.

GRAPHIC PRESENTATION



Churchill Engineering Corporation, N. Y. C.

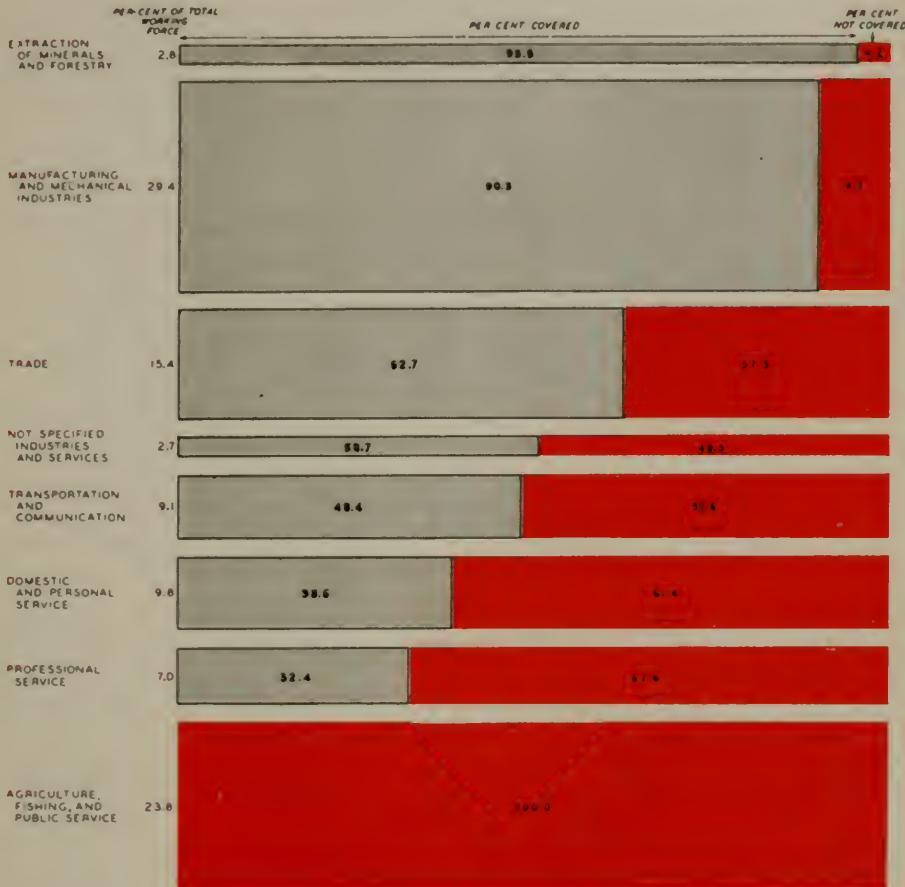
The Distortion in Prevailing Prices of Seventeen Items of Roofing Products Manufactured by One Company in the United States as Determined by the Churchill Engineering Corporation.

Weighting the bars by showing volume as well as price gives a more accurate picture than a simple bilateral chart would give. However, a representation of volume is not always necessary.

AREA BAR CHARTS

CHARACTERISTICS OF AREA BAR CHARTS:

1. Useful in presenting material which gives parts of a total.
2. They show in one view two independent groups of facts.



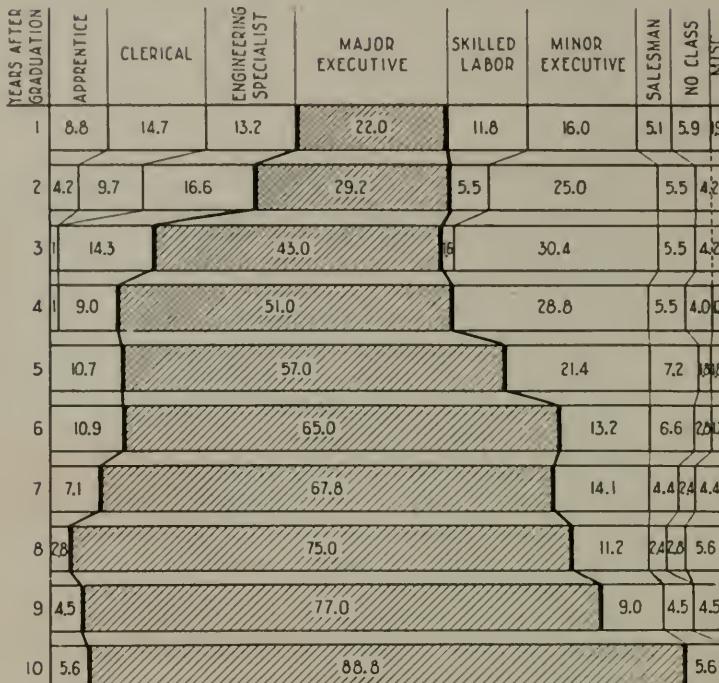
National Industrial Conference Board, Inc., N. Y. C., February 11, 1937.

SCALE .7

Proportion of the Working Population Covered by the Old Age Provisions of the Social Security Act in the United States, Using the Distribution of Occupations of the 1930 Census.

1. Not only the percentage covered or not covered by old-age provisions of the Social Security Act is presented, but also the percentage of the total working force of each of the types of labor.
2. If only the percentage covered in each type of industry were given, the representation would be obviously false.

GRAPHIC PRESENTATION



Massachusetts Institute of Technology, "The Technology Review," February 1933.

Occupational Distribution in 1930 of 134 MIT Graduates of the Classes of 1917 to 1929 Inclusive.

1. This chart is in reality a group of 100% bar charts. It was placed in this chapter because of its resemblance to the preceding charts.
2. The emphasis on the area for "Major Executive" tends to make the comparison a vertical one, resulting in area comparison.

CHARACTERISTICS OF AREA BAR CHARTS:

Area bar charts may take one of two forms:

- a. They may have one dimension in percentages of a total and the second dimension in numerical values.
- b. They may have both dimensions in percentages of two different totals. They then become 100% squares or blocks.

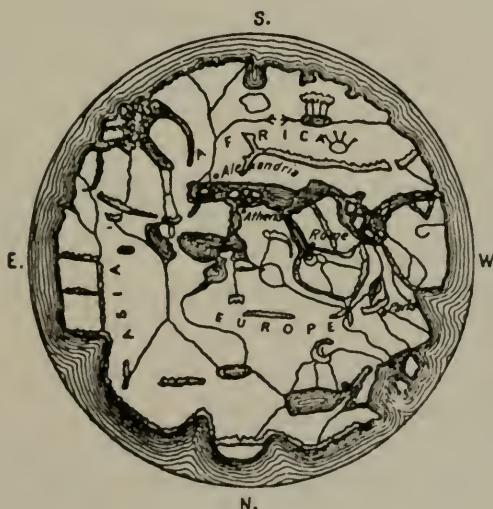
Chapter 18

GENERAL USE OF MAPS

DOTS, circles, bars, curves, symbols, etc., may be placed on a base map to give the geographic location of statistical data. When used in this way, the general term "statistical map" may be applied. Synonyms for statistical map are cartogram, map chart.

GENERAL REFERENCES

- Paullin, Charles O., *Atlas of the Historical Geography of the United States*, Carnegie Institute of Washington and American Geographical Society of New York, 1932
- Raisz, Erwin, *General Cartography*, McGraw-Hill Book Co., Inc., New York City, 1938

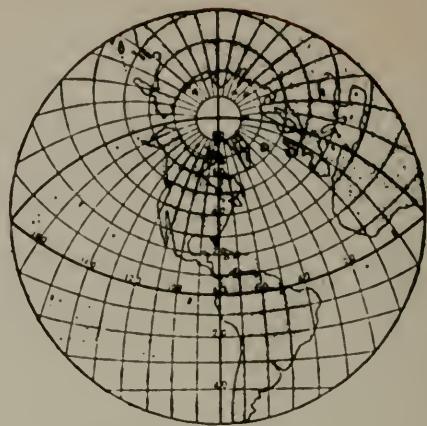
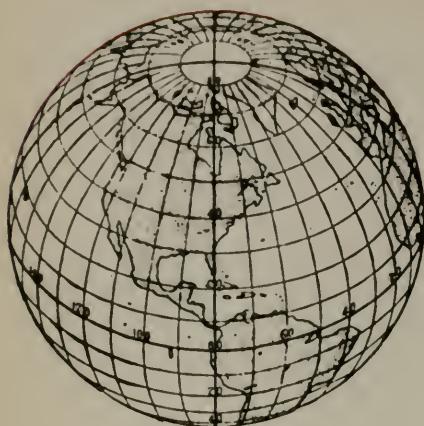


Encyclopedia Americana.

Outline Sketch of Borgia Map of the Fifteenth Century, A. D.

1. Man's earliest maps consisted of simple drawings. The map shown above is in a more advanced form.
2. Long before the Christian era, people living in Egypt and Mesopotamia constructed maps. For an early Mesopotamian map, see 170.

GRAPHIC PRESENTATION



Encyclopedia Americana.

Maps Drawn on Orthographic and Stereographic Projection on the Plane of a Horizon.

1. When the discovery was made that the earth was round, map-makers were faced with the problem of how to present on a plane a picture which was best presented by a globe.
2. This involved transforming the lines of latitude and longitude on the earth into planer magnitudes.
3. The projections above illustrate two of many solutions to this problem.

BASE MAPS

Base maps to be used for presenting quantitative data may be secured from the following companies:

American Map Co., New York, N. Y.

Educational Exhibition Co., Providence, R. I.

C. S. Hammond & Co., New York, N. Y.

Rand-McNally Co., New York, Chicago, Washington, D. C., San Francisco, and Los Angeles

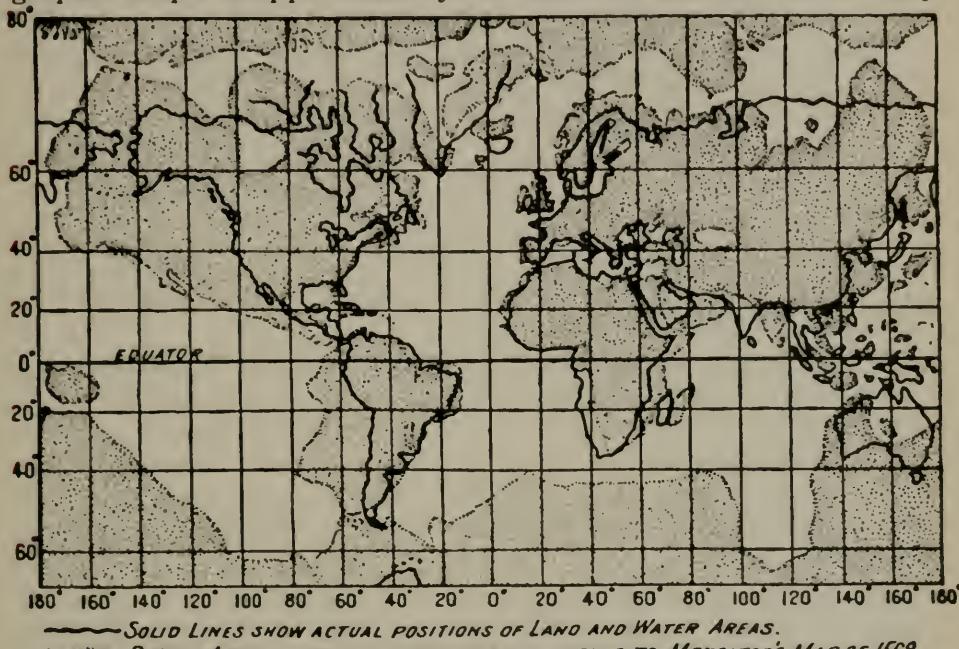
Maps may be ordered in many different forms: paper; cloth-mounted; sized surface; washable surface; wooden rollers; spring-roller case; pin-map board; cork carpet for pins; framed and braced.

In making graphic representations of different sections of a city, it is often difficult to secure base maps of a suitable scale. Frequently maps can be obtained from the various city departments, or from public utility companies covering the area of special interest.

GENERAL USE OF MAPS

GENERAL information about United States government maps may be secured from Map Information Office, North Interior Department Building, Washington, D. C. Aerial photographs are card-indexed, as well as other maps. This enables the Map Information Office generally to state whether or not an area has been photographed, and if so, from what source prints are procurable. The following are important government mapping agencies from which maps may be obtained directly:

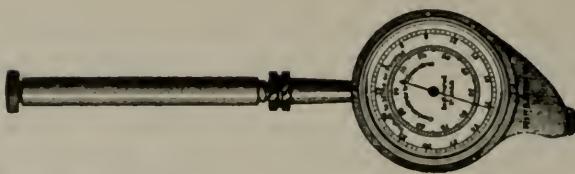
Geological Survey, U. S. Department of Interior. Basic topographic maps of approximately one-half the United States. Key



Encyclopedia Americana.

A Map Drawn on Mercator Projection, A "Developed" Projection.

1. The term "developed" is derived from the method: a cylindrical or conical surface is substituted for the plane of projection and then is "developed" or rolled out in a plane. The two types of projection most commonly used today are the Mercator and the polyconic.
2. The Mercator projection was first introduced in 1568 by Gerardus Mercator, a Flemish lecturer on geography and astronomy. In the Mercator projection a tangent cylinder is employed. The meridians and parallels of latitude cut each other at right angles and are represented by straight lines.
3. The polyconic projection employs an infinite number of tangent cones. The starting point for these cones is at the middle parallel or latitude of the area mapped.
4. See 267.



Keweenaw & Esser Co., New York City.

Map Measuring Device.

This instrument is used to measure lines and distances on a map. The small wheel follows the line and the distance is recorded on the dial in inches or centimeters.

maps made for individual states and distributed without charge are used in ordering specific sections. Geologic maps for many sections of the United States and Alaska.

Coast and Geodetic Survey, U. S. Department of Commerce. Navigational charts of the coasts of the United States and its possessions. Air route maps covering the entire United States.

General Land Office, U. S. Department of Interior. Wall map of the United States showing the national parks, national monuments, and other useful information. Maps of the 29 public-land states, Alaska, and Hawaii.

Hydrographic Office, Bureau of Navigation, U. S. Department of the Navy. Maps and charts required in navigation in foreign waters and on high seas.

Corps of Engineers, U. S. Army, Engineer Reproduction Plant, Fort Humphreys, D. C. Special topographic maps of areas of military importance. Some topographic maps not covered by the Geological Survey.

Forest Service, U. S. Department of Agriculture. Geographic maps of national forests. Topographic maps of portions of them.

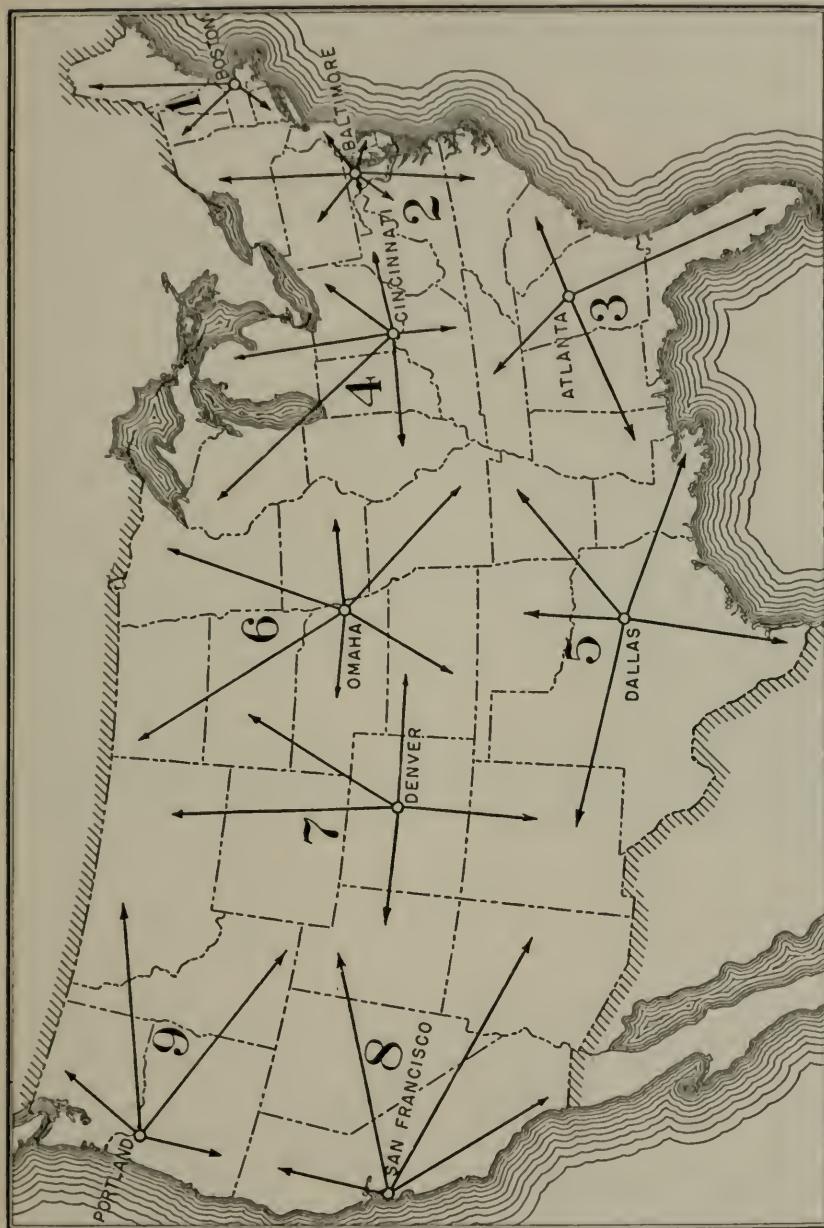
Bureau of Reclamation, U. S. Department of Interior. Topographic maps of many federal irrigation projects.

Office of Indian Affairs, U. S. Department of Interior. Portions of the Indian reservations.

Mississippi River Commission, Vicksburg, Mississippi. Profile of the river and topography along the shores.

International (United States-Alaska-Canada) Boundary Commission, Washington, D. C. Topographic maps of the United States-Canada boundary line and east boundary of Alaska

Lake Survey, Patrol of Lakes and Coasts, U. S. Department of Commerce. Hydrographic charts of Great Lakes.



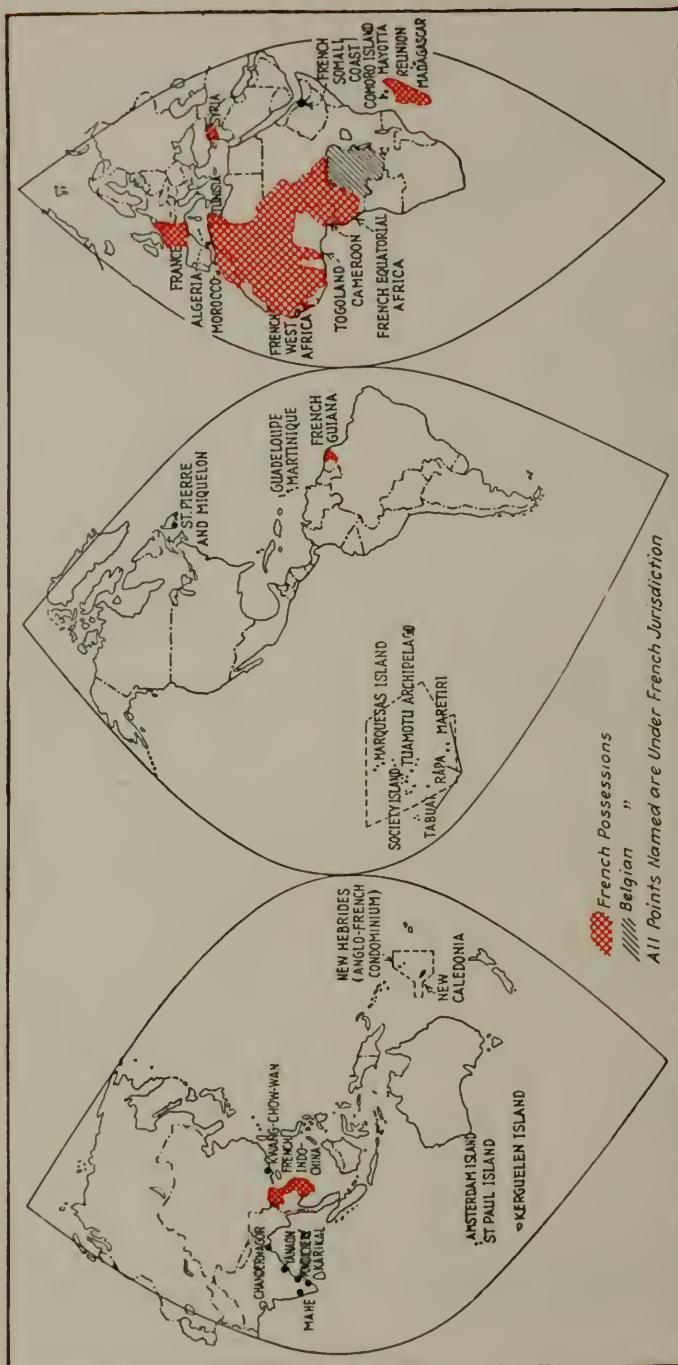
National Resources Committee, "Progress Report," 1938.

Field Offices and Planning Districts of the National Resources Committee.

This map is similar to a base map and illustrates the point that maps simplify the presentation of material of this type.

SCALE .6

GRAPHIC PRESENTATION



American Machinist, January 31, 1929.

Modern Orange Peel Map.

This map was designed by the Coast and Geodetic Survey of the U. S. Department of Commerce for scale maps. All areas are shown in their correct proportions.



Courtesy of Commission of the Government of the Commonwealth of Australia From Exhibit at New York World's Fair, 1939.

Inclined Rotating Globe So Balanced That Only Support Is Half-Inch Tube Containing Electric Wires.

1. Land with the exception of the British Empire is shown in brilliant blue celluloid, raised above the aluminum surface. The British Empire is in red celluloid with the area for Australia cut out and illuminated from within so that the red of Australia shows more brilliantly than the rest of the British Empire. The sphere is over six feet in diameter, made from individual discs of plate aluminum, about 30 inches in diameter, spun to the correct spherical curvature. Discs were cut and welded to build up a continuous surface, the joints practically invisible.
2. Special feature of this globe is that it is supported by a half-inch diameter tube and rotated by internal mechanism so balanced that the axis of the earth is inclined in the proper relation. Celluloid of Australia is removable as a man-hole cover so that a small workman may go inside if necessary. Mirror below assists in accenting the southern polar region relative to Australia.



Ford Motor Company.

Globe Used in the Ford Exhibit in the Rotunda Building in Dearborn, Michigan.

This relief globe does not give the names of countries or cities, but the character of the land and its relation to sources of supply and distribution of product are strikingly shown.

See 155 and 156

Bureau of Chemistry and Soils, U. S. Department of Agriculture. Maps showing the character of soils.

Soil Conservation Service, U. S. Department of Agriculture. Maps compiled from aerial photographs.

Bureau of Public Roads, U. S. Department of Agriculture. Maps of the United States showing the federal aid system of highways. Maps of some of the states.

Bureau of Agricultural Economics, U. S. Department of Agriculture. Various maps relating to agricultural economics.

Chapter 19

GUIDE AND ROUTE MAPS

One purpose of guide and route maps is to show details which might be helpful in planning moves from one point to another. The form of guide and route maps is well known, and may be used for classifications as well as for routes.

REFERENCES

- National Resources Committee, *Suggested Symbols for Plans, Maps and Charts*, Washington, D. C. A free pamphlet, sent on request.
- U. S. Geological Survey, "Standard Symbols Adopted by the Board of Surveys and Mays," a sheet 18 $\frac{1}{2}$ " x 30". Price 40c from U. S. Geological Survey, Washington, D. C.

Map Printed on a Post Card to Show by a Dotted Line the Advantage of a Parkway Crossing Croton Dam in Westchester County, New York.

1. This map in convenient form was of great assistance in securing adoption of the route now called the Briarcliff - Peekskill Parkway which includes 2300 acres of forest reserve.
2. The line of dashes, purposely made heavy, indicates a direct route which is the natural extension of the Sawmill Valley Parkway.
3. Words alone would have presented a less striking argument.



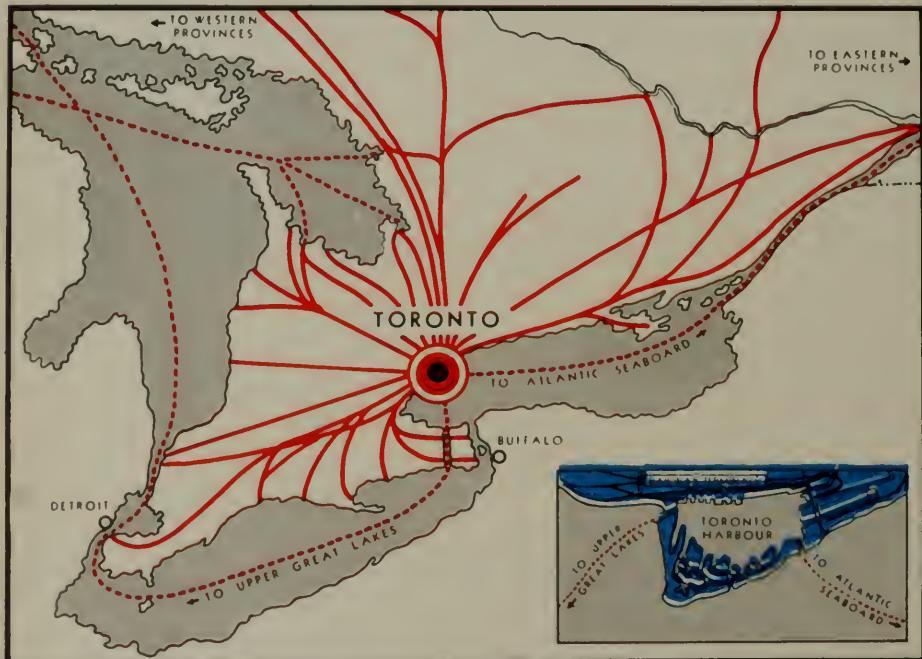
Original as Proposed by Willard C. Brinton in 1921.
SCALE .7



Issiah Bowman, "The New World," World Book Co., N. Y. C., 1930.

A. Anatolia and Arabia Superimposed on the United States to Illustrate Their Relative Areas.

Seldom is a verbal explanation of the difference in area of two countries satisfactory. Presented in this form, the difference is readily seen.



Toronto Industrial Commission, "Canada's National Market," 1938.

SCALE .9

B. Transportation Facilities of Toronto, Canada, in 1937.

The inclusion of a detail of a large map clarifies and explains. In this map, the detail in the lower right corner made it possible to designate the city Toronto merely as a circle in the larger map.

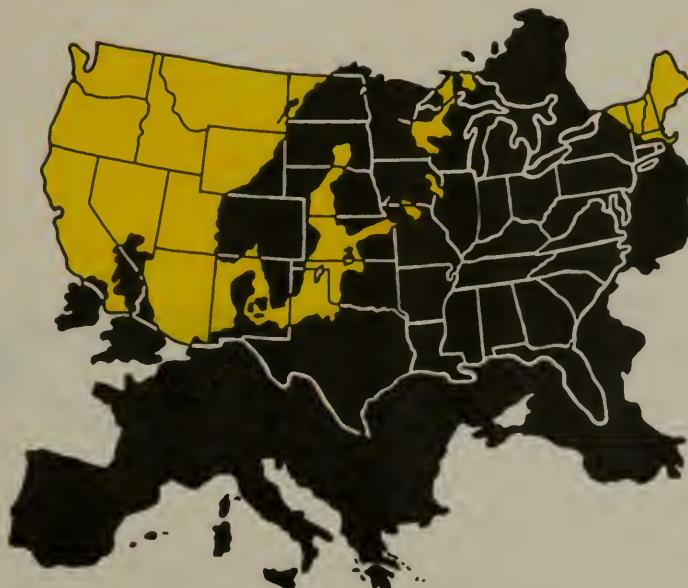


Eastern Air Lines, N. Y. C.

SCALE .8

A. A Comparison of the Air Line Routes in 1928 and in 1938 of What Is Now the Eastern Air Lines in the United States.

1. A "then" and "now" comparison is easily made on two maps.
2. Note that a great deal of black ink was used and that as a result the routes and the names of the cities are easily seen.

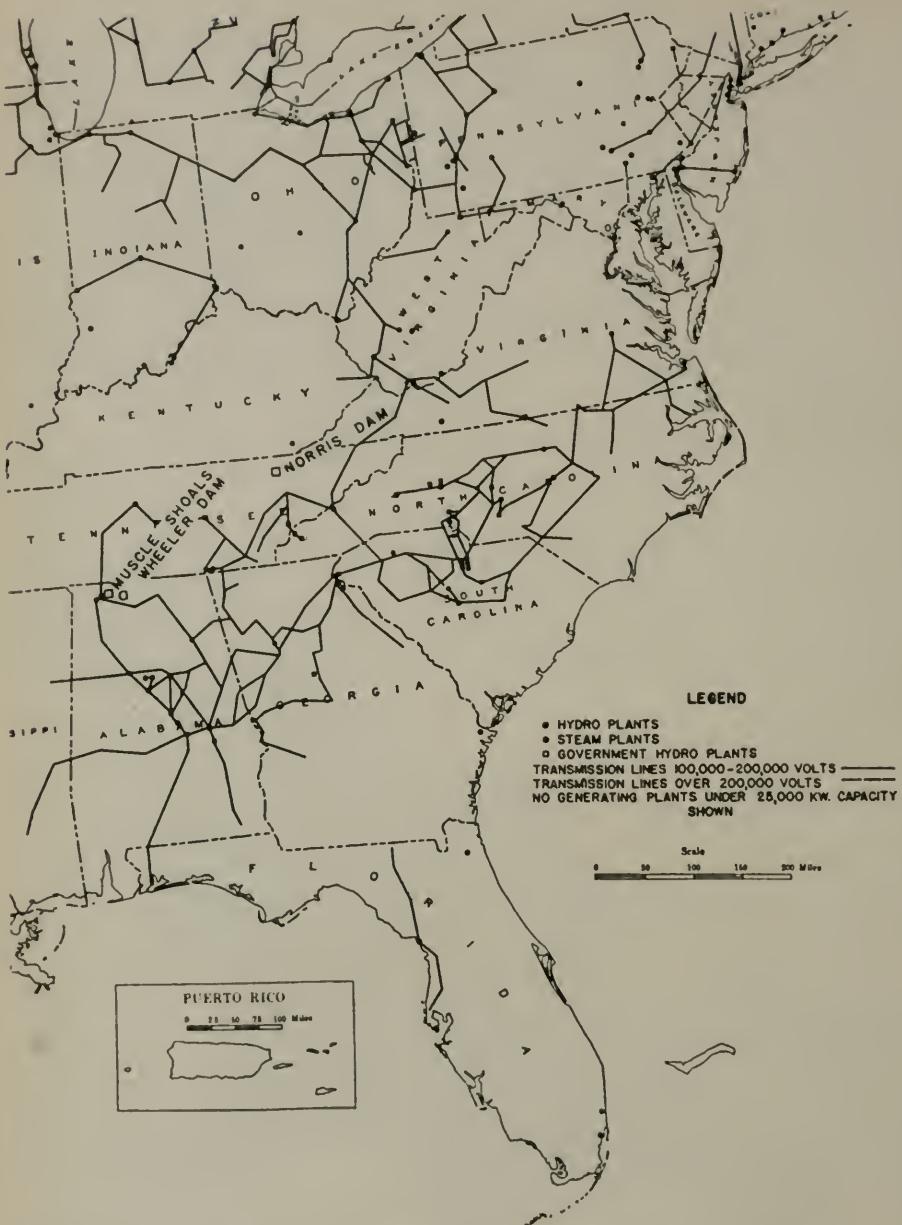


SCALE .8

B. Comparison of the Areas of the United States and Europe.

Compare the effectiveness of this with 162A.

GRAPHIC PRESENTATION



National Resources Board, "Report of the Water Planning Committee, Part III," 1934.

Main Electric Transmission Lines in the United States in 1933.

1. In the original of this map, the whole of the United States was given.
2. In order not to reduce the map and thus lose much of its detail, a section only is reproduced.

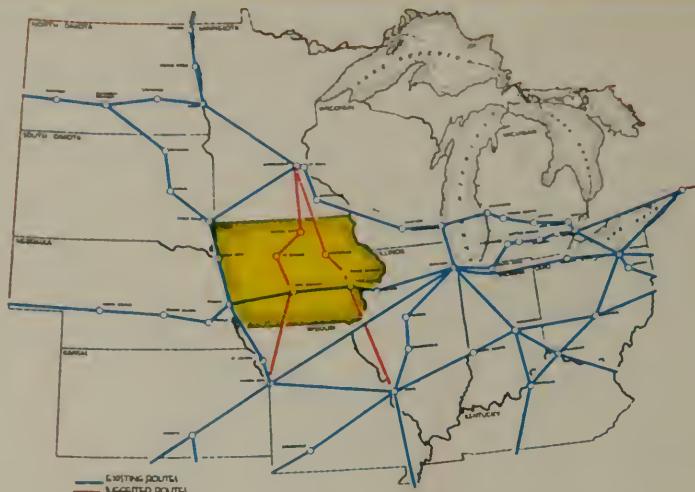


National Resources Committee, "Our Cities," June 1937

Location, Membership Distribution, and Interrelationships of State Municipal Leagues in the United States in 1937.

1. This is, in a way, an organization chart presented geographically.
2. The numbers within each circle indicate the number of member municipalities in the state.

GRAPHIC PRESENTATION



National Resources Board, "State Planning," 1935.

SCALE .5

A. Existing Routes of Midwestern Airways and Routes Suggested by the Iowa State Planning Board.

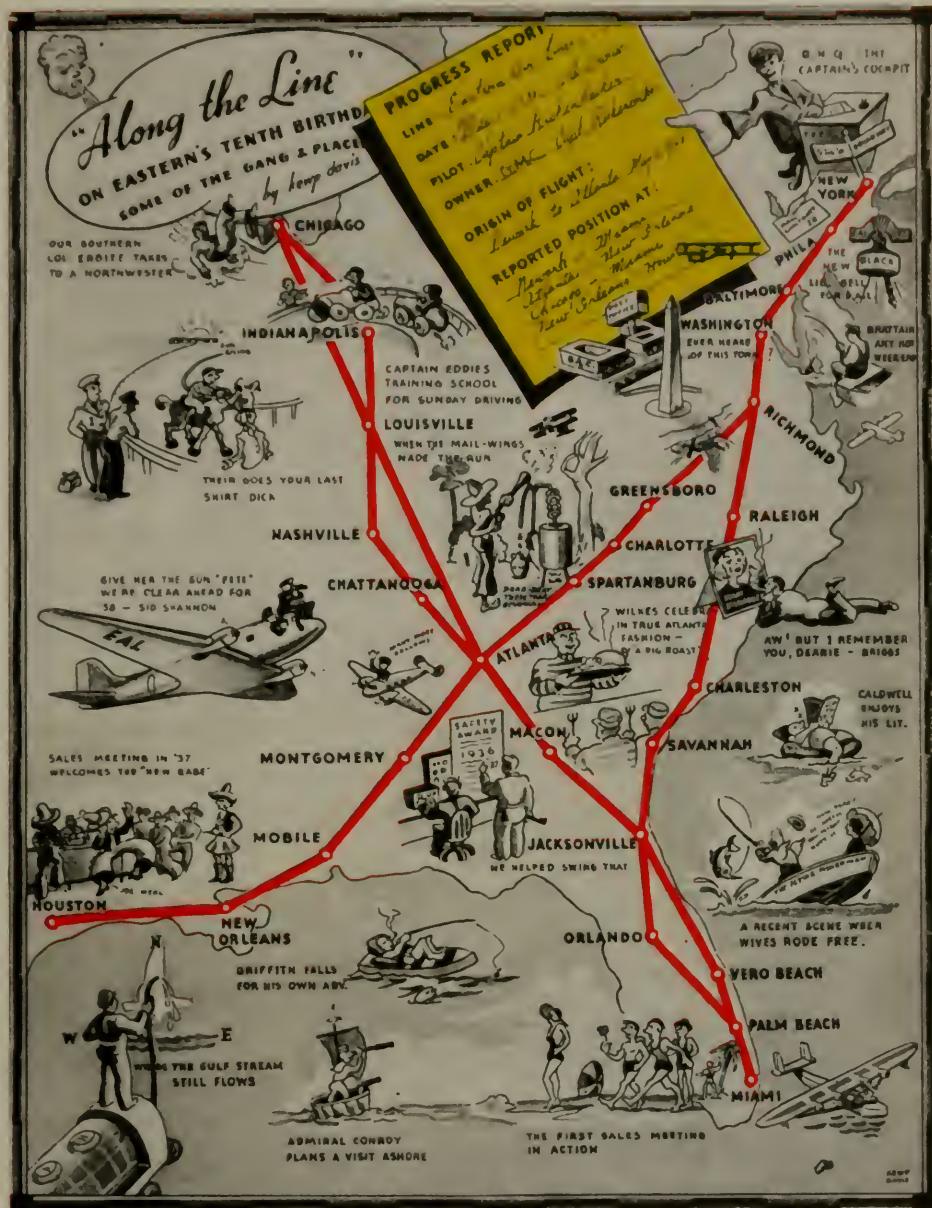
1. Because its state planning board prepared this map, Iowa is emphasized.
2. The inclusion of states other than Iowa makes it clear why the new air routes are suggested.



Engineering News Record, October 1938, Part of an Editorial on Public Relations for Industry. SCALE .6

B. States from Which Materials and Equipment for the Construction of Boulder Dam Were Secured.

This type of map, whether it includes one continent or the whole world, is effective in explaining the interdependence of peoples. For the construction of Boulder Dam, materials had to be secured from forty-six states.



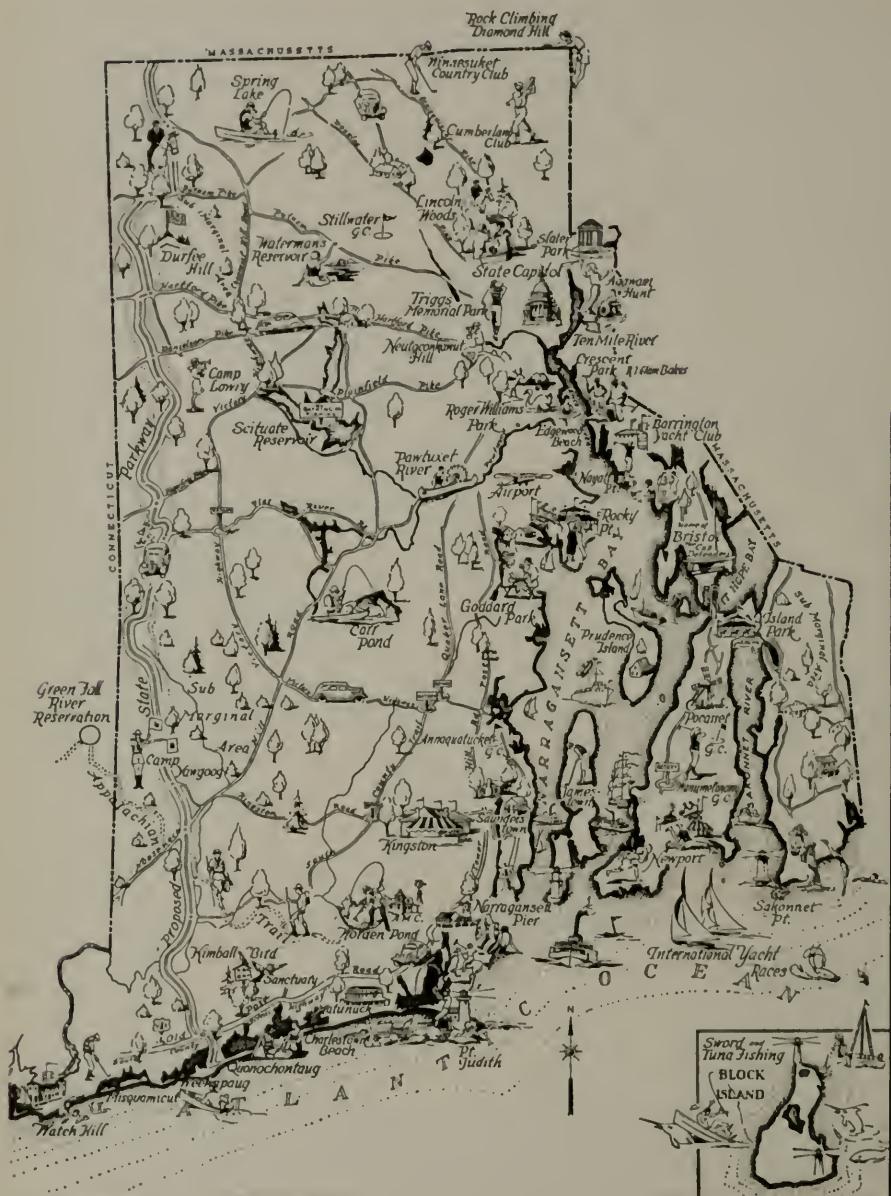
American Aviation, May 1, 1938.

SCALE .6

Pictorial Map of the Route of Eastern Air Lines in 1938.

1. A pictorial map attracts and teaches.
 2. Compare this with 163A.

GRAPHIC PRESENTATION



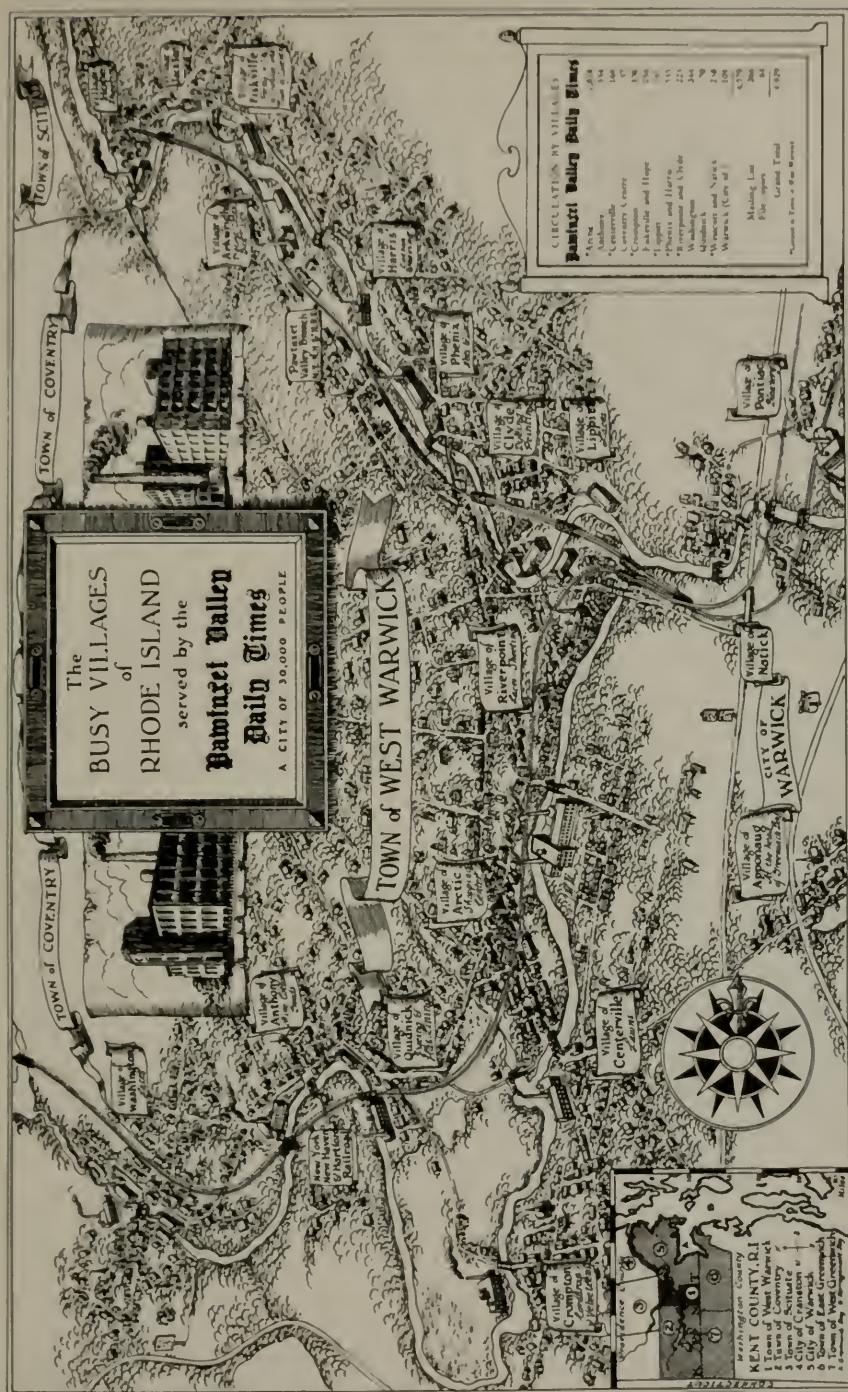
National Resources Board, "State Planning," 1935.

SCALE .7

Recreation Facilities of the State of Rhode Island in 1935.

By means of numerous line drawings, a base map could easily be converted into a pictorial map similar to the one shown above.

GUIDE AND ROUTE MAPS



SCALE .5

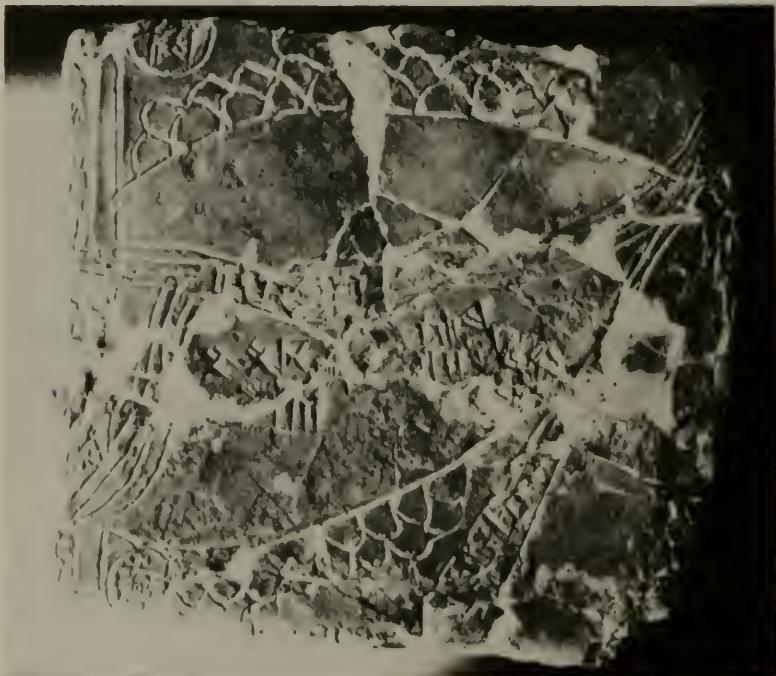
J. J. Devine & Associates, Inc., N. Y. C.
Pictorial Map of a Group of Villages in Rhode Island.

Chapter 20

RELIEF AND AERIAL MAPS

AERIAL MAPS, whether actual photographs, drawings, or photographs of models give a bird's-eye view of buildings, roads, trees, mountains, cities, etc. Relief maps are best known for their use in showing elevations and surface undulations of a country, but may be used effectively also in presenting statistical data.

Talley, Capt. B. B., *Engineering Applications of Aerial & Terrestrial Photogrammetry*, Pitman Publishing Company, New York City



The American Schools of Oriental Research, New Haven, Connecticut.

Clay Map from Mesopotamia, Dated About 2500 B.C.

This is perhaps the oldest known map. On it are marked positions of cities, indicated by circles; mountains, indicated by scales; and rivers, indicated by wavy lines.

REFERENCES ON MAP PROJECTION

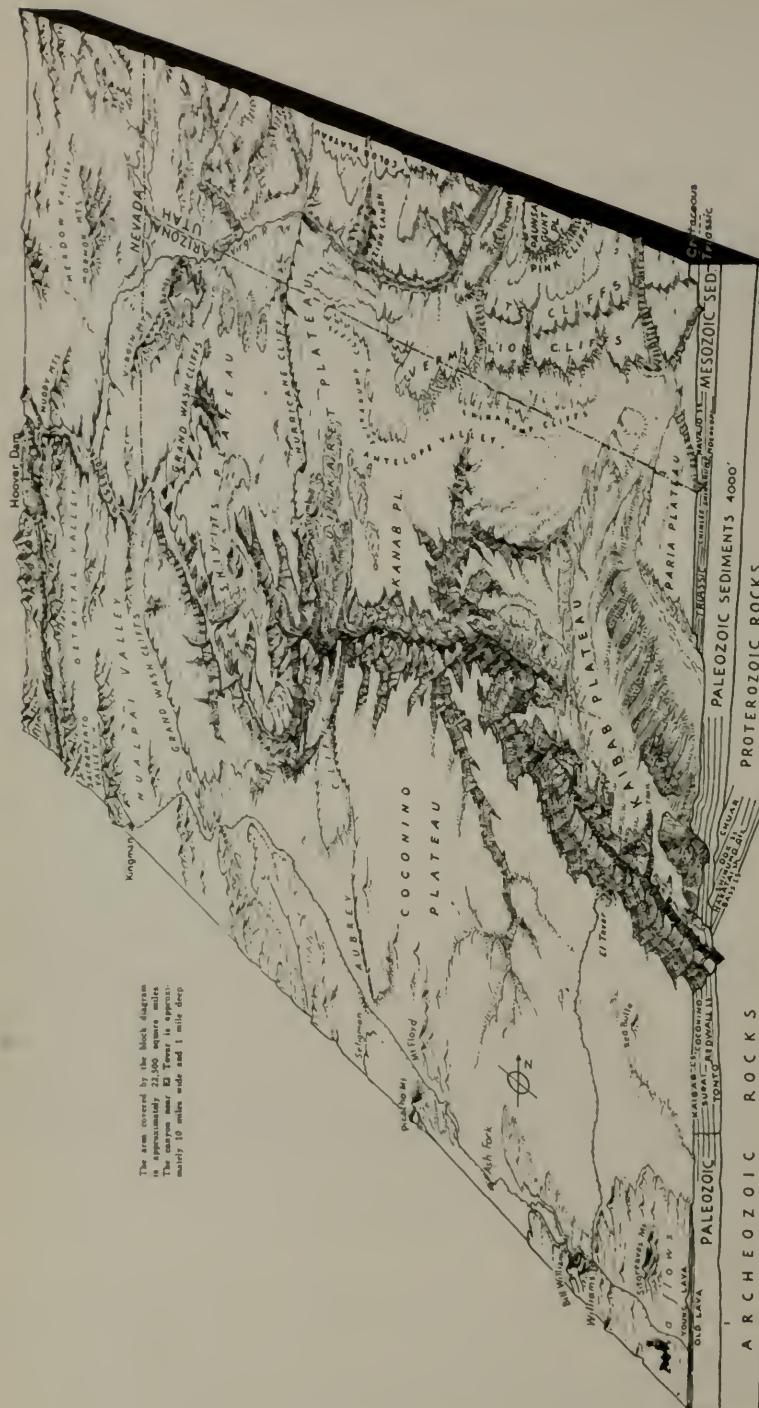
Hinks, A. R., *Map Projections*, Cambridge University Press,
England, 1922



Warren H. Manning, "A National Plan Study Brief," *Landscape Architecture*, July 1923, American Association of Landscape Architects, Cambridge, Mass.

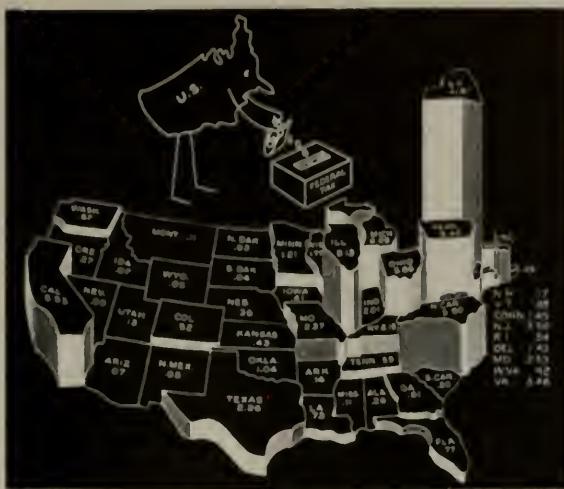
Relief Map of the United States.

1. The purpose of this type of relief map is to aid the study of the geographical features of the nation.
2. Relief maps emphasize rivers, lakes and harbors. They are therefore especially effective for depicting facilities for water transportation.



Noble, Inc.
SCALE .5

A Block Diagram Illustrating the Stratigraphy, Structure, and Physiography of the Grand Canyon Region in the United States.

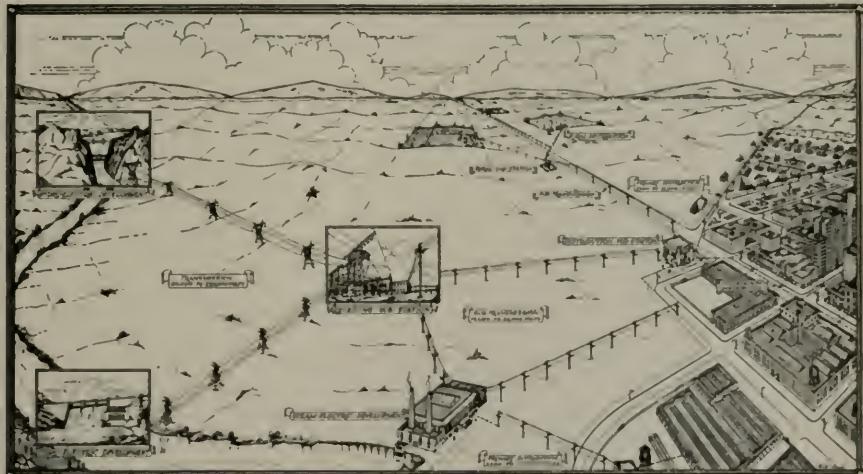


Sales Management, N. Y. C.

SCALE .4

A. A Relief Map Showing How the United States Would Look If Each State Were on a Level Proportionate to 1937 Federal Tax Collections.

1. The percentage of the total which each state contributes to the federal government is indicated on each state.
2. Such things as population density, sales density, and wealth density can be presented in this form.



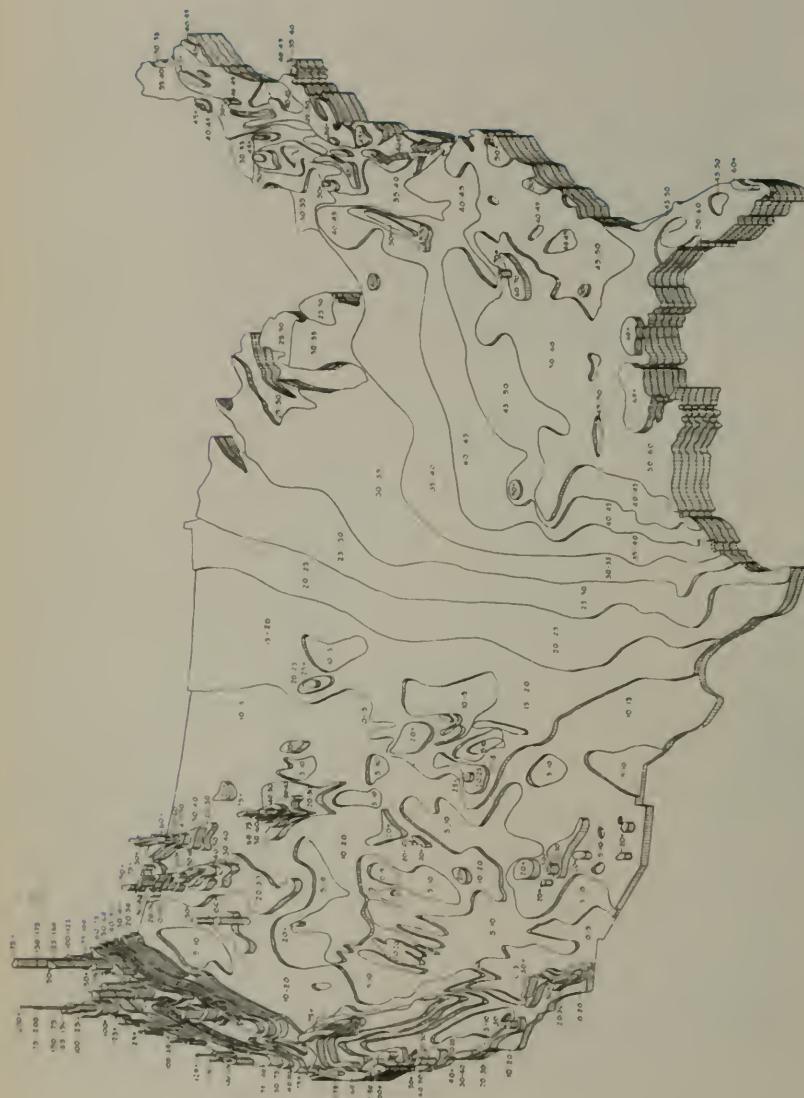
Federal Power Commission, National Power Survey, "Cost of Distribution of Electricity," 1936 SCALE .5

B. Essential Parts of a Complete Electric Power System.

1. In this diagram of the essential parts of a complete electric power system, a hypothetical land lay-out is used, since the important point is to include the information in the smallest possible space.
2. An attempt was made in this drawing to give the effect of a "bird's-eye view."

GRAPHIC PRESENTATION

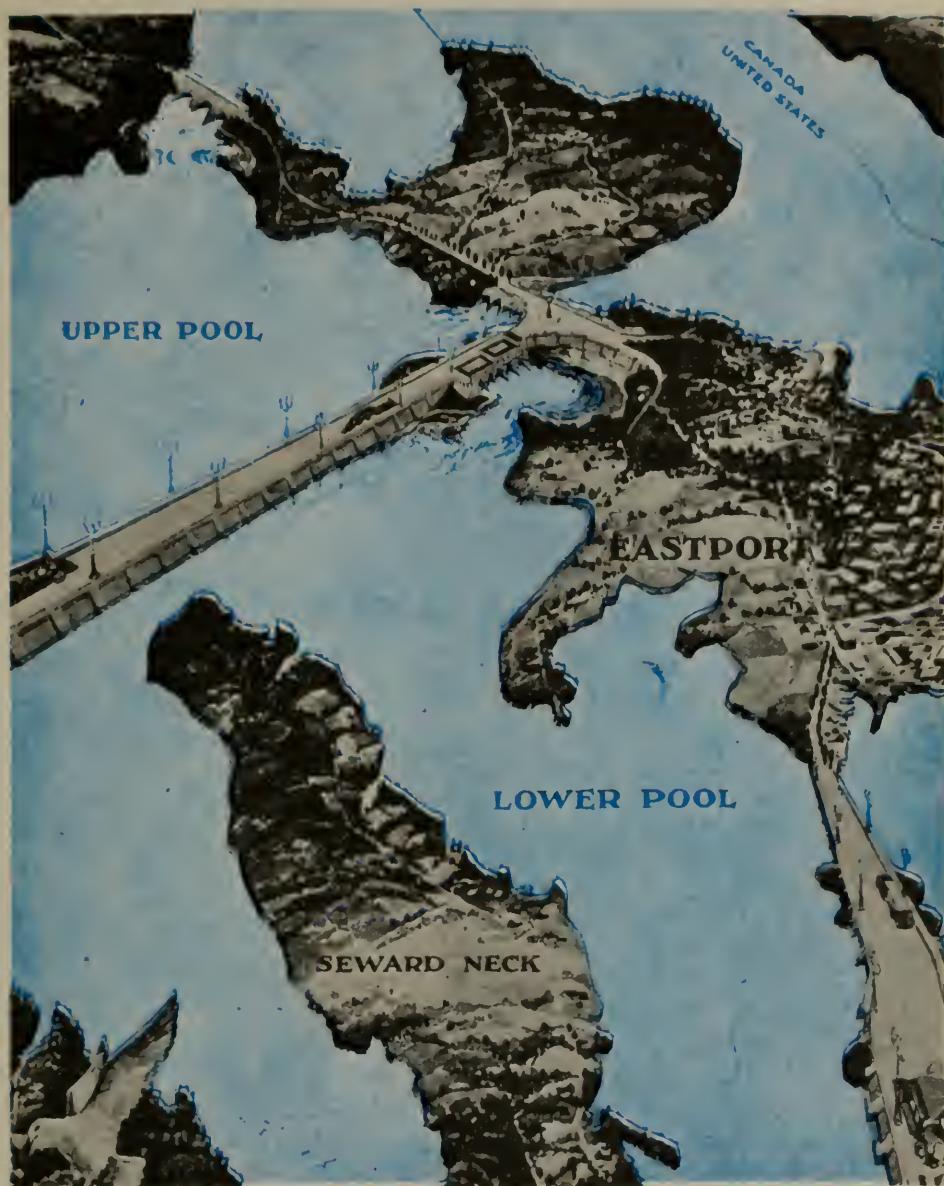
SCALE .5



National Resources Board, "Report of the Water Planning Committee, Part III," 1934.

Pictorial Representation of Depths of Mean Annual Precipitation in the United States.

The use of the principle of the relief map to illustrate things other than height of land levels is shown in this map.



National Resources Board, "State Planning," 1935.

SCALE .7

Bird's-Eye View of the Passamoquoddy Tidal Power Project in the State of Maine.

1. This is an example of a pictorial map suggesting contours and character of the region represented.
2. For popular presentation, this combines the qualities of the pictorial and relief types of map.

GRAPHIC PRESENTATION

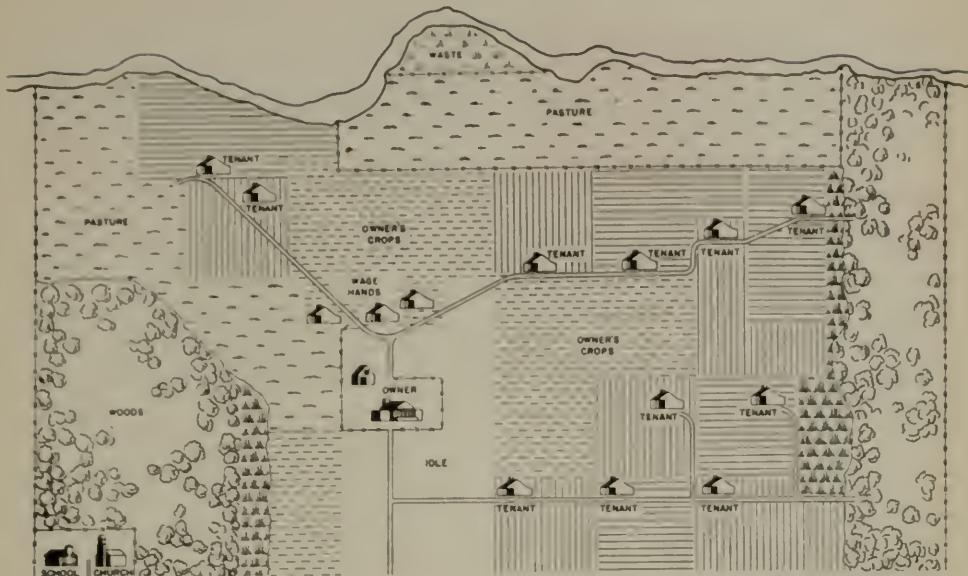


SCALE .7



SCALE .5

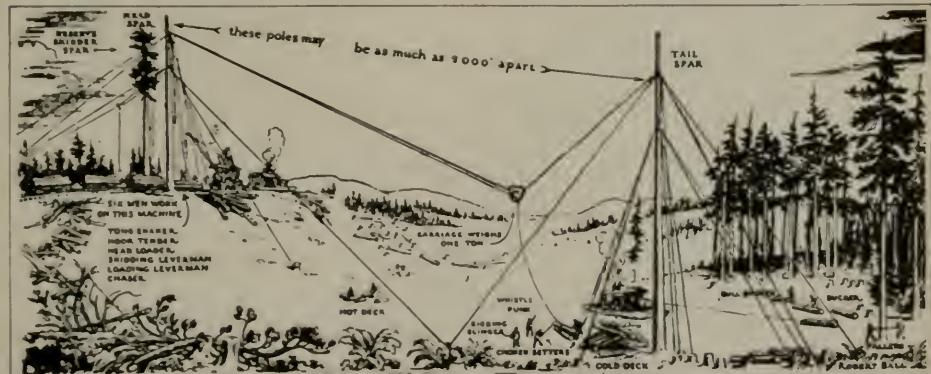
A Map Drawn on Azimuthal Projection with New York as the Central Point.



WPA, Division of Social Research, "Landlord and Tenant on the Cotton Plantation," 1936. SCALE .7

A. The Average Cotton Plantation in 1934.

Even the most elementary sketches are more effective than none at all. No attempt is made in this drawing to make it appear real, yet a clear idea of an average cotton plantation is obtained.



Reprinted by Permission of the Editors of "Fortune."

SCALE .6

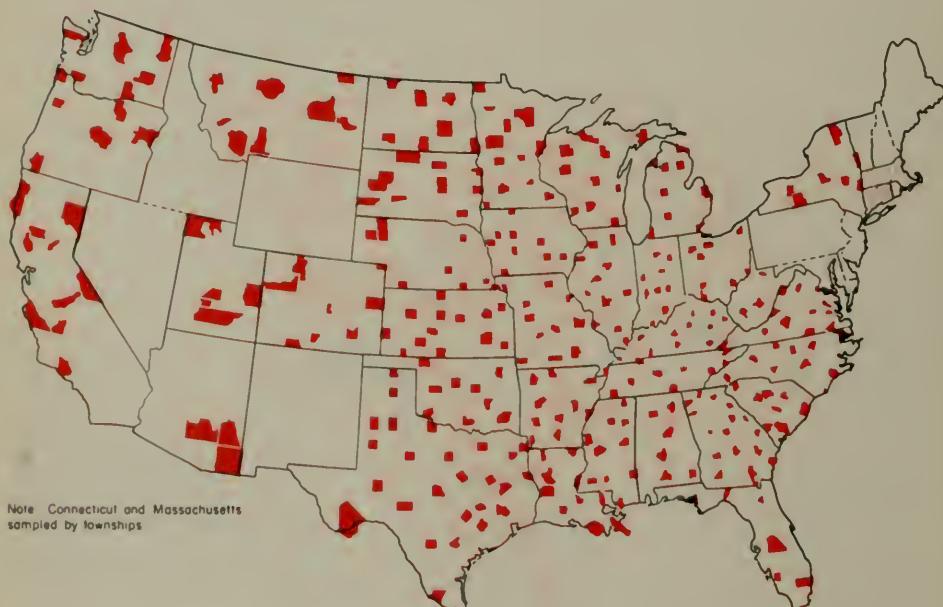
B. Diagram of Large Scale Logging Operations.

Here again the drawing is hypothetical. Compare with 173B.

Chapter 21

CROSSHATCHED AND COLORED MAPS

The variety of cross hatchings available and the use of several colors are great aids in making statistical maps. Cross hatched and colored maps are especially adaptable to the presentation of frequency distribution data. For suggestions relative to the use of gradations of cross hatchings and colors, see Chapter 44, "Suggestions for Making a Chart."



WPA, Division of Social Research, "Trends in Relief Expenditures," 1937.

SCALE .7

Distribution of 385 Sample Counties and Townships Represented in the Rural-Town Relief Study in the United States.

This map accompanied a very extensive study on rural-town relief. The validity of the conclusions drawn from that study may depend upon its method of sampling.

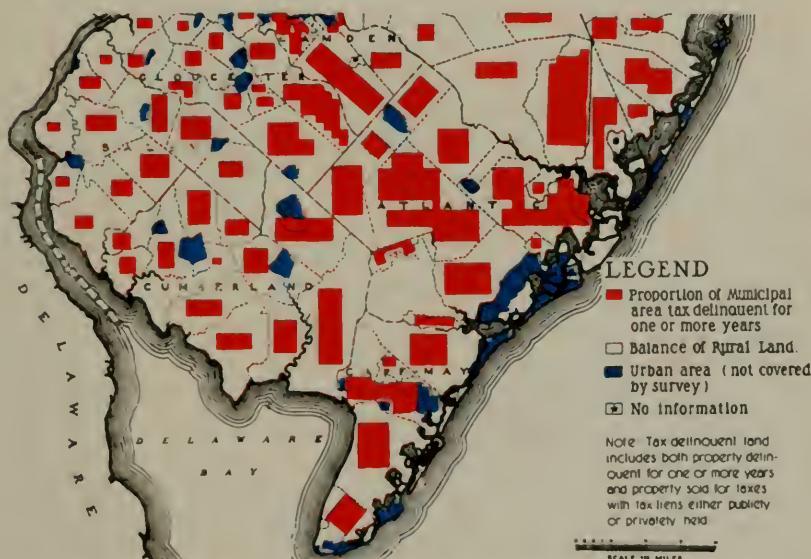


Courtesy of The First National Bank of Boston, Mass., August 1938.

SCALE .8

A. Federal Expenditures for 1929 and 1937 Represented as Income of Two-Thirds of the Population of California and as Income of Thirteen States, Respectively.

1. Although federal expenditures have increased vastly since 1929, the presentation of that information in this form distorts the facts.
2. The basis for coloring the states was according to the income of the population of those states. Since the income in the United States is not distributed uniformly throughout the United States, an area comparison is not valid.
3. This would be a true presentation of facts only if the area of each of the states were in uniform proportion to its wealth.



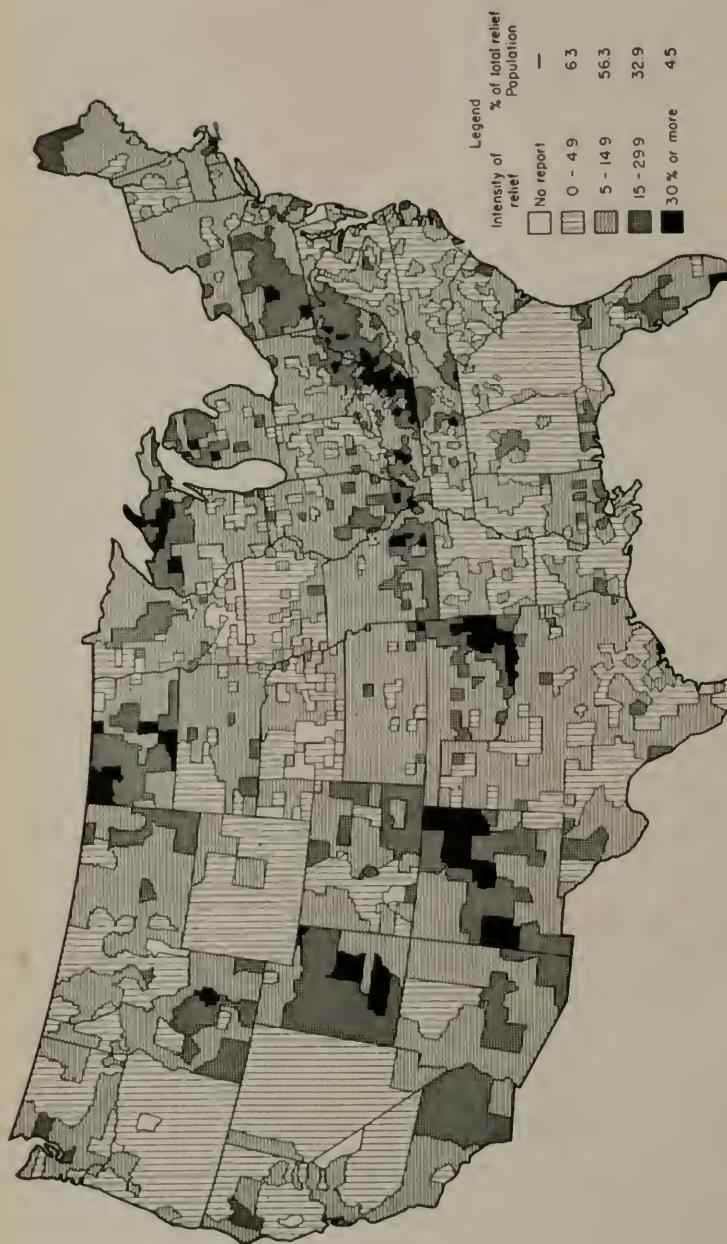
New Jersey State Planning Board, "Rural Tax Delinquency in New Jersey," 1938.

SCALE .6

B. Tax Delinquent Rural Land in a Section of New Jersey as of January, 1936.

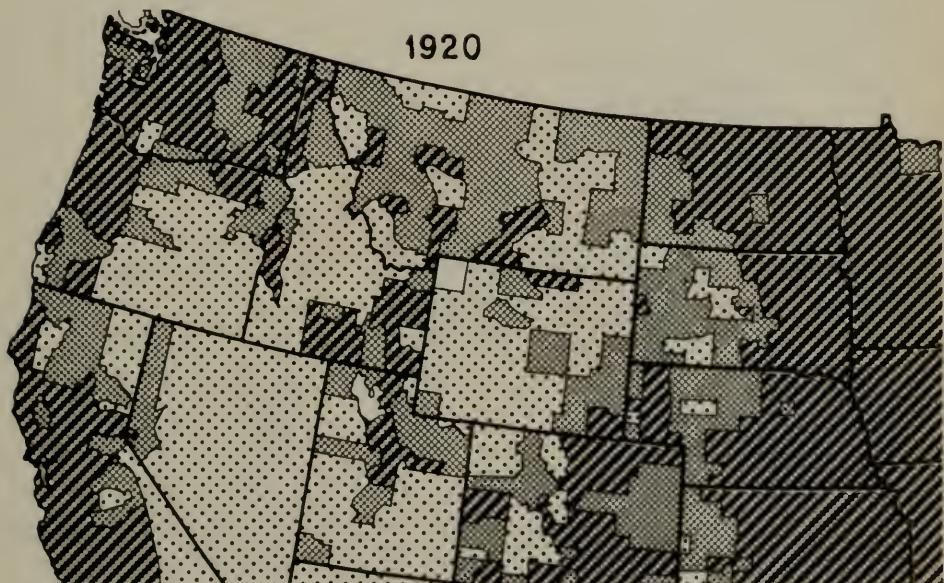
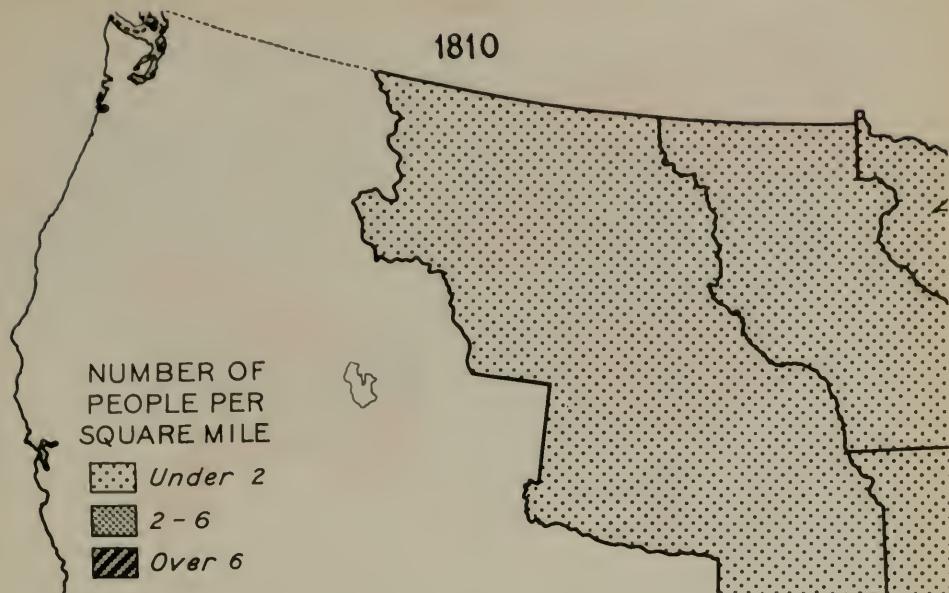
1. There are many kinds and types of cross hatchings and shadings. In this map, three very simple types are used.
2. In choosing shadings be sure they are distinctive.

GRAPHIC PRESENTATION



WPA, Division of Social Research, "Rural Youth on Relief," 1937.
**Intensity of Relief in the United States Showing the Ratio of Persons Receiving Relief in October 1935 to Total Population
 April 1930, by Counties.**

When frequency distribution or density facts are presented on a shaded map, it is important that the gradations of the shadings should be arranged according to degrees of darkness. See 422A.

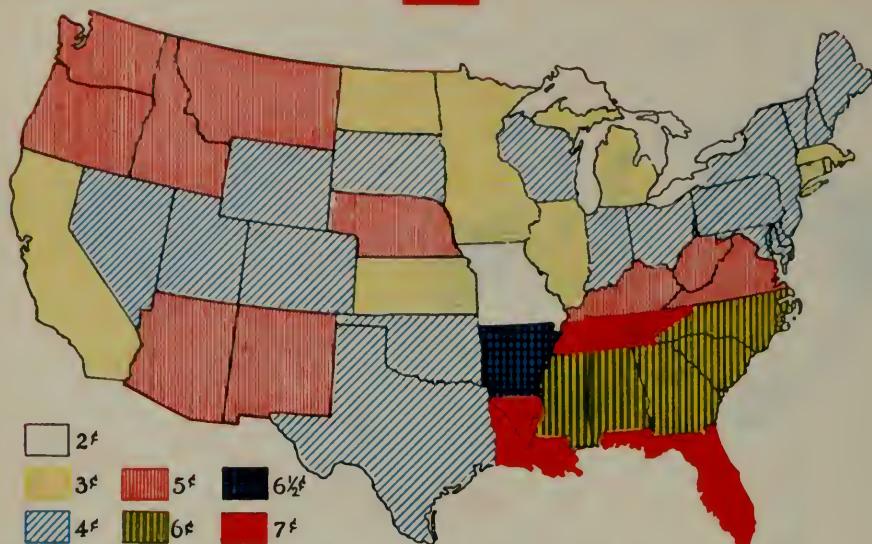


U. S. Department of Agriculture, Bureau of Agricultural Economics.

Population of a Section of the United States in 1810 and 1920.

1. A comparison of these two maps shows at a glance the sections in which the greatest growth of population had taken place in a period of 110 years.
2. In view of the 1920 map, see 179A.

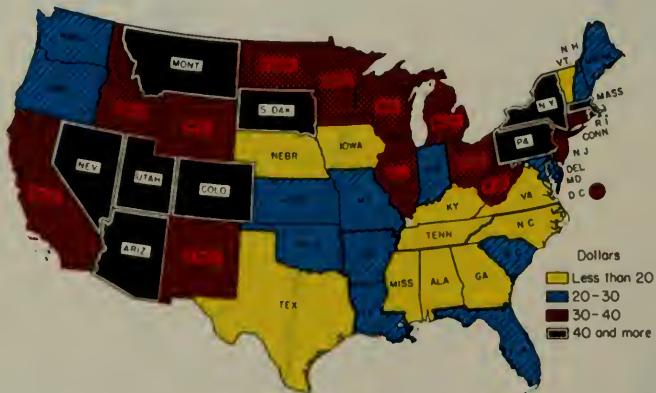
GRAPHIC PRESENTATION



National Association of Motor Bus Operators, Washington, D. C., "Bus Facts for 1938."

A. Rates of Gasoline Tax Per Gallon in the Various States as of January 1, 1938.

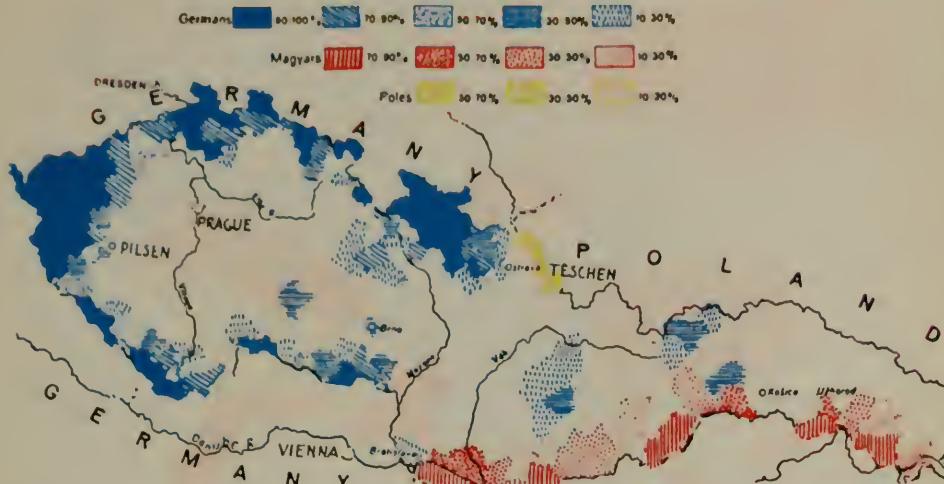
Compare this method of presenting gasoline tax information with the method used in 195A.



WPA, Division of Social Research, "Landlord and Tenant on the Cotton Plantation," 1936.

B. Per Capita Amount of Obligation Incurred by Each of the States for Emergency Relief for Thirty-three Months—January 1933 to September 1935.

1. The appearance of this map indicates that it was made on a "mechanical" intensity shading map, a device developed by the graphics section of the Works Progress Administration. "State pieces" of the desired shading are placed in "state compartments" of an aluminum base map of the United States. These state pieces are interchangeable, and there are six sets of shadings from which to choose.
2. The time required to prepare such a density map, photographing included, is about one hour, compared with eight hours if the shading had been done by a draftsman.

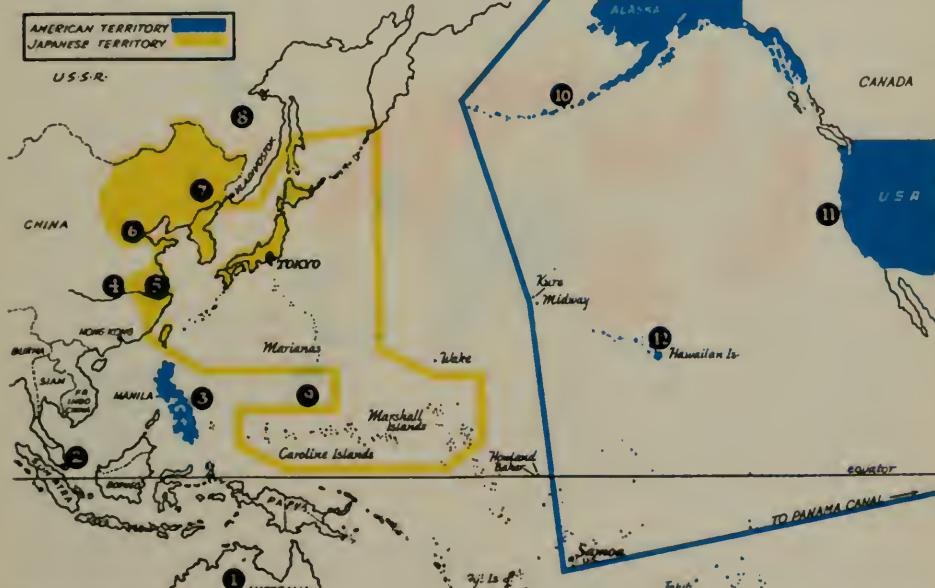


New York Herald Tribune, September 20, 1938.

SCALE .7

A. Racial Minorities in Western Czechoslovakia in 1938.

The variety of shadings given in this map is particularly interesting, as well as the arrangement of the legend.



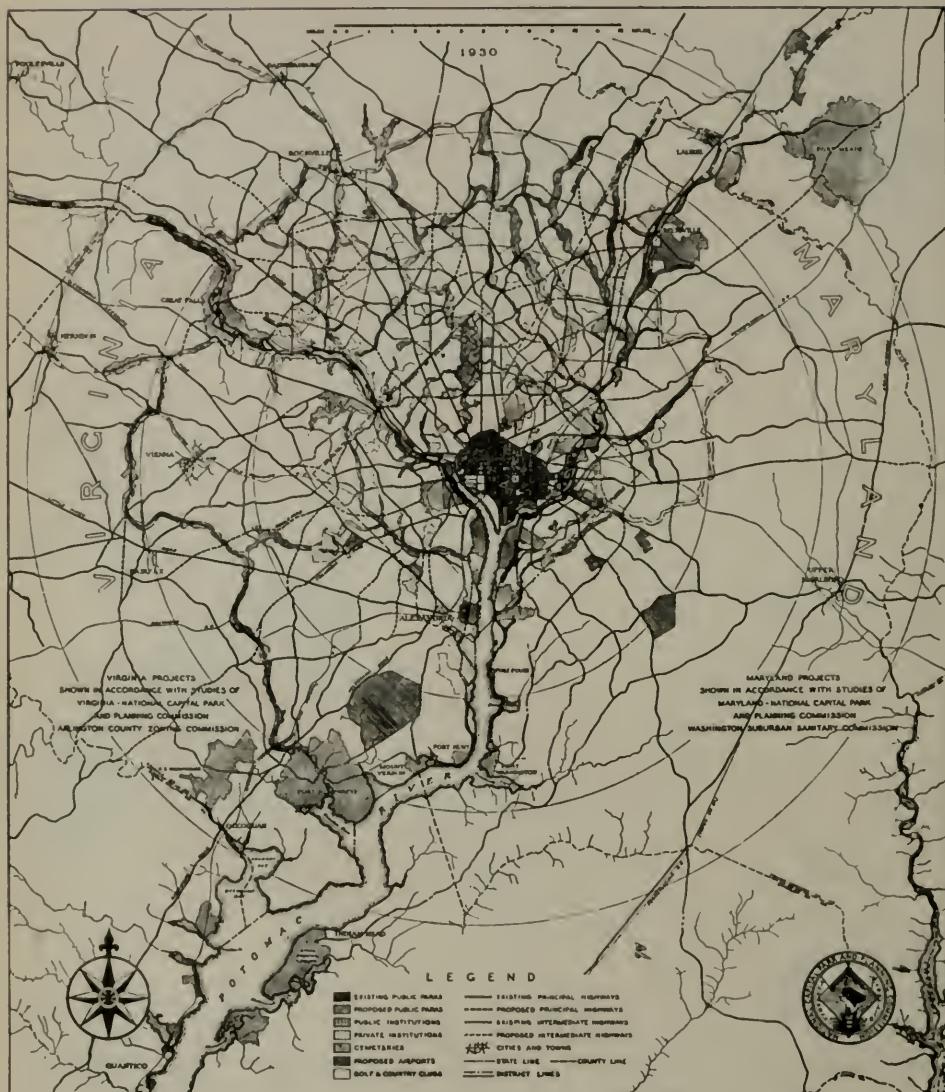
The Seattle Star, March 4, 1938.

SCALE .6

B. The Division of the Pacific.

This chart shows a good device in enclosing within black and shaded lines the minutely visible territorial possessions of the United States and Japan respectively.

GRAPHIC PRESENTATION

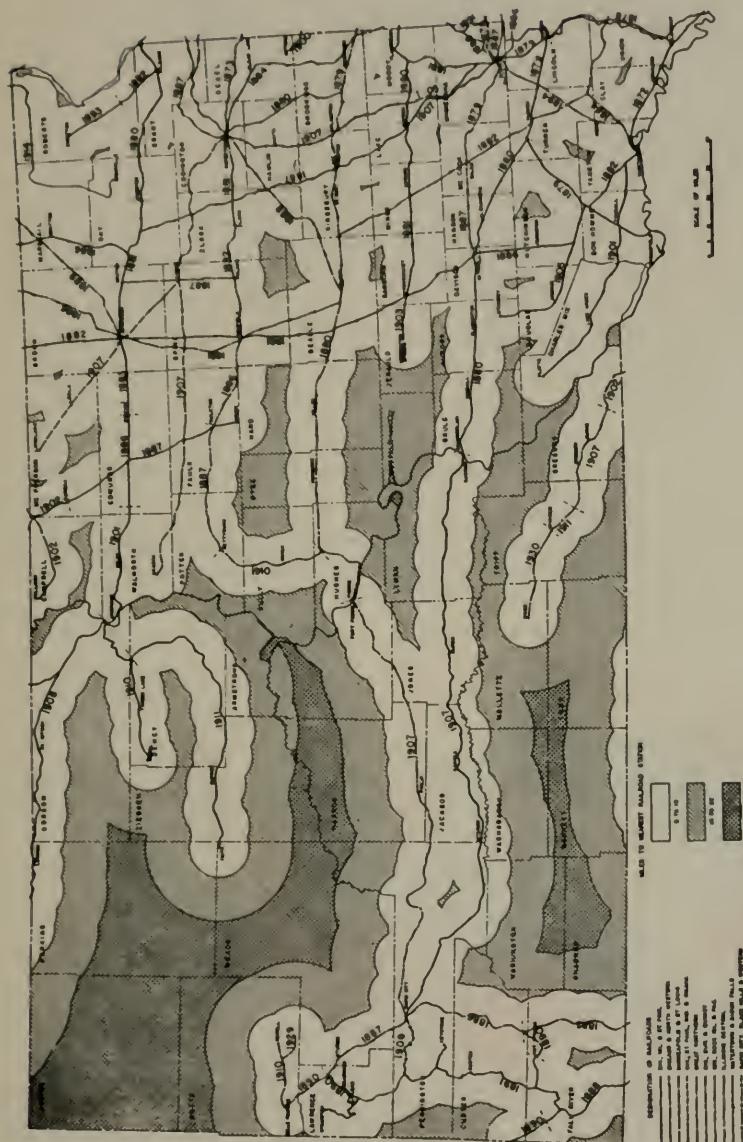


National Resources Board, "State Planning," 1935.

SCALE .7

Regional Plan for Washington, D.C., and Its Environs.

As a plan for Washington, D.C., and the surrounding country, this map necessarily includes a great deal of information. Its value here lies not as a map for study, but rather as an example of what can be done on a map in the way of regional planning.

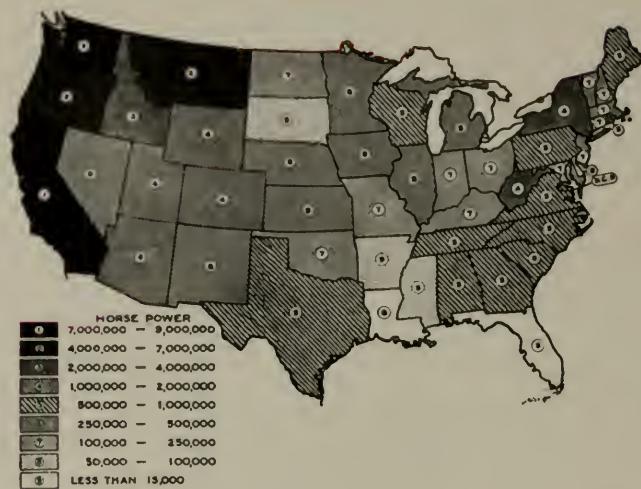


National Resources Board, "State Planning," 1935.

Railroads and Railroad Stations in South Dakota.

1. When crosshatchings are used to designate the number of miles to the nearest railroad station, the sections best served and the sections least served by the railroads are easily determined.
2. Note that in this chart density of shading does not denote density of service. This is a case where the increasing numerical quantities in the key actually denote more meagre service.

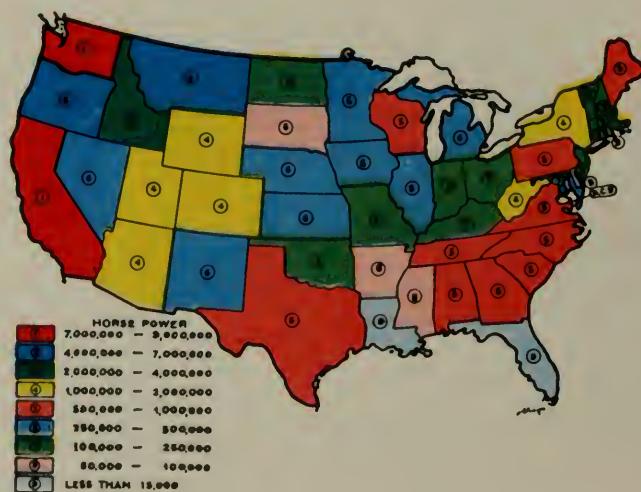
SCALE 6



SCALE .7

Brinton, "Graphic Methods," McGraw-Hill Book Co., Inc., New York City, 1914.

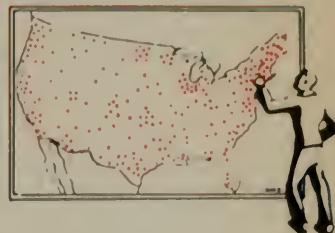
1. This is an example of the contrasts in shading made possible by the Ben Day mechanical processes of engraving. Nine contrasting shades increasing in darkness are used here with absolute distinctness. The small numbers in the circles are used to identify the shadings.
2. The illustration below presents the same information in color.



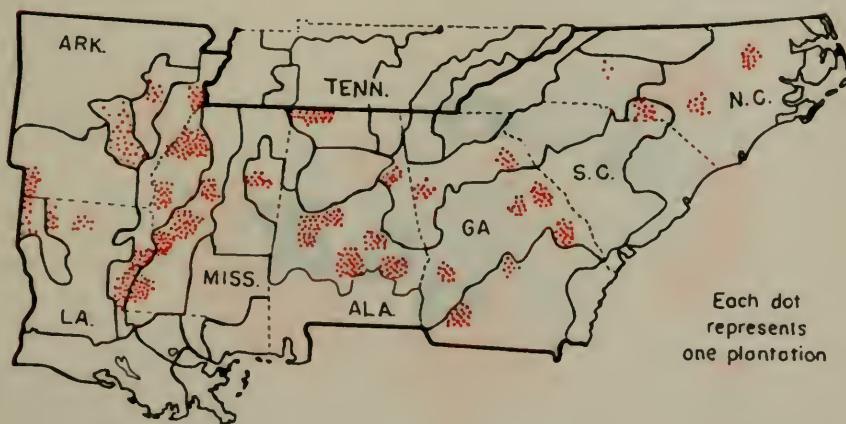
Potential Water Power in the Different States of the United States, as Estimated in 1914.

Chapter 22

DOT AND PIN MAPS



One well known use of dot and pin maps is to present geographic distribution data. In this form, the dots or pins represent numerical values and effectively show geographic location. The placing of the dots is an important item. If the exact geographic distribution of the data is known, the placing of the dots is no problem. However, when the data is in the form of general geographic distribution, such as data for an entire state, the dots are distributed throughout the whole state although one section may have contributed the total amount.

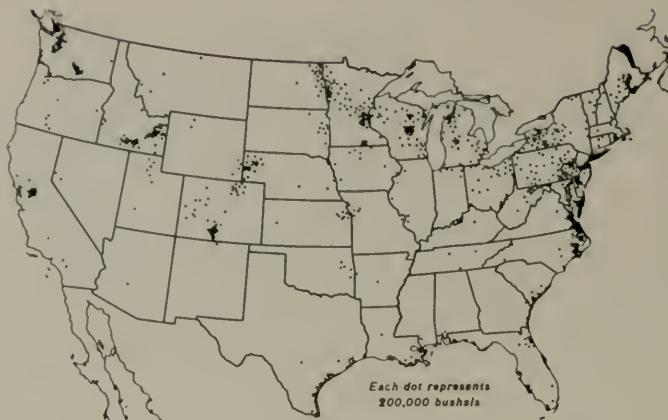


WPA, Division of Social Research, "Landlord and Tenant on the Cotton Plantation," 1936.

Distribution of the Plantations Which Were Enumerated in the Study of the Cotton Plantation Made by the Works Progress Administration.

When the number of samples is small, the location of each may be shown on a map as was done here. Compare with 178.

GRAPHIC PRESENTATION



WPA, National Research Project, "Changes in Technology and Labor Requirements in Crop Production—
Potatoes," 1938.

SCALE .8

A. Potatoes Produced for Sale in the United States in 1929.

1. In a dot map it is important to know whether the dot has been placed in its exact geographical position or whether the dots are distributed within a county or state irrespective of the exact location.
2. In this case, there is little doubt but that the dots were placed where the potatoes were produced.



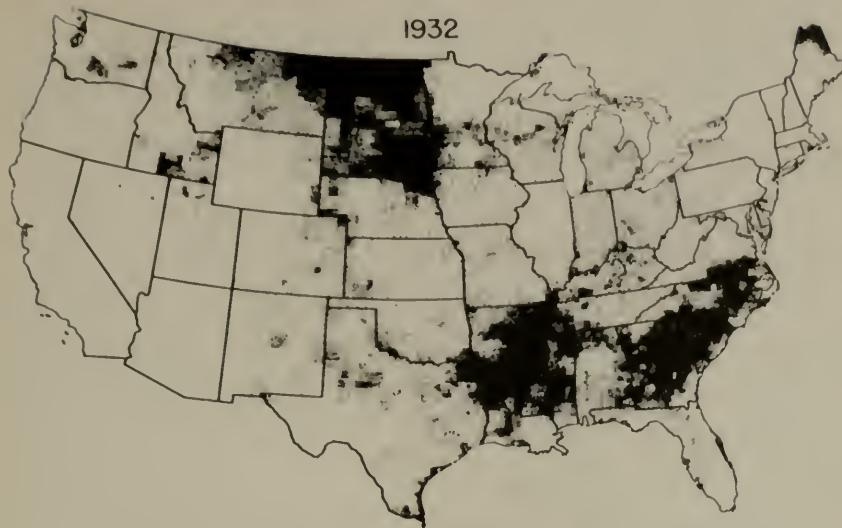
WPA, Division of Social Research, "Rural Youth on Relief," 1937.

SCALE .8

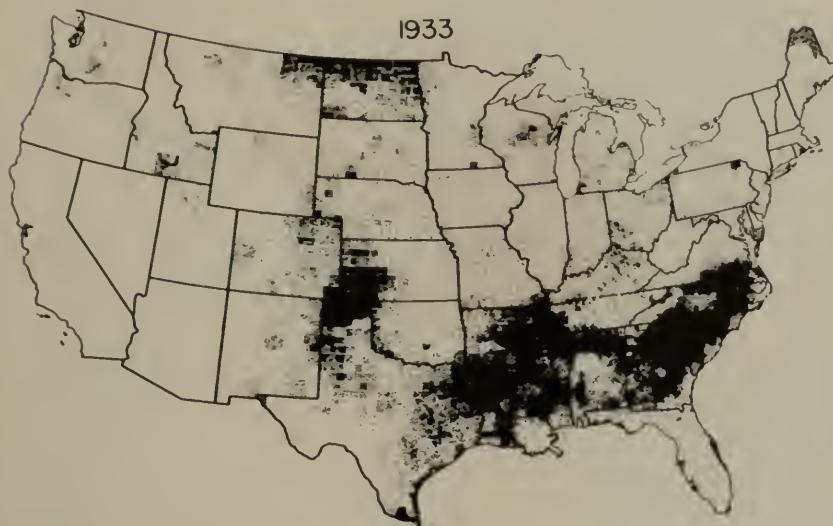
B. Rural Rehabilitation Cases Receiving Advances of Capital or Goods in the United States in 1935.

1. Note the square of dots in the state of South Dakota, as well as in other states. This indicates that the distribution of the dots was by counties; that is, statistics for each county were secured and the dots were distributed in each county irrespective of the exact geographical location.
2. Compare with A above.

DOT AND PIN MAPS



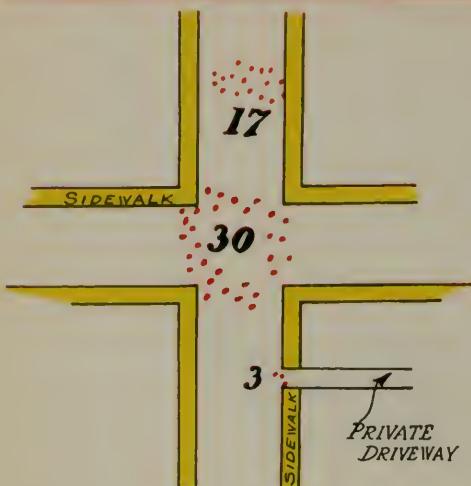
Each dot represents \$1,000 or fraction thereof



WPA, Division of Social Research, "Landlord and Tenant on the Cotton Plantation," 1936.

Amount of Emergency Crop and Feed Loans Extended by the Farm Credit Administration, by Counties in the United States in 1932 and 1933.

1. The distribution of the dots in this chart is definitely by counties.
2. The shift from the Dakotas in the one year period is quite pronounced.



**National Automobile Chamber of Commerce,
1927.** **SCALE .7**

A. Graphic Distribution of Position at the Time of the Accident of 50 Pedestrians Who Were Hit by Automobiles in Hartford, Connecticut, During the First Six Months of 1927.

This chart should be read as follows: in Hartford, Connecticut, during the first six months of 1927, 30 persons were hit by automobiles at street intersections, 17 were hit while crossing the street in the middle of the block, and 3 were hit by cars coming out of private driveways.

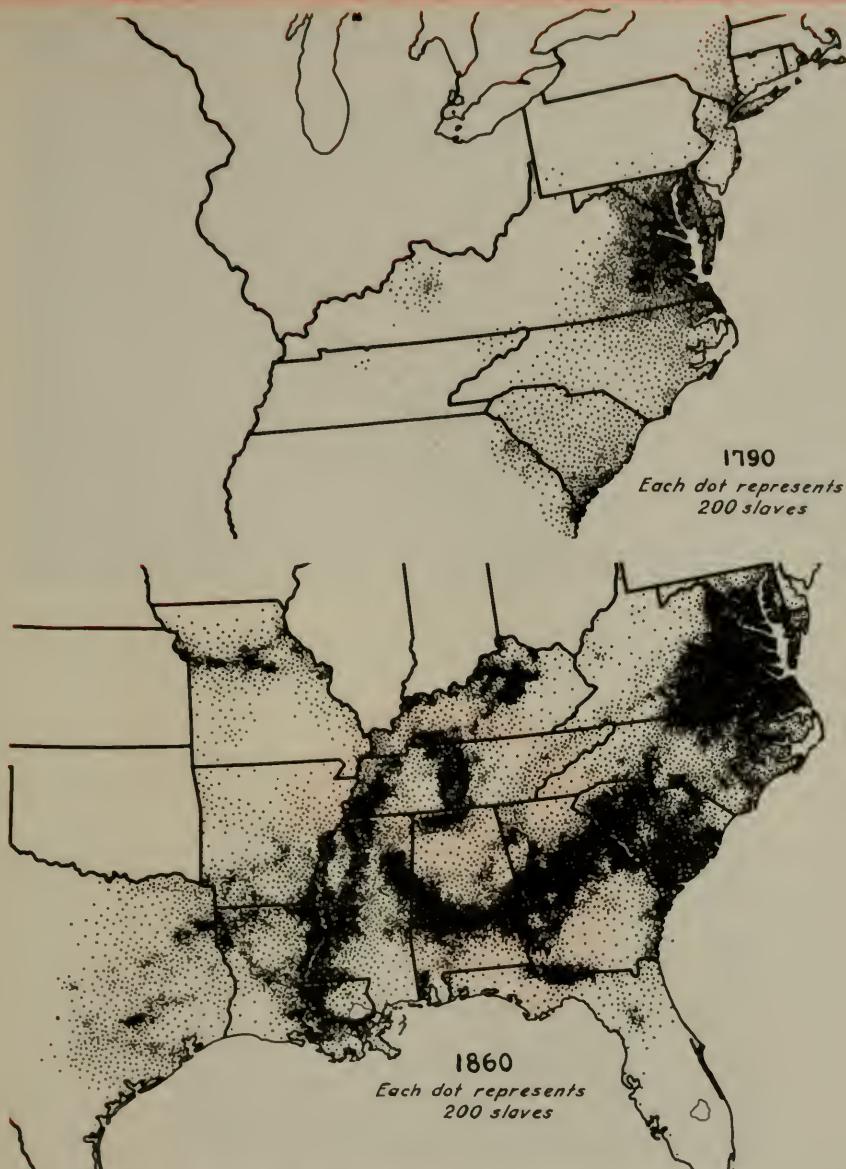


Toronto Industrial Commission, "Canada's National Market," 1938.

SCALE .6

B. Concentration of Buying Power of Canada's National Market Within a Radius of 100 Miles of Toronto.

1. Although no key accompanied this chart, according to another map in the same pamphlet, the dots represent population. The numerical value of each dot was not given.
 2. The important feature about this map is the use of color to emphasize the circle around Toronto.



U. S. Department of Agriculture, Bureau of Agricultural Economics.

SCALE 1:8

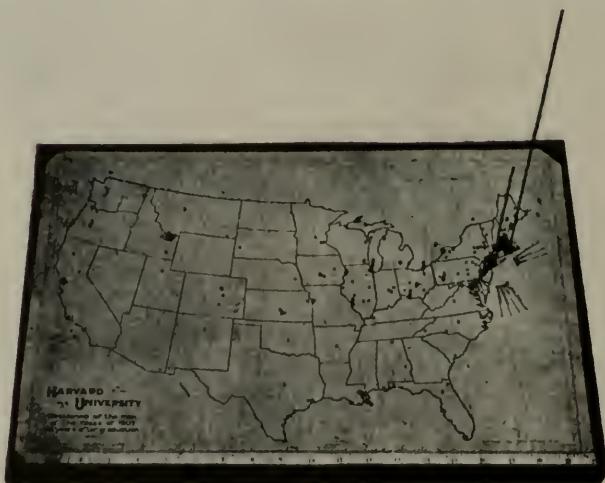
Number of Slaves in the United States in 1790 and in 1860.

1. These two maps are the first and last of a group of six. Space does not allow all six to be shown here.
2. The use of these two maps in a history lesson would clarify and simplify the slave problem of 1860. This material in tabulated or verbal form would be formidable.
3. Only a section of each map is reproduced here.



Bell Telephone Laboratories, Inc., New York City.

A. Exhibit of the Bell System at the New York World's Fair, 1939.



Brinton, "Graphic Methods," McGraw-Hill, 1914.

B. Residence of the Men of the Class of 1907, Harvard University, Six Years After Graduation. The Bead Wire for Boston Includes All Men Living Within Twenty-five miles of the City Hall.

1. Rather than have a pin for each individual stuck in the map around the city in which he lived, a bead was put on a wire for each person in the same city.
2. Every tenth bead on a wire is white to aid in counting the beads.

DOT AND PIN MAPS



Series 500



Series 600



Series 5400



Series 5000



Series 5000 Special Markings

The Most Common Size used is this spherical head pin.

For Congested Maps or charts and holding territory or route card in place use this pin

Glass Spot Pin The spot or "Ring Pin" is fused in the head of the pin. It cannot come off.

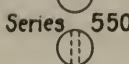
Enamel Spots can be furnished as a DIABH or CROSS if desired.



Oil Well Pin. Shape resembles oil well derrick. Can be supplied with two-colored head



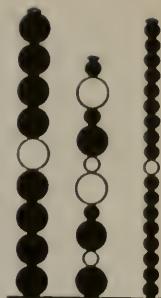
Series 4500



Series 550



Series 650



A. B. C.



Series 6300



Series 6100



Series 6400



Series 6200

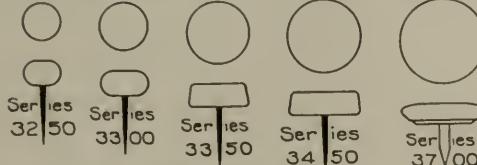
Tetangular or Square Head pins are used where the 16 colors do not furnish sufficient variety. They also help color-blind users. These pins show distinctive shapes when photographed whereas some colors photograph the same.

Pins and Beads

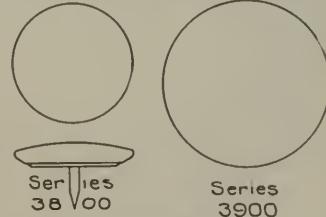
	Beads
Red	Machine No. 1
Green	Machine No. 2
Yellow	Machine No. 3

	Plns
Red	Consumer
Green	Retailer
Blue	Jobber

A red pin and a red bead mean that a No. 1 machine was sold to a customer, etc. Where several customers are in one town or city building, alternate large and small heads are piled on a long pin. See illustration (B).



Glass Head Pins



Series 3900

Celluloid Tacks

Pins and Tacks with Writing Surface. Rough surface glass head pins and rough surface celluloid tacks are convenient because you can write data on them with pencil or with India Ink. Pencil can be erased with ordinary erasers and ink washed off with water and a little soap, so that pins can be used again and again.

Educational Exhibition Co., Providence, Rhode Island.

Map Marking Devices.

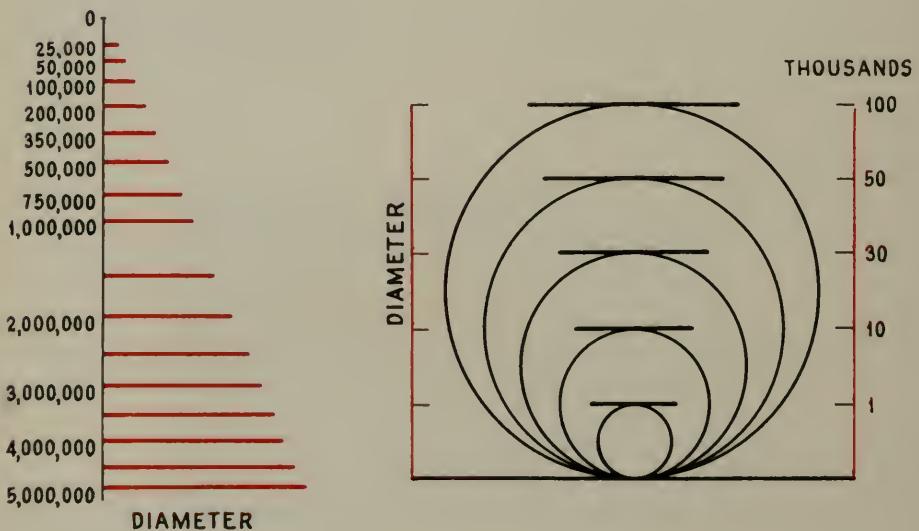
1. A very effective method of using beads is to string them either on a long pin or on a drill rod of small diameter, and then place them upright on a map. See 192B. In selecting drill rods, the largest size that will go through the hole of the bead should be chosen. Beads for this purpose may be obtained at any variety store.
2. Beads on pins have been used very effectively on a map showing intended civic improvements. Red beads indicated assessed valuations on buildings, while green represented assessed valuations on land. Each bead represented a certain number of dollars and each pin represented an individual property. The wide adaptability of this material is evident.

Chapter 23

MAPS WITH CIRCLES AND SECTOR CHARTS

THE chief advantage of placing circles and sector charts on maps is that the geographic location of the information is given. The general rules for sector charts in Chapter 9 may be followed here also.

1. A white line separating overlapping circles prevents any confusion.
2. Actual amounts and percentages for each geographic division should be given.



Two Methods of Making a Scale to Indicate What the Area of a Circle Represents by Measuring Its Diameter.

Since it is difficult to determine the relative areas of circles, a very clear and concise scale should be given. The two methods above give the measurement of the diameters which would correspond to given area representations.

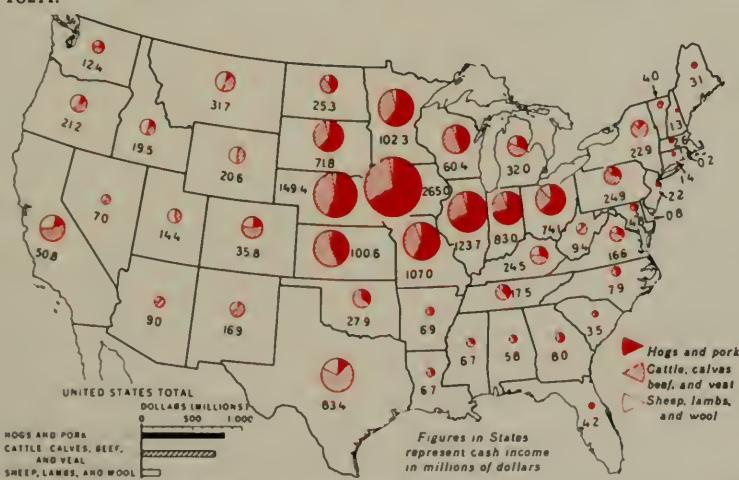


American Petroleum Institute, N. Y. C., "Petroleum Facts and Figures," 1937.

SCALE .7

A. Gasoline Tax Rates in the United States as of November 1, 1937.

Compare this as a method of presenting gasoline tax information with the method shown in 182A.

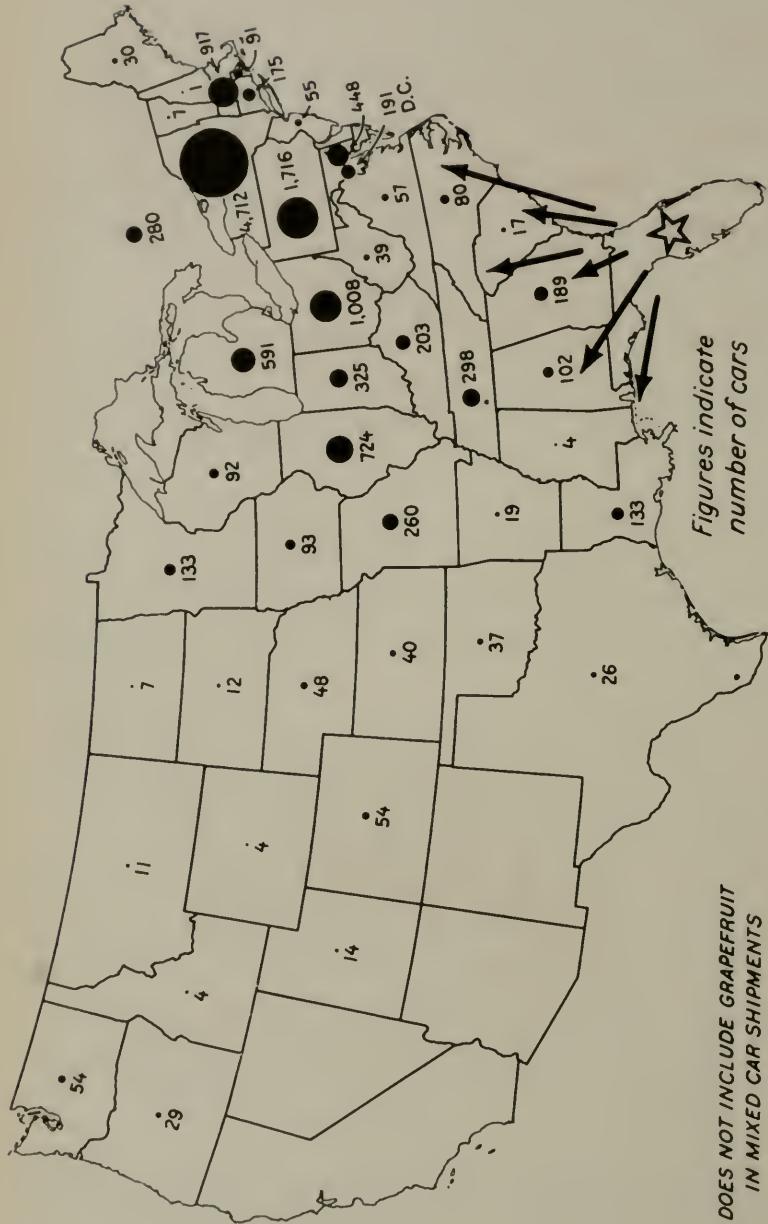


U. S. Department of Agriculture, Bureau of Agricultural Economics.

SCALE .5

B. The Average Cash Income Received from Meat Animals, Meat, and Wool Sold by Farmers in the United States in the Period from 1929 to 1933.

Two sets of data are presented on this map. The percentage comparison of the sectors shows the distribution of cash income among the three categories at the lower left. The areas of the circles show the amount of cash income.



U. S. Department of Agriculture, Bureau of Agricultural Economics

Distribution by States of 13,330 Car-loads and Boat Shipments of Florida Grapesfruit for the 1932-33 Season.

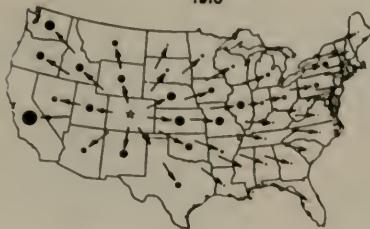
The inclusion of figures in addition to the circles is very helpful when area comparisons are made. Note that there is only one symbol and one amount for both car-lot and boat shipments.

MAPS WITH CIRCLES AND SECTOR CHARTS

197

Migration From State

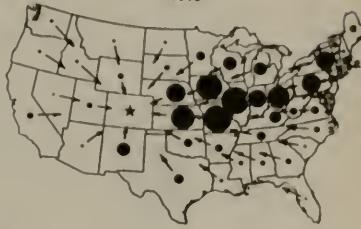
1910



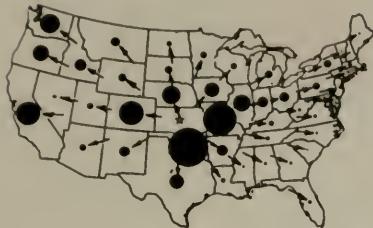
COLORADO

Migration To State

1910



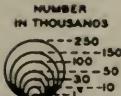
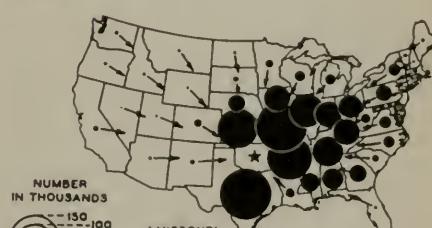
KANSAS



NEW MEXICO



OKLAHOMA

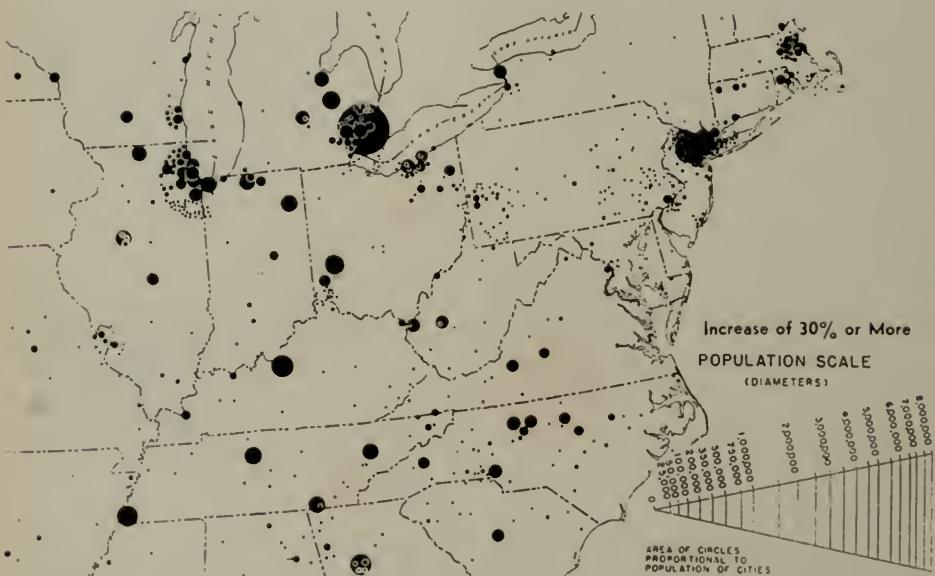


1 MISSOURI
2 ARKANSAS

WPA, Division of Social Research, "The People of the Drought States," March 1937.

Study of Migration To and From Four Drought States, Based on Place of Residence in 1910.

1. The four maps on the left show the states to which native white migrants have gone, and the four maps on the right show the states from which residents of the four states in 1910 have come.
2. Although a general idea of the amount of migration to and from these four states is obtained by glancing at the maps, to secure the actual amount would be quite a task.

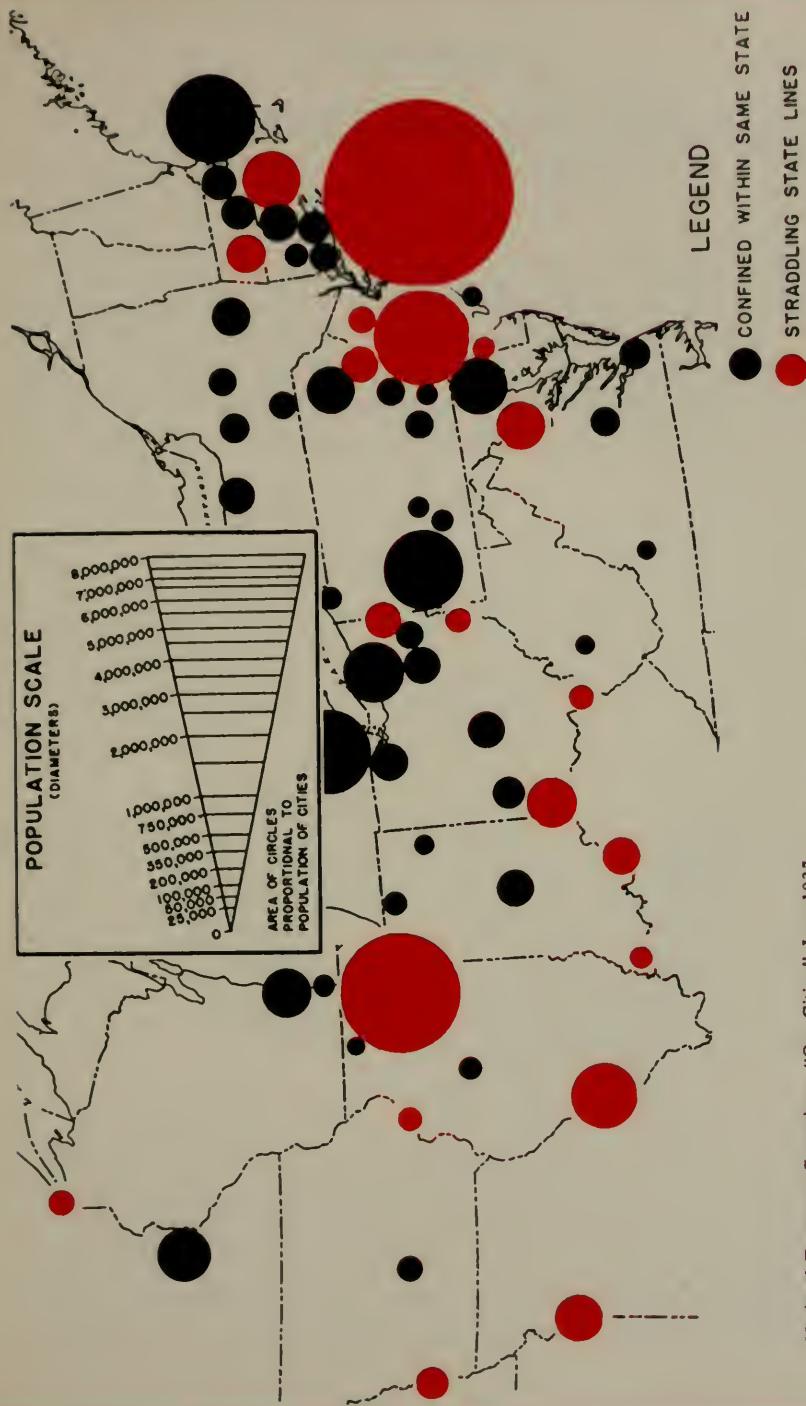


National Resources Committee, "Our Cities," June 1937.

SCALE .7

Urban Places in the United States Which Have Had an Increase of 0 to 30% and of 30% or More in Population from 1920-1930.

A section only of the original map is shown to illustrate the method of putting a white border around black circles which necessarily fall on top of each other.



National Resources Committee, "Our Cities," June 1937.

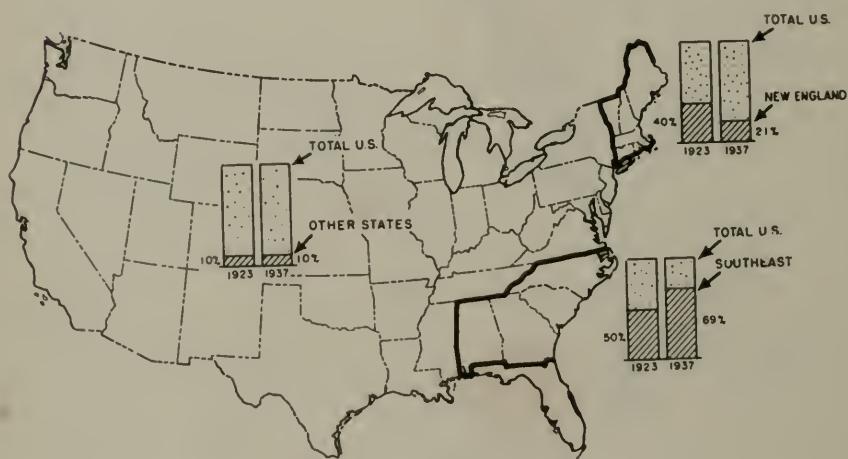
Metropolitan Districts in the United States, Using 1930 Census Figures.

- In the original of this map, the entire United States was given. It was impossible to reproduce the whole map here without reducing it so much that all detail would be lost.
- Compare this method of indicating the area of the circles with 194.

Chapter 24

MAPS WITH BAR CHARTS

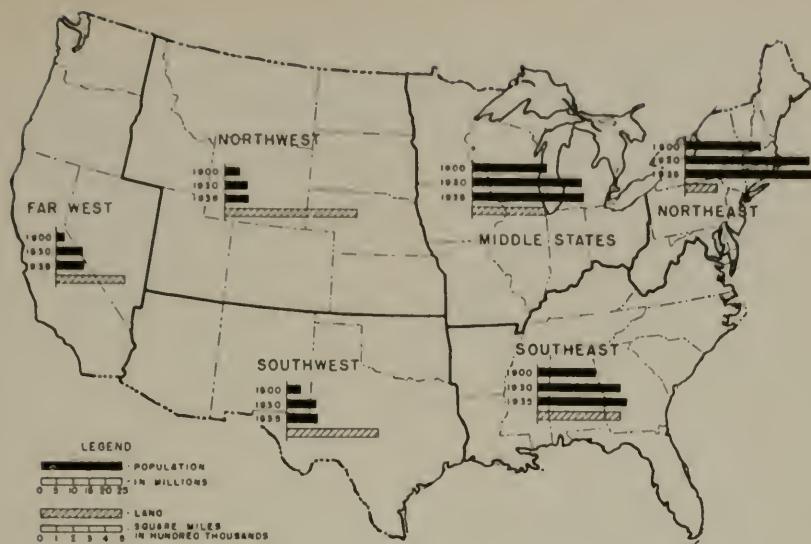
Bars superimposed on a map allow a great many comparisons not possible with one cross hatched map. Time-series bars may be placed on a map. A comparison of several items rather than the presentation of just one item may be obtained. The practices commended in the chapters on bar charts, pages 92-152, should be adhered to when bars are placed on a map.



"The Federal Chart Book," Prepared by the Central Statistical Board and National Resources Committee,
January 1938. SCALE .7

Geographical Shift in Cotton Manufacturing in the United States from 1923 to 1937.

1. Bar charts may be used as effectively as sector charts in presenting information for geographical divisions.
2. Note the method of outlining in black the section of the United States to which specific groups of bars refer.
3. See 93 A 4.



"The Federal Chart Book," Prepared by the Central Statistical Board and National Resources Committee, January 1938. SCALE .7

- A. Population and Area of the United States by Regions in 1900, 1930, and 1935.
- When the United States is divided in this way, the horizontal bars seem to fit into the spaces very well.
 - See 93 A 4.



GRAPHIC PRESENTATION

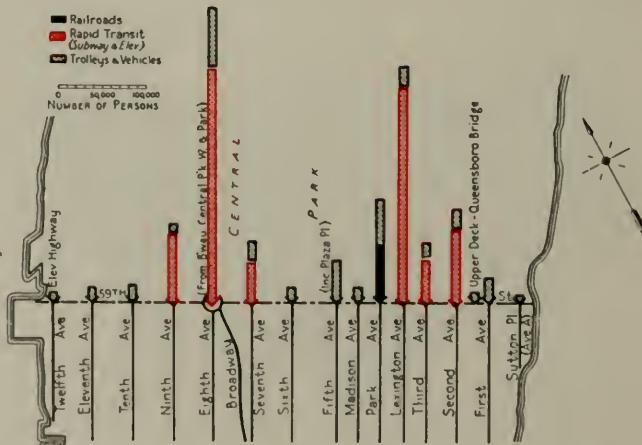


U. S. Department of Agriculture, Bureau of Agricultural Economics.

SCALE .4

A. Average Sales Per Farm Through Cooperative Associations for Each of the United States in 1919, 1924, and 1929.

1. While this same material could be presented in a series of groupings with a common horizontal base, superimposing the bars upon a map not only condenses the material but also gives the geographical distribution.
2. Note the use of arrows to connect the bars with the states. Compare with 201B.

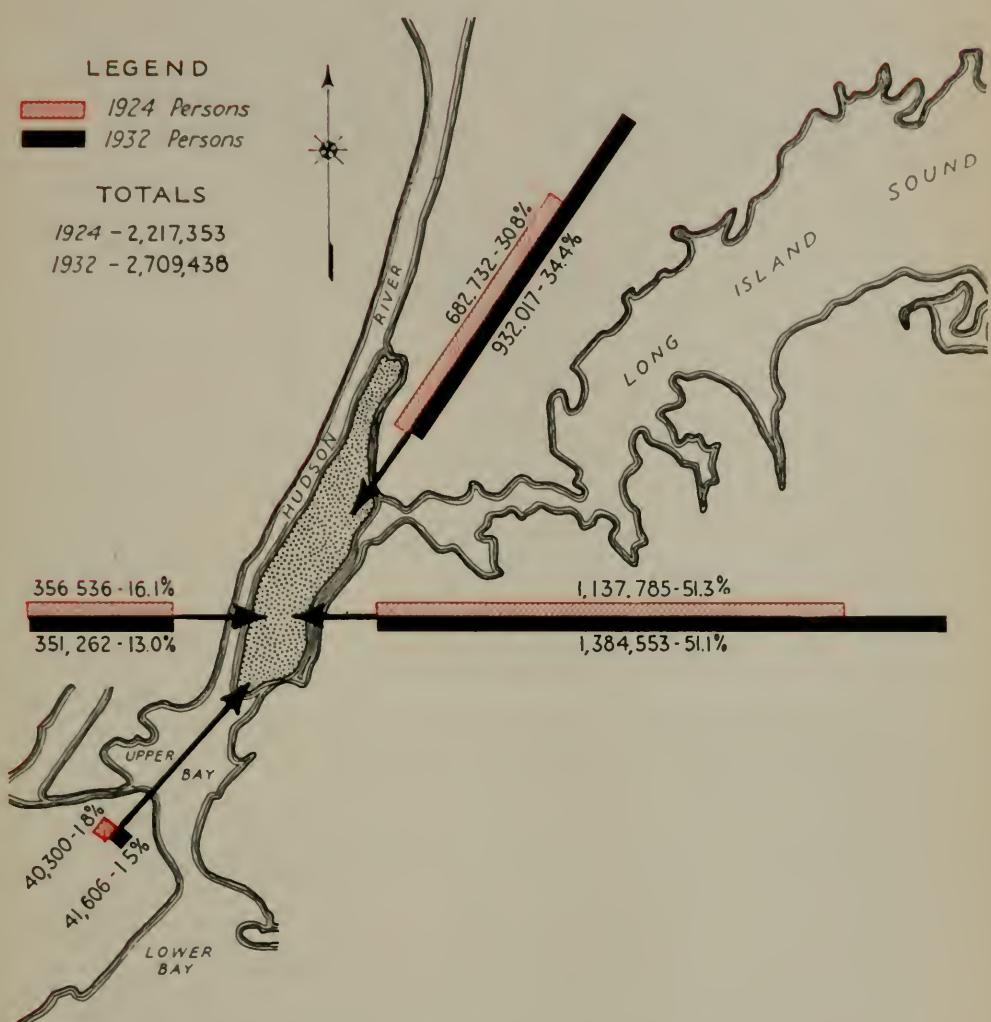


Regional Plan Association, Inc., N. Y. C., "Information Bulletin No. 11," Jan. 30, 1933.

SCALE .6

B. The Number of Persons Crossing 59th Street South Bound in New York City, by Railroads, Rapid Transit, Trolleys, and Vehicles for a Typical Business Day in 1932—(24-hour Period).

A traffic study of a particular street is perhaps best presented in this way rather than as a flow map with the width of the lines proportional to the traffic.



Regional Plan Association, Inc., N. Y. C., "Information Bulletin No. 11," Jan. 30, 1933.

Number of Persons Entering the Borough of Manhattan, New York City, During 24 Hours on a Typical Business Day in 1932 and in 1924.

1. The inclusion of numerical values and percentages in this map is particularly good.
2. Compare with 227.

GRAPHIC PRESENTATION

EXPLANATION OF MILITARY HISTORY SERIES

British and British-Colonial forces in Colonial Wars; United States forces in Revolutionary, 1812, and Mexican Wars; Texans in Texan Campaigns; and Federals in Civil War.

French and Spanish forces in Colonial Wars; British in Revolutionary and 1812 Wars; Mexicans in Mexican War and Texas Campaigns; Confederates in Civil War.

X	Battle	X
X	Drawn Battle	X
•	Point occupied	•
◦	Point occupied and later abandoned	◦
○	Point taken against resistance	○
✗	Unsuccessful siege	✗
◎	Point taken after siege	◎
↑↓	Blockade	↑↓
H Q	Headquarters	H Q
W Q	Winter quarters	W Q
S	Surrender	S
E	Evacuation	E
—□—	{Starting point of military movement continued from preceding map of a series	—□—
S	Siege	S
—	Approximate route, major advance	—
—	Approximate route, minor advance	—
— - -	Approximate route, major retirement	— - -
— - -	Approximate route, minor retirement	— - -

Dates of battles, etc. are shown in the color of the successful force, dates on which unsuccessful siege operations began in color of besieging force and on which the siege was raised in color of besieged force; dates of evacuations in color of enemy of evacuating force.

Symbols for contemporary or closely consecutive operations are connected.

For example, — - - might show a siege initiated and abandoned by the United States force whose line of march is indicated by the blue line. Symbols representing earlier routes are broken so as to appear to pass beneath those representing routes or other operations of later date. Successive occupations, sieges, etc., of the same place are shown by concentric circles or semicircles, the inner ones representing operations of earlier date. For example



might show place (1) at first held by United States force, (2) later taken after siege by enemy force B and (3) subsequently reoccupied by United States force "A".

Route symbols in general show approximate rather than precise routes and are sometimes arbitrarily made to cross one another in order more graphically to bring out the sequence of events.

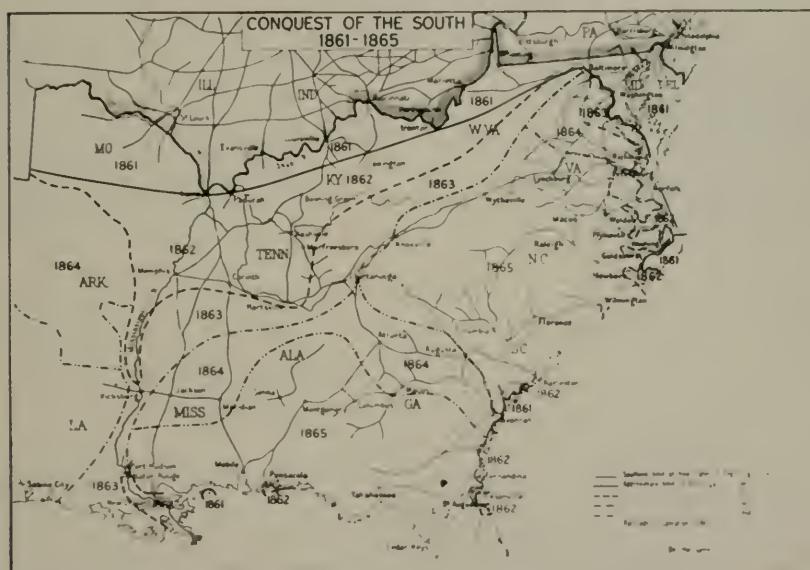
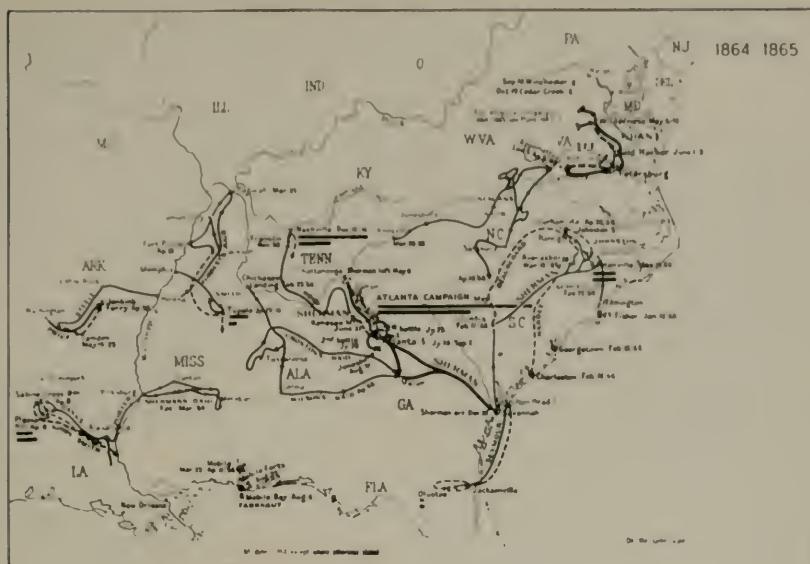
Charles O. Paullin, "Atlas of the Historical Geography of the United States," Carnegie Institute of Washington and American Geographical Society of New York, 1932.

Legend for the Two Maps on Page 205.

This legend was used for a series of military history maps, but it applies here only to the two following maps on the Civil War.

The symbols of the original were in red and blue.

MAPS WITH BAR CHARTS

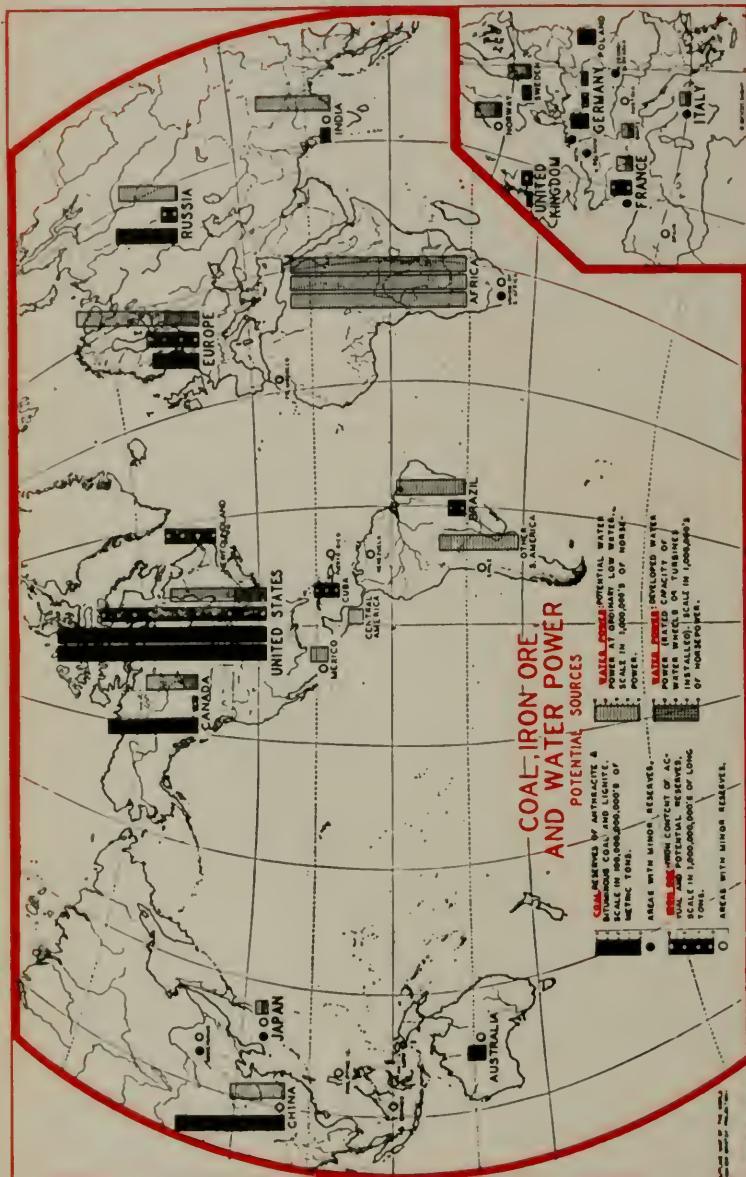


Charles O. Paullin, "Atlas of the Historical Geography of the United States," Carnegie Institute of Washington and American Geographical Society of New York, 1932.

SCALE .5

Two Historical Maps Showing the Progress of the Civil War from 1863 Through 1865 and a Resume of the Entire War.

The bars and war lines in the originals of these two maps were in red and blue.



SCALIE 6

Potential Sources of Coal, Iron Ore, and Water Power Throughout the World.

- When a map of the world is used as the base for statistical representations, some sections cannot be presented clearly in detail.
 - The small detailed map in the lower right corner adds much to the value of this exhibit.



Map of Great Britain's Merchant Marine at the New York World's Fair, 1939.

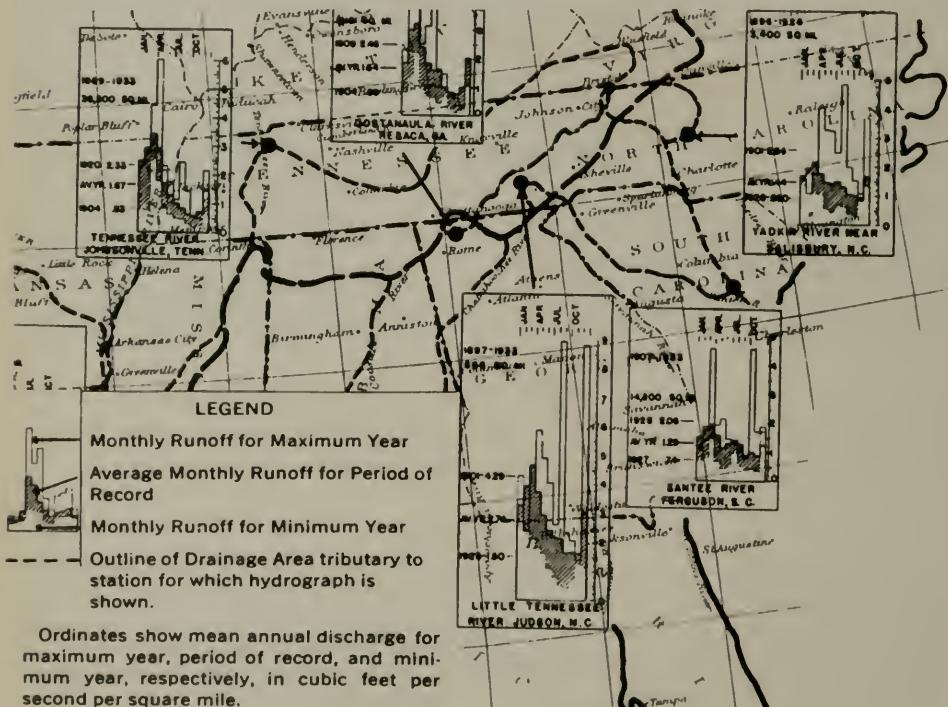
1. The models of the ships represent Great Britain's merchant marine.
2. The map and models are not built to the same scale.

In the Arctic Exploration Building of the U.S.S.R. at the New York World's Fair, 1939, there is an exhibit in which the whole Arctic region at the center of a hemispherical dome is painted with luminous paint. As ultra-violet lights go on and off in short cycles, the paint shows up routes of recent exploration.

Chapter 25

MAPS WITH CURVE CHARTS

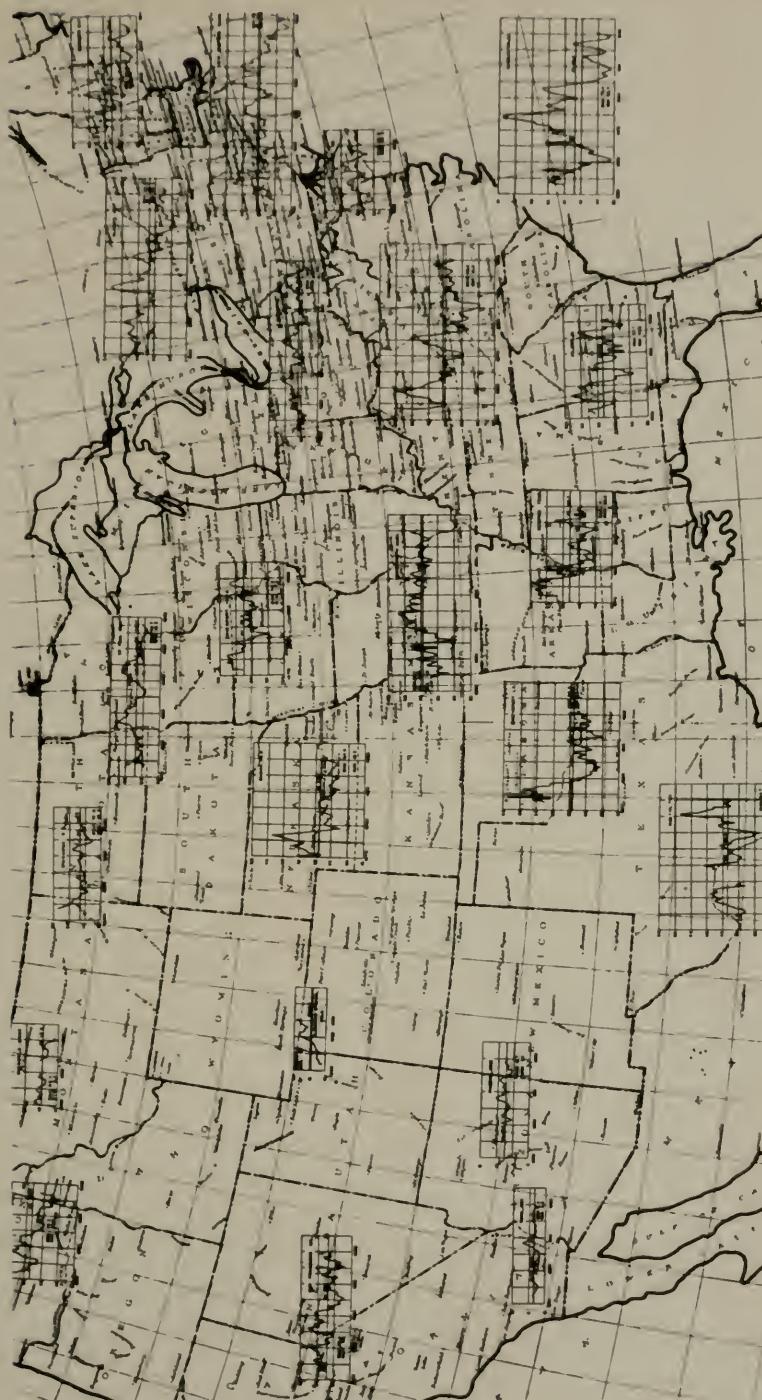
THE three statistical maps in this chapter, all of which deal with precipitation, demonstrate the value of showing the location of data for geographic regions. While other maps may show that there was rainfall, these maps show the actual amount of precipitation. See "Flow Maps," pages 216-230. Although curve charts have not been discussed up to this point, maps with curve charts are included here in order to keep the map section intact.



National Resources Board, "Report of the Water Planning Committee, Part III," 1934.

Characteristics of Runoff from Typical Drainage Areas in the United States.

Only a section of the original map is shown.

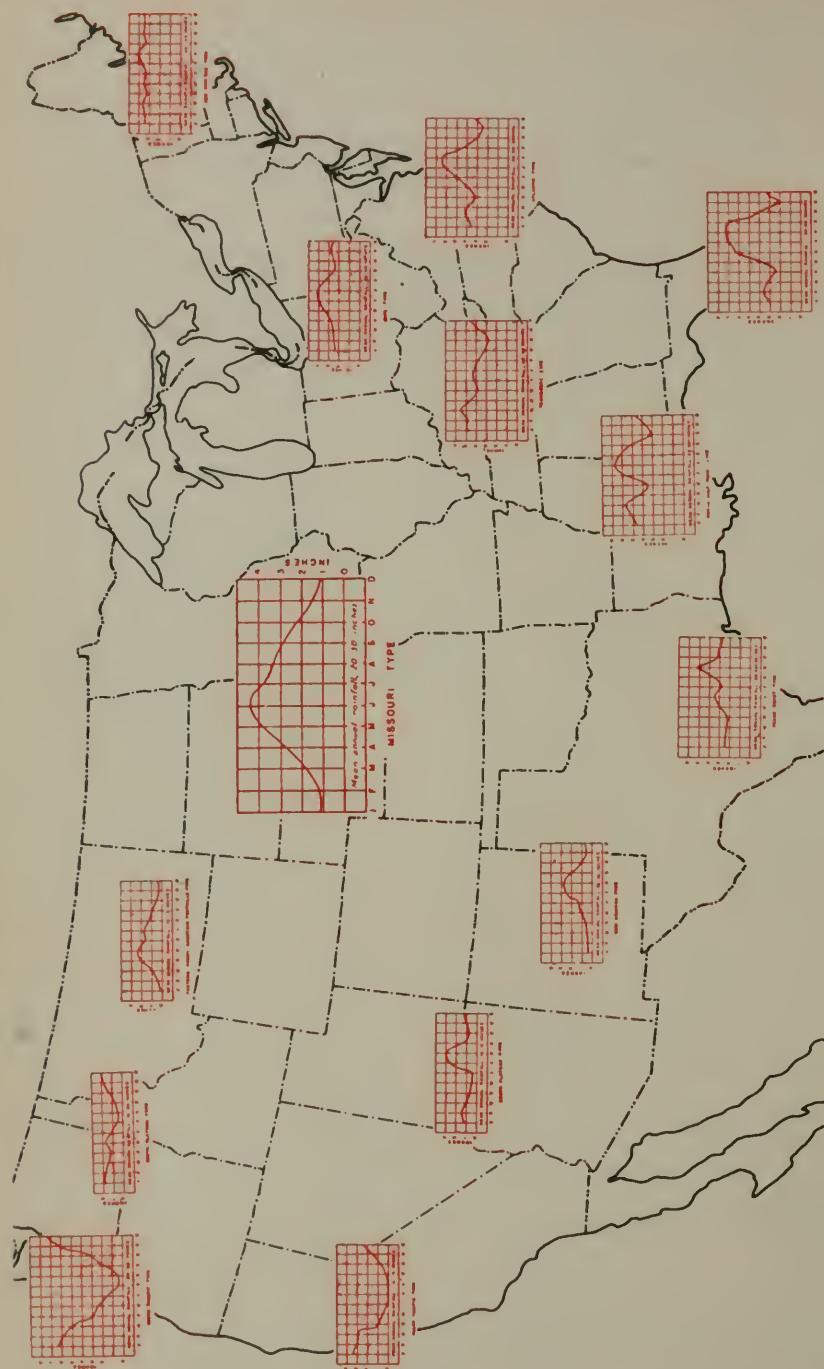


National Resources Board, "Report of the Water Planning Committee, Part III," 1934.

Moving Averages of Precipitation at Typical Stations in the United States.

SCALE .5

SCALE .5



National Resources Board, "Report of the Water Planning Committee, Part III," 1934.
Distribution of Monthly Precipitation in the United States.



Chapter 26

New York World's Fair,
1939.

MAPS WITH SYMBOLS

QUANTITATIVE material may be presented in the form of symbols by increasing the number of symbols as in "Pictorial Unit Bar Charts" on pages 121-131. A variation in the type of symbol may also indicate a quantitative difference.



WPA, Division of Social Research, "The Migratory-Casual Worker," 1937.

SCALE .8

State of Principal Employment for 100 Migratory-Casual Workers in 1933 and 1934
in the United States.

1. From this map, it can be seen that certain states offer relatively more casual employment to the migratory worker than others.
2. Note the relationship between this map and 230.

GRAPHIC PRESENTATION

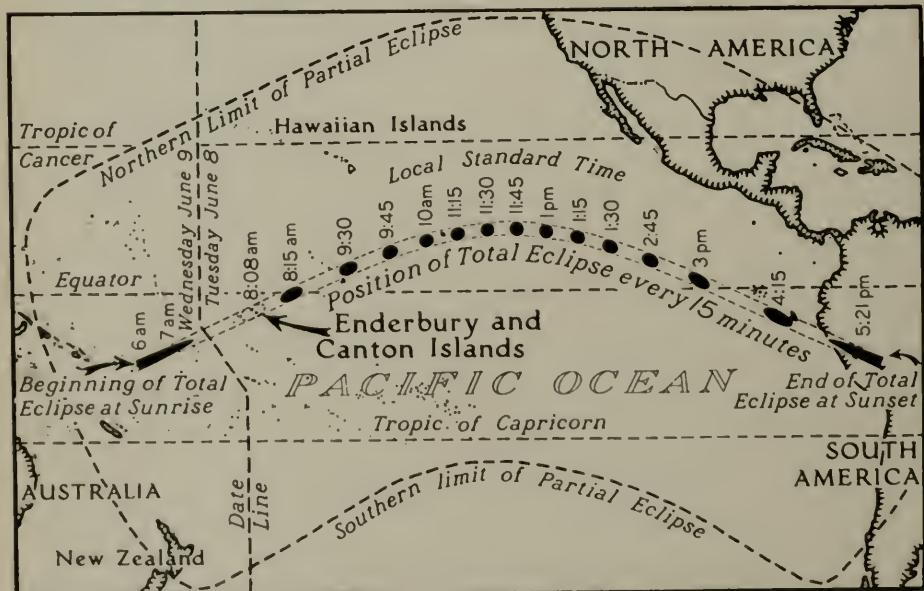


WPA, Division of Social Research, "Urban Workers on Relief," 1936.

SCALE .7

A. Principal Occupations in Selected Cities of the United States in 1936.

No quantitative data is presented in this map. It is merely a device to show the principal occupations in certain cities of the United States.

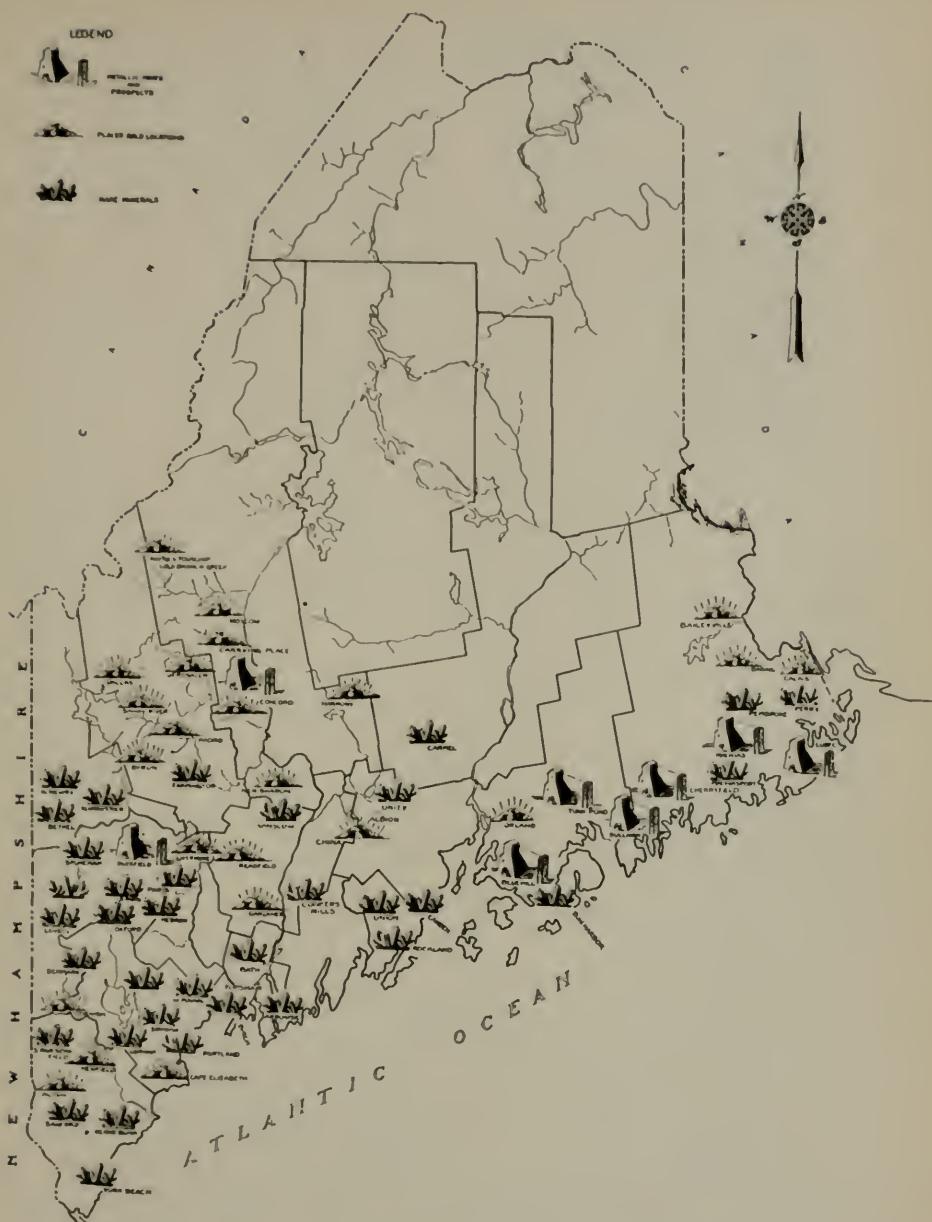


The National Geographic Society, Washington, D. C., 1937.

SCALE .6

B. Map of the Eclipse of the Sun June 9th and 8th, 1937.

By the use of symbols, a time-analysis of the eclipse of the sun is made. The "date line" showing the change from Wednesday to Tuesday is particularly interesting.

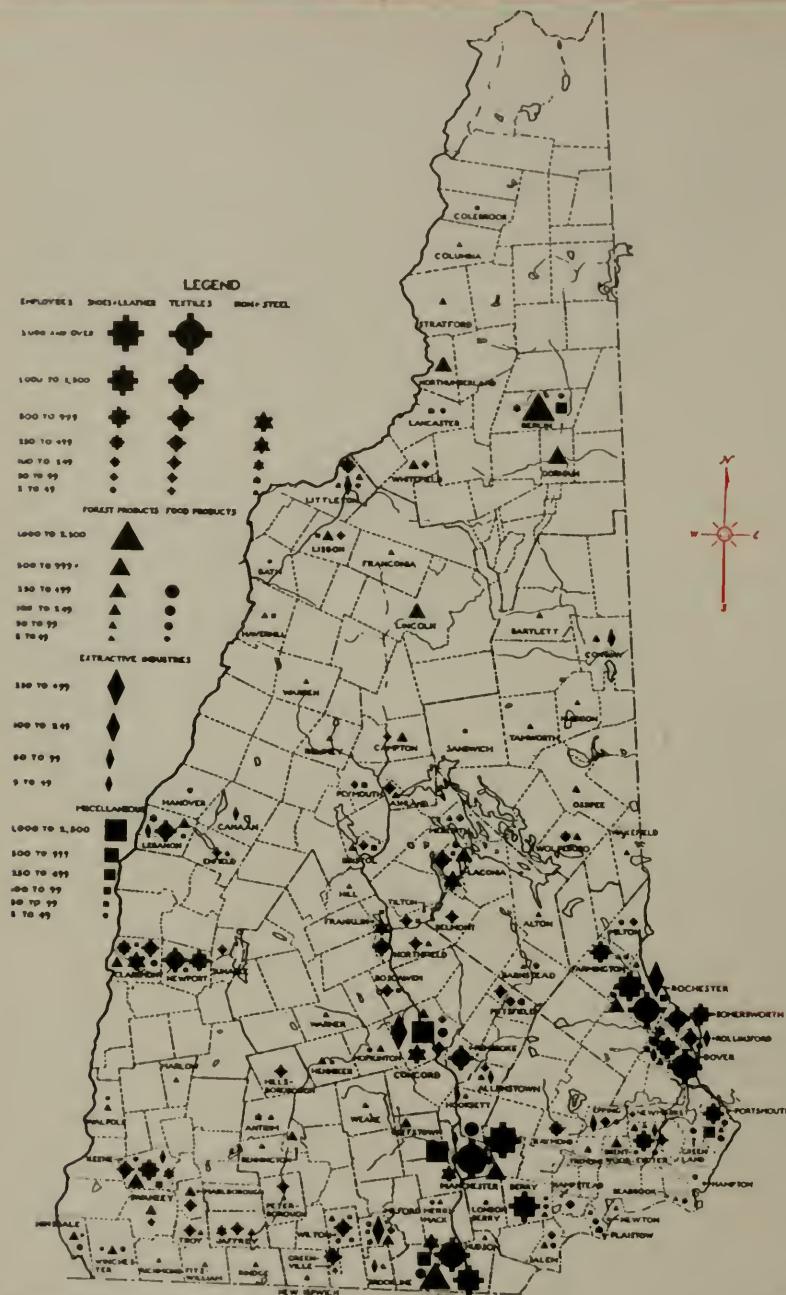


National Resources Board, "Stats Planning," 1935.

SCALE .7

Metallic Ores and Rare Minerals in Maine, August 1934.

The purpose of this symbol map is to show the geographic location of metallic ores and rare minerals in Maine. No quantitative data is presented.



National Resources Board, "State Planning," 1935.

SCALE .8

Industrial Distribution in the State of New Hampshire in 1932.

By increasing the size of the symbol, a quantitative as well as a location analysis is made.

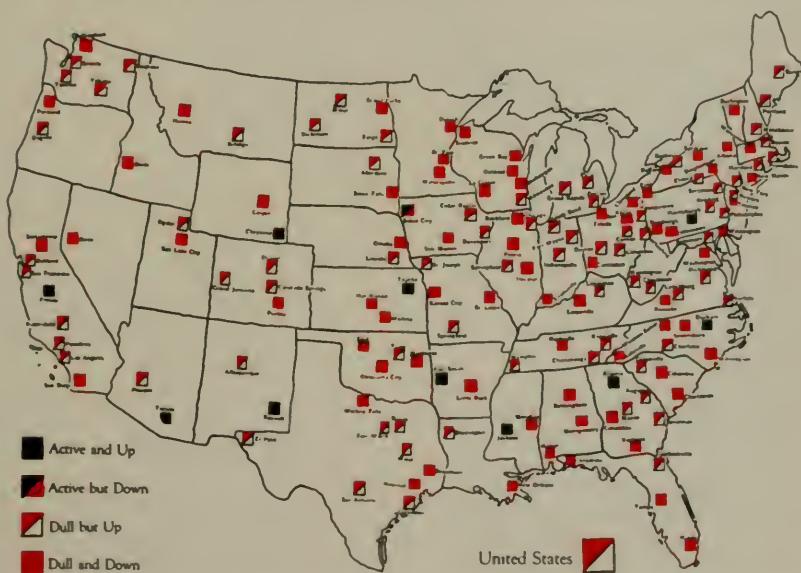


American Iron and Steel Institute, N. Y. C., 1937.

SCALE .6

A. Steel Ingot and Finished Steel Capacity of the United States in 1937.

This combination of circles and squares gives a concise statement of two sets of data: steel ingot capacity and finished steel capacity in the United States. A section only of the original map is shown.



Alexander Hamilton Institute, Bureau of Business Conditions, "Business Conditions Weekly," July 23, 1938.
SCALE .5

B. Map of Credit and Sales Conditions in the United States in July 1938.

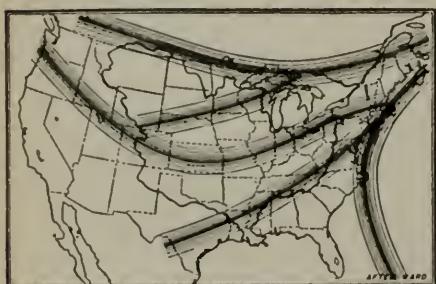
Since interest is chiefly in the "active-and-up" cities, the choice of a solid black symbol to represent them was a logical one.

Chapter 27

FLOW MAPS

Flow maps may be used to show both qualitative and quantitative flow of goods, persons, automobiles, etc. When a flow map is used to indicate the number of persons or automobiles on streets and highways, it is generally called a traffic map.

See Cosmographs in "Flow Charts" on pages 73-80.



National Resources Board, "Report of Water Planning Committee, Part III," 1934.
SCALE .8

A. Generalized Spring and Autumn Storm Paths in the United States.

1. Although spring and autumn storms may not always follow these paths, it is more than likely that they will.
2. The use of a flow map to show the path of a storm is not an uncommon one.
3. The lines here show the center path and the outlying borders. For comparison see 216B and 218.



American Mutual Liability Insurance Co., Boston, Mass., "Watch," 1939. SCALE .6

B. A Map of Hurricanes Which Have Occurred Between September 16 and 30 During the Last Fifty Years in the Eastern Part of the United States.

1. During the half-century ten hurricanes have struck inland in the latter half of September.
2. Hurricanes usually originate off the northern coast of South America, move west from Africa, and travel toward the West Indies and Florida, moving about 300 miles per day.
3. The hurricane of 1938 moved 750 miles in 12 hours from Cape Hatteras, North Carolina, to Burlington, Vermont.

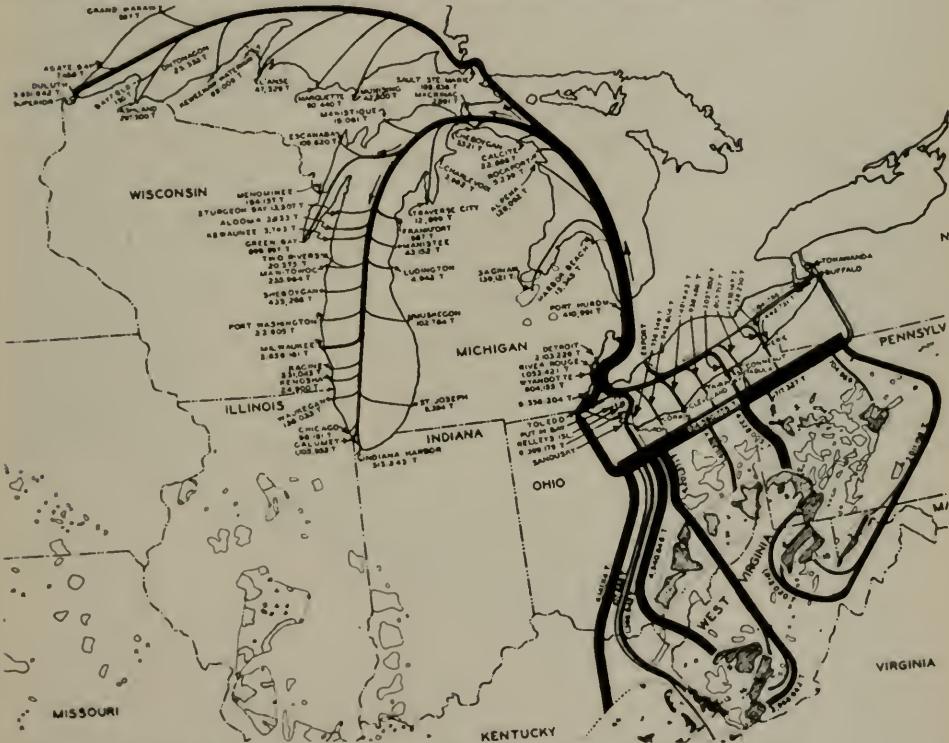


National Resources Board, "Report of the Water Planning Committee, Part III," 1934.

SCALE .8

A. Prevailing Winds in January and in July in the United States.

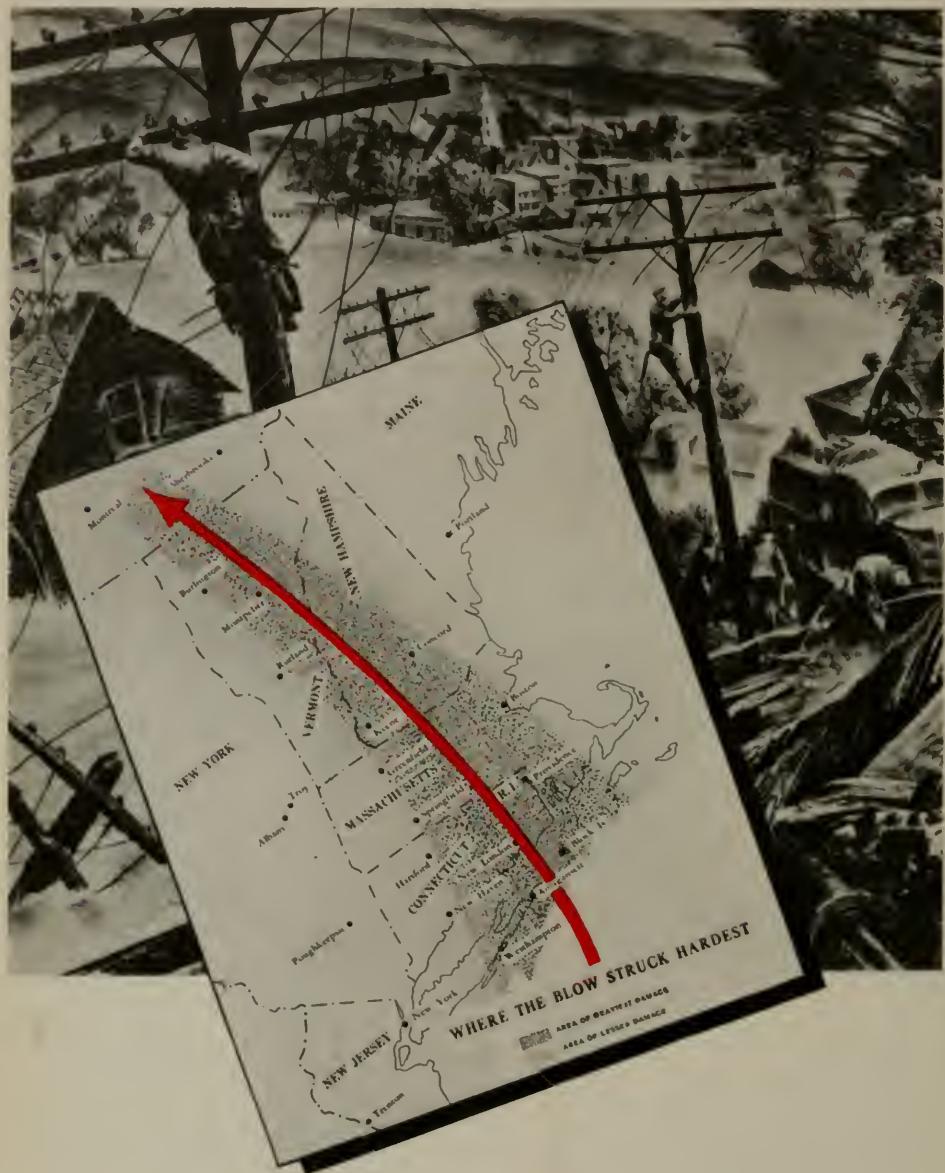
1. Arrows to show the course of the wind on a weather map are often seen in daily weather reports.
 2. These two maps shows the prevailing winds for two months in the year.



National Resources Board, "State Planning," 1935.

B. Origin and Ports of Destination of Cargo Shipments of Bituminous Coal from the Great Lakes in the United States in 1932.

The tonnage of the various shipments of coal is given at the end of each line.



American Telephone and Telegraph Company, N. Y. C.

SCALE .6

Map Showing Where the Hurricane of 1938 Hit Hardest in the United States.

This map of the path of the 1938 hurricane appeared in an advertisement of the Bell Telephone. Compare with 216B.

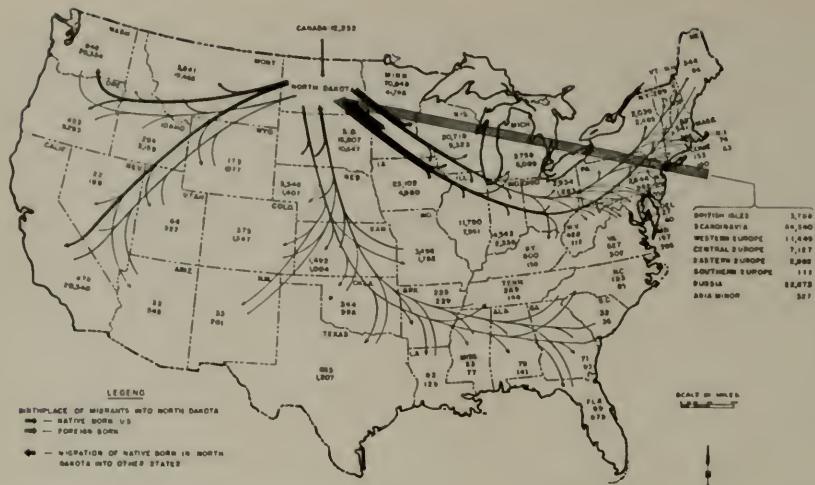


National Resources Board, "State Planning," 1935.

Volume and Distribution of Traffic in Oklahoma for an Average 24-Hour Period, Based on an Average 24-Hour Count Taken Once a Week on Successive Days Over a Period of 7 Weeks in 1930.

In this traffic map, the width of the line indicates the volume of traffic. Compare this method with 203.

GRAPHIC PRESENTATION

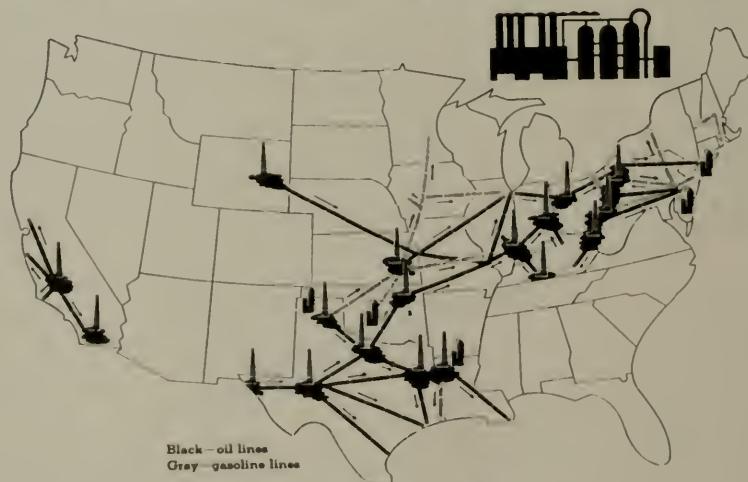


National Resources Board, "State Planning," 1935.

SCALE .5

A. Migration Into and from North Dakota for the Period from 1920 to 1930.

1. In the original of this map, the migration from North Dakota was indicated in red ink.
2. The two groups of figures in each state give the inflow and outflow. The top figure represents the outflow to North Dakota, the bottom figure the inflow from North Dakota.
3. While there is no scale to give the exact proportion of the width of the lines to the number of people, the width of the lines gives some indication of this.



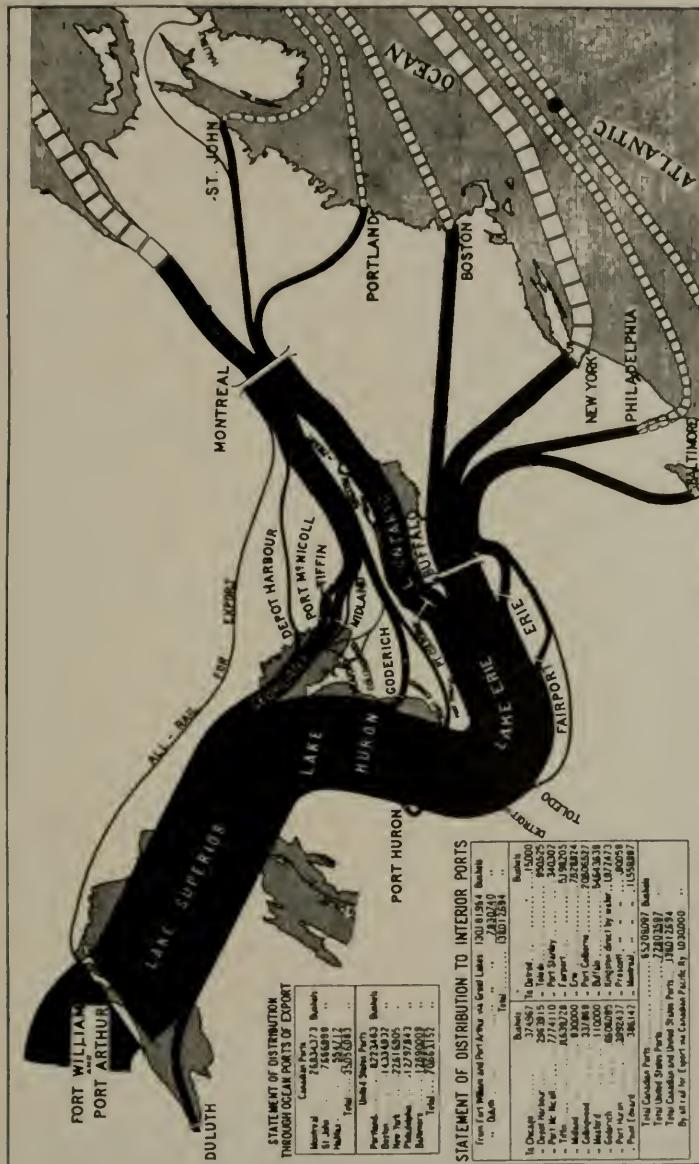
American Petroleum Institute, N. Y. C., "Petroleum Facts and Figures," 1937.

SCALE .8

B. Directional Flow Map of Crude Oil and Gasoline Pipe Lines in the United States in 1936.

There is no quantity representation in this map. It is purely a directional flow.

FLOW MAPS



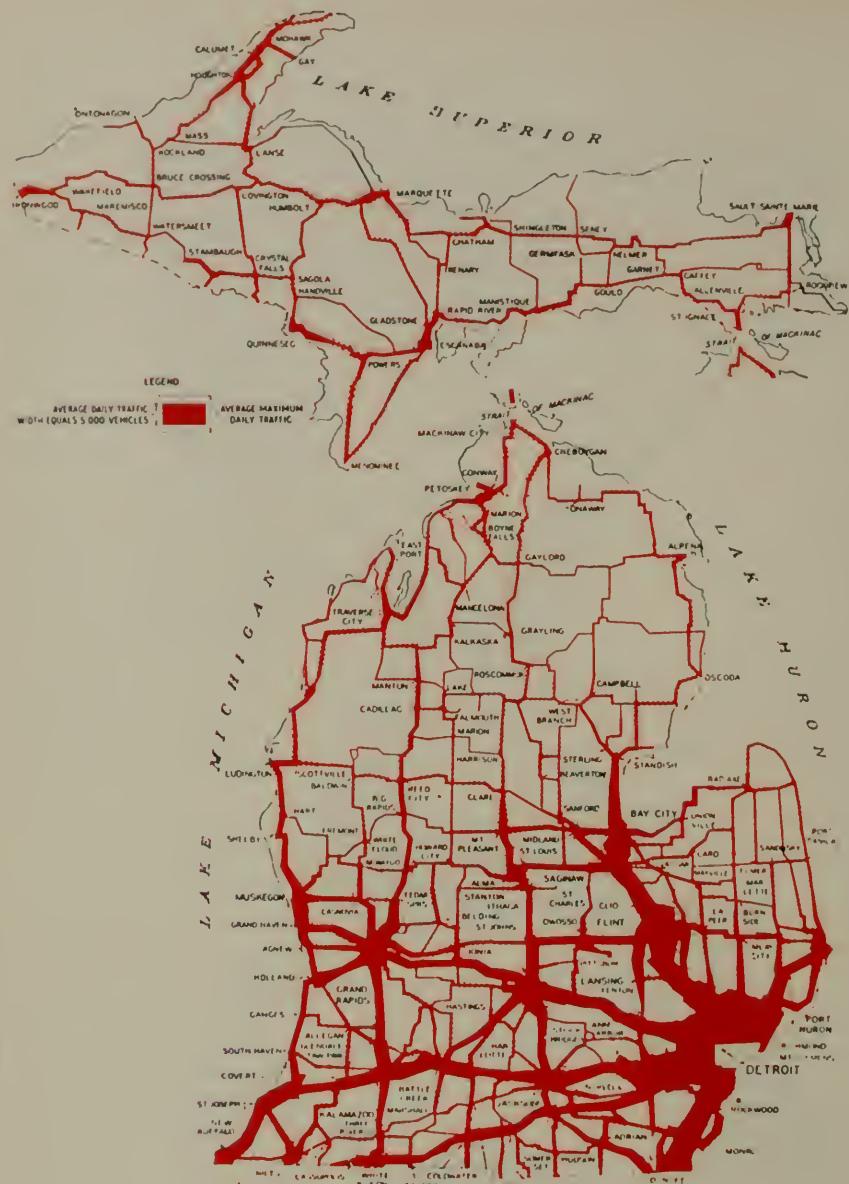
SCALE .8

Eastbound Movement of Western Canadian Wheat in the Calendar Year 1913.

1. The flow map could be used more extensively than it has been to indicate such things as movement of wheat, exports and imports.
2. Note that the width of the lines indicates volume.

W. Sanford Evans, "Statistical Examination—Georgian Bay Canal," 1916, Ottawa, Canada.

GRAPHIC PRESENTATION

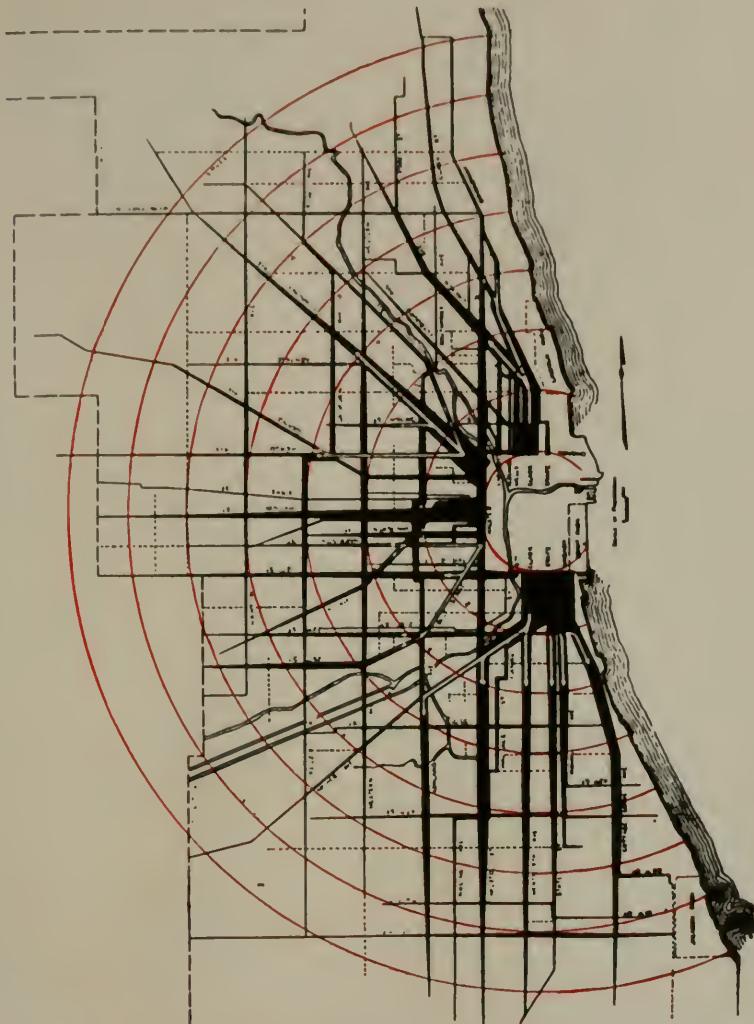


National Resources Board, "State Planning," 1935.

SCALE .7

Average Daily Traffic on Michigan Trunk Line Highways Based on the Years 1930 and 1931.

1. The legend for this traffic map might have been better if a scale for the widths of line had been given.
2. The inclusion of the names of the cities is an advantage.

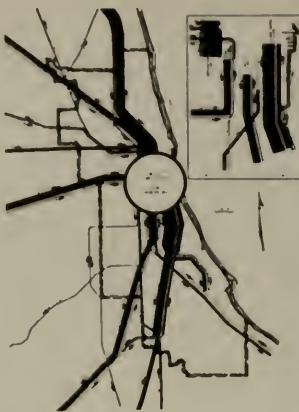
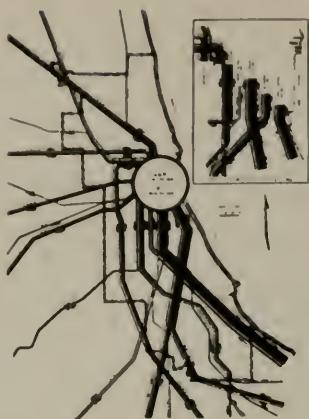


James R. Bibbins and Bion J. Arnold, "Our National Transportation System," Proceedings of New York Railroad Club, April 1923.

Flow Diagram Showing the Rush Hour Passenger Traffic Outbound from One-Mile Zone on the Surface Lines in Chicago.

Because this was reproduced from a photostat, much of the detail is lost. The important feature, the use of circles to show the mile zones, is effectively shown even in this reduced scale.

GRAPHIC PRESENTATION

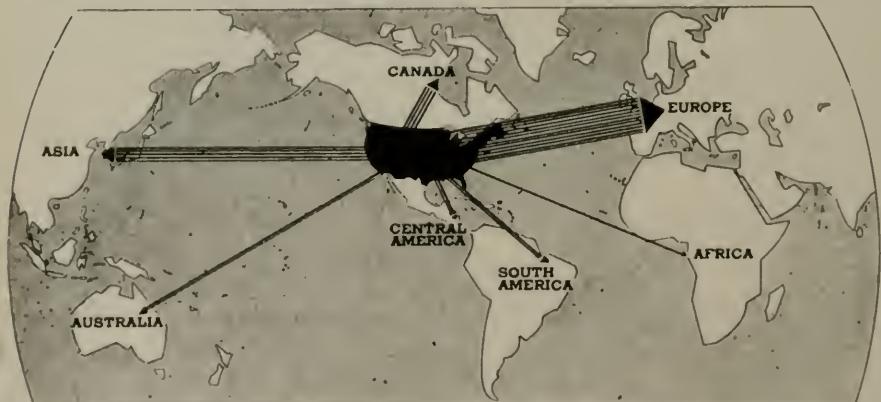


J. R. Bibbins, and Bion J. Arnold, "Our National Transportation System," Proceedings of New York Railroad Club, April 1923.
SCALE .6

A. Main Line Passenger Rush Hour Car Movement to and from Chicago Terminals from 7 to 8 a.m.

B. Suburban Passenger Rush Hour Car Movement to and from Chicago Terminals from 5 to 6 p.m.

Comparison of the routes taken by two groups of passengers is made in these two traffic maps.

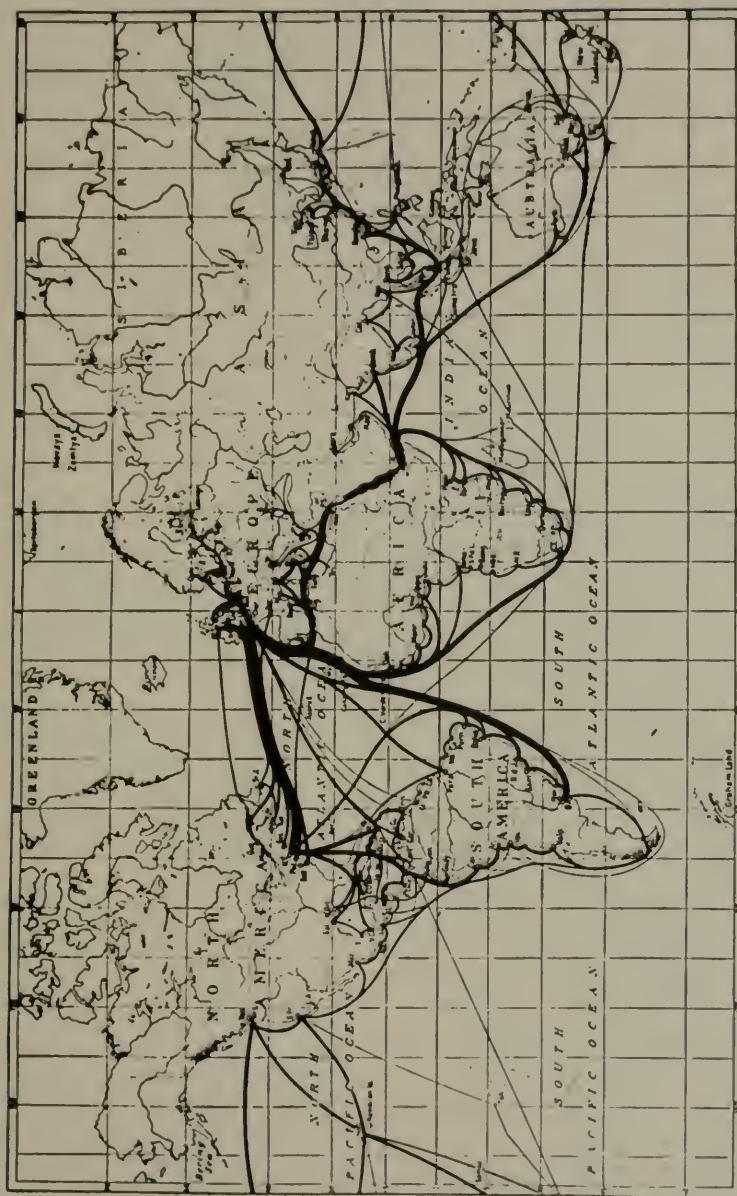


Each line represents 10 million dollars' worth of petroleum products

American Petroleum Institute, N. Y. C., "Petroleum Facts and Figures," 1937.

C. Petroleum in United States Export Trade in 1936.

1. The representation of volume in this map is correct in that the general idea that Europe receives most of the petroleum products of the United States is obtained.
2. As a method of graphic presentation it is incorrect in that two lines, or 20 million dollars, is visually about three times as wide as one line, or 10 million dollars. The error is greater when there are just a few lines.



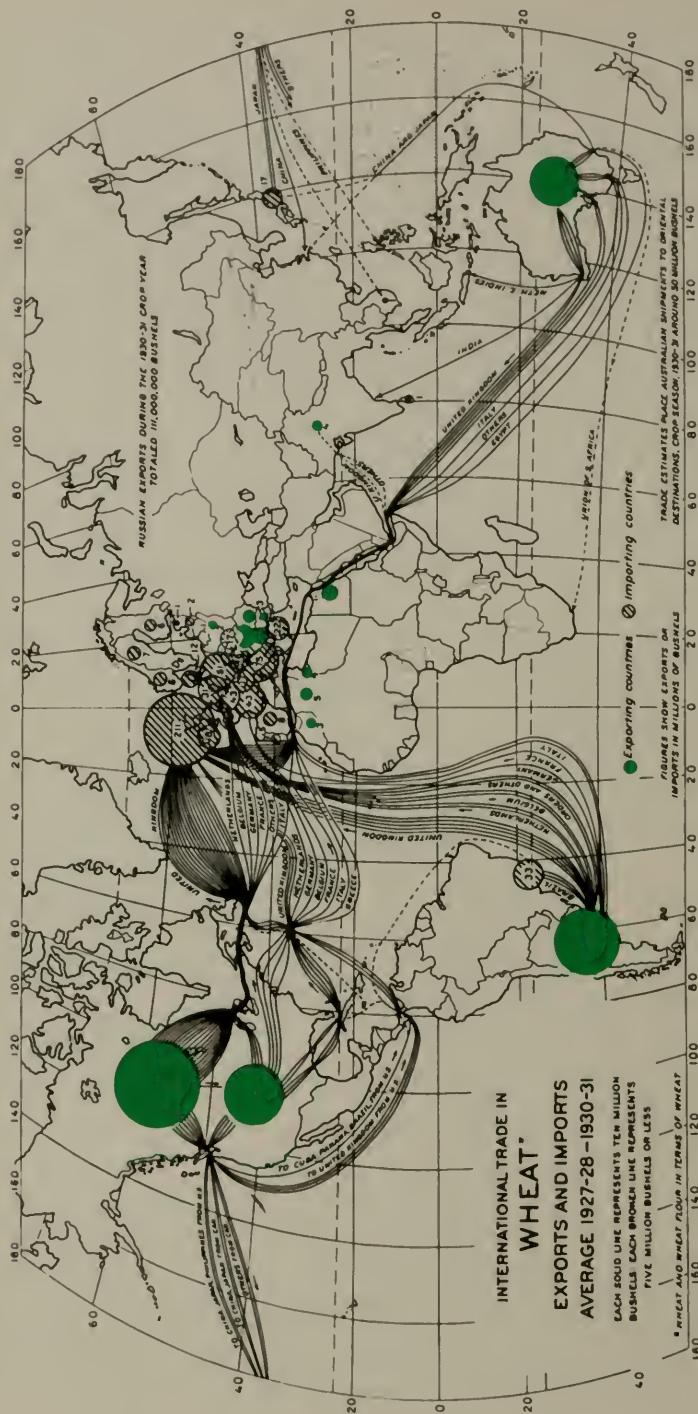
Isaiah Bowman, "The New World," World Book Co., N. Y. C., 1930.

Shipping Routes of The World. The Widths of the Lines and Bands Are in Proportion to the Tonnage.

1. The numerical proportion of the bands to tonnage was not given.
2. This is a very good example of a map made on Mercator's projection. See 155.

SCALE .8

GRAPHIC PRESENTATION

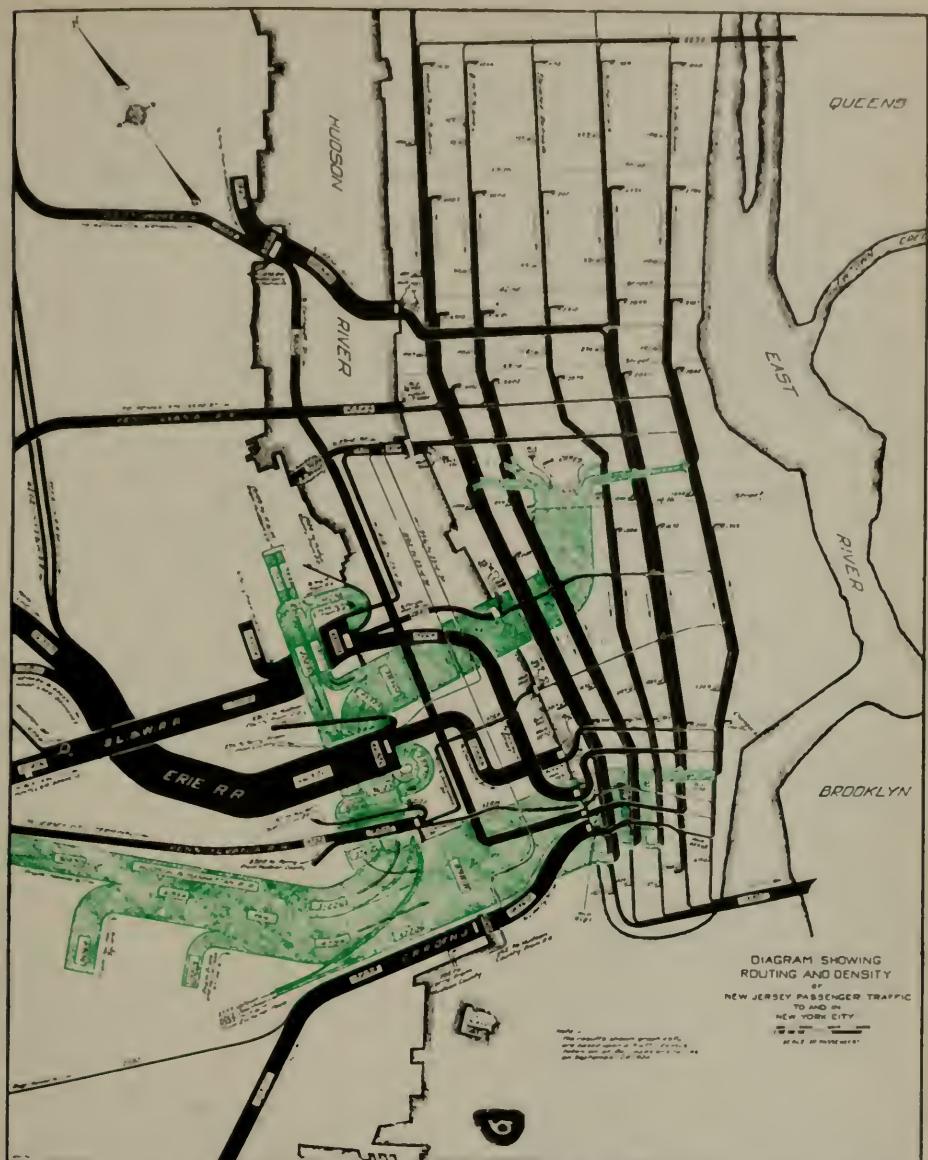


U. S. Department of Agriculture, Bureau of Agricultural Economics.

International Trade in Wheat. Average 1927-28—1930-31.

1. The combination of circles and lines is effective.
2. The same criticism of the use of lines made in 224C could be applied here.

FLOW MAPS



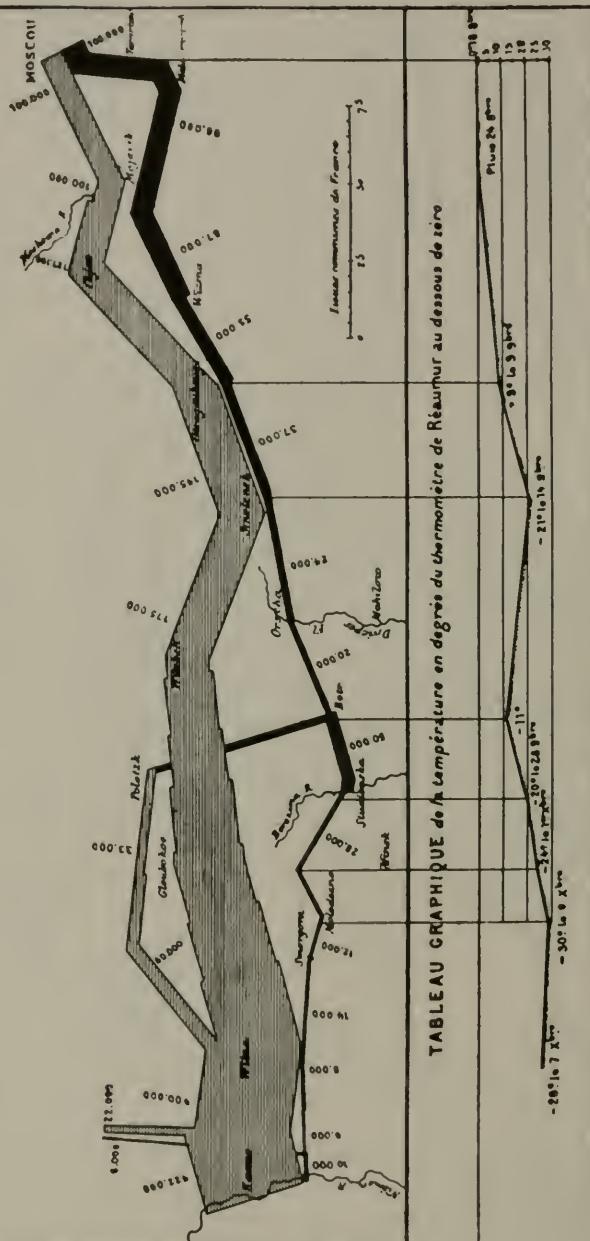
North Jersey Transit Commission, "Summary of 1926 Report, Rapid Transit for Northern New Jersey," January 15, 1926.

Diagram Showing Routing and Density of New Jersey Passenger Traffic to and in New York City in 1924.

1. A great many people commute to New York City from New Jersey. Few persons realize the number. Although this is a 1924 analysis, a later study has not superseded it.
2. Note again 203.

GRAPHIC PRESENTATION

CARTE FIGURATIVE des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.
Dressée par M. Minard, inspecteur Général des Ponts et Chaussées en retraite.



From E. J. Marey, "La Méthode Graphique," Paris, 1878. Chart by M. Minard.

Flow Chart of the Successive Losses of Men from the French Army in the Russian Campaign, 1812-1813.

- SCALE .7
1. Napoleon's tragic retreat from Moscow in 1812 and 1813 is told here much more clearly than could be done in words. In commenting on this chart, E. J. Marey said that the graphic presentation of the march of the army attains a degree of brutal eloquence which seems to defy the pen of the historian.
 2. The temperature chart along the bottom of the chart adds much to the effectiveness of the entire presentation.

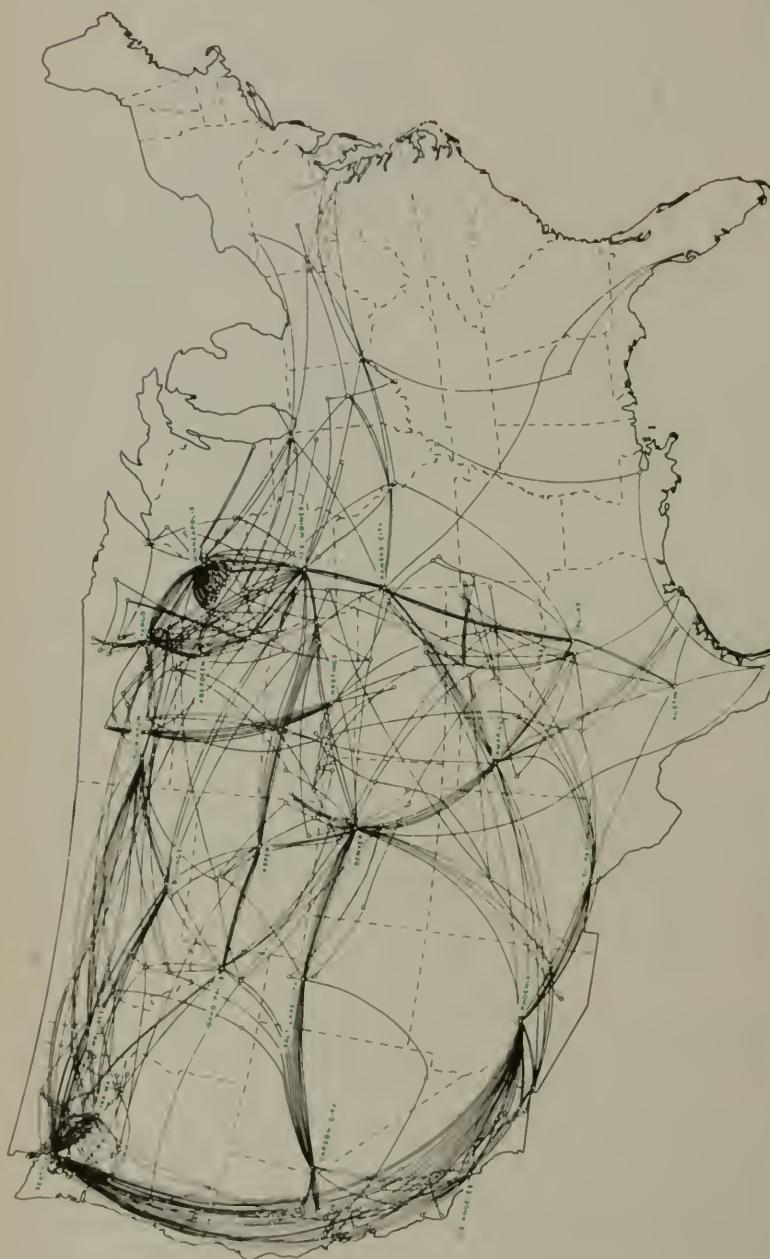
FLOW MAPS



From "A Report on the Street Traffic Control Problem of the City of Boston" Prepared under the Direction of the Mayor's Street Traffic Advisory Board by Albert Russel Erskine Bureau of Harvard University, 1928.

Time Zones on Seventeen Highway Routes to and from Corner Park and Tremont Streets in Boston During the Morning and Evening Rush Hours from June to September 1927.

While most of the traffic maps give the amount of traffic, this map gives the length of time it takes to get into Boston from outlying districts.



WPA, Division of Social Research. "The Migratory-Casual Worker," 1937.

Routes of Travel During Employment of 100 Migratory-Casual Workers in Agriculture in the United States in 1933 and 1934.

The lines in this map follow the exact routes of 100 migratory-casual workers in agriculture. The flow up and down the Pacific Coast is predominant.

SCALE .7

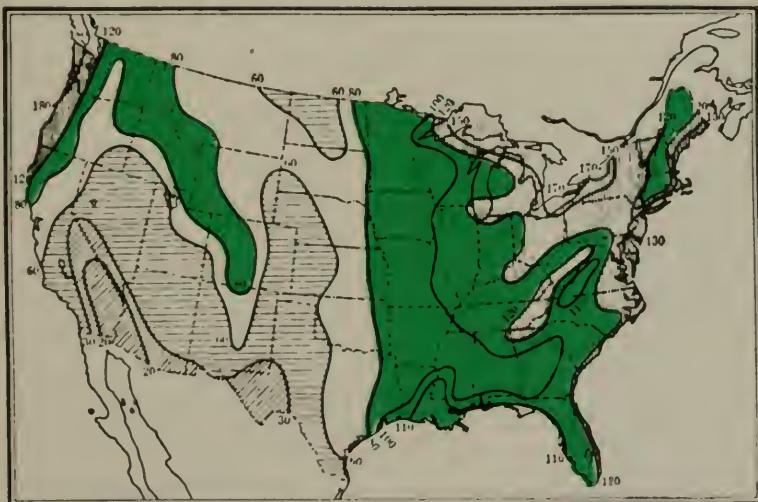
Chapter 28

CONTOUR MAPS

Contour maps may be used to show lines of erosion, precipitation, climatic conditions, as well as the topography of the land. Gradations of shading and cross hatching may be used on contour maps to differentiate. For suggestions relative to the arrangement of shadings, see "Suggestions for Making a Chart," pages 367-380.

GENERAL REFERENCES

Raisz, Erwin, *General Cartography*, McGraw-Hill Book Co., Inc., New York City, 1938

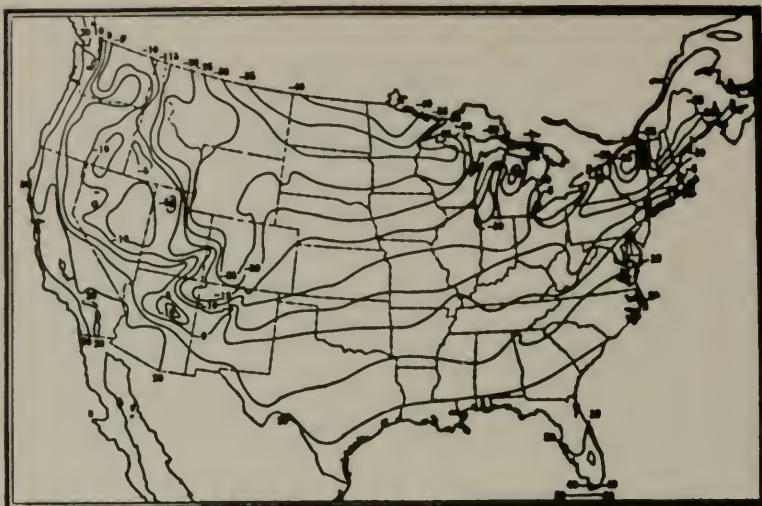


Robert Ward - "Climates of the United States," Ginn & Co., Boston and New York, 1925.

Average Annual Number of Rainy Days in the United States.

1. While the contour map is best known for its use in giving the topography of land, it may also be used to show precipitation, temperatures, and erosion.
2. Since no key for the shadings was given with this map, it is rather difficult to read accurately.

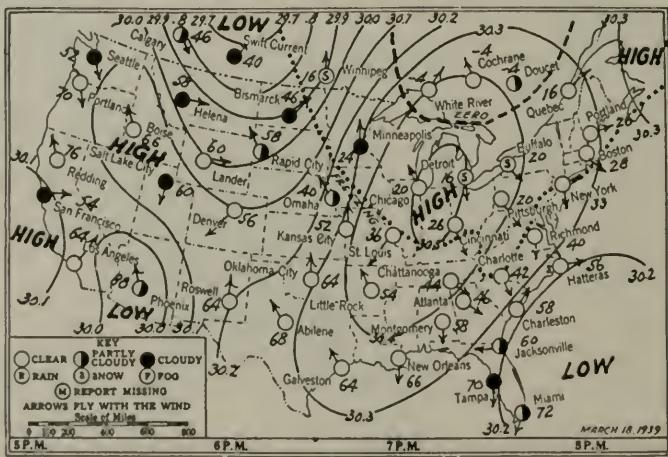
GRAPHIC PRESENTATION



Robert Ward, "Climates of the United States," Ginn & Co., Boston and New York, 1925.

A. Average Annual Minimum Temperatures in the United States.

- Because "contour" means "outline," lines may be used to outline the major temperature sections of the United States.
- Comparison with a topographic map would reveal no doubt, a relation between the elevation of the land and the temperature.



The New York Times, March 19, 1939.

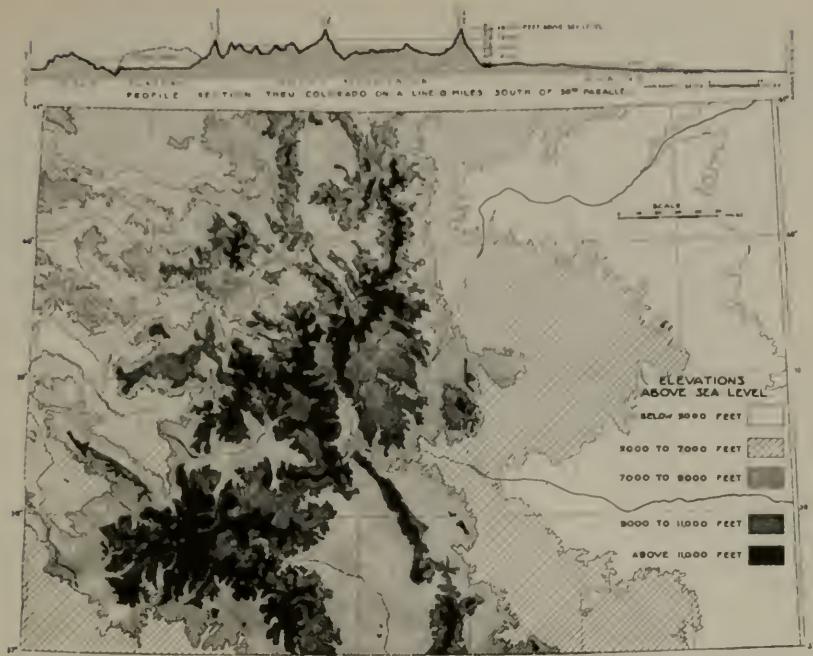
SCALE .6

B. Weather Map of the United States at 7:30 p.m. E.S.T. March 18, 1939.

- The reports on this map are for exactly the same time; that is, although it was 7:30 p.m. Eastern standard time, it was several hours earlier by the clock on the Pacific Coast.
- Compare this method of indicating rain with the method shown in 234A.

CONTOUR MAPS

233

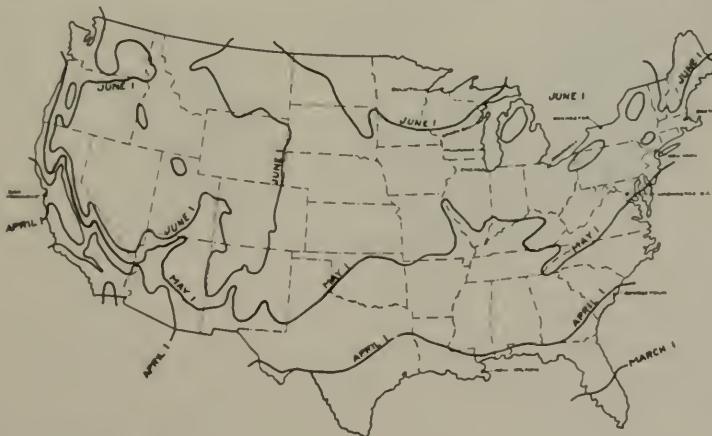


National Resources Board, "State Planning," 1935.

SCALE .5

A. Topographic Map of Colorado, Showing Contour Lines at Intervals of 2000 Feet.

The combination of a topographic map and a profile section makes this a valuable map.

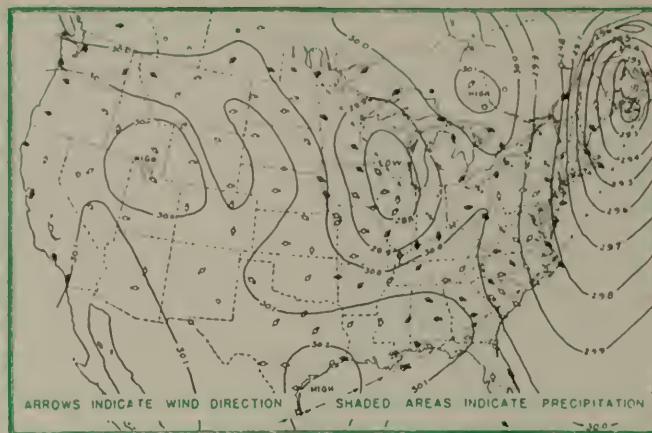


MacElwee & Crandall, Inc., N. Y. C.

SCALE .4

B. Comparative Dates on Which the Chance of Killing Frost Falls to Ten Per Cent in the Spring in the United States.

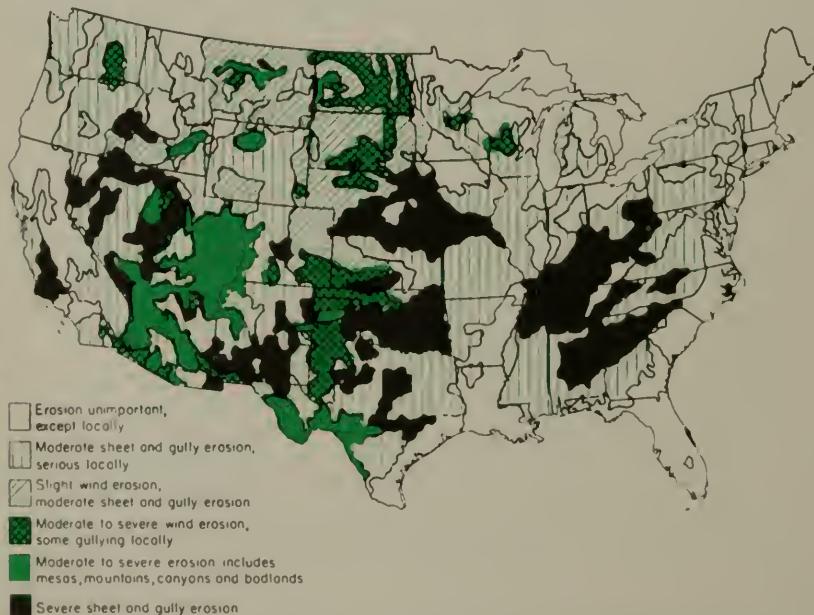
GRAPHIC PRESENTATION



National Resources Board, "Report of Water Planning Committee Part III," 1934.

A. Weather Map for the United States at 8:00 a.m., February 2, 1934.

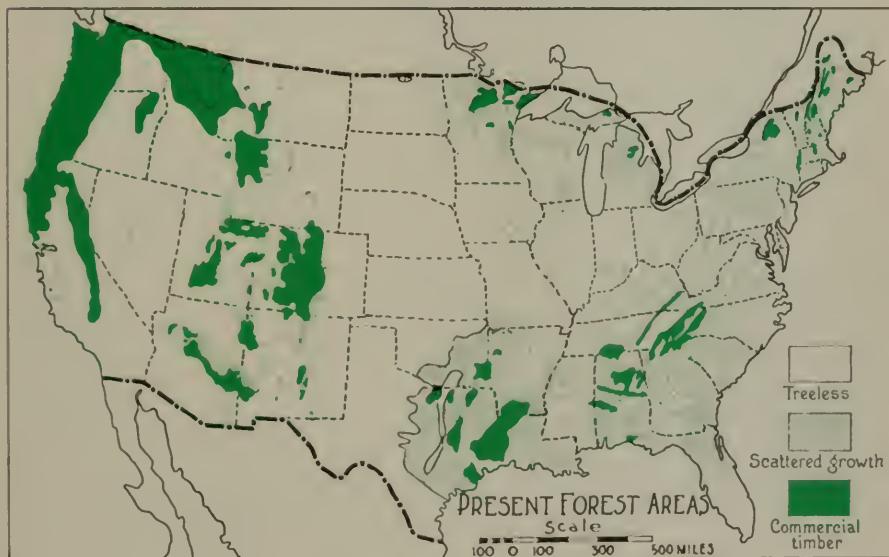
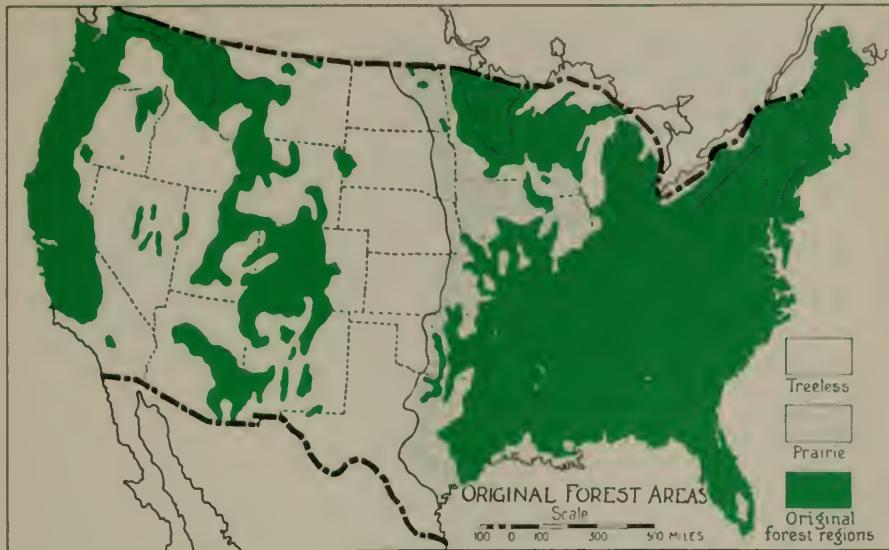
1. Weather reports rather than weather maps are most often consulted in daily newspapers. However, for an over-all view of the United States, this type of weather map is good.
2. Note particularly the use of shaded areas to indicate rain.



WPA, Division of Social Research, "Landlord and Tenant on the Cotton Plantation," 1936.

B. General Distribution of Erosion in the United States in 1936.

This map reveals that the South suffered as much from soil erosion as the mid-West.

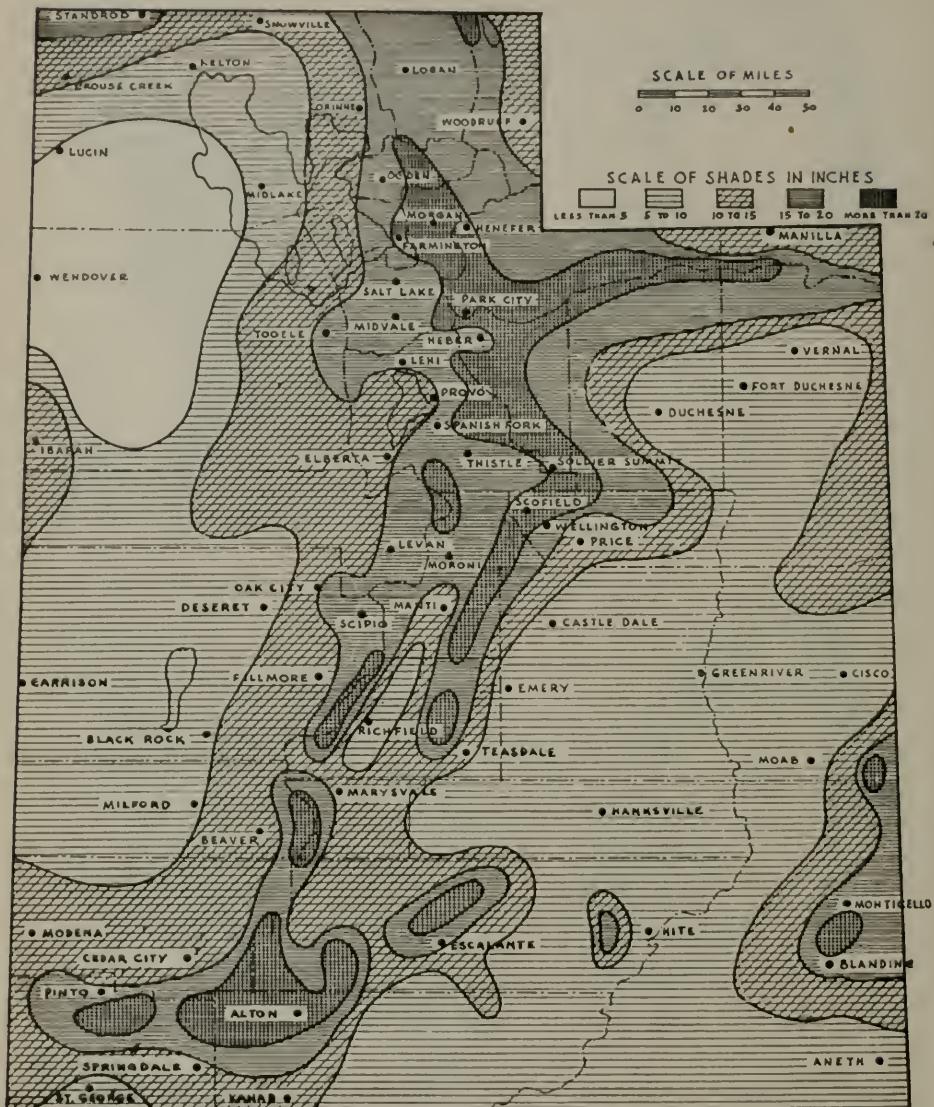


Warren H. Manning, "A National Plan Study Brief," Special Supplement to Landscape Architecture, July 1923, American Association of Landscape Architects, Cambridge, Mass.

Original and Present Forest Areas in the United States.

Before and after comparisons are always interesting. These two maps tell the story of the vanishing forest.

GRAPHIC PRESENTATION



National Resources Board, "State Planning," 1935.

SCALE .7

Average Annual Precipitation in the State of Utah.

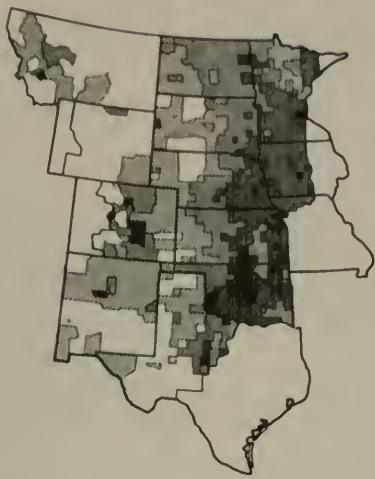
Since a key to the shadings is given in this map, it is much easier to read than 231.

CONTOUR MAPS

1870



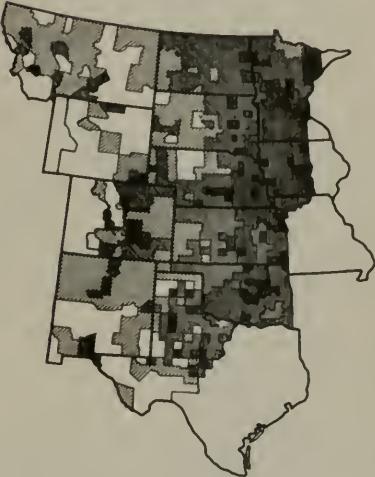
1910



1890



1930



LEGEND

INHABITANTS PER SQUARE MILE

<input type="checkbox"/> FEWER THAN 2	<input type="checkbox"/> 2 - 5	<input type="checkbox"/> 6 - 17	<input type="checkbox"/> 18 - 44	<input type="checkbox"/> 45 - 89	<input type="checkbox"/> 90 AND MORE
---------------------------------------	--------------------------------	---------------------------------	----------------------------------	----------------------------------	--------------------------------------

WPA, Division of Social Research, "The People of the Drought States," March 1937.

Density of Population in the Drought Area in the United States for the Years 1870, 1890, 1910, and 1930.

While the lines for 1870 and 1890 seem to follow natural contours, the lines for 1910 and 1930 are definitely county lines.

Chapter 29

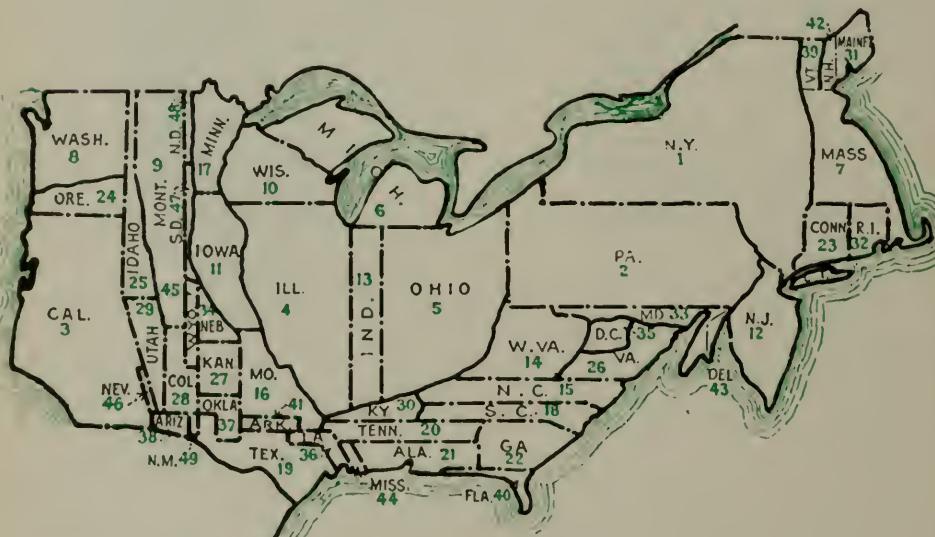
DISTORTED MAPS

IN A distorted map, geographic location of data is maintained by making the area of states, countries, etc., proportional to the quantitative data.

Distorted maps are sometimes called proportional maps.

GENERAL REFERENCES

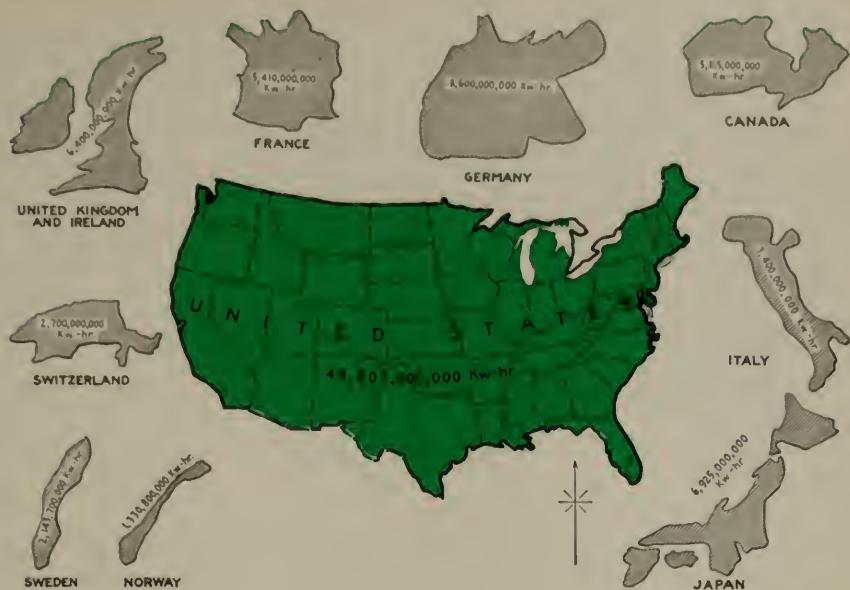
Raisz, Erwin, *General Cartography*, McGraw-Hill Book Co., Inc., New York City, 1938



Literary Digest, April 23, 1921.

Relative Size of Each of the United States If Based on Electrical Energy Sold for Light and Power in 1921.

The theory behind the construction of a distorted map is to represent the area of each state as proportional in size to some value other than land area. Thus the geographical position of the state is maintained, and the new area values can be compared.

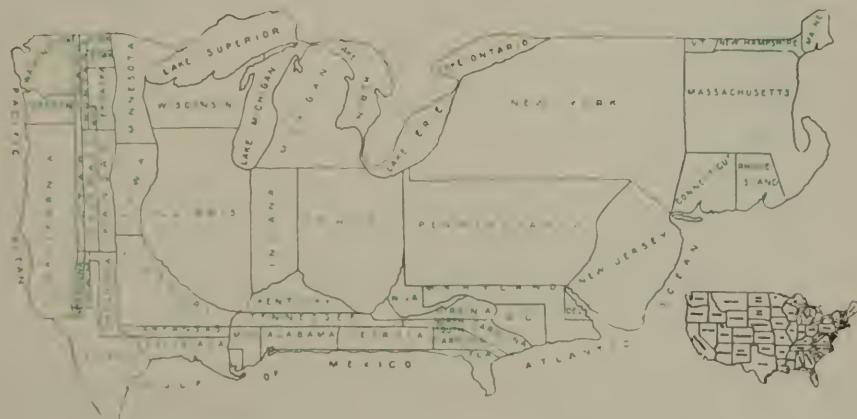


Electrical World, January 6, 1923.

SCALE .7

A. Comparative Size of Leading Nations If Area Is Based on Total Amount of Electrical Energy Consumed.

The form of this comparison map eliminates the greatest fault of the distorted map: that is, changing the shape of the country, or state.



The Dartnell Corp., Chicago, Ill., 1931.

SCALE .4

B. The United States With the Area of the States Proportional to the Urban Population of 1930.

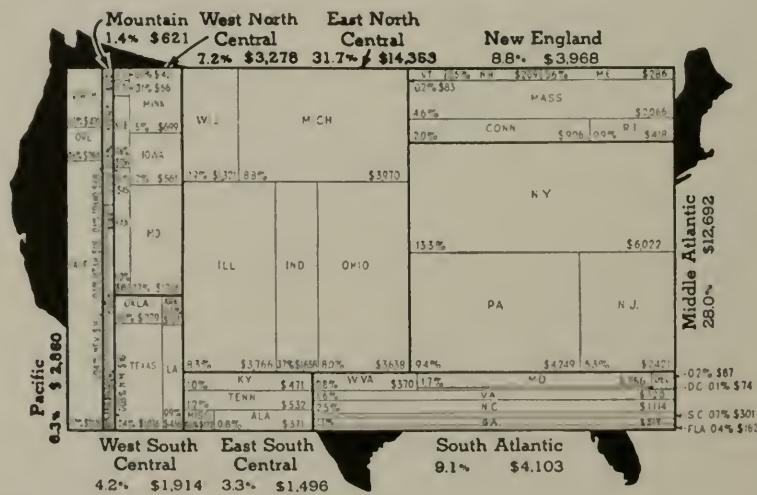
This map represents a popular form of distorted map.



Power Plant Engineering, New York City, 1933.

A. Horsepower Map of the United States in 1933 With the Area of Each State Drawn Proportional to the Amount of Horsepower Installed in the State.

Horsepower is one of many things which a distorted map may present.



Business Week, June 12, 1937, New York City.

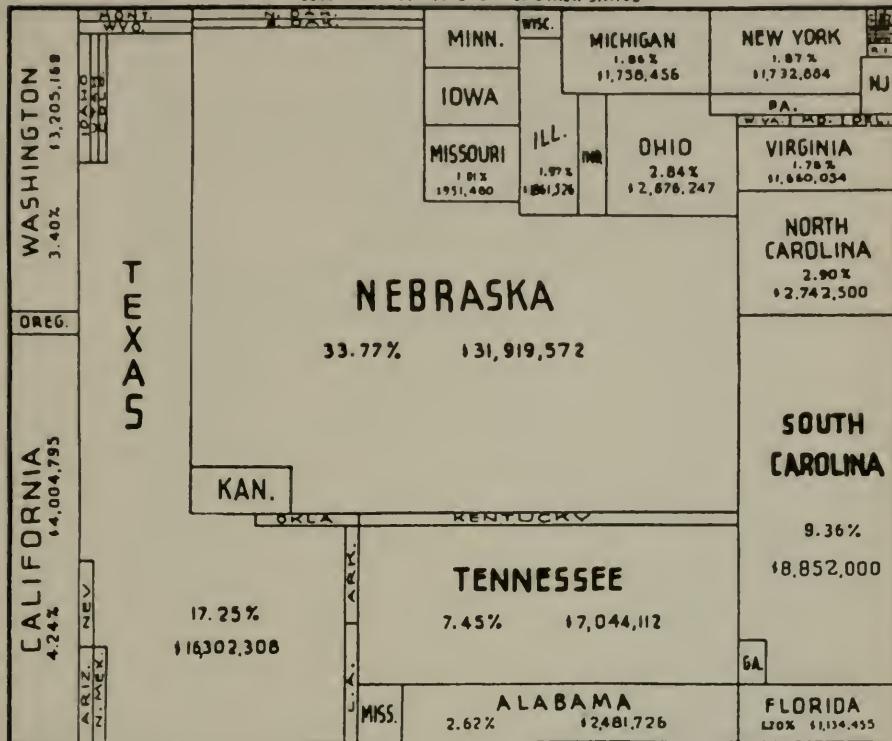
SCALE .6

B. The United States With the Areas of the States Proportional to Their Manufacturing Output in 1935.

1. Rather than attempt to maintain a semblance of the map of the United States, this map presents all the states in rectangular form. In so doing, it seems to lose some of its attractiveness as a distorted map.
 2. The inclusion of the percentages for each state and for each section as demonstrated should be encouraged.

DISTORTED MAPS

TOTAL OF LOANS AND GRANTS IN THE UNITED STATES, \$94,326,263
 93.50% TO 15 STATES AS SHOWN BELOW
 LESS THAN 1% TO EACH OF OTHER STATES

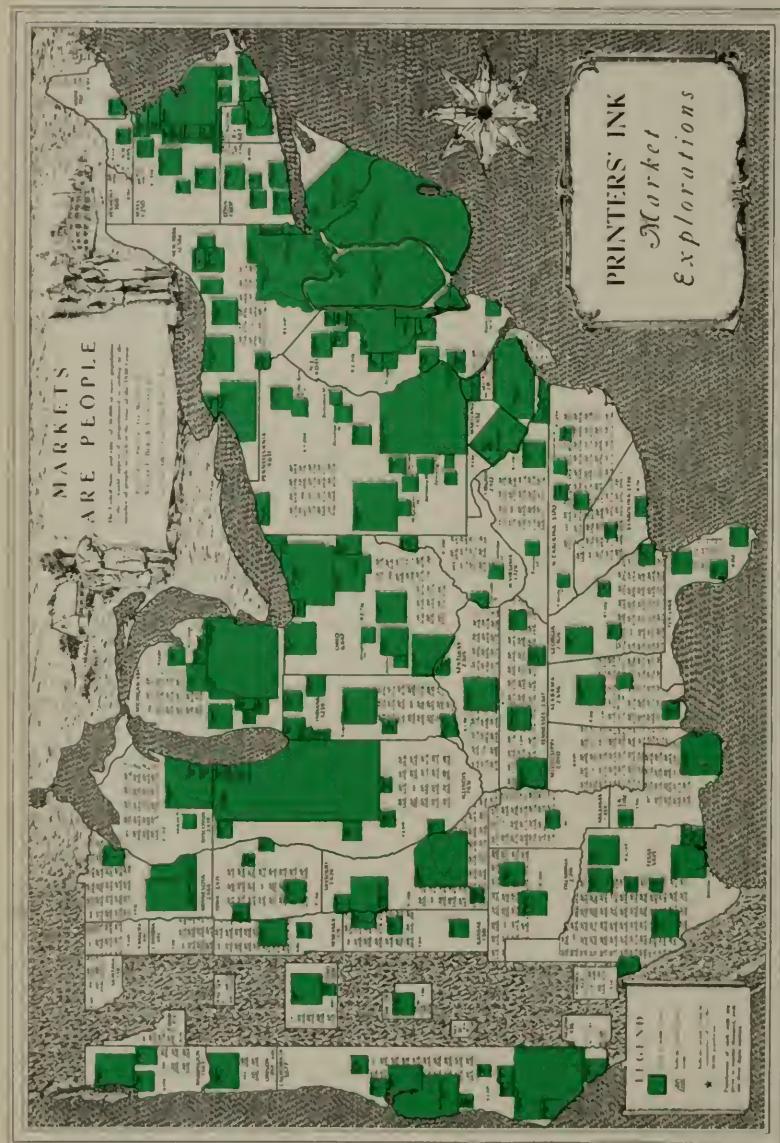


Public Utilities Fortnightly, February 3, 1938, Washington, D. C.

How Each State Shared in PWA Allotments for Non-Federal Power Projects as of July 1, 1937.

Only a slight attempt was made to maintain the geographical location of each of the states.

When a chapter name or number is given as a reference, turn to the Topical Index, either on Page 1 or Page 247, and spin pages to the desired chapter.



Printers' Ink Publishing Co., Inc., Chart by Walter P. Burns and Associates, Inc., New York City.

A Distorted Map of the United States Showing Population of Each State and of Cities of 50,000 or More in 1930.

The presentation of cities whose areas are proportional to their population is the outstanding feature of this map. This illustrates the validity of the comments in 179A.

Chapter 30

RATING CHARTS

IN RATING charts, the "rank" of items is presented in graphic form. The arrangement of the material is determined by the quantitative value of each item.

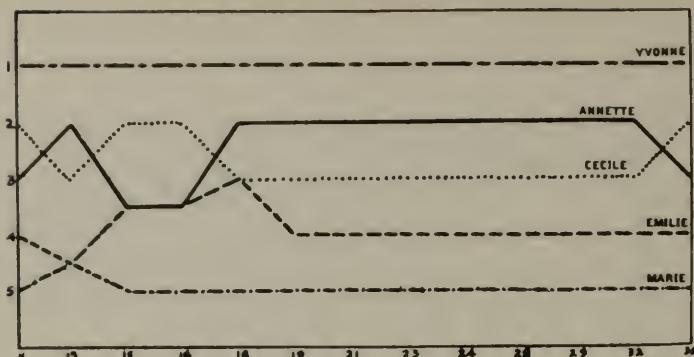


American Iron & Steel Institute, New York City, "Safety in Steel," December 1938.

The Safety-Record Rating of the Steel Industry in the United States From 1934 to 1937.

The rating chart is a relatively simple kind of graphic chart and may take a variety of forms. This chart merely gives the position of "Steel" on a safety score board in 1-2-3 order.

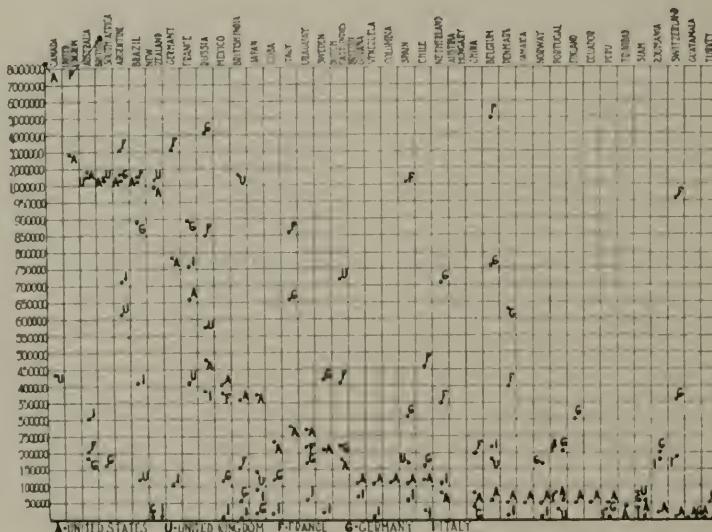
GRAPHIC PRESENTATION



From "Collected Studies of the Dionne Quintuplets" by W. E. Blatz et al., St. George's School for Child Study, University of Toronto, 1937. Reproduced by Permission of the Authors.

A. A Comparison of the Records of Each of the Dionne Quintuplets in Mental Development From 12 to 35 Months of Age.

1. Converted into this form, the progress of each of the quintuplets in comparison with the others is easily followed.
 2. Compare this form with 243 and 245.



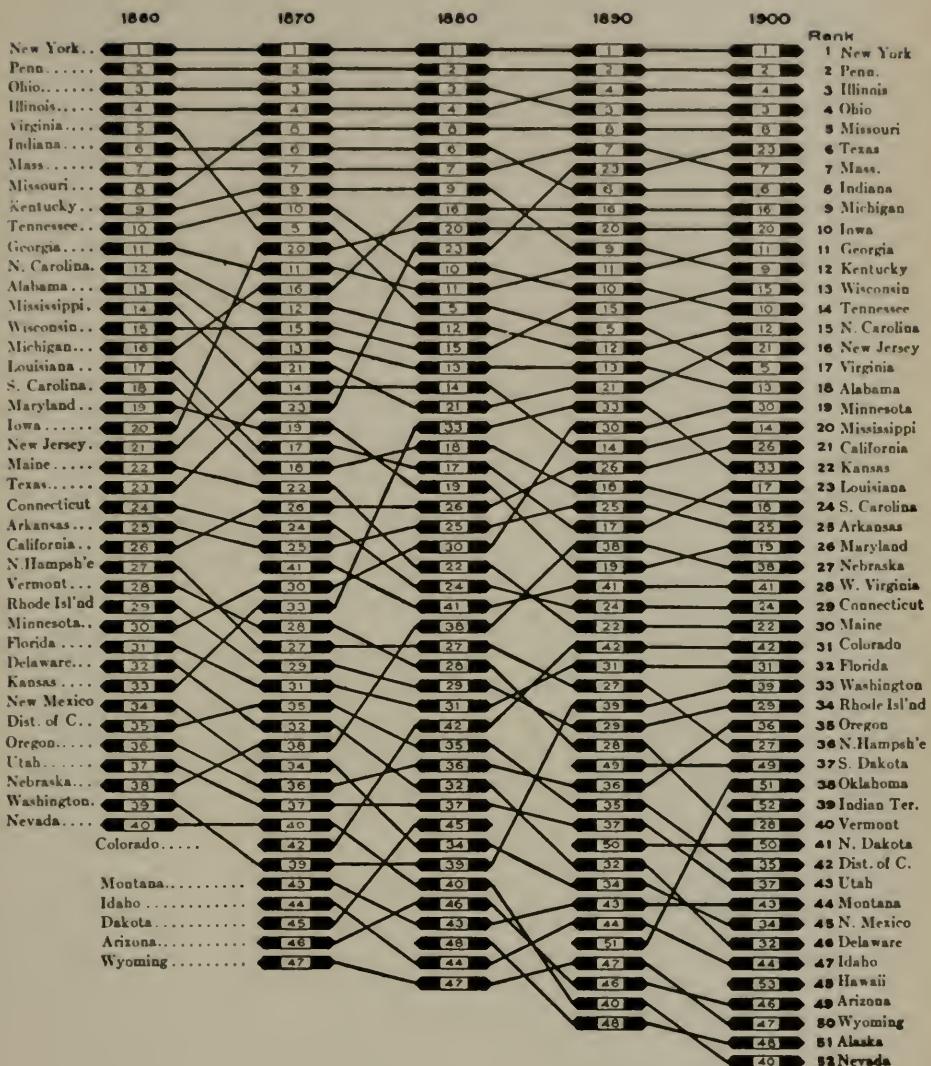
Automotive Industries, June 12, 1919.

SCALE .5

B. Pre-War Status of Automobile Shipments to Forty Principal Nations in the World.

1. This tabulation-form of rating chart is not as clear as other forms.
 2. It is read as follows: taking the column under Canada, the United States shipped over 8,000,000 automobiles to Canada, while the United Kingdom was the only other country among the 40 principal nations that shipped any to Canada.

RATING CHARTS



W. C. Brinton, "Graphic Methods," McGraw-Hill, 1914.

SCALE .9

Rank of States and Territories in Population at Different Census Years From the Civil War to the Beginning of the Twentieth Century.

The column at the left gives the key number for each state, while the column at the right gives the rank of the state in 1900.

GRAPHIC PRESENTATION

		Share of		Argentina	Bolivia	Brazil	Chile	Colombia	Ecuador	Paraguay	Peru	Uruguay	Venezuela
		in exports of.....	in imports of.....	*	*	-	*	*	*	+	*	*	*
Uruguay	in exports of.....	*	*	*	*	*	*	*	*	-	*	*	*
Uruguay	in imports of.....	*	*	*	*	*	*	*	*	+	*	*	*
Colombia	in exports of.....	*	*	*	*	*	-	*	*	*	*
Colombia	in imports of.....	*	*	*	*	*	*	*	*	*	*
Netherlands West Indies	in exports of.....	*	*	*	*	*	+	*	*	*	+	*	+
Netherlands West Indies	in imports of.....	*	*	*	*	*	*	*	*	*	*	*	+
India	in exports of.....	*	*	*	*	*	*	*	*	*	*	*	*
India	in imports of.....	+	*	*	*	-	*	*	*	+	*	*	*
Spain	in exports of.....	*	*	*	*	*	*	*	*	*	*	+	*
Spain	in imports of.....	*	*	*	*	*	-	+	*	*	*	-	-
Sweden	in exports of.....	*	*	*	+	*	+	*	*	*	*	*	*
Sweden	in imports of.....	*	*	+	*	*	+	*	*	*	*	*	*
Venezuela	in exports of.....	*	*	*	*	*	*	*	*	*	*	*	*
Venezuela	in imports of.....	*	*	*	*	*	+	*	*	*	*	*	*
Denmark	in exports of.....	+	*	*	*	*	*	*	*	*	*	*	*
Denmark	in imports of.....	*	*	*	*	*	*	*	*	*	*	*	*
Norway	in exports of.....	*	*	*	*	*	*	*	*	*	*	*	*
Norway	in imports of.....	*	+	*	*	*	*	*	*	*	*	*	*
Portugal	in exports of.....	*	*	*	*	*	*	*	*	*	*	*	*
Portugal	in imports of.....	*	*	-	*	*	*	*	*	*	*	*	*
Trinidad	in exports of.....	*	*	*	*	*	*	*	*	*	*	*	+
Trinidad	in imports of.....	*	*	*	*	*	*	*	*	*	*	*	*
All others	in exports of.....	+	-	+	-	-	-	-	-	-	+	-	-
All others	in imports of.....	+	-	+	+	-	-	+	-	-	+	+	+

* Not among ten leading trading nations.

Increases (+)

Decreases (-)

Chamber of Commerce of U. S., Foreign Commerce Dept., Washington, D. C., "South America's Trade," 1938.

Increases and Decreases in the Share of Important Trading Nations in the Trade of Each South American Republic From 1936 to 1937.

This chart is read as follows: from 1936 to 1937, the exports of Paraguay to Uruguay decreased, as indicated by the minus sign, while the imports of Paraguay from Uruguay increased, as indicated by the plus sign.

In this book, an illustration occupying a full page is referred to by page number. When there is more than one illustration on a page, each is identified by a letter of the alphabet. When there is more than one footnote beneath an illustration, each is numbered. Thus the cross reference 267B2 means page 267, illustration B, note 2.

TOPICAL INDEX (2nd Half)

247

*Place right thumb on triangle, fingers inside back cover.
Spin pages to desired chapter.*

- | | |
|----------------|--|
| 248-255 | 31. Chronology Charts — |
| 256-262 | 32. Progress Charts — |
| 263-274 | 33. Curve Charts — |
| 275-285 | 34. Comparisons with Two Curves — |
| 286-293 | 35. Comparisons with Curves — |
| 294-300 | 36. Component Parts Shown by Curves — |
| 301-309 | 37. Index Numbers Shown by Curves — |
| 310-319 | 38. Frequency Charts — |
| 320-330 | 39. Correlation Charts — |
| 331-338 | 40. Ogive and Lorenz Charts — |
| 339-353 | 41. Ratio Charts — |
| 354-359 | 42. Three-Dimensional Methods — |
| 360-366 | 43. Composite Charts — |
| 367-380 | 44. Suggestions for Making a Chart — |
| 381-396 | 45. Standards for Time Series Charts — |
| 397-404 | 46. The Camera and Its Use — |
| 405-409 | 47. Lantern Slides — |
| 410-422 | 48. Preparation of Illustrations — |
| 423-428 | 49. Color and Its Use — |
| 429-434 | 50. Methods of Reproducing — |
| 435-442 | 51. Methods of Printing — |
| 443-448 | 52. Selection of Paper — |
| 449-453 | 53. Binding Techniques — |
| 454-463 | 54. Graphic Charts in Advertising — |
| 464-474 | 55. Quantitative Cartoons — |
| 475-485 | 56. Quantitative Posters — |
| 486-493 | 57. Displays and Exhibits — |
| 494-496 | 58. Dioramas — |
| 497-500 | 59. Graphic Charts in Conference Rooms — |
| 501-505 | 60. Glossary — |
| 506-511 | Index — |

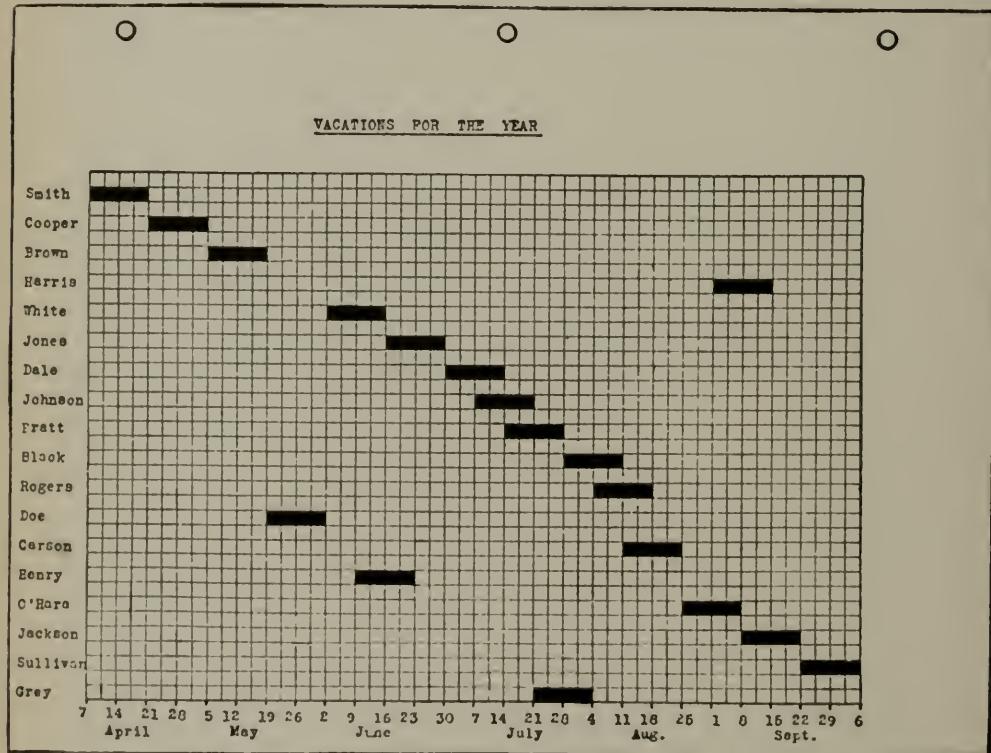
(For 1st Half of TOPICAL INDEX, See Page 1)



Chapter 31

CHRONOLOGY CHARTS

The practice of showing time as a straight line is utilized in making chronology charts. Often the line is widened to make it possible to shade sections. Both quantitative and qualitative data may be presented.



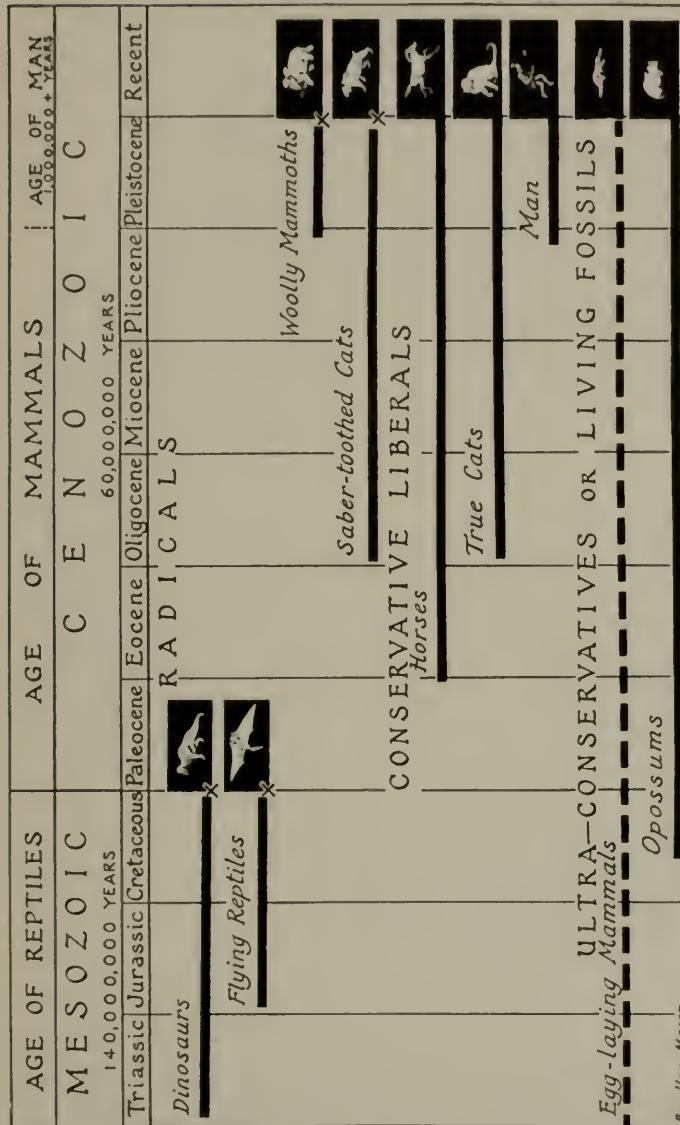
Brinton, "Graphic Methods," McGraw-Hill, 1914.

SCALE .9

Chart for Assigning Vacation Periods in a Large Office.

With such a chart, one can see at a glance just how many persons from an office will be gone at the same time. This form is valuable in planning vacations so that two persons doing the same type of work will not be on vacation.

CHRONOLOGY CHARTS



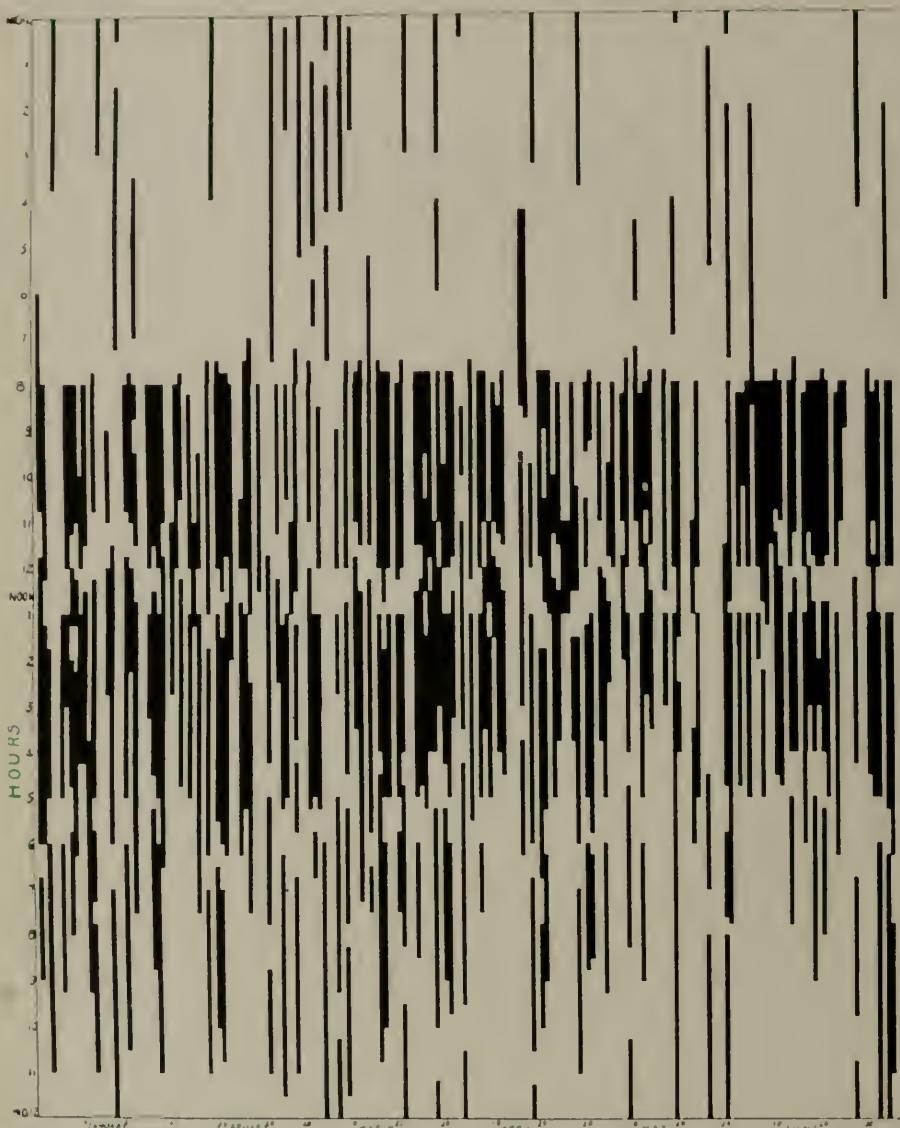
Erich M. Schlaikjer, "Living Prehistoric Animals," Natural History, February 1937.

The Length of Existence of Three Classes of Animals—Radicals, Conservatives, and Ultra-Conservatives—Showing Graphically That the Opossums and Egg-Laying Mammals Belong to Another World. They Are "Living Relics from the Mesozoic."

1. In thinking of time as a straight line, we often start a new line for the beginning of each new item, and when that item is ended the line stops. Here lines are used to illustrate the periods of time during which different kinds of animals lived.
2. The visual captions make the titles more clear and demonstrate that graphic charts can be a universal language.

SCALE 6

GRAPHIC PRESENTATION



F. P. Foister, "Decasualizing Longshore Labor and the Seattle Experience," Waterfront Employers of Seattle, Wash., February 1, 1934.

SCALE .7

Exact Hours and Days Worked in 1929 by the Highest-Earnings Holdman in Oregon Ports.

The extreme irregularity of the work of longshore labor is shown in this study. The black sections show the number of hours worked per day according to the scale at the left, and the scale at the bottom shows the days.

CHRONOLOGY CHARTS

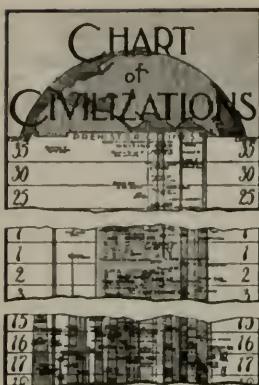


F. P. Forise, "Decasualizing Longshore Labor and the Seattle Experience," Waterfront Employers of Seattle, Wash., February 1, 1934. SCALE 7

The Working Year of Pacific Lighterage Corporation Deep Sea Gangs by Days for 1932, Showing Analysis of Broken Working Time and Leisure Time.

Presented along a horizontal line instead of in a circle, this study would have taken a great deal more space. In this form it is concise and adequate for the purpose.

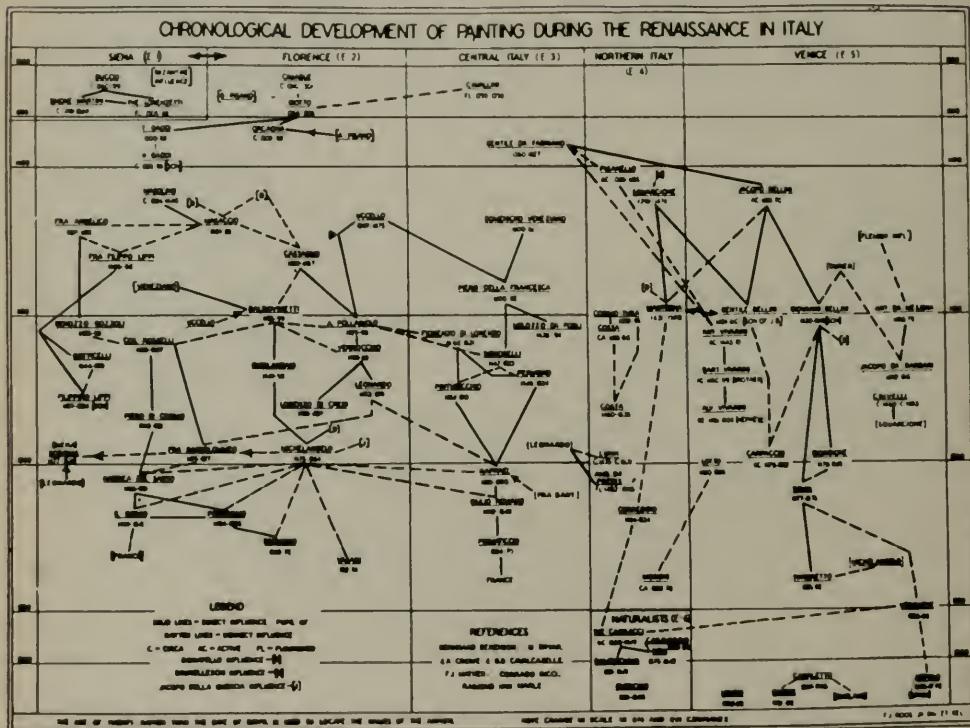
GRAPHIC PRESENTATION



Courtesy of M. F. Gelletly, Baltimore, Md.
SCALE .8

A. Three Cross Sections of a Chart of Civilizations.

The original of this chart is 14½ by 54 inches, in nineteen colors, and shows history of civilization from 3500 B.C. to date.



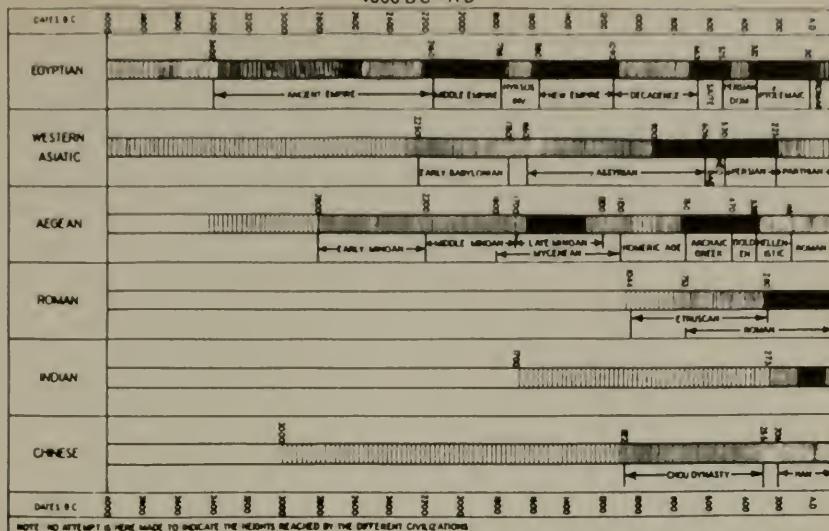
Frank J. Roos, "An Illustrated Handbook of Art History," Macmillan Co., New York City, 1937.
SCALE .6

B. Chronological Development of Painting During the Renaissance in Italy.

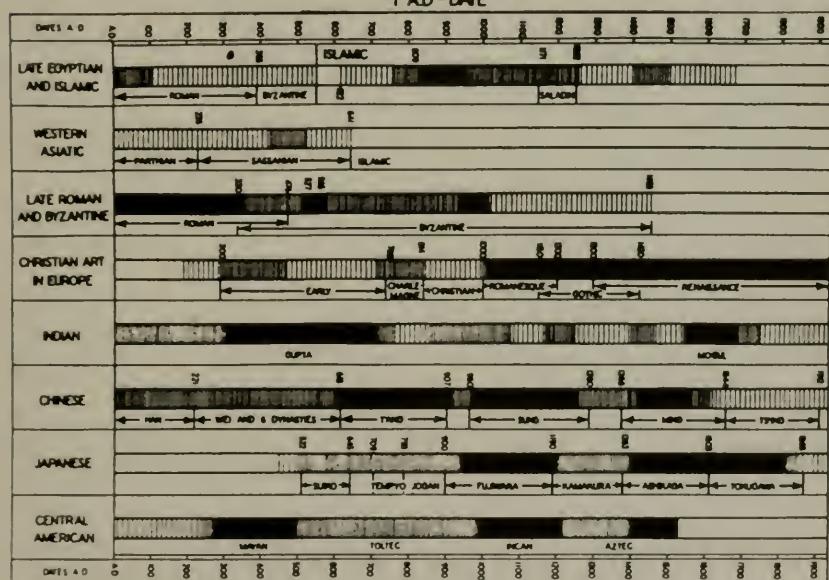
1. Most people are familiar with the blackboard illustration showing how the lives of writers, philosophers, or rulers overlap, with time represented as a straight line.
2. This chart shows the influence of Italian painters during the Renaissance upon others, as well as the chronological place of each painter.

CHRONOLOGY CHARTS

4000 BC AD



I AD-DATE



LEGEND - BASED ON THE MAJOR AND MINOR ARTS

[Hatched] PERIOD OF DEVELOPMENT, OR LAST STAGES OF DECADENCE [Solid Black] PERIOD OF TRANSITION, OR DECADENCE [White] HEIGHT OF THE ARTISTIC EVOLUTION OF THE CIVILIZATION

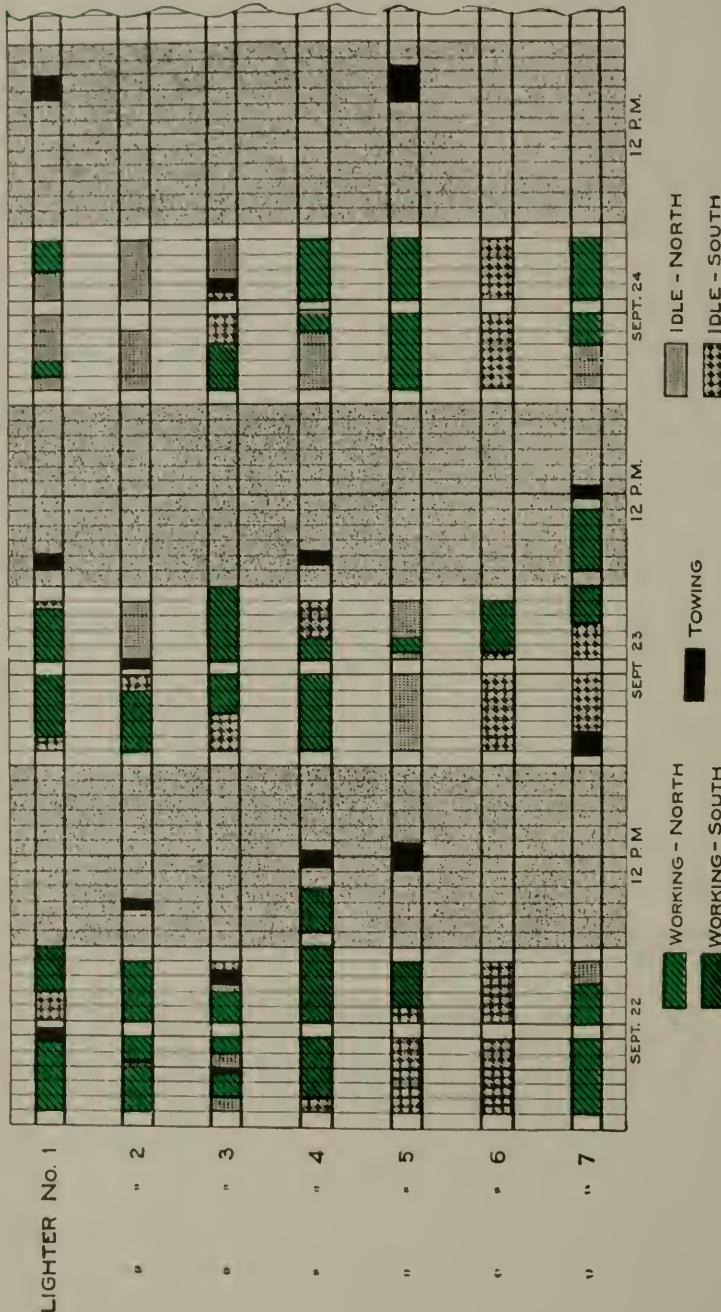
Frank J. Roos, "An Illustrated Handbook of Art History," Macmillan Co., New York City, 1937.

SCALE .6

Chronological Development of Art Periods From 4000 B.C. to 1937.

The shading of the bars indicates gradations in the development of art, and thus gives meaning to art periods named beneath the bars.

GRAPHIC PRESENTATION



Brinton, "Graphic Methods," McGraw-Hill, 1914.

Chart Showing the Operation of Seven Freight Lighters in New York Harbor.

1. Each horizontal bar represents one lighter. The gray vertical areas represent night hours from 6 p.m. to 6 a.m.
2. In the original chart, of which this is just a part, the use of colors presented the information much more clearly.

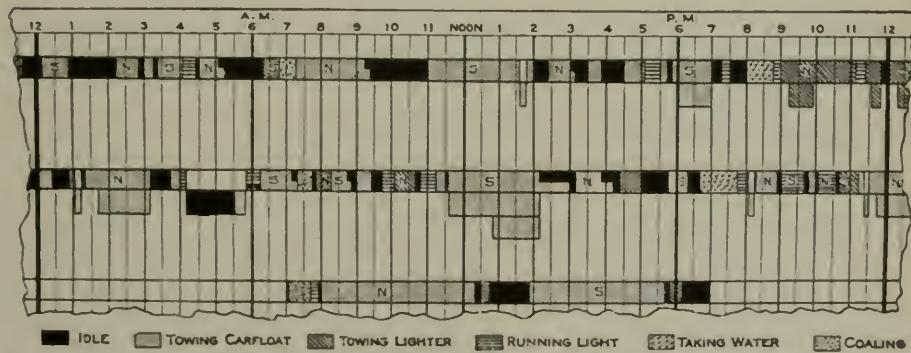
CHRONOLOGY CHARTS



Electric Storage Battery Co., Philadelphia, "Exide-Ironclad Topics," May 1933.

A. Study of the Time Spent Delivering Milk on Seven Different Routes.

The purpose of this chart is to compare the length of time spent delivering milk by horse-wagon with the time spent delivering milk by electric truck.



W. C. Brinton, "Graphic Methods," McGraw-Hill, 1914.

B. Operations of Three Tug-boats in New York for Twenty-four Hours. The Boat Represented by the Lower Bar is in Service for a Twelve-Hour Shift Only

A working chart of this kind would usually be made on a long strip of co-ordinate paper. The illustration was drawn entirely by hand to show the possibilities of hand cross-hatching for bringing out information ordinarily shown in several colors.

Chapter 32

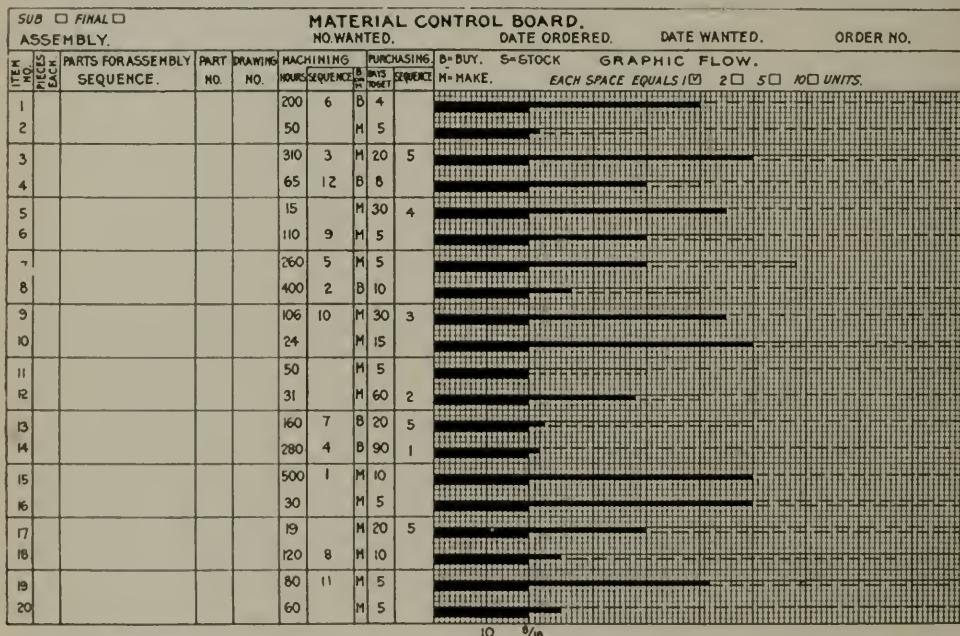
PROGRESS CHARTS

Synonyms for progress charts as used in this chapter are schedule charts, Gantt charts, procedure charts, process charts, production control charts.

REFERENCES

Clark, Wallace, *The Gantt Chart. A Working Tool of Management*, The Ronald Press Co., New York City, 1922.

Gantt, H. L., "Organizing for Work," *Industrial Management*, Vol. LVIII, August 1919 (Now *Factory Management and Maintenance*).



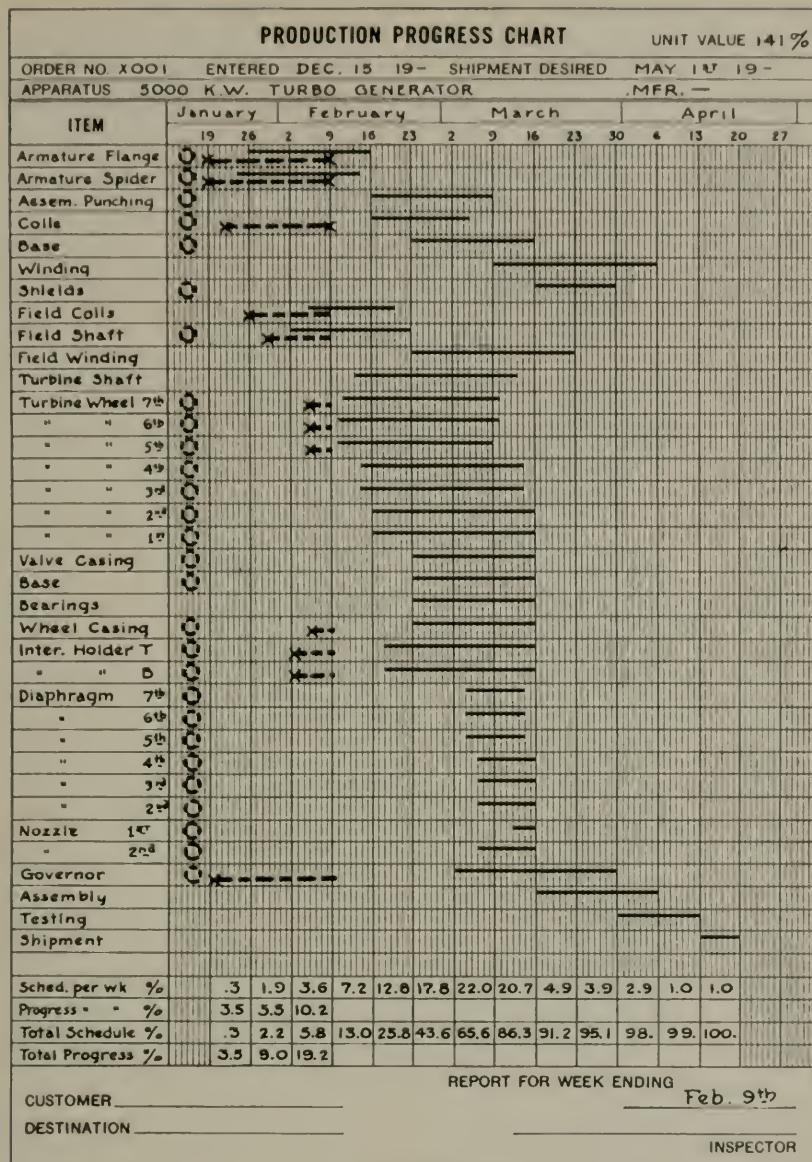
Industrial Management, December 1918.

SCALE .9

A Material Control Board

The dotted lines represent orders received. The straight lines represent materials received. The dotted lines beneath the straight lines represent orders on the factory departments. The full lines represent completion of that number of pieces.

PROGRESS CHARTS



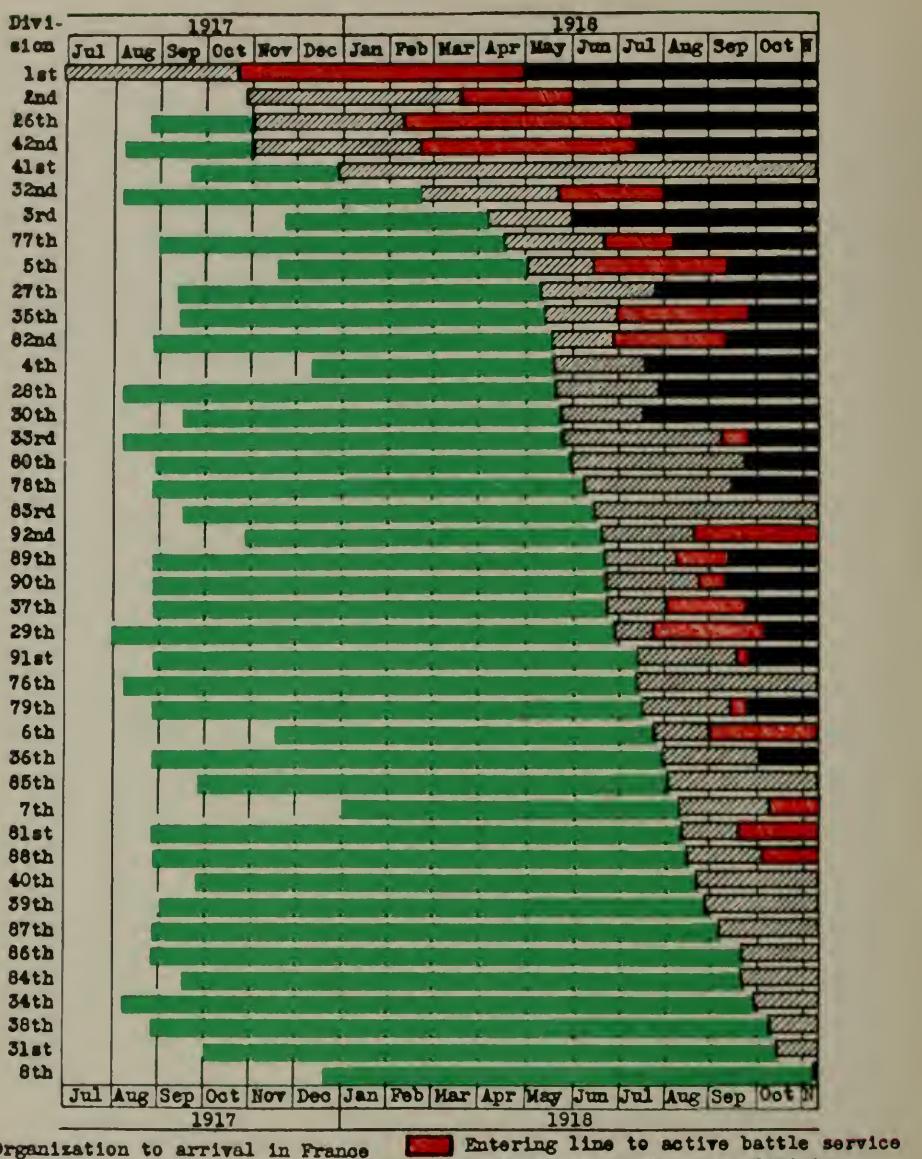
Factory, December 1919.

SCALE .9

A Production Progress Chart.

1. The solid black lines represent the schedule, while the dotted lines represent the progress made to date.
2. Note the percentage schedule per week and total at the bottom of the chart. This indicates that the job has progressed faster than schedule.

GRAPHIC PRESENTATION



Leonard P. Ayres, "The War With Germany," Government Printing Office, 1919.

A Time Study of the Various Divisions of the United States Army During the World War.

It would be interesting to have an analysis of the reasons why certain divisions, although they arrived in France before others, did not enter the line until long after and sometimes did not enter the line at all.

PROGRESS CHARTS

259

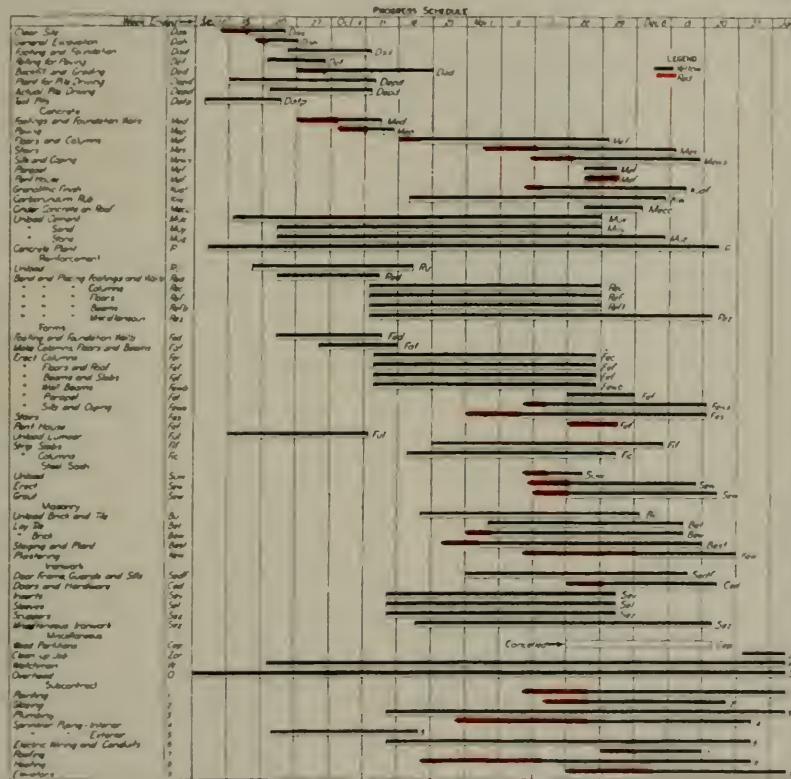
A. Progress Chart for a Catalog Production Job.

1. While each company may have its own, some form of progress chart aids in determining where certain jobs are, how far they have progressed, and how much more has to be done before the job is completed.
2. The use of colors makes a progress schedule valuable for display.

		YELLOW TACK	WHITE TACK	RED TACK	COPYCAT TACK	BLACK TACK	READY TO PRINT
		SELECTED	PRINTING	PUBLISHED	BACK IN HOUSE	FINAL CP.	POSTER
		DAINTISTS					POWER
PAGE	DEPT.						
1	Cover	●	●	●			
1	Inside Cover	●	●	●			
1	Introductory						
2	Dresses (2)	○	○	○	●	●	●
3	" (2)	○	○	○	●	●	●
4	" (2)	○	○	○	●	●	●
5	" (2)	○	○	○	●	●	●
6	" (3)	○	○	○	●	●	●
7	" (3)	○	○	○	●	●	●
8	" (4)		○	○	●	●	●
9	" (4)		○	○	●	●	●
10	" (4)		○	○	●	●	●
11	" (4)		○	○	●	●	●

Joseph R. Bolton, "Get the Catalog Out on Time," Printers' Ink, November 15, 1917.

SCALE .6



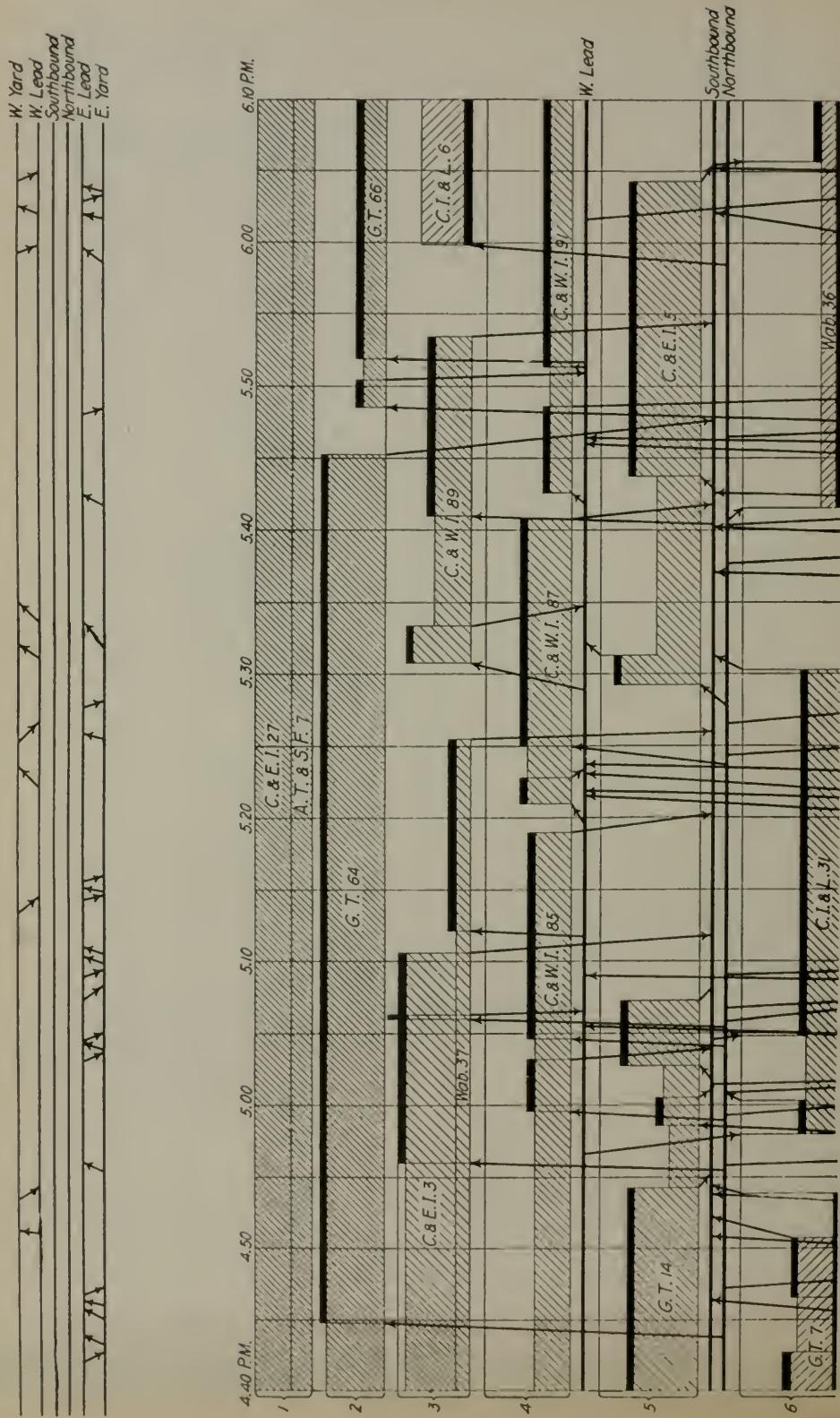
Engineering News-Record, February 3, 1917.

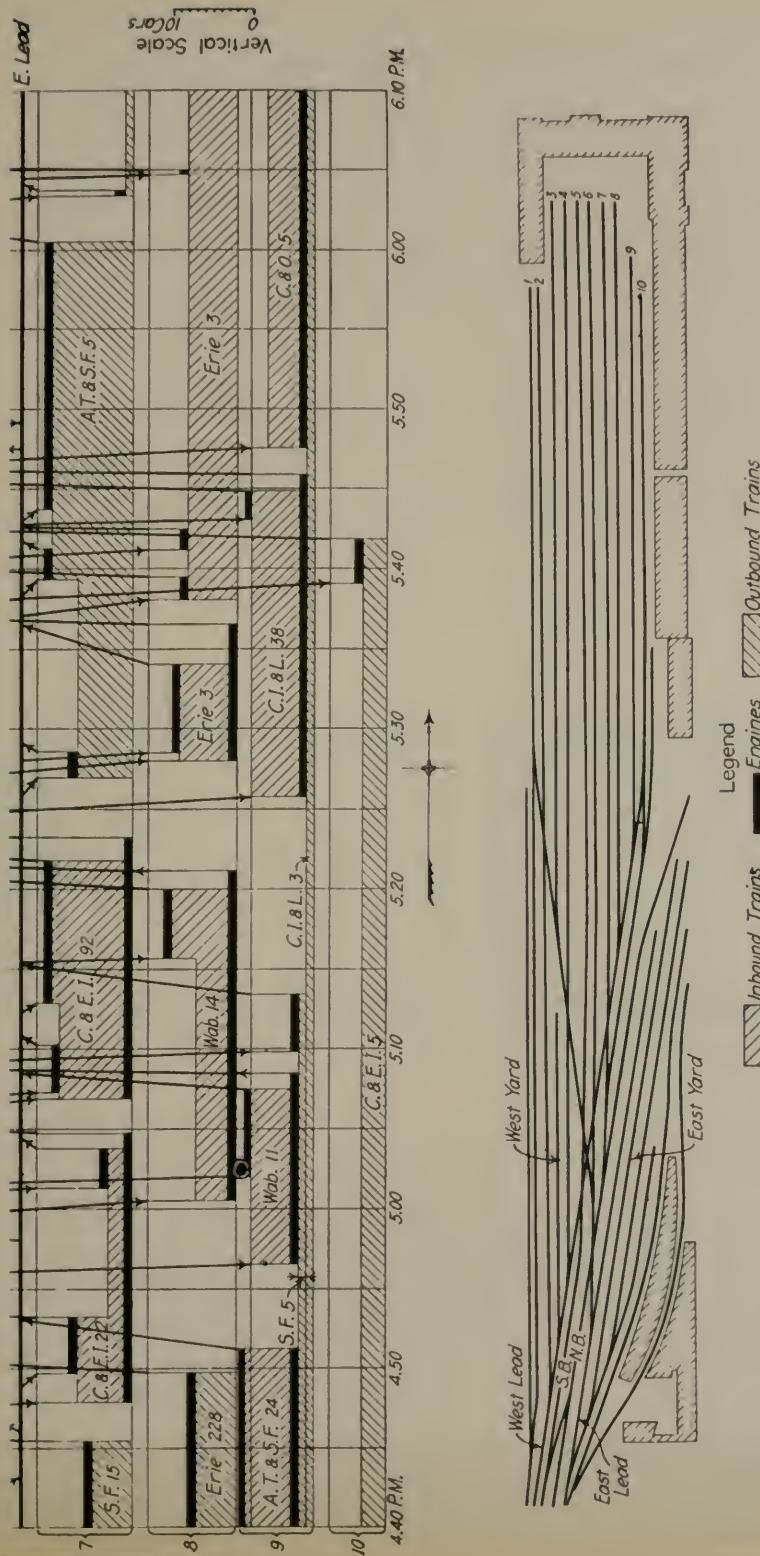
SCALE 6

B. Progress Schedule.

During the progress of the job, the horizontal lines in color, represented the quantity of work done.

GRAPHIC PRESENTATION





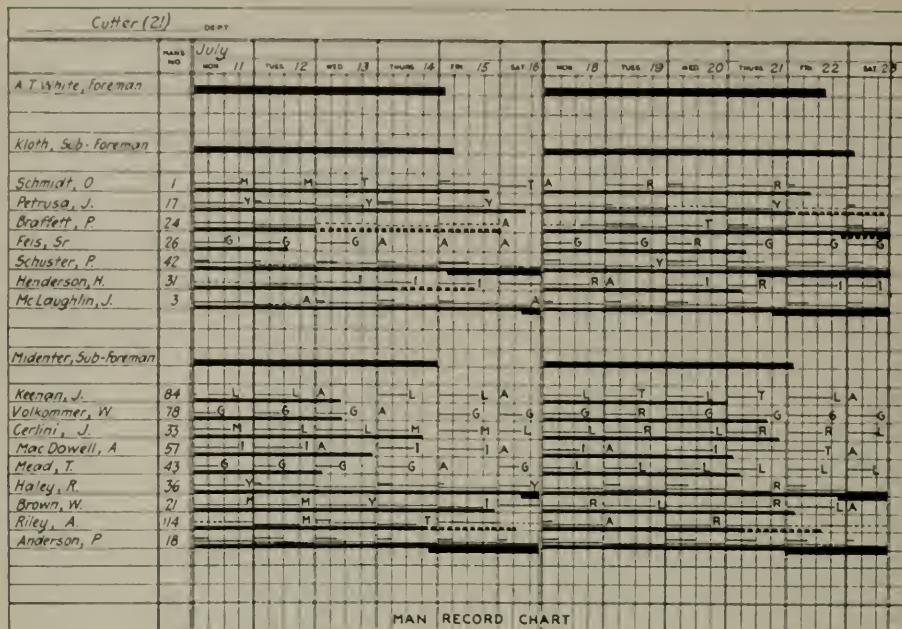
Engineering News-Record, October 9, 1915.

Dovetailing of Train and Engine Movements in Dearborn Terminal, Chicago, During Evening Rush Hour.

For another example of a train time-table see Brinton, *Graphic Methods*, McGraw-Hill, 1914, page 67. The chart "Train Chart for Bald Eagle Valley for February 3, 1912" shows train movement over an extremely busy single-track railroad.

SCALE .9

GRAPHIC PRESENTATION



LEGEND

- Width of daily space represents amount of work that should have been done in a day.
- Amount of work actually done in a day.
- - - Time taken on work on which no estimate is available.
- Total of operator. Solid line for estimated time; broken line for time spent on work not estimated.
- Total for group of operators.
- Total for department.

The portion of the daily space through which no line is drawn shows how much the man has fallen behind what was expected of him.

REASONS FOR FALLING BEHIND

- | | |
|------------------------|--|
| A—Absent | R—Repairs needed |
| G—Green operator | T—Tool trouble |
| I—Lack of instructions | V—Holiday |
| L—Slow operator | Y—Smaller lot than estimate is based on. |
| M—Material trouble | |
- When there is more than one reason for failure to do the work in estimated time, the reason entered on chart is determined by asking questions in the following order.
- R—Was the machine in good condition?
- T—Were the tools and fixtures in good condition?
- I—Was the operator given proper instructions and sufficient information?
- M—Was trouble experienced with material?
- G—Was the operator too green to do the job?
- L—Was the operator too slow?
- Y—Was the lot smaller than estimate is based on?

Wallace Clark, "The Gantt Chart—II," Management Engineering, September 1921.

SCALE .7

A Gantt Man Record Chart

This chart is one type of those identified as Gantt Charts, developed by the organization of the late Henry L. Gantt.

REFERENCES

- Knoepfel, Charles E., *Graphic Production Control*, McGraw-Hill Book Co., Inc., New York City, 1920.
- Smith, W. H., *Graphic Statistics in Management*, McGraw-Hill Book Co., Inc., New York City, 1924.

Chapter 33

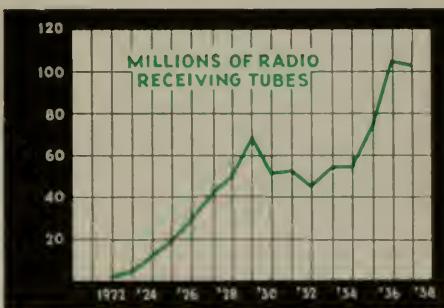
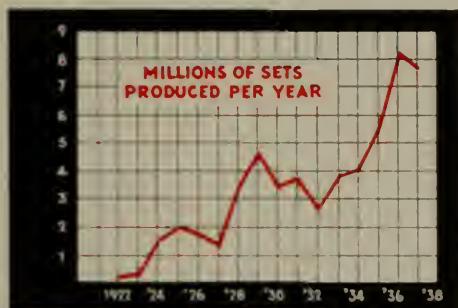
CURVE CHARTS

The curve charts in this chapter are only those having one curve on a grid. This includes those having visual captions. The chapters up through page 366 cover other types of curve charts.

REFERENCES

Karsten, Karl G., *Charts and Graphs*, Prentice-Hall, Inc., New York City, 1923.

Riggleman, John R., and Ira N. Frisbee, *Business Statistics*, 2nd edition, 1938, McGraw-Hill Book Co., Inc., New York City.

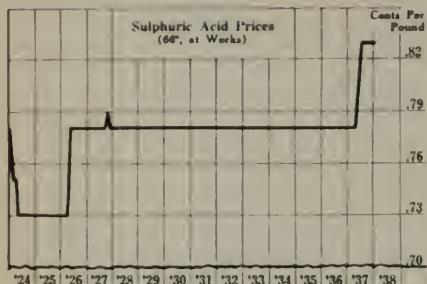


Electronics, October, 1938.

Number of Radio Sets and Radio Receiving Tubes Built in the United States from 1922 to 1937

1. The curves in these charts illustrate the plotting of a curve on a grid.
2. The points are plotted on the vertical rulings and a connecting line is drawn through each point.
3. In plotting a curve, there are two variables, the independent and the dependent. In these curves, the time scale indicates the independent variable, and the amount scale the dependent variable.

GRAPHIC PRESENTATION



Standard Statistics, Inc., N. Y. C., "Standard Trade and Securities," March 4, 1938.

SCALE .6

Abstracts from *Time Series Charts. A Manual of Design and Construction*, 1938, prepared by Committee on Standards for Graphic Presentation, under procedure of American Standards Association, with The American Society of Mechanical Engineers as sponsor body.

TIME-SERIES LINE CHARTS

The "time-series line chart" is the type in which values of a time series are plotted on a coordinate surface and the points joined together successively to form a continuous line or "curva." The line chart has a wide range of application and in most cases is relatively easy to construct and maintain.

A. THE LINE CHART SHOULD GENERALLY BE USED:

1. For series where there are many successive values to be pictured.
2. Where several series are shown for comparison on the same chart.
3. For close reading or interpolation.
4. When the emphasis should be on the movement rather than on the actual amounts.
5. When the chart is to be used for the projection of trends.

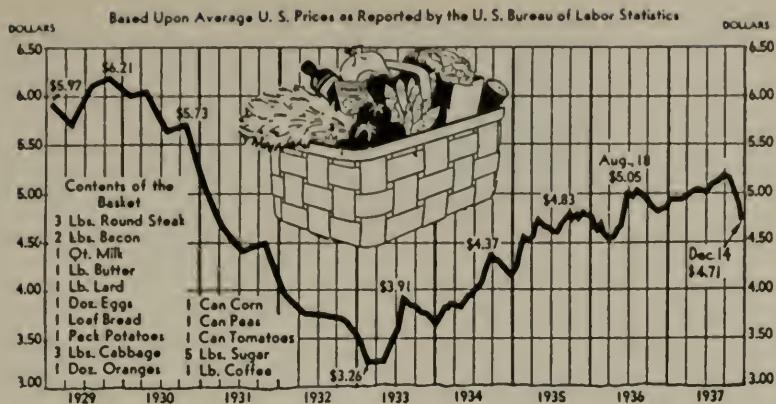
B. THE LINE CHART MAY NOT BE THE BEST TYPE:

1. Where there are relatively few plotted values in the series.
2. Where the emphasis should be on the change in amounts rather than on the movement of the series.
3. To emphasize the difference between values or amounts on different dates.
4. When the movement of the data is extremely violent or irregular.
5. When the presentation is designed for popular appeal.

A. Sulphuric Acid Prices in the United States From 1924 to 1938.

Often a curve chart takes the appearance of a stair chart when prices which remain stable over a long period of time are presented. This should not be confused with such charts as 135B.

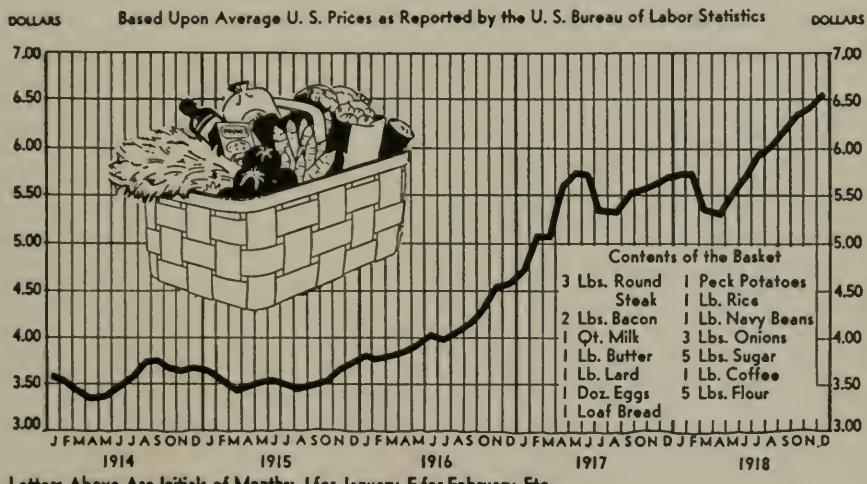
CURVE CHARTS



Chicago Tribune, "The 1938 Chart Book," February 22, 1938.

A. The Cost of the "Market Basket" in the United States Calculated From Government Prices From 1929 Through 1937.

It is not possible to compare the curve in this chart with the chart B below since the content of the "market basket" as listed is not the same.



Letters Above Are Initials of Months: J for January, F for February, Etc.

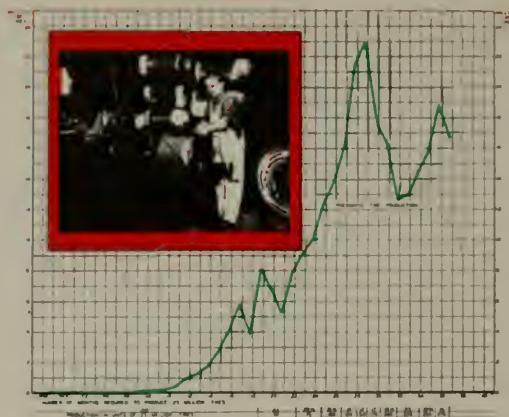
Chicago Tribune, "The 1938 Chart Book," February 22, 1938.

SCALE .8

B. The Cost of the "Market Basket" in the United States During the World War.

1. When the zero line is omitted, this is one method of indicating its absence. It might have been better if the line had been more wavy so that in reduction the irregularity would not be lost.
2. The visual caption used in this chart is very effective. By cutting an appropriate picture from a magazine or newspaper and using it in this way, a chart is easily "dressed up."

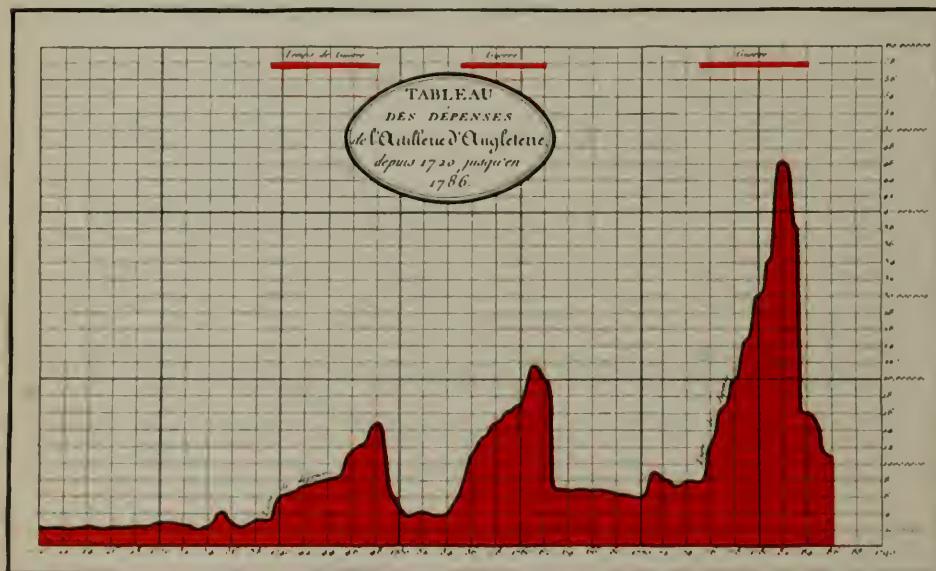
GRAPHIC PRESENTATION



The Goodyear Tire and Rubber Co., Akron, Ohio, "Annual Report to Stockholders," 1937. SCALE .5

A. Yearly Output of Goodyear Pneumatic Tires for Motor Vehicles.

1. The use of an illustration in the upper left corner is effective.
2. The small table at the bottom is read as follows: the Goodyear Tire and Rubber Company took 43 months to produce its first fifty million tires. The last report of production indicates that twenty-five million tires were produced in 15 months.

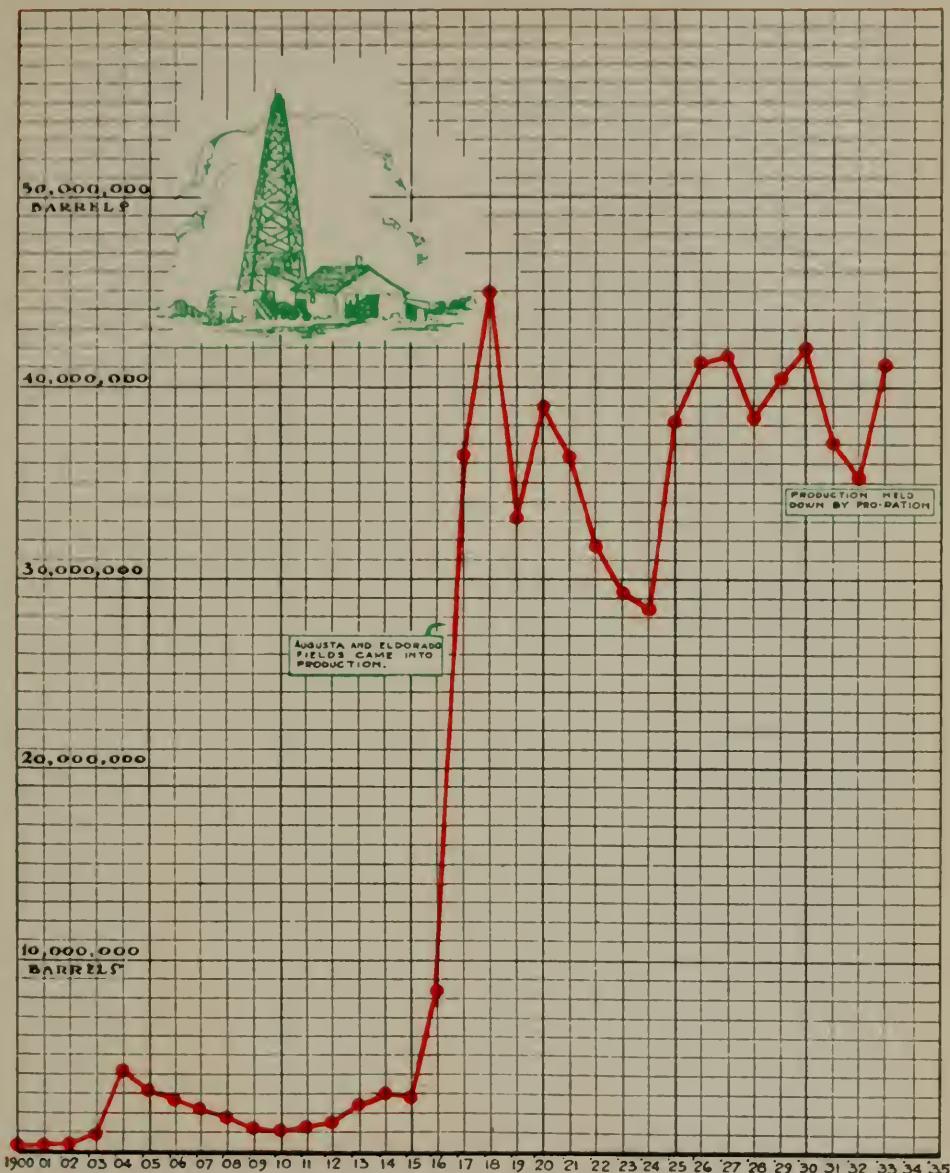


William Playfair, "Tableaux d'Arithmetique Lineaire," Paris, 1789.

SCALE .3

B. Expenditures by England for Ordnance From 1720 to 1786.

1. This is one of the first graphic charts.
2. No doubt realizing that the three humps in the chart would raise a question, William Playfair included at the top of the chart black lines indicating "time of war."



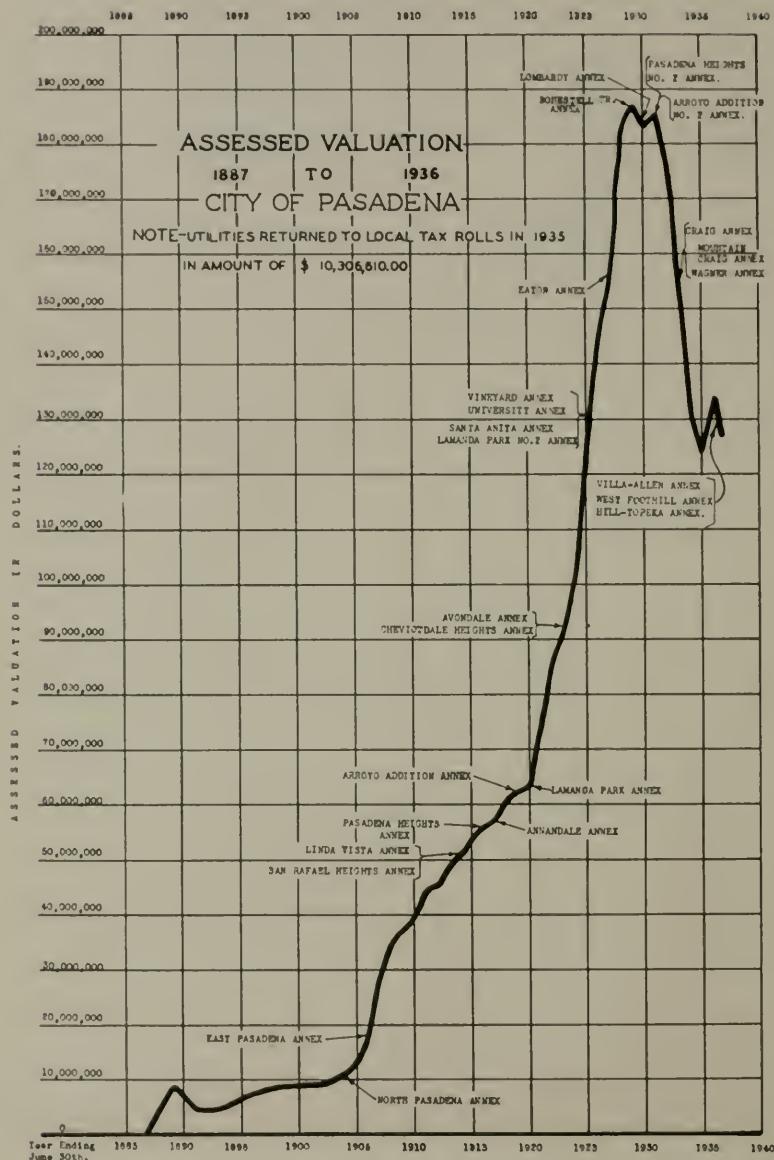
National Resources Board, State Planning, 1935.

SCALE .8

Kansas Oil Production From 1900 to 1935.

The use of illustrations on a curve chart adds to its appeal and gives some indication of the material presented. It is no problem to include a picture similar to the one shown here in a chart. A clipping from a magazine or a newspaper will suffice. See 265B.

GRAPHIC PRESENTATION



Pasadena, California, "Annual Report of the City Manager, 1936-37."

SCALE .8

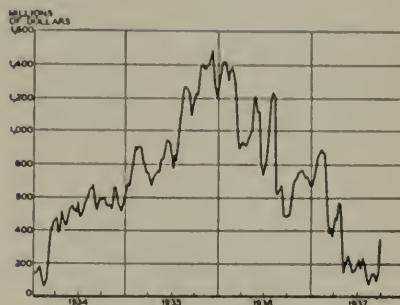
Assessed Valuation of the City of Pasadena From 1887 to 1936.

The inclusion of the notations about the annexes aids in reading this chart, since some explanation for sudden rises and falls is needed.

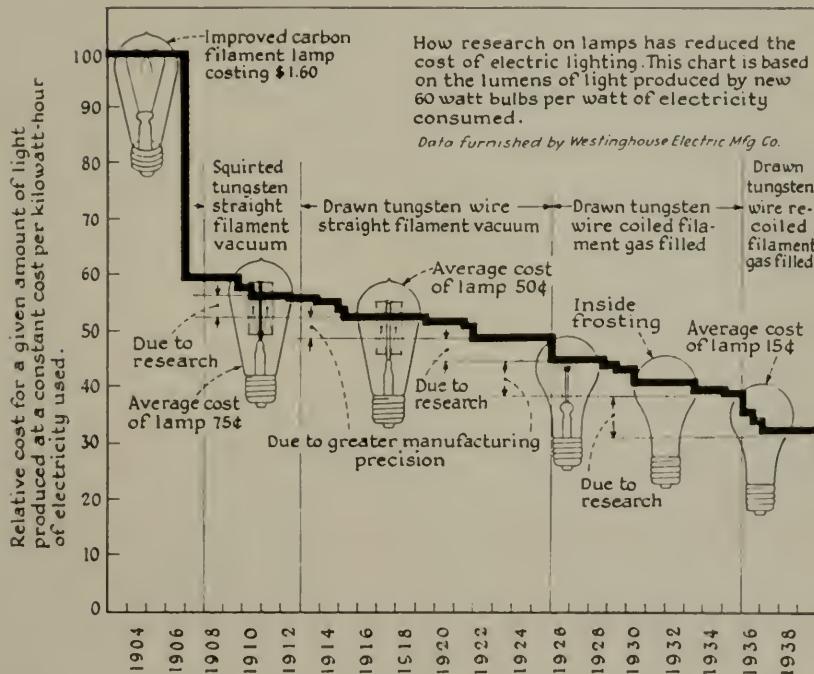
CURVE CHARTS

A. Excess Reserves of New York City Central Reserve Banks From 1934 to September 1937.

This chart presents weekly averages of daily figures.



Federal Reserve Bank of New York, "Monthly Review," October 1, 1937. SCALE .6

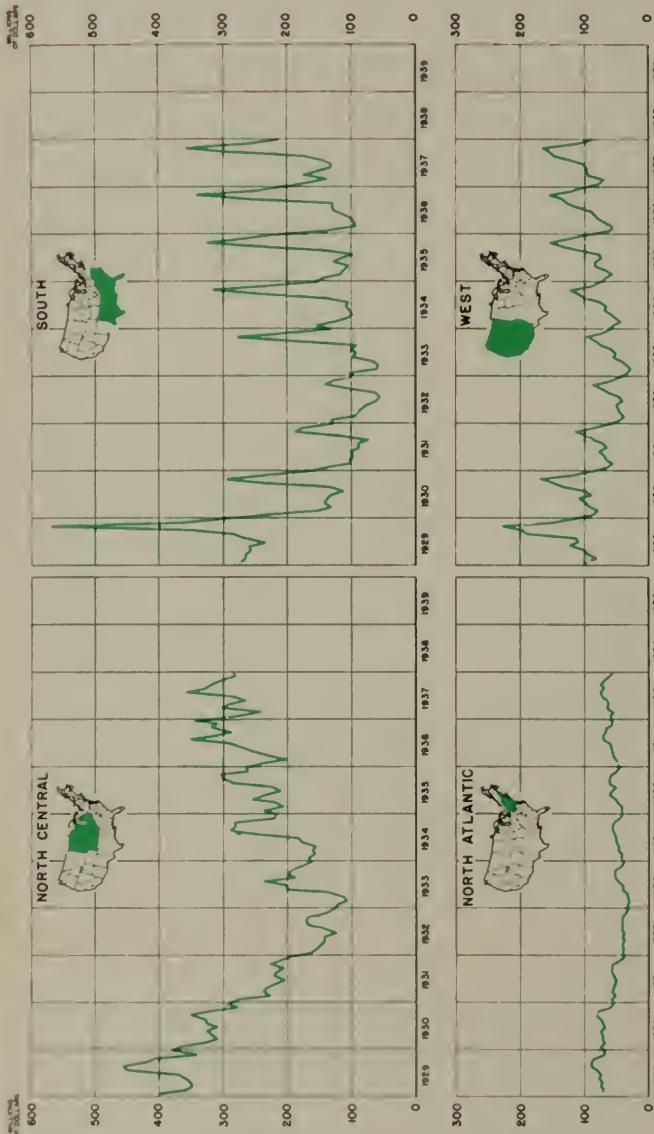


Product Engineering, October 1938. Part of an Editorial on Public Relations Entitled "Research in America—the Key to Better Living."

B. The Effect of Research on the Price and Quality of Light From 1904 to 1938.

Supplementing the information given here with further details, it is estimated that if the illumination of 1937 had been attempted with the lamps of 1900, it would have cost two billion dollars more for electricity alone at present power rates.

GRAPHIC PRESENTATION



"The Federal Chart Book," Prepared by the Central Statistical Board and National Resources Committee, January 1938.

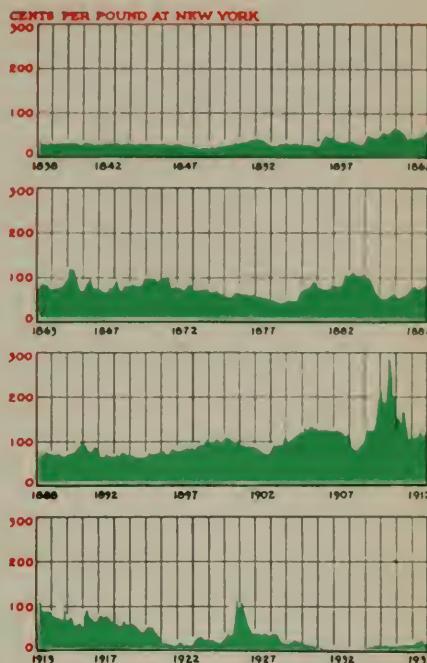
Receipts from Sales of Principal Farm Products in the Four Sections of the United States From 1929 to 1938.

1. The great fluctuation of receipts in the South as compared with the North Atlantic is the thing which stands out in these four charts.
2. Note the technique of using a shaded map of the United States to indicate the states included in each section.
3. See 93A4.

SCALE .4

CURVE CHARTS

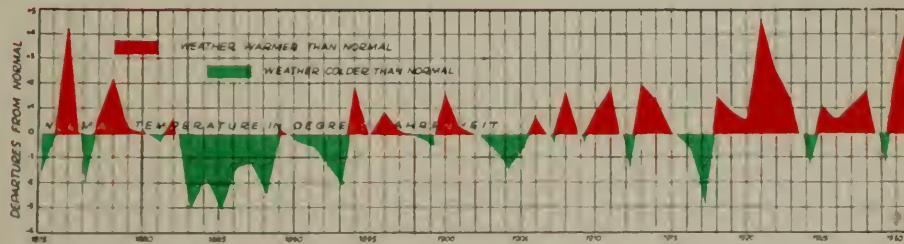
271



A. Cost of Rubber Per Pound in New York From 1838 to 1937.

When data over a long period of time is plotted in curve form, it is usually necessary to allow a great deal of space horizontally, or to condense the years so that a trend only is indicated. This method of breaking a series of years into four parts solves both these difficulties.

U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce, "Domestic Commerce," July 20, 1938. SCALE .8



Science Service Inc., Washington, D. C., "Science News Letter," February 20, 1932.

SCALE .7

B. The Deviation From Normal Temperature in Iowa From 1873 to 1931.

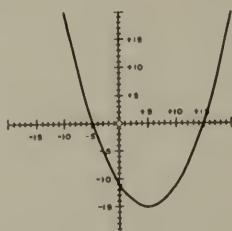
In this chart a normal was first decided upon and marked as zero. The departures from this normal, or average, were then plotted above and below the zero line. The deviations below normal are distinguished from those above normal by color.

GRAPHIC PRESENTATION

Abstracts from *Time Series Charts. A Manual of Design and Construction*, 1938, prepared by Committee on Standards for Graphic Presentation, under procedure of American Standards Association, with The American Society of Mechanical Engineers as sponsor body.

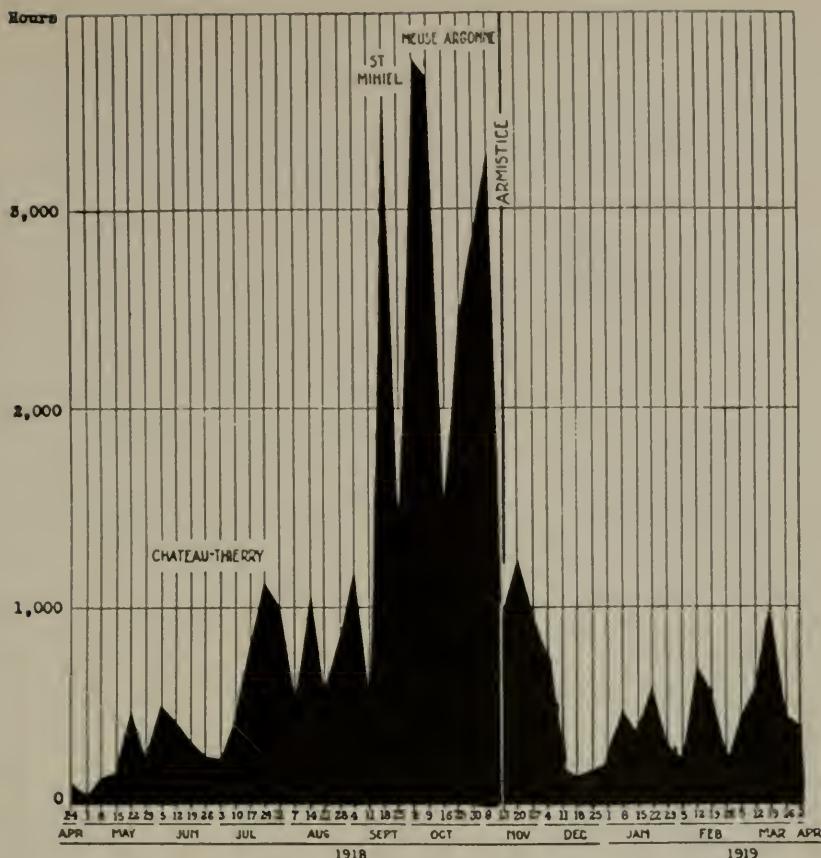
FUNDAMENTAL CONVENTIONS OF FORM

1. A Time-Series Chart is one of several types of bi-numerical scale charts. A bi-numerical scale chart is based on the conception of two-dimensional movement in a single plane.
2. The field or coordinate surface on which the values are located is formed by intersecting vertical and horizontal rulings located at measured intervals from the two principal axes.
3. It is the convention that positive values are measured upward from the horizontal axis and to the right of the vertical axis and negative values are measured downward from the horizontal axis and to the left of the vertical axis.
4. In a time-series chart the vertical or Y axis measures amount, and the horizontal or X axis measures time.
5. Time values in a time-series chart are usually represented as positive and move from left to right on the horizontal or time scale.
6. Every plotted point in a time-series chart has two values: An amount value measured on the vertical axis and a time value measured on the horizontal axis.
7. The horizontal axis, zero line or other line of reference, should be accentuated so as to indicate that it is the base for comparison of values. There is no such base for comparison for the time scale in a time-series chart, however, there being no beginning or end of time.
8. In a time-series chart the plotted points are generally joined consecutively by straight lines to form a continuous line movement which is conventionally spoken of as a curve. The points of value can be indicated by means of other graphic forms such as columns or surfaces, but the fundamental principle is the same.
9. The values on the amount scale should be continuous; and points on the scale with their corresponding horizontal rulings should reflect the actual intervals on the scale.
10. Time should be regarded as continuous with vertical rulings used to indicate only certain intervals of time. Equal intervals of time should be indicated by equal space intervals on the scale.



Mathematical graph

CURVE CHARTS



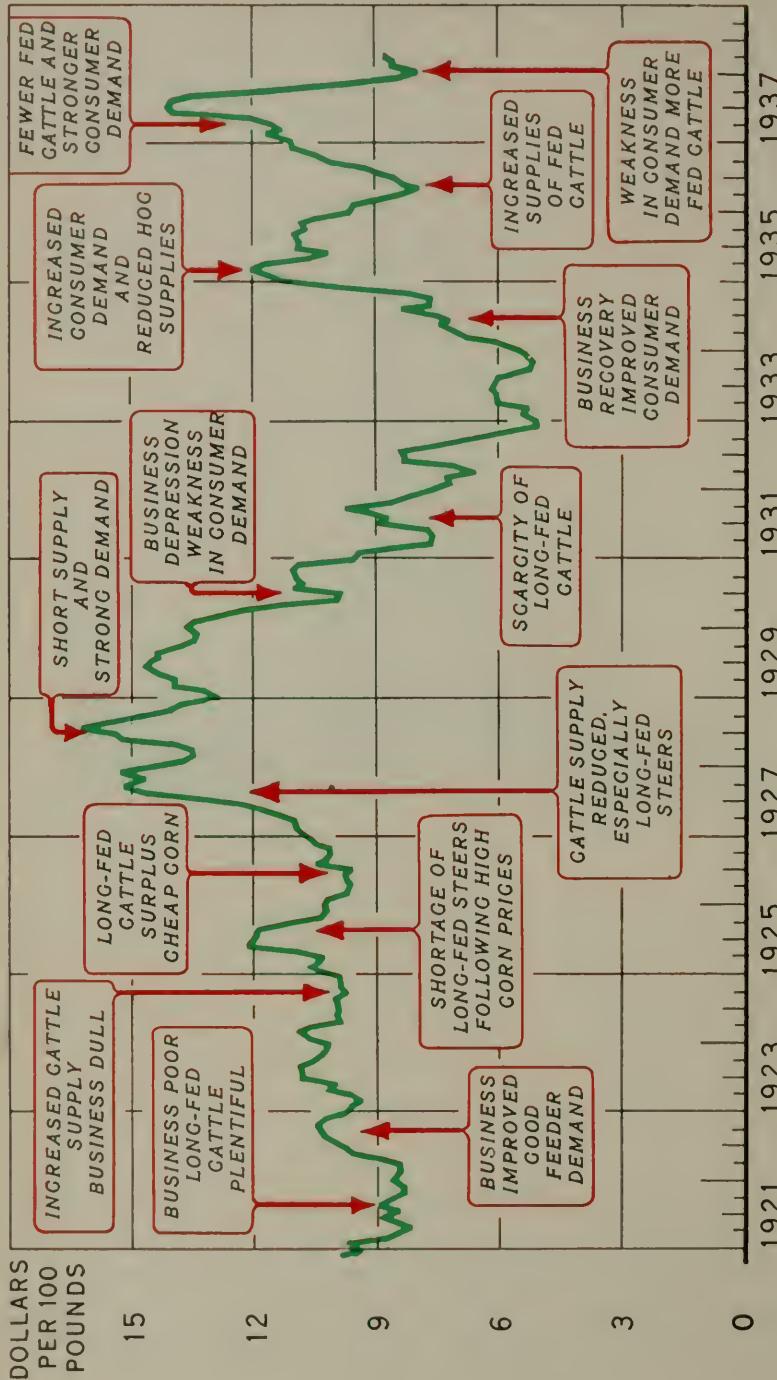
Leonard P. Ayres, "The War With Germany," Government Printing Office, 1919.

Hours Spent in the Air by American Service Planes at the Front During the World War.

1. The historical labels marking three important attacks of the World War and the Armistice give meaning to the curve.
2. Note the method of indicating the year, the month, and the day.

In this book, an illustration occupying a full page is referred to by page number. When there is more than one illustration on a page, each is identified by a letter of the alphabet. When there is more than one footnote beneath an illustration, each is numbered. Thus the cross reference 267B2 means page 267, illustration B, note 2.

GRAPHIC PRESENTATION



U. S. Department of Agriculture, Bureau of Agricultural Economics.

Factors Affecting the Price of "Good" Beef Steers in the United States From 1921 to 1937.

The important feature in this chart is the use of boxed explanations for the rise or fall in price.

Chapter 34

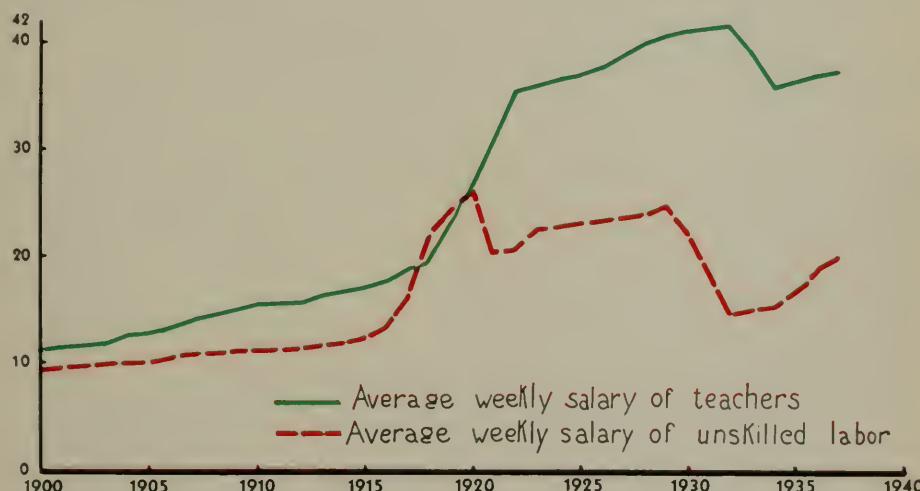
COMPARISONS WITH TWO CURVES

THE types of curve charts covered in this chapter are simple comparisons of two curves, cumulative curves, causal relationships and high-low curves.

REFERENCES

Arkin, Herbert and Raymond R. Colton, *Graphs: How to Make and Use Them*, Harper & Brothers, New York City, 1937.

Croxton, Frederick E., and Dudley J. Cowden, *Applied General Statistics*, Prentice Hall Inc., New York City, 1939.



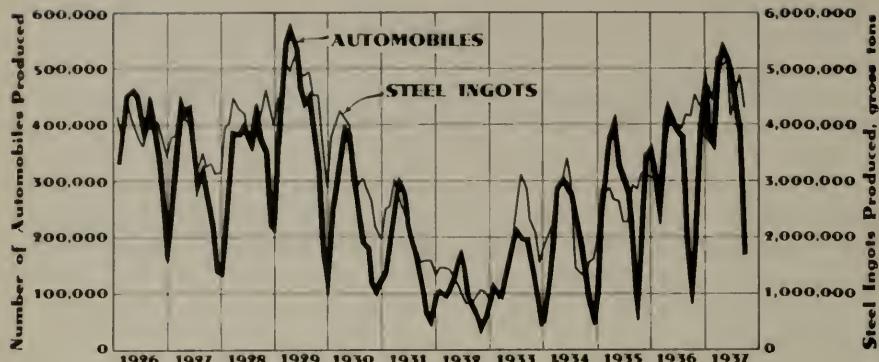
National Educational Association, "Research Bulletin," May 1938.

SCALE .9

Trends in Teachers Salaries and Wages of Unskilled Labor in the United States from 1900 to 1937.

- When more than one curve is put on a grid, it is necessary to make some differentiation between the curves. A dotted line is one solution.
- The grid of a chart may be omitted to great advantage in some cases. Since the omission often hinders the reading of the chart, the practice should not be encouraged.

GRAPHIC PRESENTATION

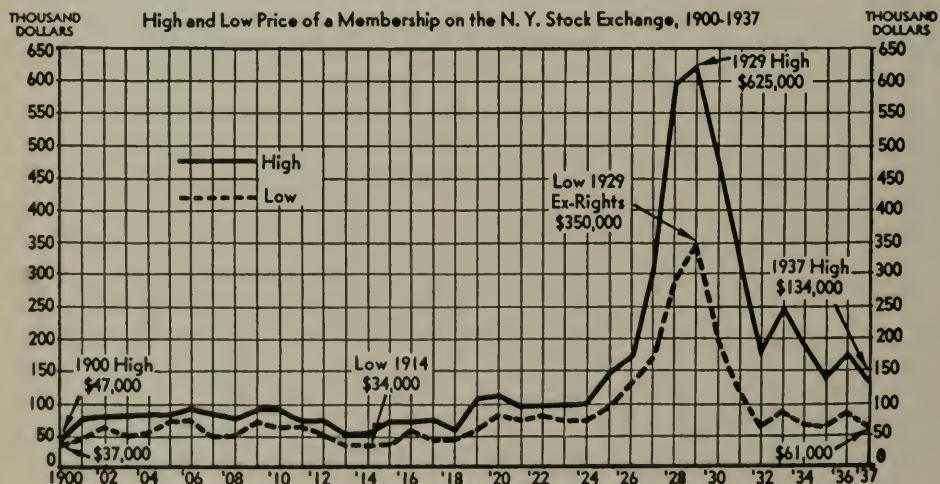


Annual Review Number of Iron Age Magazine, January 6, 1938.

SCALE .7

A. Comparison of the Record of Automobile Production and Steel Ingot Production in the United States from 1926 Through 1937.

1. If this material had been plotted on a grid with one scale, it would have resulted in too large a chart. When a common grid is thus used for two scales, care should be taken to put the zero of each at a common starting point.
2. Note the lag of the automobile curve as compared with the steel ingot curve.



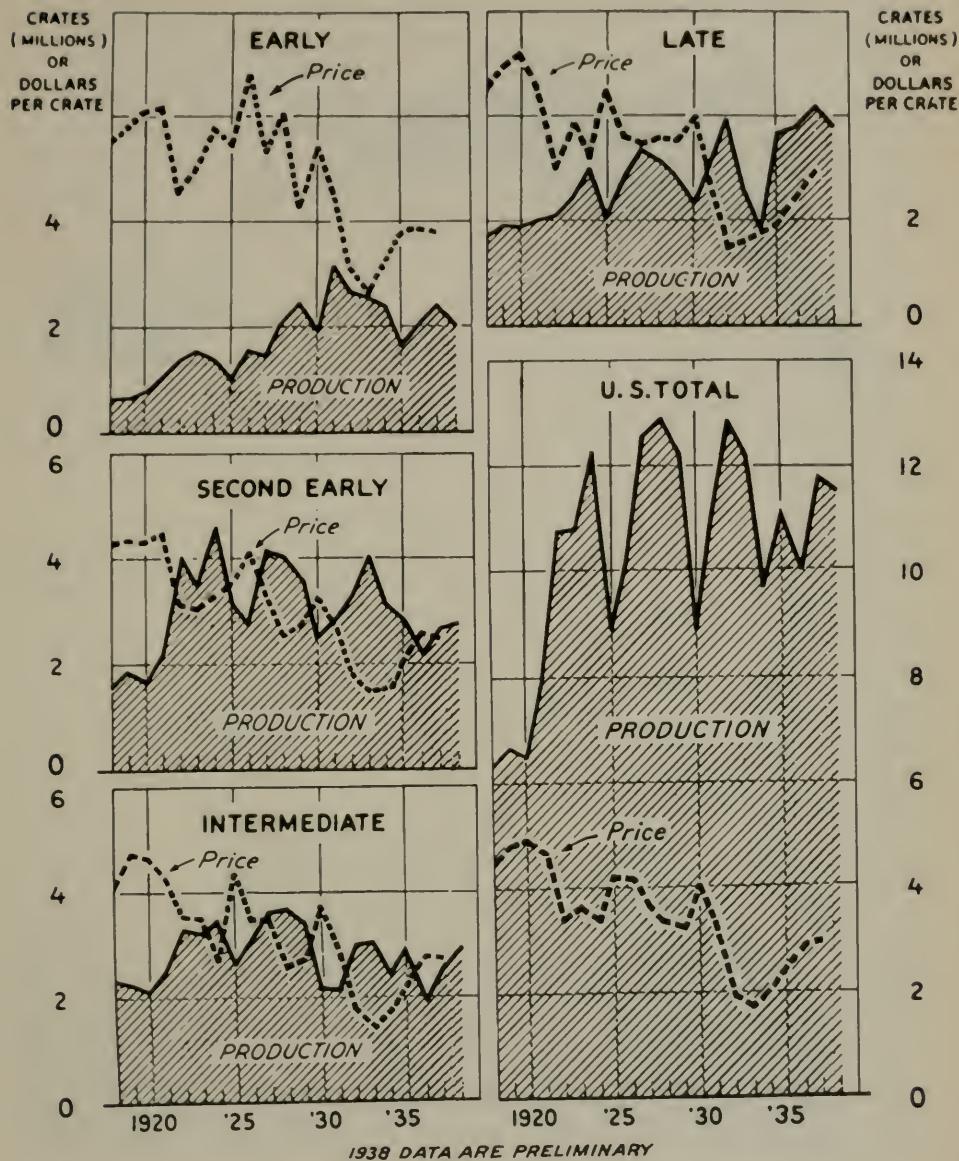
Chicago Tribune, "The 1938 Chart Book," February 22, 1938.

SCALE .8

B. The Price of Memberships on the New York Stock Exchange from 1900 to 1937.

Compare this method of presenting high-low data with 285B.

COMPARISONS WITH TWO CURVES



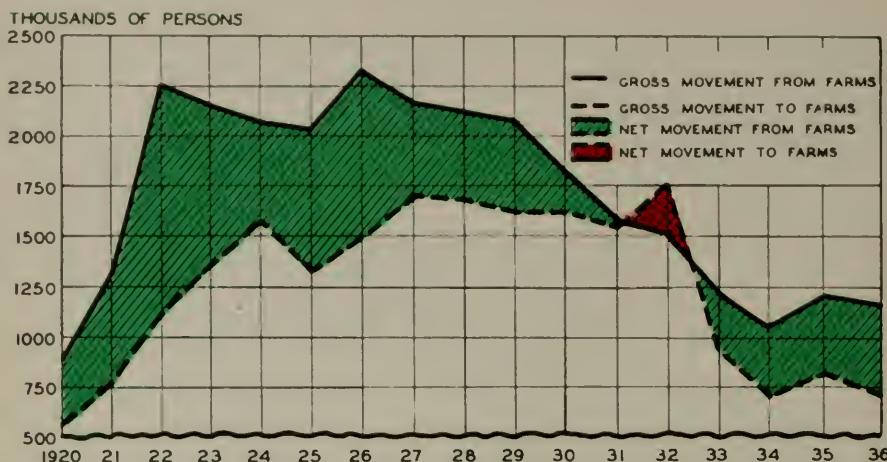
U. S. Department of Agriculture, Bureau of Agricultural Economics.

SCALE .8

Production and Farm Prices of Strawberries in the United States from 1918 to 1938.

This chart shows an effective way of comparing two curves. Note the combination of the shaded curve and the dotted-line curve.

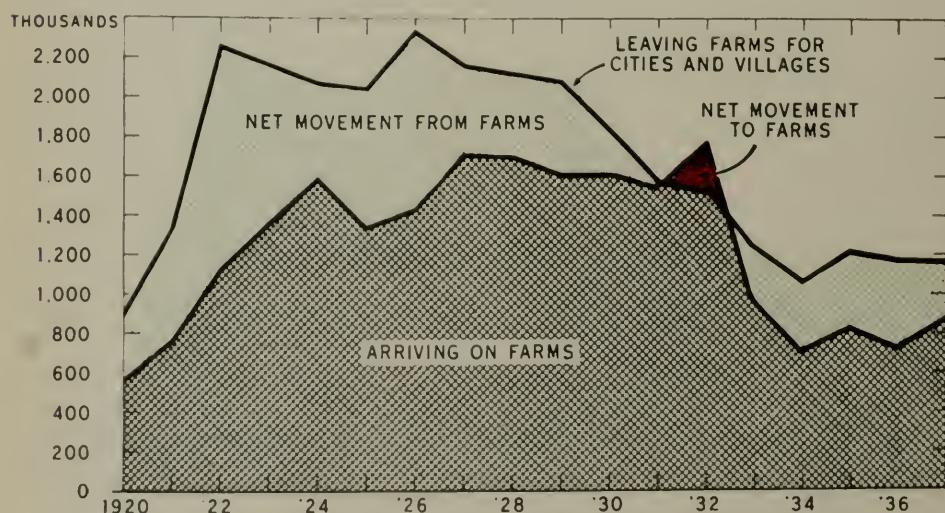
GRAPHIC PRESENTATION



WPA, National Research Project, "Summary of Findings to Date," March 1938.

A. Movement to and from Farms in the United States from 1920 to 1935.

This information is also given in B below. Here the emphasis is on the population movements to and from the farms. These two charts illustrate the technique of shading different sections of the same chart for different emphasis.

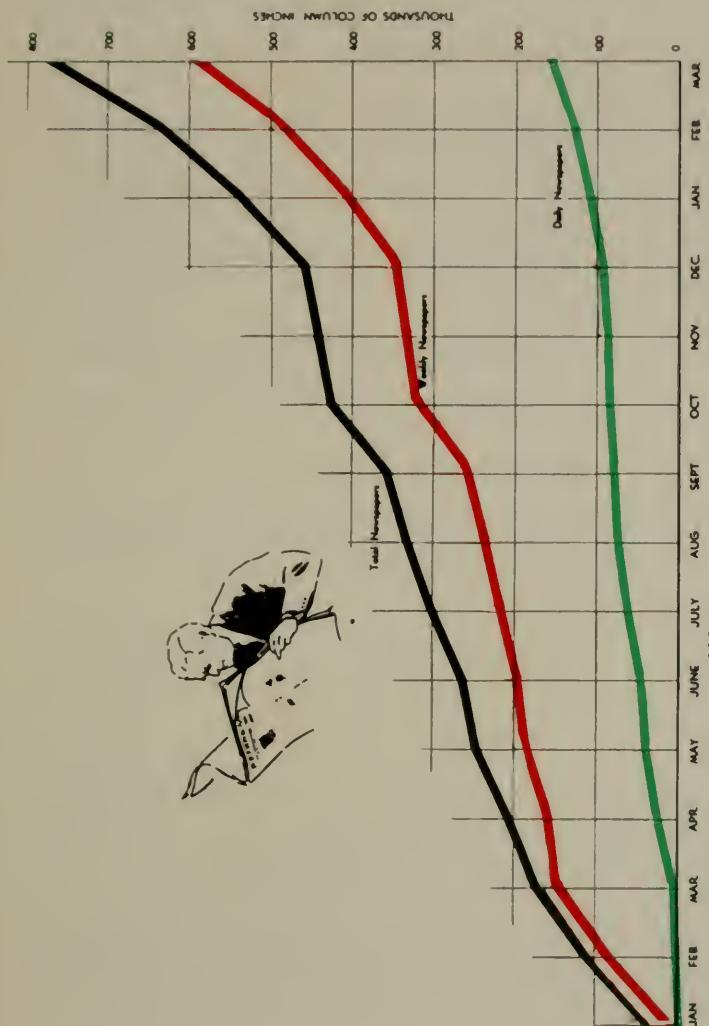


U. S. Department of Agriculture, Bureau of Agricultural Economics.

SCALE .6

B. Movement to and from Farms in the United States from 1920 to 1937.

The interest in this chart is centered on the number of people who came to the farms, causing an accumulation of farm population. As a result, the section labelled "arriving on farms" is shaded darker than the "net movement from farms."



New York World's Fair, 1939, Treasury Division, Methods and Planning Dept.

Three Cumulative Curves Showing the Thousands of Column-Inches Which the New York World's Fair Received in Out-of-town Daily and Weekly Newspapers from January 1937 to March 1938.

Beginning January 1937, the number of column inches is zero. At the end of January, the total for each of the three classifications is plotted on the grid. At the end of February, the total number of column inches from the first of January is plotted, and so forth. At the end of December 1937, the total number of column inches for the year is given.

GRAPHIC PRESENTATION

Abstracts from *Time Series Charts. A Manual of Design and Construction*, 1938, prepared by Committee on Standards for Graphic Presentation, under procedure of American Standards Association, with The American Society of Mechanical Engineers as sponsor body.

MULTIPLE AMOUNT SCALES

Principles

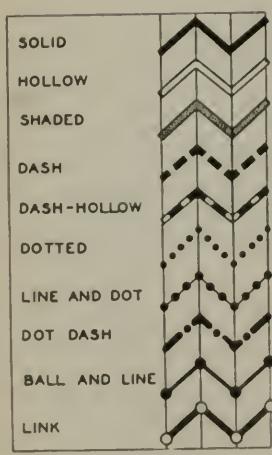
1. The purpose of multiple amount scales is to compare the movements of two or more series differing considerably in magnitude.
2. Multiple amount scales can be effectively used for comparing on the same grid two or more series not measured in comparable units (e.g., dollars and tons).
3. In general, the use of multiple amount scales should be restricted and regarded as a device for special cases.

Procedures

1. **LIMITED NUMBER DESIRABLE.** Multiple scales should normally be limited to two, as more are likely to be confusing.
2. **SAME RULINGS FOR BOTH SCALES.** Scales should be so selected that all horizontal rulings for both scales will coincide.
3. **ZERO VALUES SHOULD APPEAR.** The zero lines of both scales should, if possible, be included on the chart and should coincide.
4. **WHEN ZERO IS OMITTED.** If the zero lines of the two scales cannot well be shown on the chart, the scales should be so adjusted that the zero lines would coincide if the scales were extended to zero. This procedure, illustrated at the right, will present the curves in their correct relationship.
5. **CONTROLLING CURVE MOVEMENT.** Scales should be selected which will avoid undue emphasis of any one curve. (So selected that the relative movement of the various curves will be comparable. It is not permissible to enlarge the movement of one curve arbitrarily while minimizing the movement of the other.)
6. **WIDE SEPARATION UNDESIRABLE.** Scales should be selected that will bring the curves in close enough proximity for ready comparison.
7. **THE SCALE RATIO.** If possible, scale intervals of one scale should be in even multiples of the intervals of the other scale so as to facilitate comparisons of relative magnitude.
8. **LOCATION OF SCALE DESIGNATIONS.** Normally, it is best to designate one scale at the left and the other at the right.
9. **ALTERNATIVE METHOD OF PRESENTATION.** The difficulties of multiple scale presentation may be avoided by converting both series to a common base (e.g., index numbers, per cent of average for period, etc.).

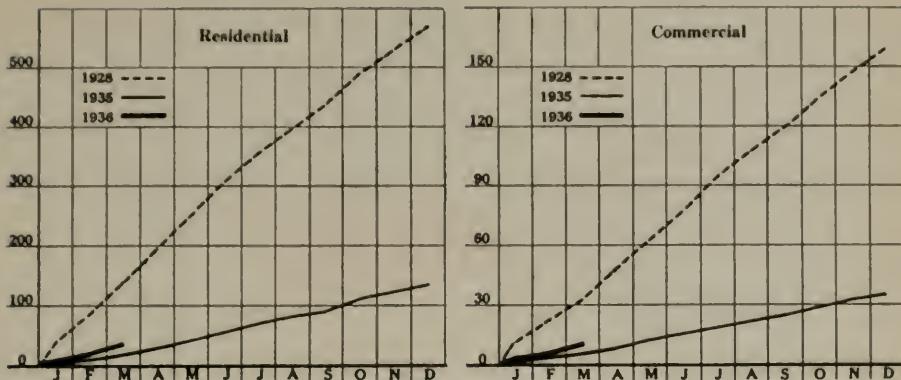
CURVE PATTERN

1. Curve patterns should be so selected that the curves can be distinguished readily from each other.
2. In general, the simplest patterns are most effective and most economical.
3. In selecting curve patterns, it is well to bear in mind the drafting difficulties and disturbing optical effects of complicated patterns.



Curve patterns

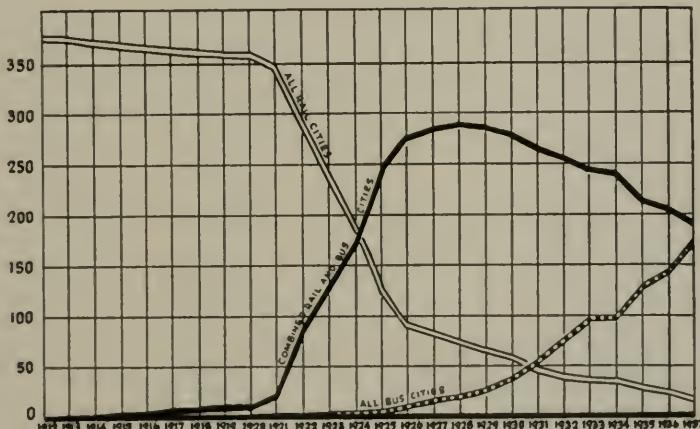
COMPARISONS WITH TWO CURVES



Standard Statistics Co., Inc., N. Y. C., "Standard Trade and Securities," May 29, 1936. SCALE .7

A. Building Contracts Awarded for Residential, Commercial, and Industrial Use in the United States for 1928, 1935, and 1936.

For explanation of cumulative curves, see 279.

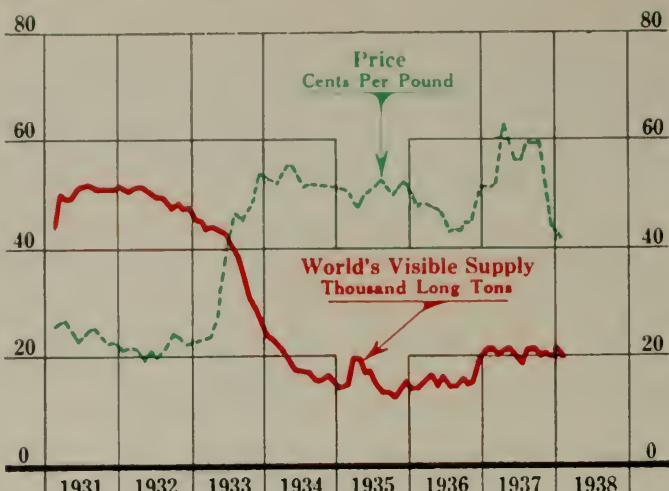


National Association of Motor Bus Operators, Washington, D. C., "Bus Facts for 1938." SCALE .9

B. Comparison of the Number of Cities Using All-Rail Transportation, Combined Rail and Bus Transportation, and All Bus Transportation in the United States from 1912 to 1937.

- In this chart, as the number of cities using rail and bus transportation increased, the number using only rail transportation necessarily decreased, since the number of cities included in the study varies little over a period of years.
- In more recent years, as those using buses only increased, the number of cities using the combination system decreased.
- This type of record would be affected by any change in the total number of cities within the three classifications. Similar charts might be based upon 100%. See 298A.

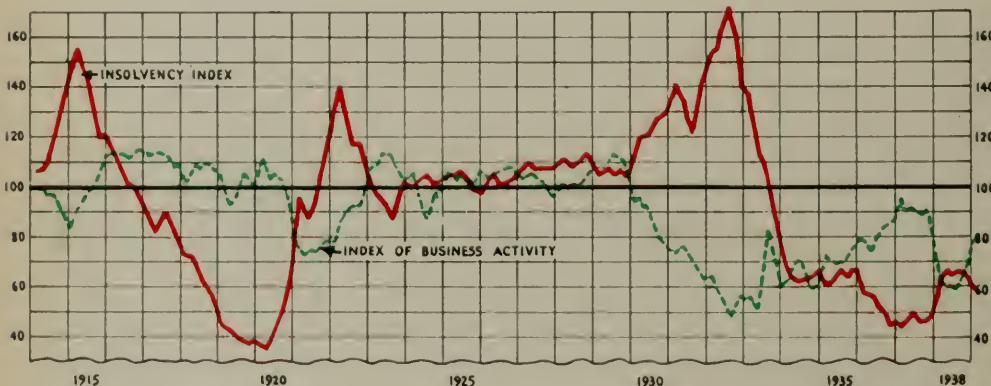
GRAPHIC PRESENTATION



Standard Statistics Co., "Standard Trade and Securities," March 4, 1938.

A. The Price of Tin Per Pound in the United States from 1931 to 1938.

1. The inverse relationship chart is an especially interesting one. If there is a causal relationship, a rise in one curve may cause a fall in the other.
2. The causal relationship between supply and demand and its effect upon price is well known and is presented in this chart. As the "world's visible supply" of tin goes down, the price per pound goes up, but not necessarily at the same rate.
3. One of the most common forms of inverse relationship is that as production increases, unit costs usually decrease.

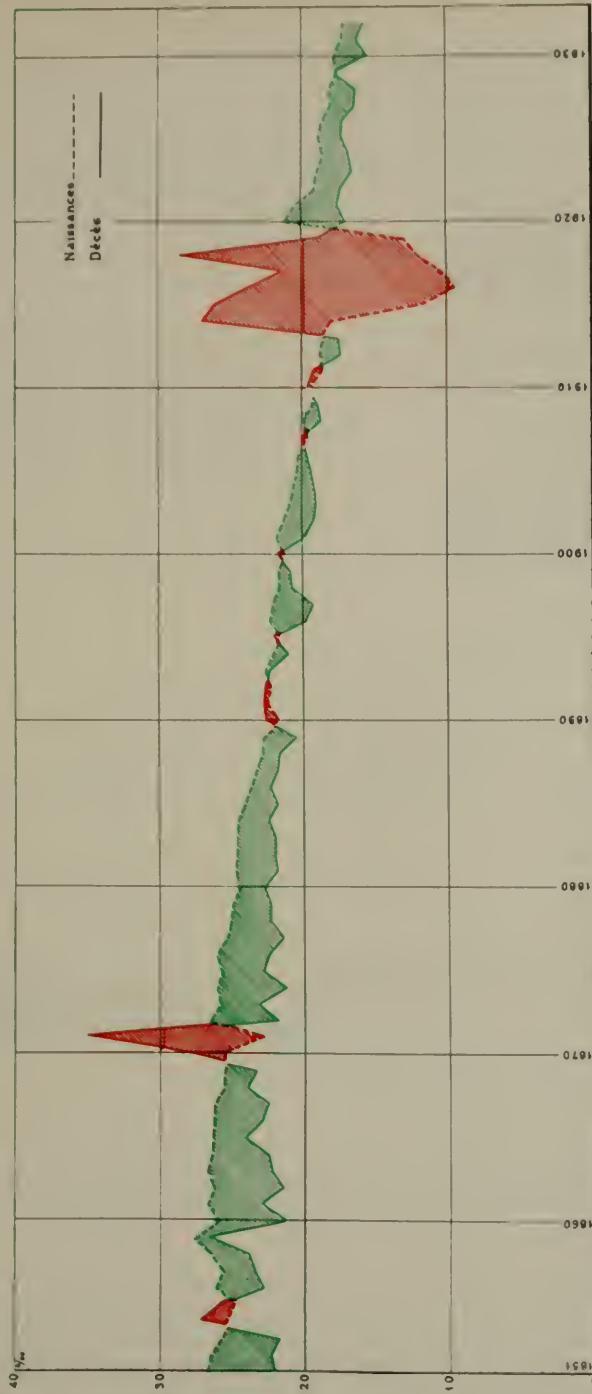


Dun's Review, February 1939.

SCALE .7

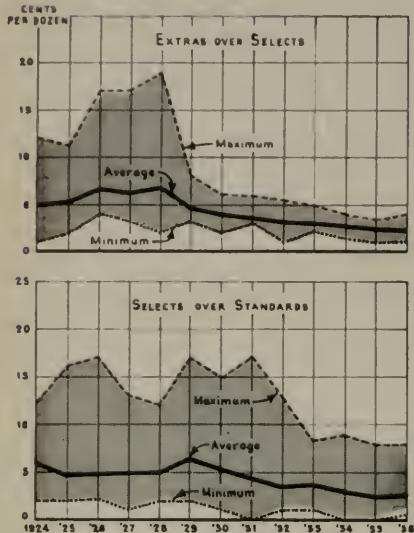
B. Twenty-five Year Comparison of Dun's Insolvency Index and the Cleveland Trust Company Index of Business in the United States.

1. Compare with A above.
2. Obviously the records of insolvency show an increase during periods of lessened business activity.



1. The recording of historical events relative to deaths would be of interest in this chart. For example, the large number of deaths in the years from 1914 to 1918 could be explained by the World War.
2. The two curves in the original of this chart were in color, and when photostatted reproduced as black and white. To secure a distinction, the curve for the "proportion of births per 1000 inhabitants" was dotted with black ink on the negative photostat. Thus in the positive, this line appeared broken.

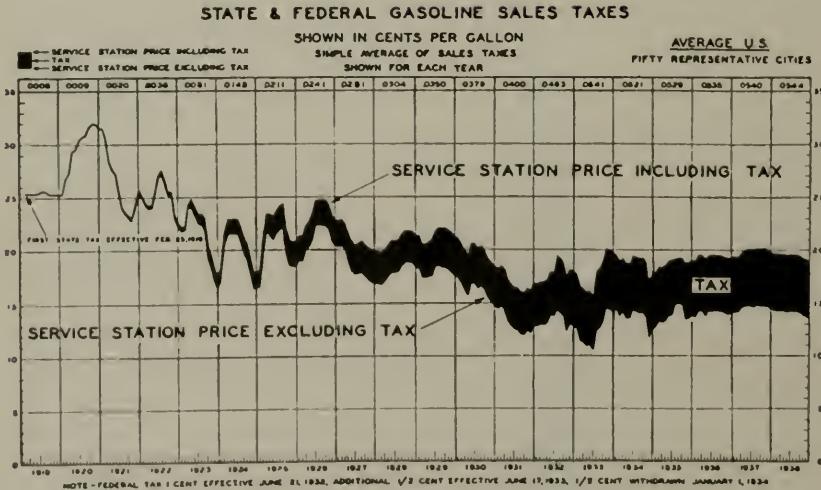
GRAPHIC PRESENTATION



Redrawn from U. S. Farm Credit Administration,
Cooperatives Division, "Business Analysis of
the Utah Poultry Producers Cooperative As-
sociation," Dec. 1937.
SCALE .6

A. Maximum, Average, and Minimum Prices of 2 Grades of Eggs in the State of Utah from 1924-1936.

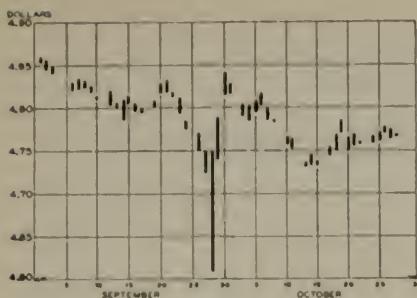
In the chart from which this was redrawn, the colored section was dotted. In the process of photo-stating, some of the dots were lost, with the result that uniformity of shading was lost. For that reason the chart was redrawn.



Joseph E. Pogue, "Economics of the Petroleum Industry," March 1939, The Chase National Bank of the City of New York.

B. Trend of Average Retail Price of Gasoline in Fifty Representative Cities in the United States by Months, 1919-1938, Showing Incidence of Gasoline Sales Tax. Courtesy of The Texas Company.

COMPARISONS WITH CURVES



Federal Reserve Bank of New York, "Monthly Review," November 1, 1938. SCALE .6



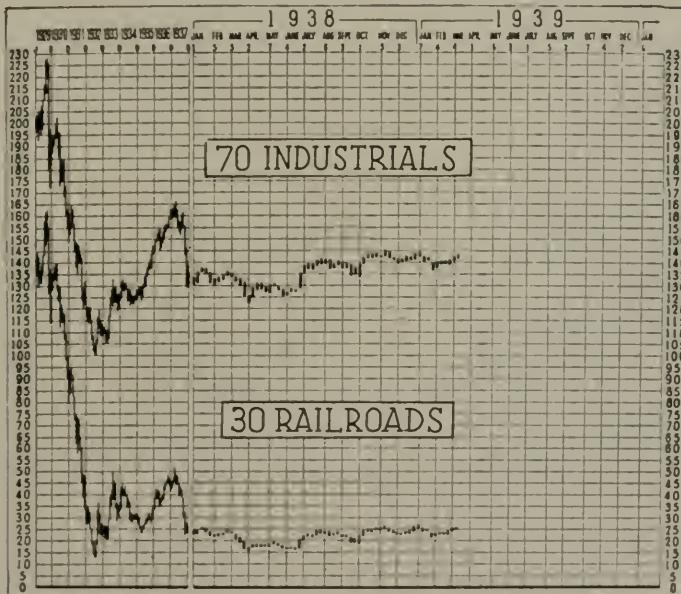
Federal Reserve Bank of New York, "Monthly Review," December 1, 1938. SCALE .6

A. Daily Range of High and Low Quotations for Sterling Exchange at New York in September and October, 1938.

1. The range bar chart is a form of the high-low chart.
2. Daily fluctuations are presented here and in C below, while a monthly range is given in B.

B. Monthly Range of High and Low Quotations for Sterling Exchange at New York from 1931 to December 1938.

When the bars are adjacent to each other as they are in this chart, the similarity between the bar form and the curve form of high-low chart is more pronounced. See 276B.



New York Herald Tribune, March 13, 1939.

SCALE .6

C. Trend of Prices on the New York Stock Exchange Market from 1929 to March 1939.

Note the method of changing the scale to give monthly data for recent periods of time.

Chapter 35

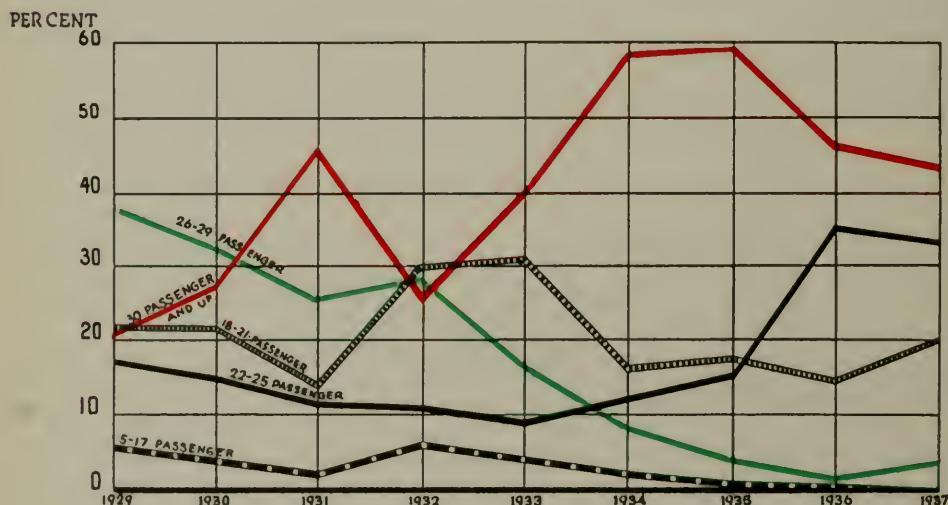
COMPARISONS WITH CURVES

The types of curve charts covered in this chapter are simple comparisons of more than two curves, progressive average curves, moving average curves, and normal trend curves.

REFERENCES

Croxton, Frederick E., and Dudley J. Cowden, *Applied General Statistics*, Prentice Hall Inc., New York City, 1939.

Karsten, Karl G., *Charts and Graphs*, Prentice-Hall, Inc., New York City, 1923.

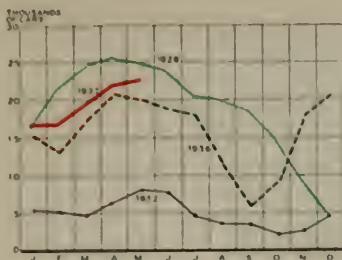


National Association of Motor Bus Operators, Washington, D. C., "Bus Facts for 1938."

SCALE .7

A Comparison of the Percentage of Sales of Five Types of Motor Coaches in the United States from 1929 to 1937.

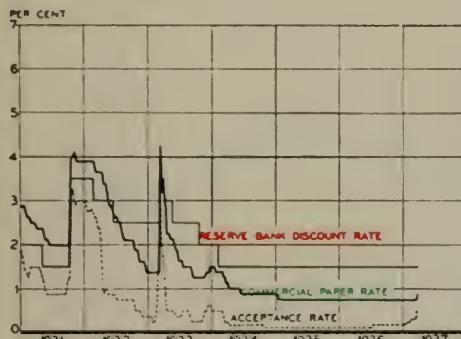
1. The total of the percentages which the lines represent is one hundred.
2. One way of differentiating a large number of curves plotted on one grid is shown here.
3. It might have been better to connect the labels to the lines with arrows, eliminating the necessity for putting them at an angle.



Federal Reserve Bank of New York, "Monthly Review," July 1, 1937. SCALE .6

A. Daily Average Production of Passenger Automobiles and Trucks in the United States in 1929, 1932, 1936, and 1937.

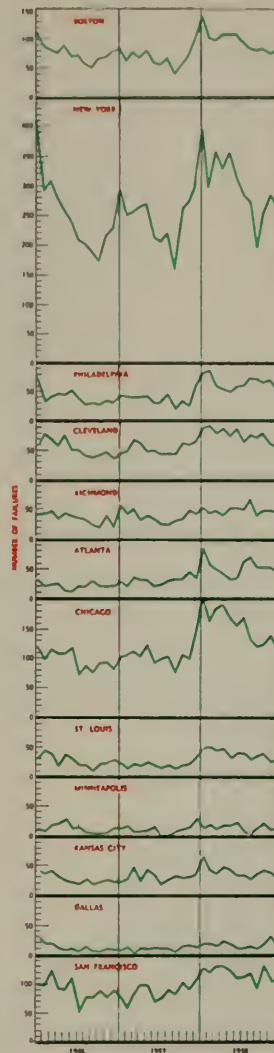
1. By using a monthly scale, the curves for several years may be plotted on the same grid with clearness and a saving of space.
 2. When letters only are used to indicate the months of a year, by noting the position of JASON in the line, it is easy to determine whether the year begins with January or June.



Federal Reserve Bank of New York, "Monthly Review," April 1, 1937.

B. Money Rates in the New York Market from 1931 to 1937.

This line chart has taken the appearance of a stair chart because money rates do not fluctuate a great deal from week to week except under unusual conditions. Compare with 135B and 264A.



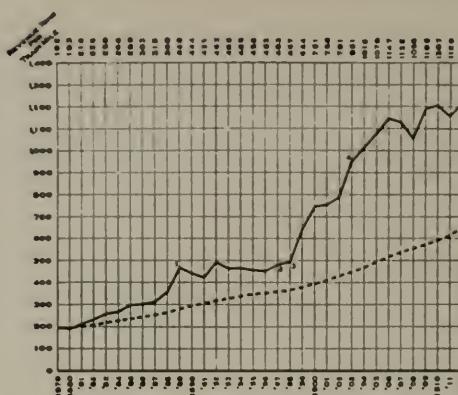
Dun's Review, November 1938.

Scale .6

C. Failures by Federal Reserve Districts in the United States from 1936 to September 1938.

1. This arrangement of curves enables one to put a great many on one grid in a very small space.
 2. Note that the zero line of each curve is the top line in the one below. Compare with 271A.

GRAPHIC PRESENTATION

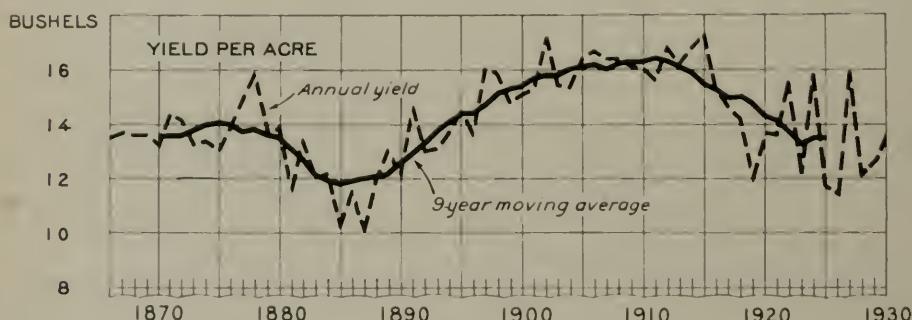


Brinton, "Graphic Methods," McGraw-Hill, 1914.

SCALE .5

A. Yearly Average of Revenue Tons per Train Mile on the Pittsburgh and Lake Erie Railroad.

1. The dotted line in this chart is a progressive average, or an average of all the items shown.
2. The numbers along the top of the chart give the value of the points on the plotted curves.
3. When space does not allow the dates to be put in full, the method shown here identifies each vertical line, and accents the decades.
4. Note the position of the scale designation in the upper left corner for both the scale and data figures.

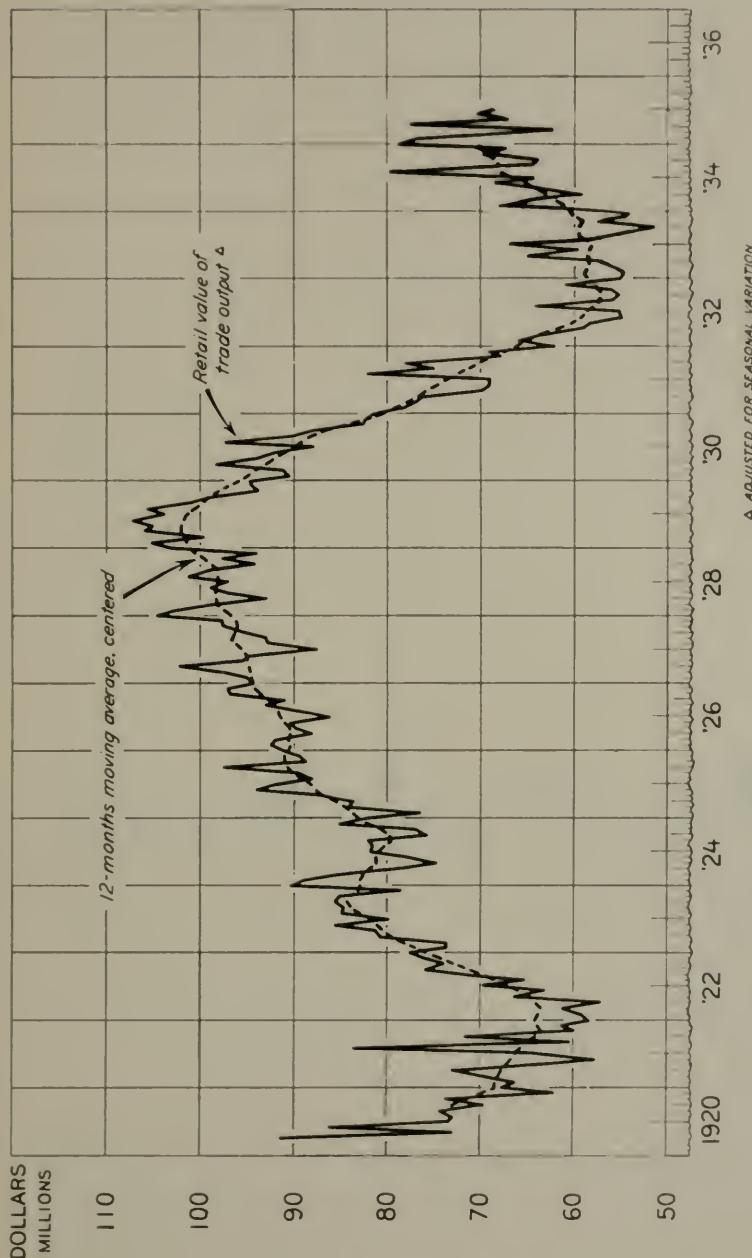


U. S. Department of Agriculture, Bureau of Agricultural Economics.

SCALE .8

B. Annual Yield and Nine-Year Moving Average Yield of Rye Per Acre in the United States from 1866 to 1930.

- A moving average, often used in graphic charts, is obtained in this way: the statistics for a number of years are averaged and the result is plotted at the half-way mark. Thus if the data for the 9 years from 1890 to 1898 had been averaged, the result would be plotted at the year 1895.



U. S. Department of Agriculture, Bureau of Agricultural Economics.

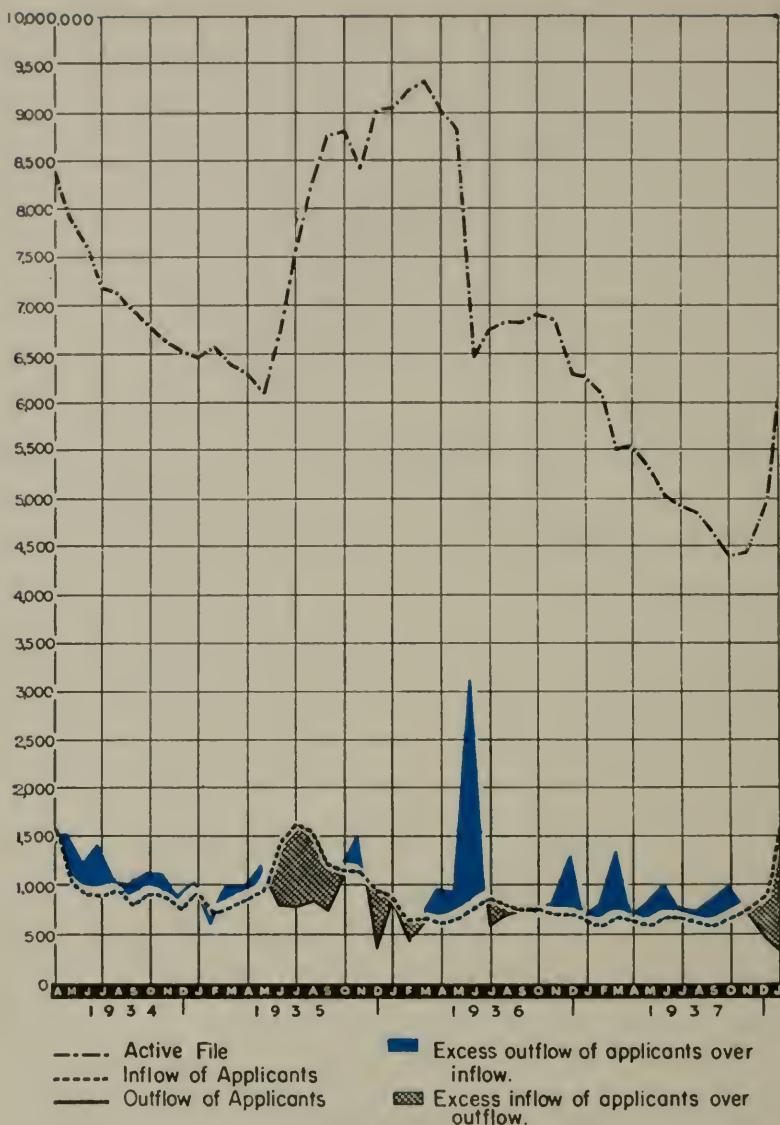
Retail Value and 12-Month Moving Average of Trade Output of Manufactured Dairy Products in the United States from 1920 to 1935.

One method of checking the validity of a centered moving average is to note whether the plotting begins half the number of years or months after the first date and ends half the number of years or months before the last date.

SCALE .7

△ ADJUSTED FOR SEASONAL VARIATION

GRAPHIC PRESENTATION

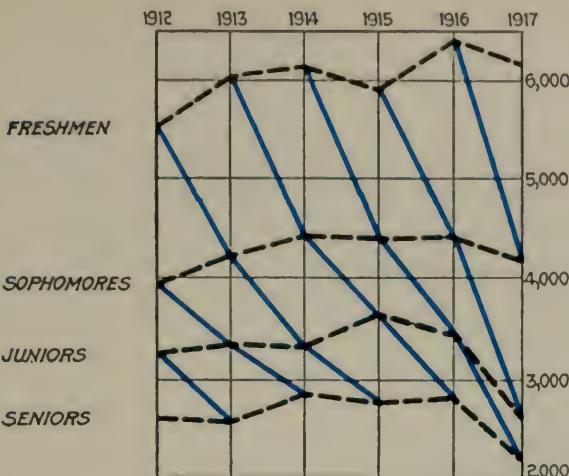


U. S. Employment Service "Survey of Employment Service Information," February 1938.

Effect of Outflow and Inflow of Applicants in the U. S. Employment Service on the Active File from April 1934 to January 1938.

- Whereas each of these three curves might have been presented separately, the combination of the three presents a picture not otherwise possible.
- Notice how a solid section in the two lines at the bottom is reflected in the upper one.

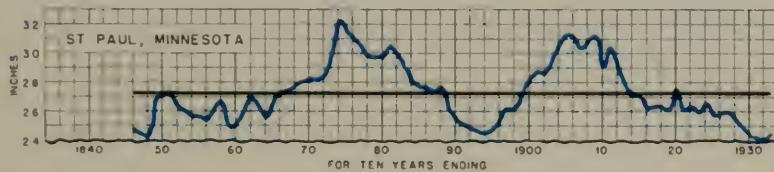
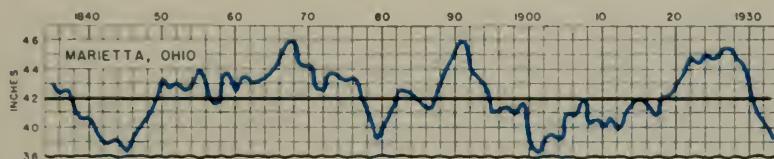
COMPARISONS WITH CURVES



Engineering News-Record, November 29, 1917.

A. Enrollment in Engineering Schools in the United States from 1912 to 1917.

1. This chart presents the effect of the draft and enlistments for the World War on the enrollment in engineering schools.
2. The dotted line gives the numbers of students enrolled as freshmen, sophomores, etc. The other line by linking these lines shows the history of the classes from the time the students entered as freshmen.
3. Thus in 1914, over 6,000 students enrolled as freshmen to be graduated in 1918. The enrollment of this class in 1917 at the beginning of its senior year had dropped to a little over 2,000.



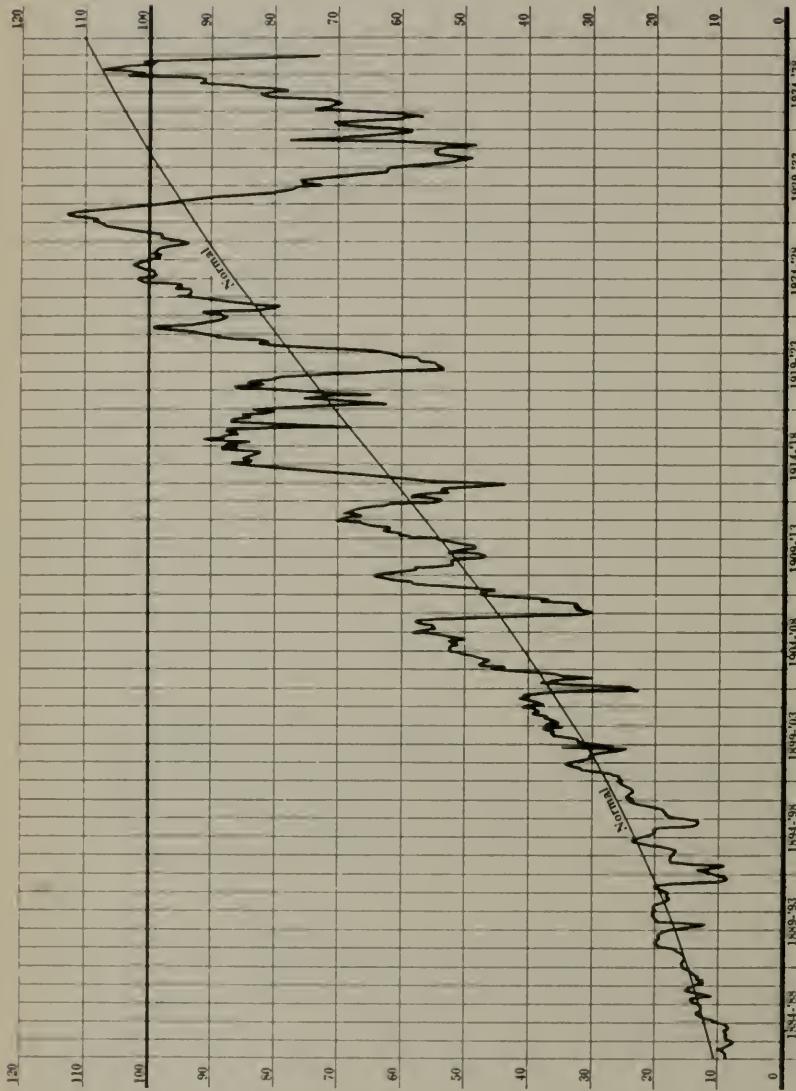
National Resources Committee, "Report of Water Planning Committee, Part III," 1934.

SCALE .7

B. Ten-Year Moving Averages of Annual Precipitation for Marietta, Ohio, and St. Paul, Minnesota, from 1840 to 1931.

This chart differs from 288B and 289 in that it is a moving average "for ten years ending" rather than for ten years "centered."

GRAPHIC PRESENTATION

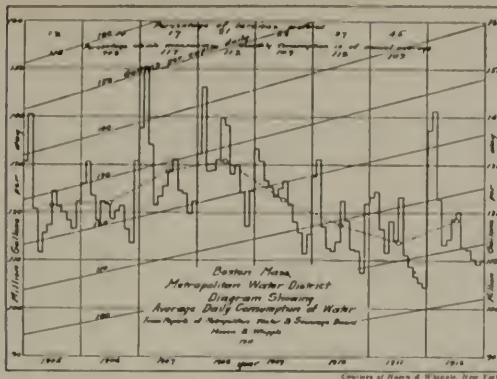


Standard Statistics, Inc., "Standard Trade & Securities," March 4, 1938.

Index of Industrial Production in the United States from 1884 to 1938. 1926 Equals 100.

For a good description of trend, see Riggelman and Frisbee, *Business Statistics*, McGraw-Hill Book Co., Inc., New York City, 1938.

SCALE .6



Brinton, "Graphic Methods," McGraw-Hill, 1914.

SCALE .9

A. Chart Showing by Months the Average Total Daily Water Consumption in Boston, and by Months the Average Daily Per Capita Water Consumption. Also the Yearly Average of Daily Consumption Stated in Total and Per Capita.

1. In this illustration, the curves may be read from either of two different sets of coordinate rulings. Using the horizontal ruled lines, we may read from the curves the average total consumption per day. By reading from the slanting lines, the same curves may be interpreted as the average consumption per capita per day.
2. The scheme of using two sets of coordinate rulings is a valuable one. The scale for "million gallons per day" should, however, have been shown only at the left, with the slanting line scale for "gallons per capita" placed in the right-hand margin for the sake of clearness.
3. The scale for "gallons per capita" is shown in the second vertical zone of the grid.



Exhibit of the Metropolitan Life Insurance Company at the New York World's Fair, 1939.

B. Curve in Neon Lights on a Glass Grid Placed in Front of Three Related Curves Painted on a Wall Surface.

1. Tubular form of the neon light lends itself particularly well to the making of illuminated curve charts without limit in size. Colors are available to give contrast in superimposed curves. Consideration should be given to glare as lights may be too brilliant for easy reading.
2. On the glass-ruled grid for the neon lights above it is unfortunate that the zero line of the death rate was omitted.
3. For other methods of display, see "Displays and Exhibits," pages 486-493.

Chapter 36

COMPONENT PARTS SHOWN BY CURVES

IN THE chapters on "100% Bar Charts," pages 92-105, and "Component Bar Charts," pages 132-141, the method of showing component parts in bar chart form is illustrated. The charts in this chapter present the same type of information in the form of curves.

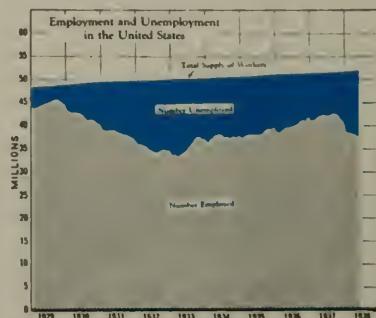
Other terms used for charts in which component parts are shown by curves are percentage charts, band charts, 100% band charts, percentage band charts, and surface charts. The terms "100% band chart," "percentage chart," and "percentage band chart," designate only those charts in which material is presented on the basis of 100%. See 297B, 299B, and 300. The terms "surface chart" and "band chart" may be used when referring to either of the two charts shown on page 300.



Federal Reserve Bank of New York, "Monthly Review," July 1, 1937. SCALE .7

A. Reserve Balance of Banks in the New York Federal Reserve Bank District from 1932 to 1937.

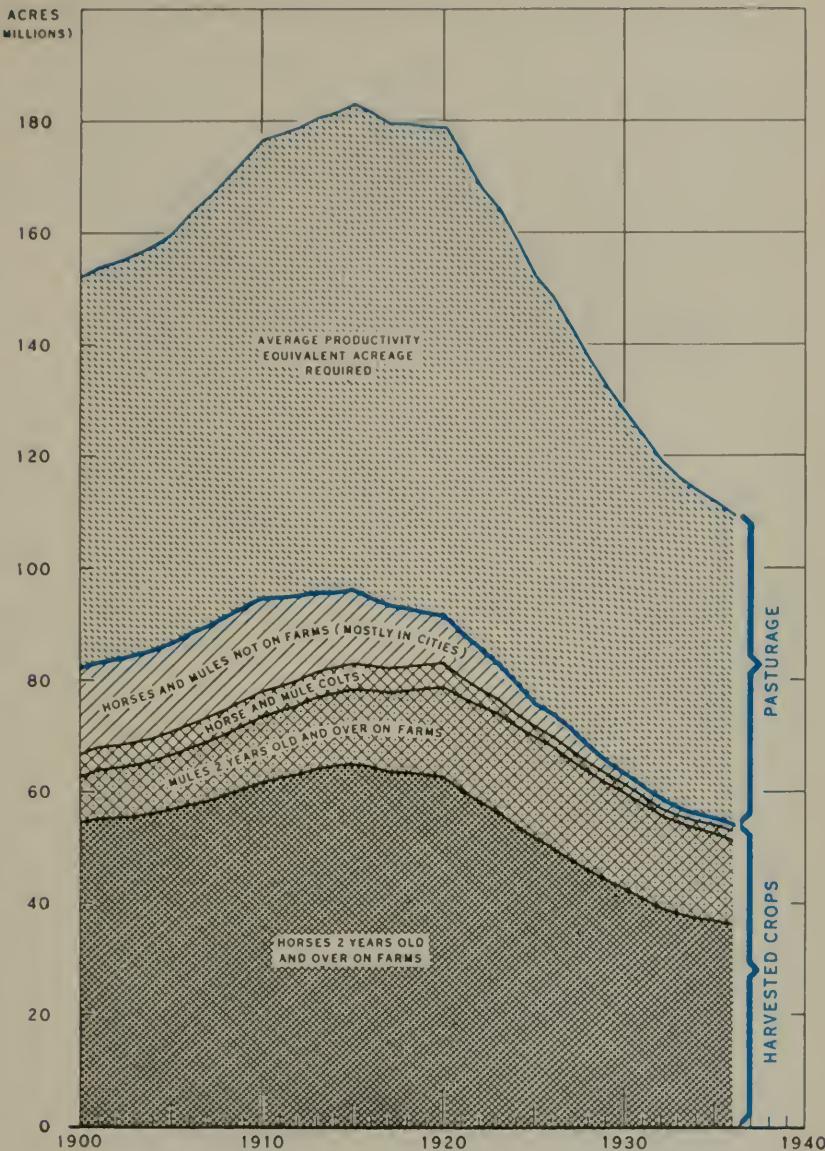
1. In a curve chart, showing component parts, it is possible to plot the totals of several groups of figures and the parts of which the total is composed.
2. In order to show rulings in a solid black or cross-hatched area, white ink is extremely useful. The white lines may be drawn after the area is completely filled in with ink.



Alexander Hamilton Institute, N. Y. C., "Business Conditions Weekly," July 23, 1938. SCALE .6

B. Employment and Unemployment in the United States from 1929 to 1938.

1. Because it probably was desired to emphasize the unemployed, the division of the total supply of workers representing the unemployed was put in black ink.
2. Note that the total supply of workers increases each year, due no doubt to the increase in population



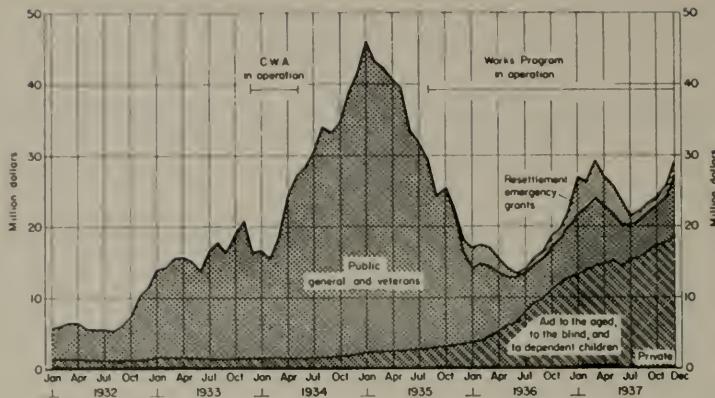
U. S. Department of Agriculture, Bureau of Agricultural Economics.

SCALE .8

Approximate Acreage of Crops Harvested and of Pasturage to Feed Horses and Mules in the United States from 1900 to 1936.

Brackets may be utilized for grouping in a number of ways. Compare this with 96A.

GRAPHIC PRESENTATION

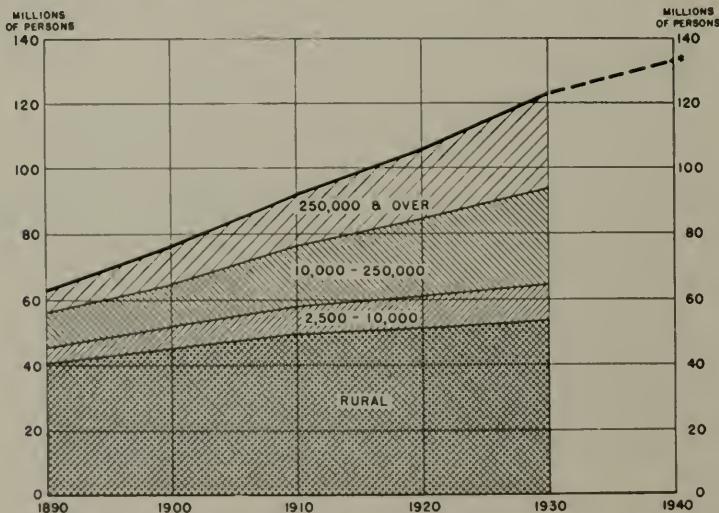


WPA and Bureau of Agricultural Economics, "Rural Poverty," 1938.

SCALE .8

A. Expenditures for Direct Rural and Town Relief in the United States from 1932 to 1937.

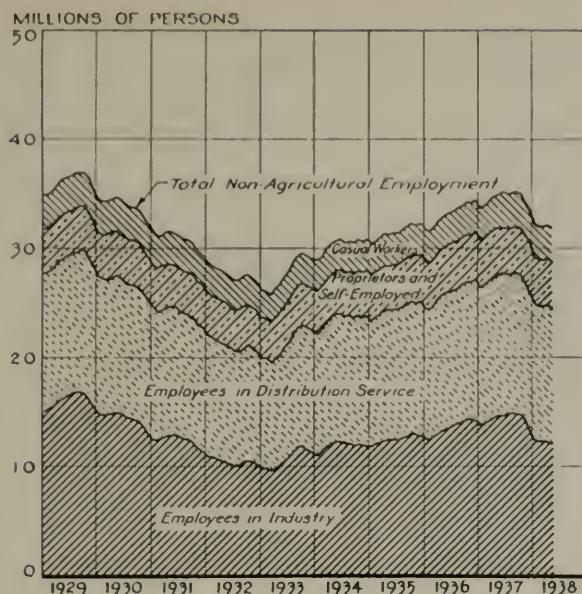
1. Because the CWA and WPA reduced the number of persons receiving direct relief, expenditures during these two periods were affected.
2. The division of the total into parts shows that public relief has been reduced since the beginning of 1935, and that another form of direct relief has increased.



"The Federal Chart Book," Prepared by Central Statistical Board and National Resources Committee, January 1938.

B. Population in the United States by Size of "Community" from 1890 to 1930.

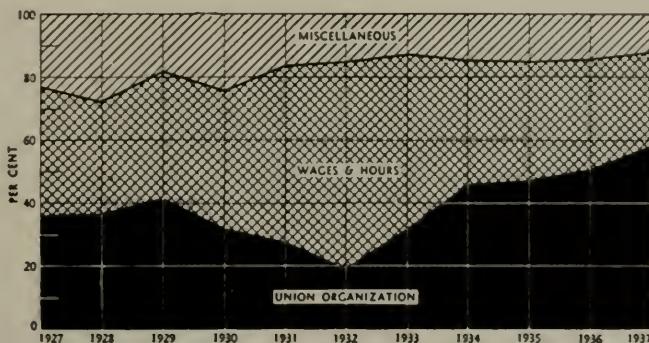
1. Each incorporated place is a separate "community." The use of a heavy line to represent the total emphasizes the fact that the lines below it are merely divisions.
2. See 93A4.



U. S. Department of Commerce, Division of Economic Research, "Survey of Current Business," July 1938.

A. Total Non-Agricultural Employment in the United States from 1929 to 1938.

- When the labels for the various sections of a component-part curve chart are indicated within the section, an attempt should be made to keep the labels on a horizontal plane.
- Note the position of the label for the "total" line.

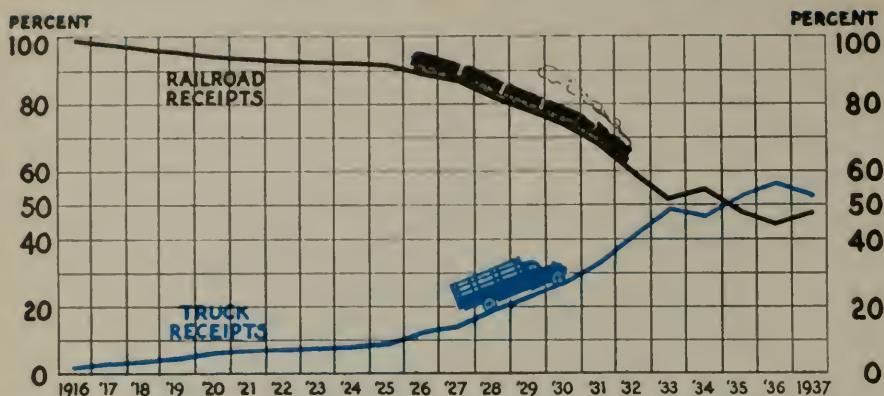


Dun's Review, August 1938

B. Percentage Distribution of Strike Issues in the United States from 1927 to 1937.

The 100% band chart is similar in principle to the charts which contain a series of 100% bars. See 102B.

GRAPHIC PRESENTATION



Automobile Manufacturers Association, "Automobile Facts and Figures," 1938.

A. Comparison of the Percentage of Receipts from Marketing Livestock by Truck and by Railroad in the United States from 1916 to 1937.

The reason for including this chart in this chapter was to show a hundred per cent chart in another form. In any one year the total of the values of the two curves is 100%. See 299A.

Abstracts from *Time Series Charts. A Manual of Design and Construction*, 1938, prepared by Committee on Standards for Graphic Presentation, under procedure of American Standards Association, with The American Society of Mechanical Engineers as sponsor body.

SURFACE CHARTS CAN OFTEN BE USED SUCCESSFULLY:

1. To add emphasis to a chart which might appear weak as a line chart.
2. To emphasize "amount" as against "ratio."
3. To picture "point" data as distinguished from "period" data (see definitions—page 9).
4. To show components of a total, especially a percentage distribution.
5. To present a general picture as against exact measurement.

SURFACE CHARTS NORMALLY SHOULD NOT BE USED:

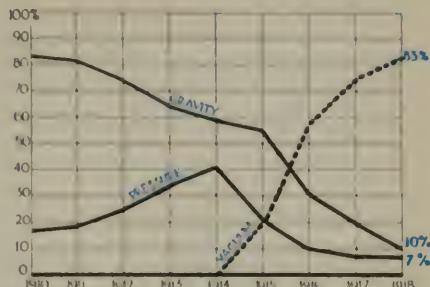
1. Where accurate reading of values is desired, in the case of more than one component.
2. For cases where irregular layers will unduly distort the contours of the others above it.
3. Where changes in the series are abrupt, causing optical distortion of the width of the strata.

Construction

1. LAYOUT AND DESIGN In general, the principles and procedures are the same as for line charts.
2. GRIDS As a surface chart is rarely used for the accurate determination of values, few horizontal rulings are necessary. They generally serve merely as bases of comparison. Surface charts are generally more effective with relatively few vertical rulings. Minor time divisions can, in such cases, be indicated by means of stubs on the horizontal scale.

A. Percentage Distribution of Three Types of Gasoline Feed in Engines from 1910 to 1918.

The total of the figures at the right-hand edge of the chart is 100%, as commented in 286.



"Automotive Industries," January 3, 1918
SCALE .6

Abstracts from *Time Series Charts. A Manual of Design and Construction*, 1938, prepared by Committee on Standards for Graphic Presentation, under procedure of American Standards Association, with The American Society of Mechanical Engineers as sponsor body.

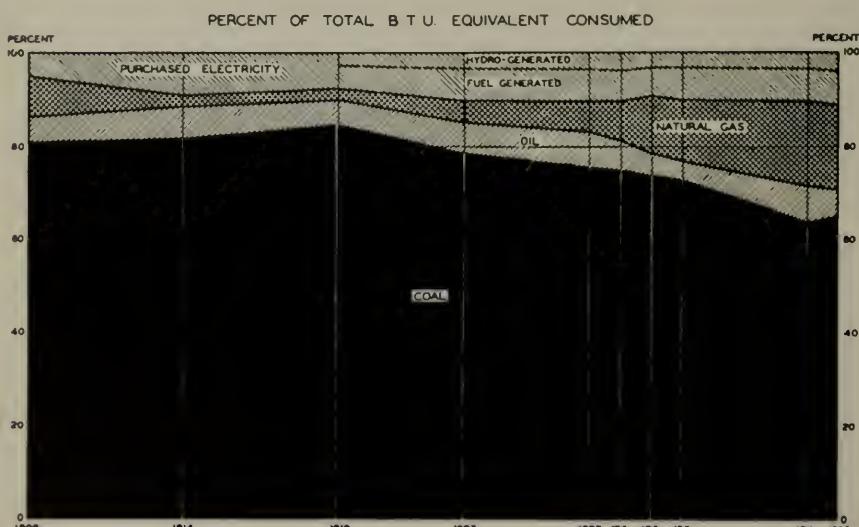
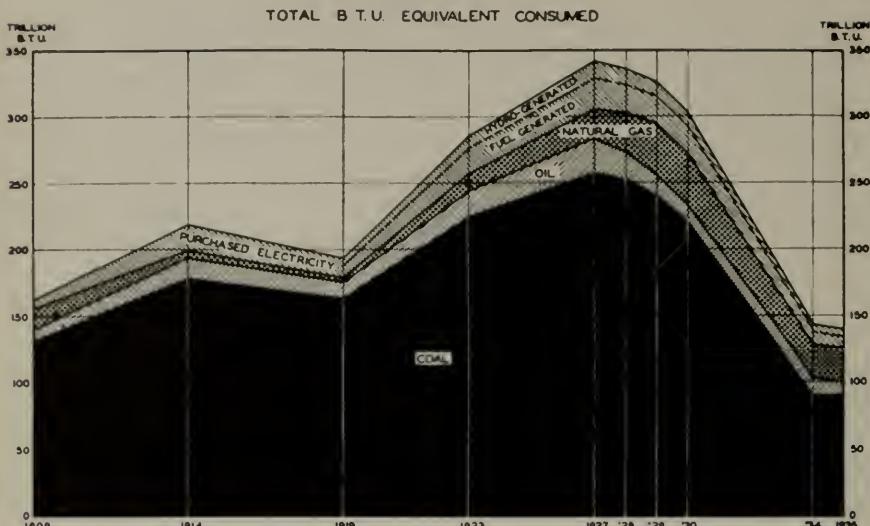
3. **SCALE SELECTION:** Since surfaces are built up from the zero line or other line of reference, the amount scale should never be broken. Multiple amount scales are not applicable to this type of presentation.
4. **SCALE DESIGNATIONS:** In general, the principles and procedures are the same as for line charts.
5. **SURFACES:** Surfaces should be so shaded as to present a pleasing, even tone. In strata charts the layers should be so shaded as to be easily distinguished. The weight and spacing of the lines and dots of the shading are important; both should be determined from a consideration of the size of the areas to be shaded and amount of reduction intended. Projected surfaces may be indicated by lighter shading of the same type as illustrated at the right.

THE FOLLOWING SHADINGS ARE SUGGESTED:

- 1(a) Black Shading for general use for purposes of emphasis. It should be used with discretion, however, and usually not for large areas. In strata charts the lowest layer should be the most important and therefore generally requires the heaviest shading (usually black).
- 1(b) Crosshatch Shading* of a relatively dark tone, is often used in place of black for large areas. A light crosshatch is often useful for small layers of a strata chart.
- 1(c) Parallel Line Shading* may be used for large or small surfaces. The lines should not parallel any appreciable length of the curves and vertical or horizontal shading is not recommended as it may be confused with grid rulings.
- 1(d) Dotted Shading (pebbled or stippled) is particularly useful for narrow layers of a strata chart.
6. **SURFACE DESIGNATION:** Labels should generally be placed entirely within their respective surfaces. If the surface is too small to permit this, a label may be placed entirely outside and related to the surface by means of an arrow. Keys should not be used if direct labeling is possible. However, the space about labels should be reduced as much as possible to avoid too great contrast.
7. **SURFACE CHART DESIGNATIONS:** In general, the principles and procedures are the same as for line charts.

*Crosshatch and parallel line shading should be drawn at a 45 degree angle. Shading constructed with vertical or horizontal lines is not recommended for surface charts.

GRAPHIC PRESENTATION



WPA, National Research Project, "Fuel Efficiency in Cement Manufacture," April 1938.

Total Energy Consumed in Hydraulic Cement Manufacture by Types of Energy in the United States from 1909 to 1935.

When component parts are presented in curve charts and if space will allow, it is desirable to use two charts, one showing quantities and the other showing percentages. The above charts illustrate the reason.

Chapter 37

INDEX NUMBERS SHOWN BY CURVES

In a chart showing index numbers, 100 is used as the basis of comparison. In computing index numbers, one item or the average of several consecutive items is represented as 100. All other items are expressed as percentages of the base.

Index numbers are computed and published by the U. S. Bureau of Labor Statistics, the Federal Reserve Board, the U. S. Department of Commerce, Dun and Bradstreet's, and many other statistical organizations.

REFERENCES

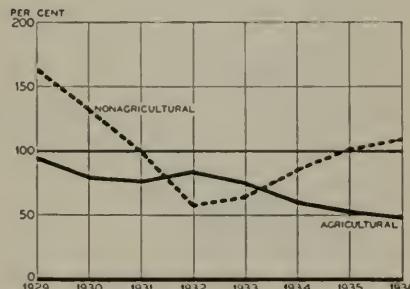
Brown, Theodore H., Richmond F. Bingham, and V. A. Temnomeroff, *Laboratory Handbook of Statistical Methods*, McGraw-Hill Book Company, Inc., New York, 1931



Federal Reserve Bank of New York, "Monthly Review," January 1, 1937. SCALE .6

- A. Index of General Production and Trade in the United States from 1919 to 1936. 1923-25 Average Equals 100%.

In index numbers, one figure is selected as 100% and all others are expressed as percentages of that figure. In this chart the average for the years from 1923 through 1925 was selected as the base figure or 100%.

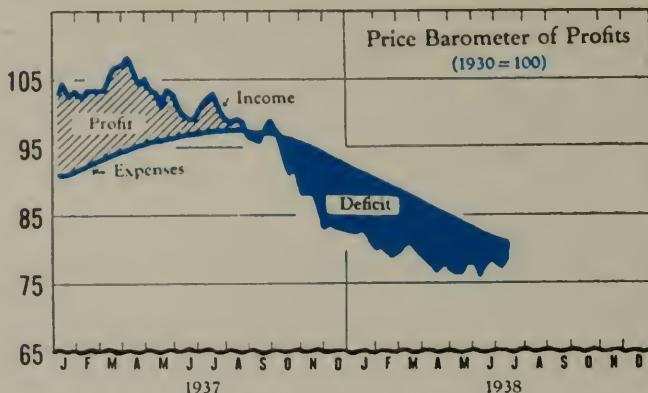


Federal Reserve Bank of New York, "Monthly Review," March 1, 1937. SCALE .7

- B. Indexes of Volume of Agricultural and Non-Agricultural Exports in the United States from 1929 to 1936. 1923-25 Average Equals 100%.

It is better to have both the 100% line and the zero line heavier than the others in an index-number chart.

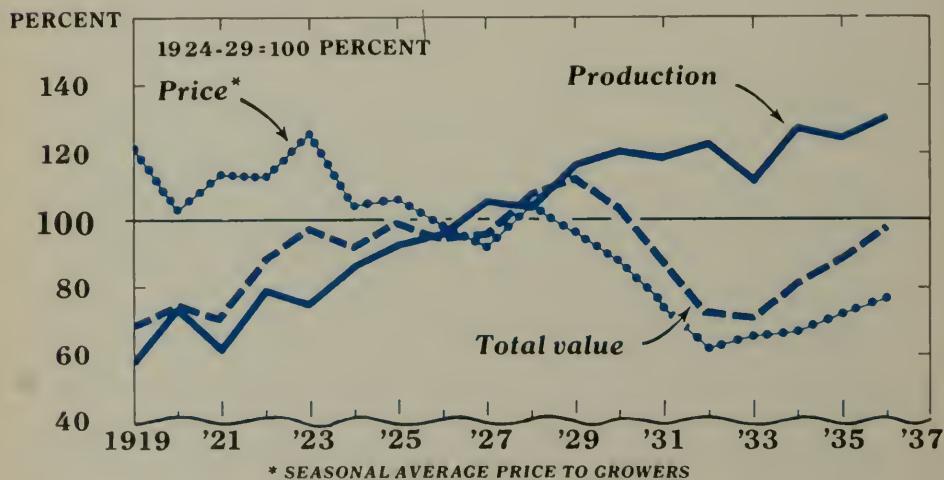
GRAPHIC PRESENTATION



Alexander Hamilton Institute, "Business Conditions Weekly," July 23, 1938.

A. Price Barometer of Profits in the United States from January 1937 to July 1938.

The crossing of two lines often creates areas which can be labelled. Compare the shading of these two areas with 283.



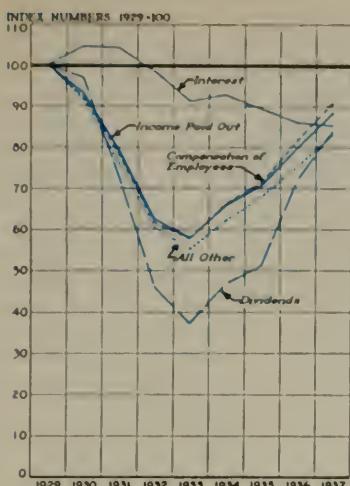
U. S. Department of Agriculture, Bureau of Agricultural Economics.

SCALE .6

B. Comparison of the Indexes of Production, Total Value, and Price of Seventeen Vegetables for Fresh Market in the United States from 1919 to 1936.

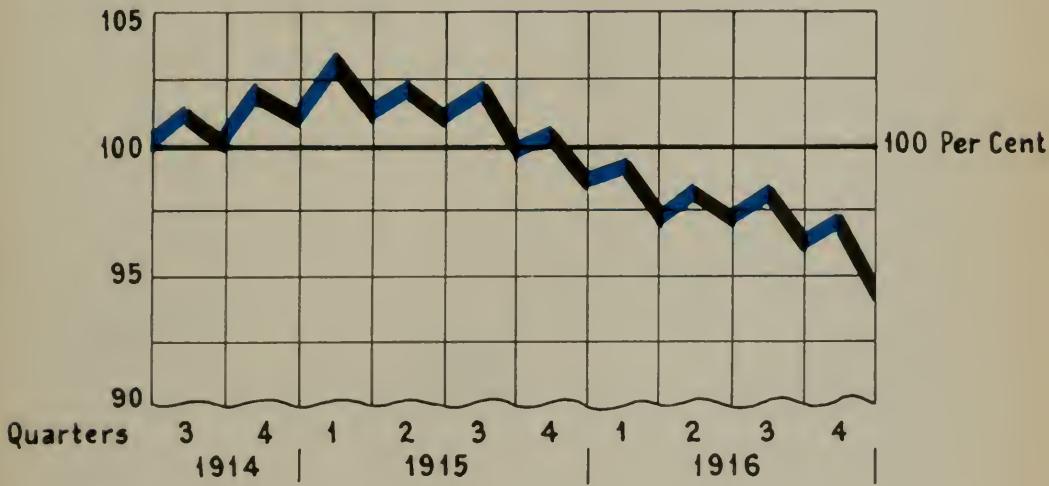
In curve charts, when a number of curves are plotted on the same grid and when a number of curve patterns are used, it is better to have the curves labelled as they are here than to have a boxed legend or key to identify them.

INDEX NUMBERS SHOWN BY CURVES



U S Department of Commerce, Division of Economic Research, "Survey of Current Business," June 1938
SCALE 9

Per Cent



Leonard P. Ayres

B. Method Developed in Washington, D. C., During the World War to Keep Track of British Ship-Building.

The blue lines going up show the new tonnage built in each three months' period. The black lines going down show the tonnage sunk. Thus at the end of any quarter, it was possible to ascertain the gains and losses, as well as the total remaining.

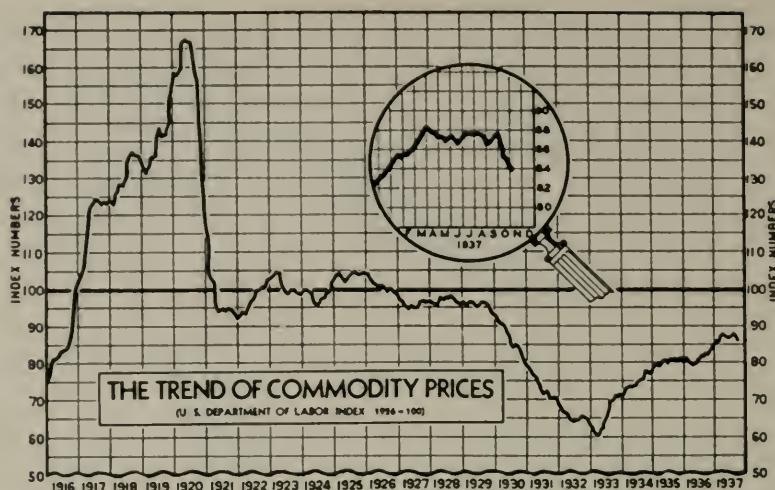
One hundred per cent equals British seagoing steam vessels at the beginning of the war.

This consisted of 18,892,089 gross tons, plus 725,500 seized from the Germans and Austrians.

A. Indexes of Income Paid Out by Type of Payment in the United States from 1929 to 1937. 1929 Equals 100%.

1. The theory of index numbers is clearly demonstrated in this chart. Since the figures for 1929 are equal to 100%, every curve begins at the same point in 1929.
2. In choosing a base year, care should be taken to select one which is representative, and devoid of "high peaks" or "low valleys."
3. For another method of presenting this material, see 114A.

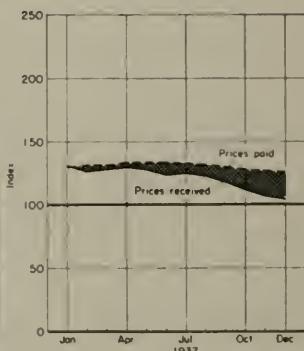
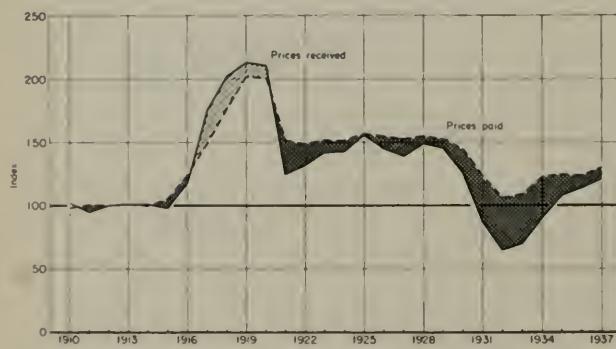
GRAPHIC PRESENTATION



The Magazine of Wall Street, November 20, 1937.

A. Changes in Major Commodity Price Group in the United States from 1916 to November 1937.

The technique of putting the detail for the last year under a magnifying glass is good.

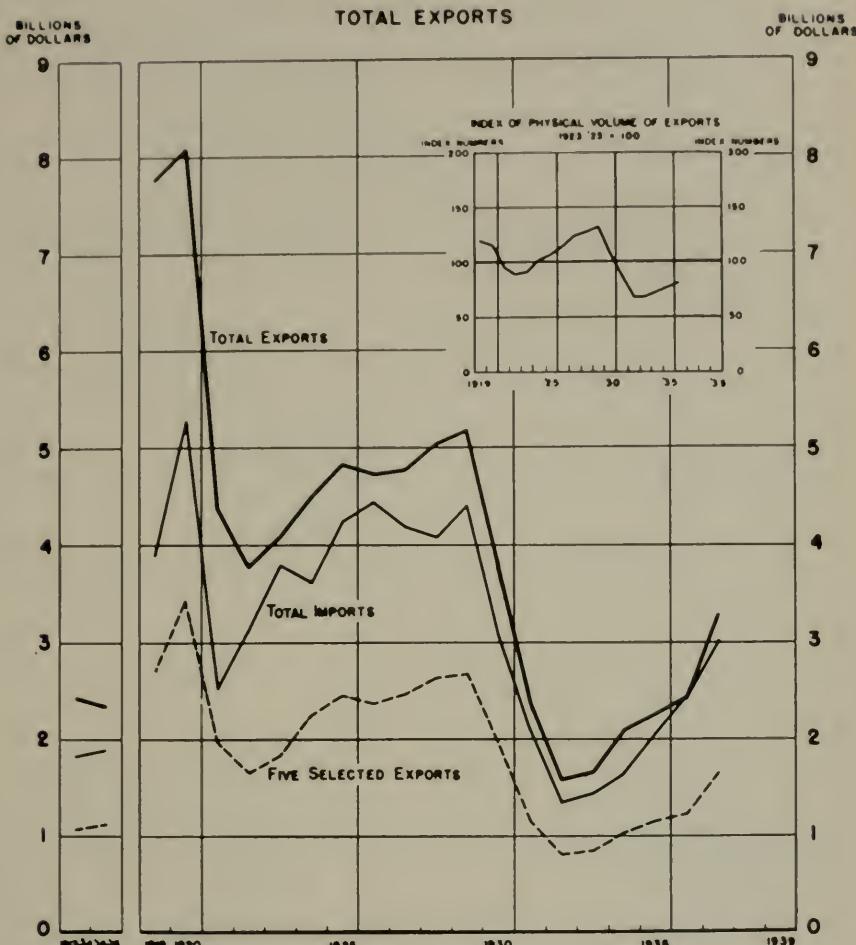


WPA. and Bureau of Agricultural Economics, "Rural Poverty," 1938

SCALE .7

B. Prices Paid and Prices Received by Farmers in the United States 1910-1937.
For Prices Paid the Average Year August 1910-1914 Equals 100%. For Prices Received the Average Year August 1909-1914 Equals 100%.

Since the chronological scale from 1910 to 1937 is by years and the scale for 1937 is by months, the latter is presented as if it were a separate chart. Compare this with 304A and 285C.

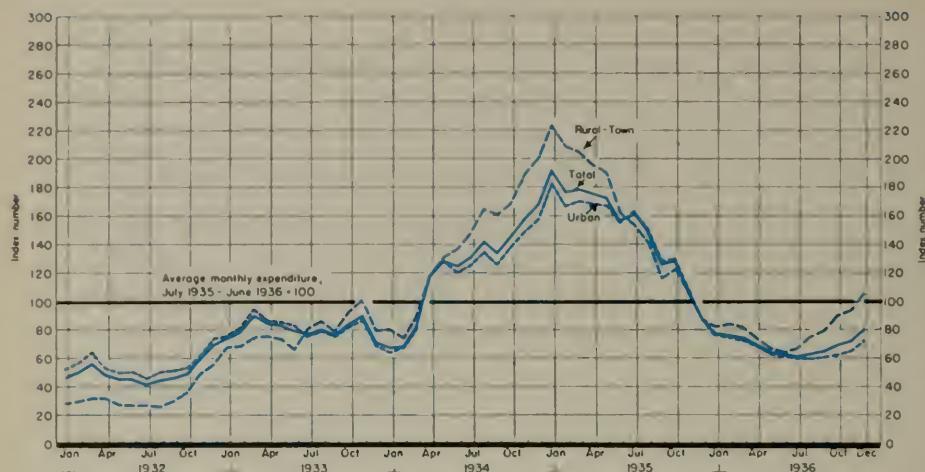


"The Federal Chart Book," Prepared by Central Statistical Board and National Resources Committee,
January 1938.
SCALE .7

Total Exports and Imports of the United States Compared with the Index of Physical Volume of Exports from 1919 to 1937.

1. To add meaning to numerical values, a comparison with index numbers is often useful. The insertion of the small index number chart in the space at the upper right shows one method of accomplishing this.
2. Note the method of breaking the grid to indicate an omission of a period of years.
3. See 93A4.

GRAPHIC PRESENTATION

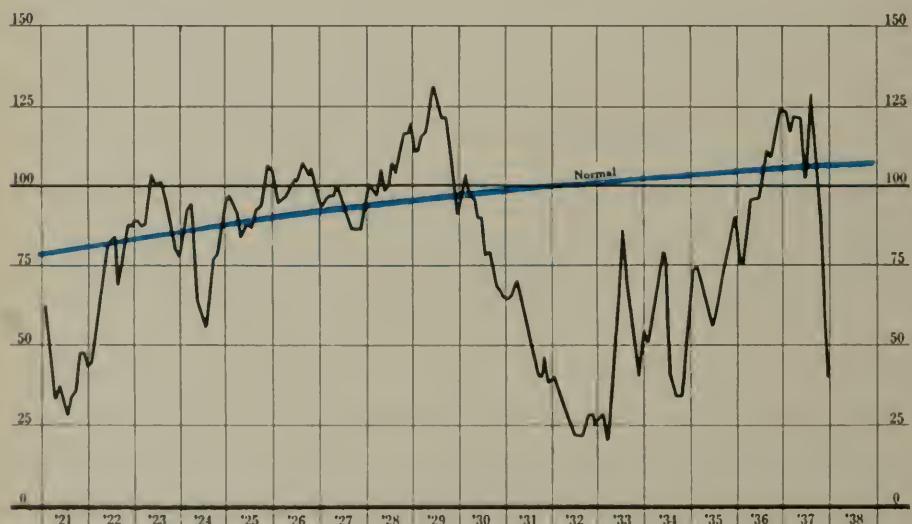


WPA, and Bureau of Agricultural Economics, "Rural Poverty," 1938.

SCALE .7

A. Trends of Expenditures for Relief in the United States from 1932 to December 1936.

When a broad line is used for a curve, the point in the middle of the line is the plotted point. If great accuracy is desired, a thin line should be used. The advantage of a thick line is that it is easily seen from a distance.



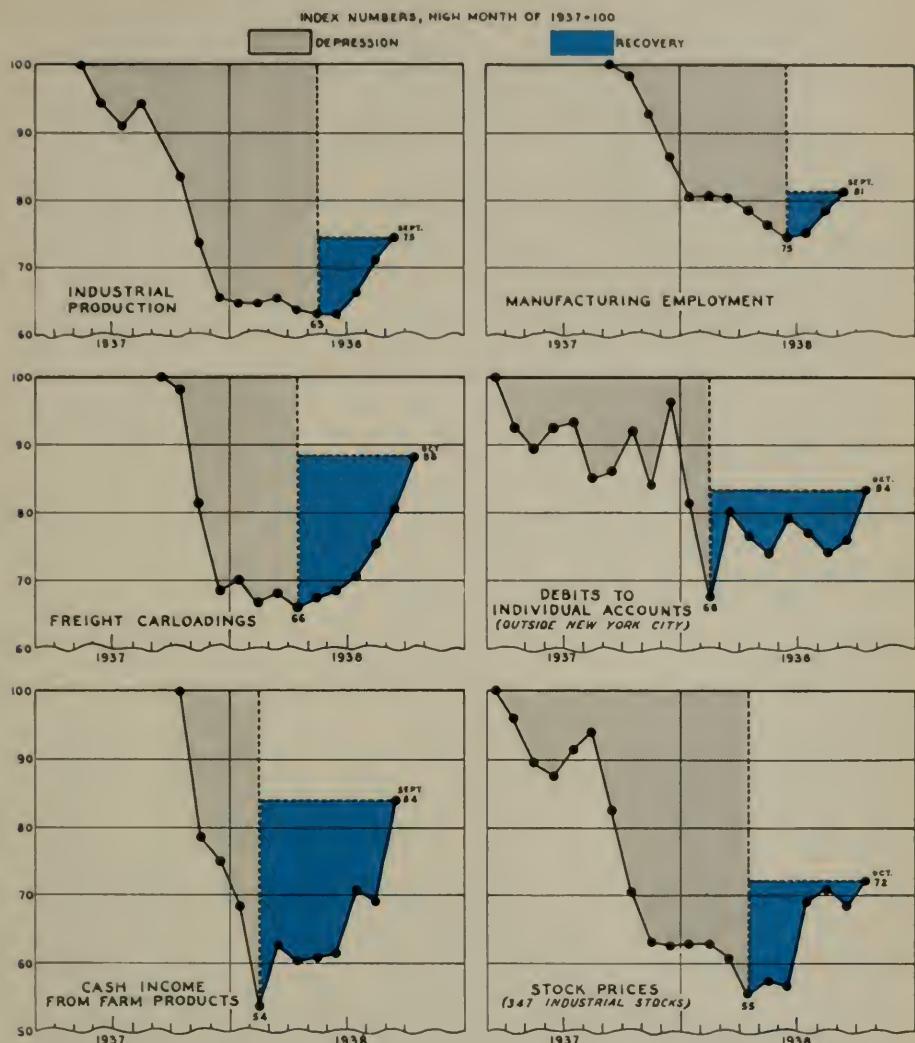
Standard Statistics Co., "Standard Trade and Securities," March 4, 1938.

SCALE .7

B. Steel Production in the United States from 1921 to 1938. 1926 Equals 100%.

This chart shows concretely that the average for the base period actually averages 100% on the chart. See also 302B.

INDEX NUMBERS SHOWN BY CURVES



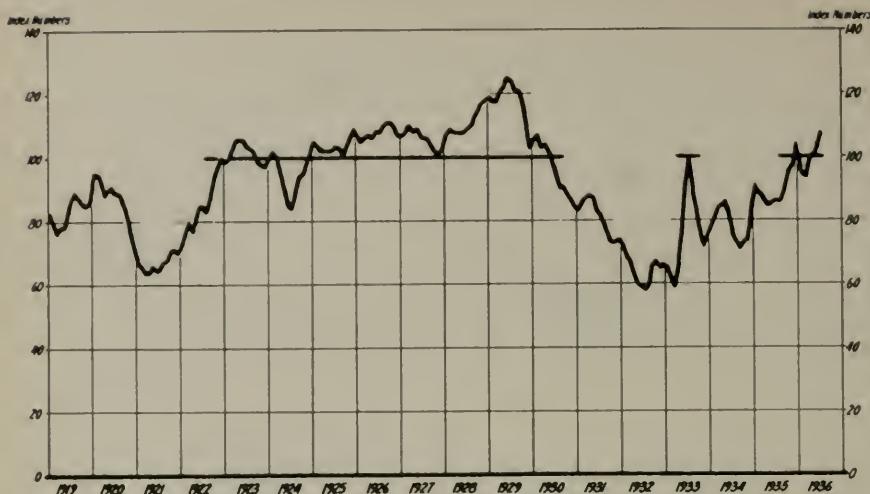
National Industrial Conference Board, Inc., November 25, 1938

SCALE 7

Depression and Recovery in the United States for the Years 1937 and 1938.

1. The most interesting feature of this chart is that the high month of 1937 is equal to 100% in each of the six charts. The result is that each curve has a different base figure.
2. The lowest point from that date to the date when the data were last available was designated the end of the depression period. As a result, there is a variation in the date at which the depression period supposedly ends in each of the six charts.

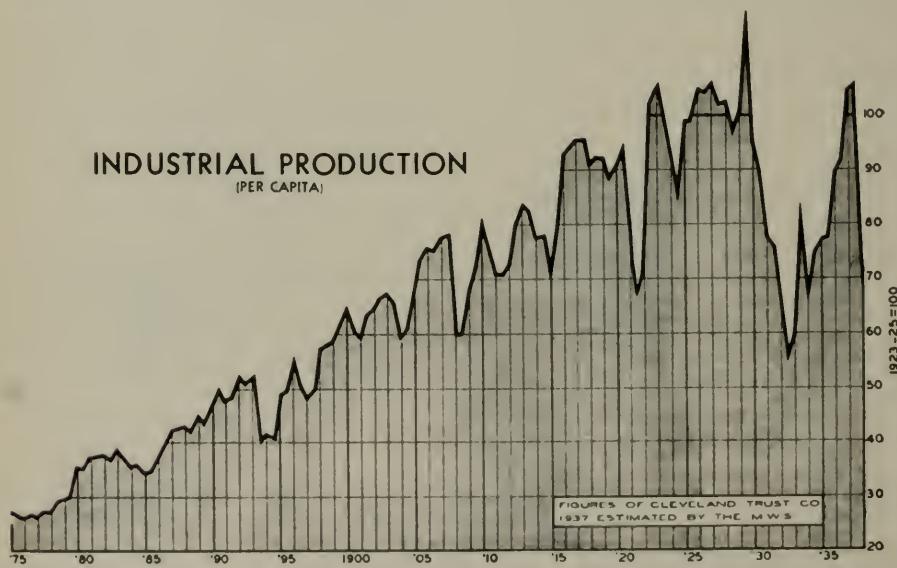
GRAPHIC PRESENTATION



U. S. Department of Labor, Bureau of Labor Statistics, "Labor Information Bulletin," April 1936.

- A. Physical Volume of Industrial Production in the United States from 1919 to 1936. 1923-25 Average Equals 100%.

Compare with B below.



Magazine of Wall Street, January 29, 1938.

SCALE .7

- B. Per Capita Industrial Production in the United States from 1875 to 1938. 1923-25 Average Equals 100%.

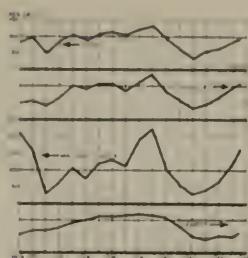
This silhouette is different from most in that the grid above the plotted line is eliminated.

Compare this chart with A above and 273.

INDEX NUMBERS SHOWN BY CURVES

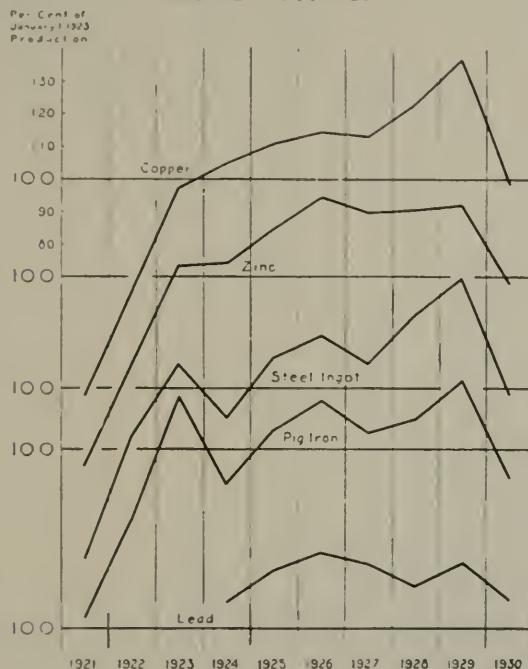
A. Yearly Output of Four Important Industries in the United States from 1919 to the Middle of 1936, Relative to 1923-25 Average.

1. Note the use of arrows to indicate the scale applicable to the data.
2. The reason for presenting this material in this form was no doubt to avoid crossing the curves. Compare this method with 303A.



Federal Reserve Bank of New York, "Monthly Review," August 1, 1936.

INDEXES OF INDUSTRIAL PRODUCTION METAL INDUSTRIES



Brown, Bingham, and Tammmeroff, "Laboratory Handbook of Statistical Methods," McGraw-Hill, 1931.

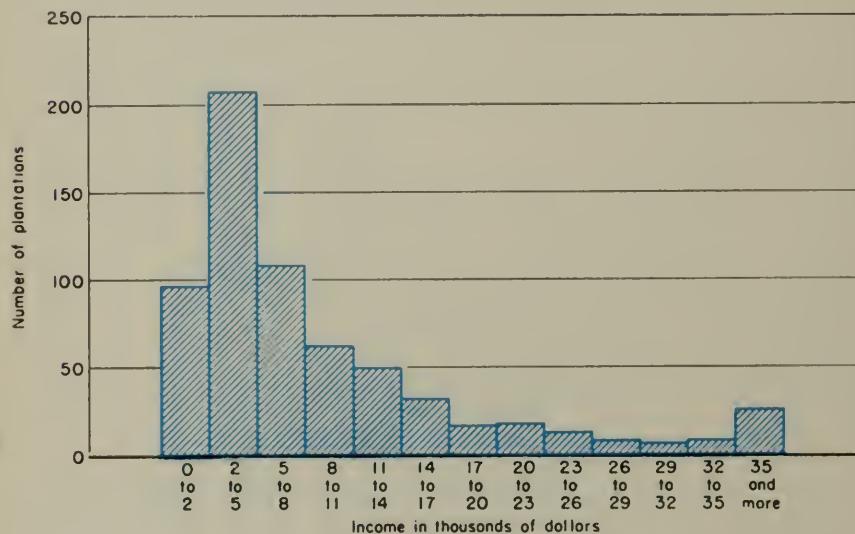
B. An Example of a Multiple Axis Graph.

1. It has been noted that when a multiple scale is used on an arithmetic chart, all scales must have a common zero line. When the data are changed to index numbers, it is possible to arrange the curves on a multiple axis; that is, each curve fluctuates around its own base, or 100, and can be moved farther from or closer to other curves without distorting the facts presented.
2. The purpose of this arrangement is to facilitate comparisons of the time and amplitude changes in the curves.

Chapter 38

FREQUENCY CHARTS

THE charts in this chapter present data showing frequency distribution. The most common bases of classification or arrangement are according to kind, size, location, or time of occurrence. Other terms that may be applied to this type of chart are histogram, distribution chart, and block diagram. When the curve in a frequency chart assumes the shape of a bell, it may be called a bell curve chart.



WPA, Division of Social Research, "Landlord and Tenant on the Cotton Plantation," 1936.

Distribution of Total Gross Income of 645 Cotton Plantations in the United States in 1934.

A frequency chart is a distribution according to certain categories. In this chart the categories are income groups. The first bar represents the number of cotton plantations in the United States with an income less than \$2,000 a year, while the last bar represents the number of plantations with an income of \$35,000 or more.

FREQUENCY CHARTS

MACHINE OPERATORS



HAND CIGAR MAKERS



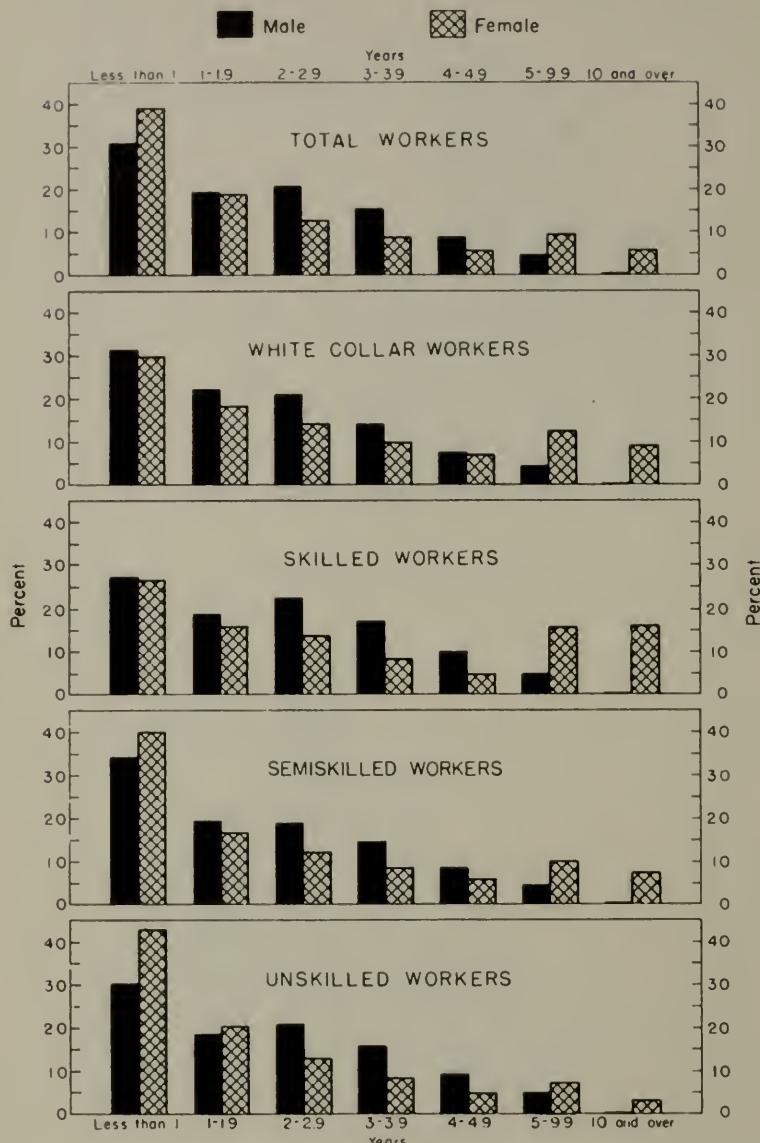
WPA National Research Project, "Cigar Makers—After the Lay-off," December 1937.

SCALE .9

Age of Machine Operators in Cigar Factories and Hand Cigar Makers in the United States as of July 1931.

1. A comparison of these two frequency charts indicates that machine operators are relatively much younger than hand cigar makers.
2. The notation of the median age means that there are as many men younger than 26 working as machine operators as there are men older than 26.

GRAPHIC PRESENTATION



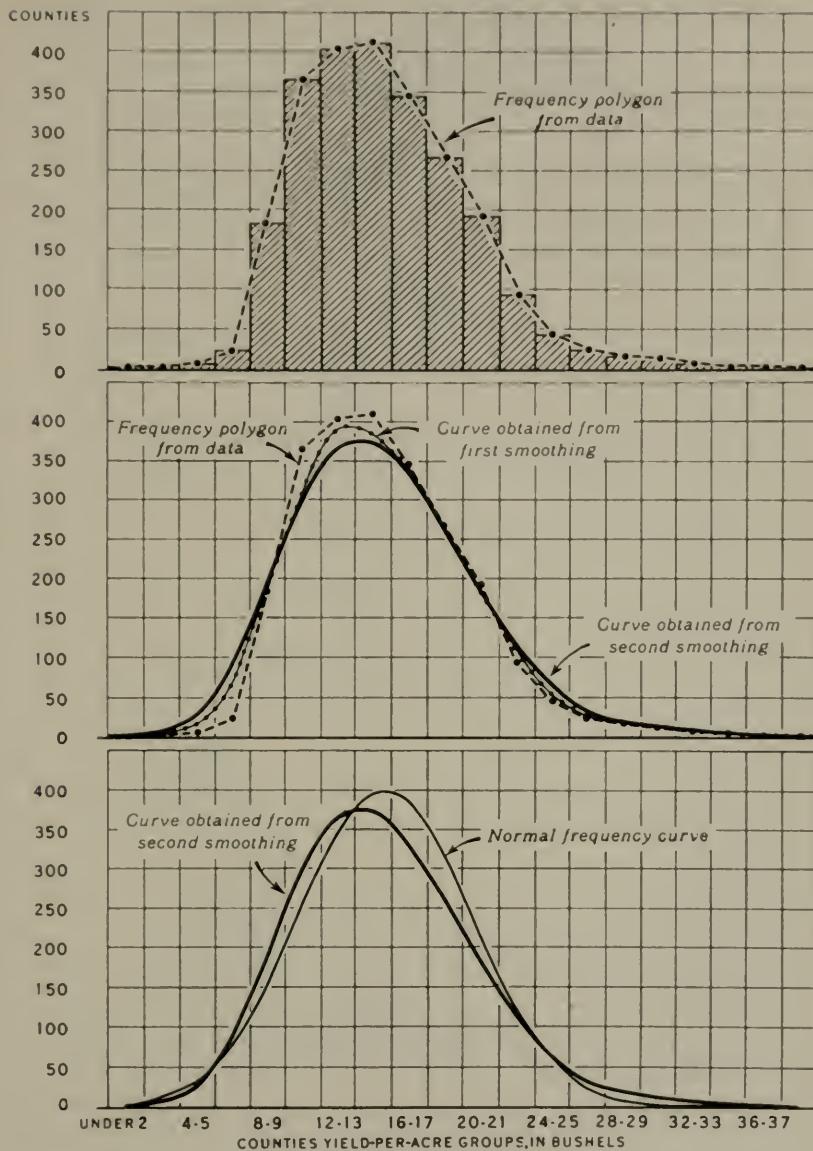
WPA, Division of Social Research, "Urban Workers on Relief," 1936.

SCALE .9

Duration of Unemployment Since Last Non-Relief Job of Unemployed Workers on Relief in May 1934 by Socio-Economic Group of Usual Occupation in the United States.

Note that the total of the bars representing any one group, such as female unskilled workers, is equal to 100 per cent.

FREQUENCY CHARTS



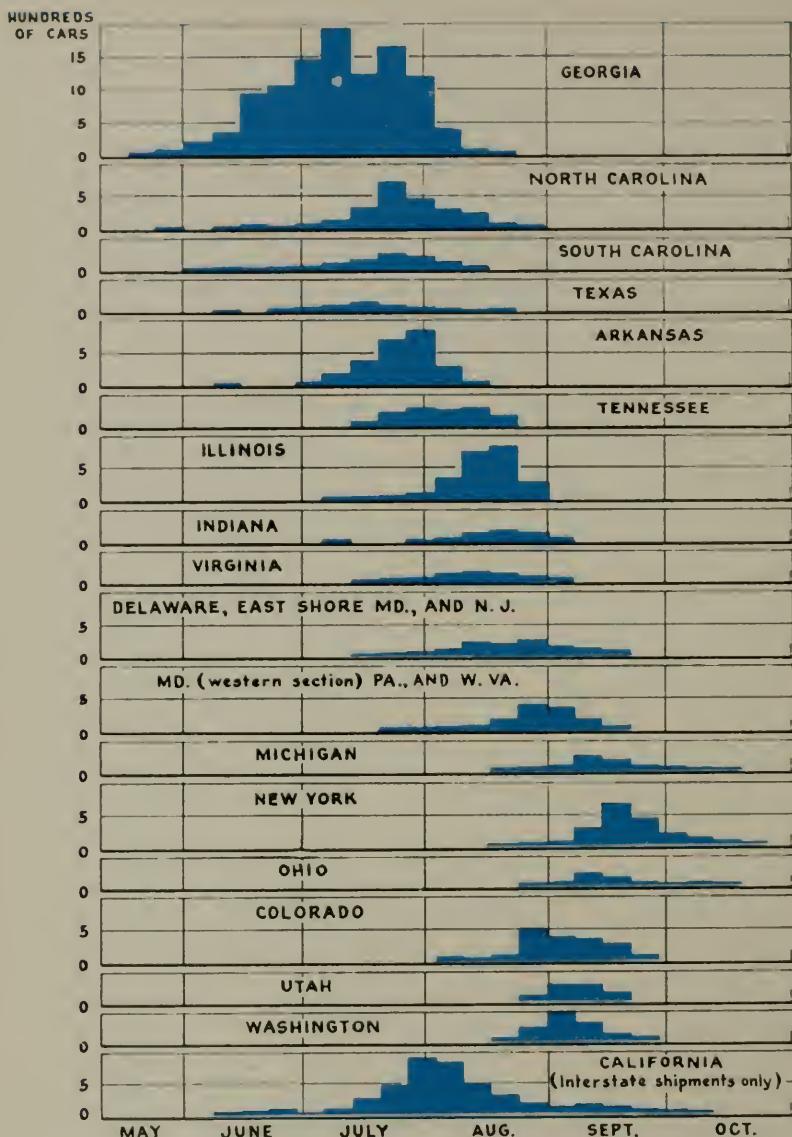
U. S. Department of Agriculture, Bureau of Agricultural Economics.

SCALE .8

Distribution of 2,412 Counties in the United States Into Wheat Yield-per-acre Groups.

This shows the three steps in securing a frequency curve.

GRAPHIC PRESENTATION



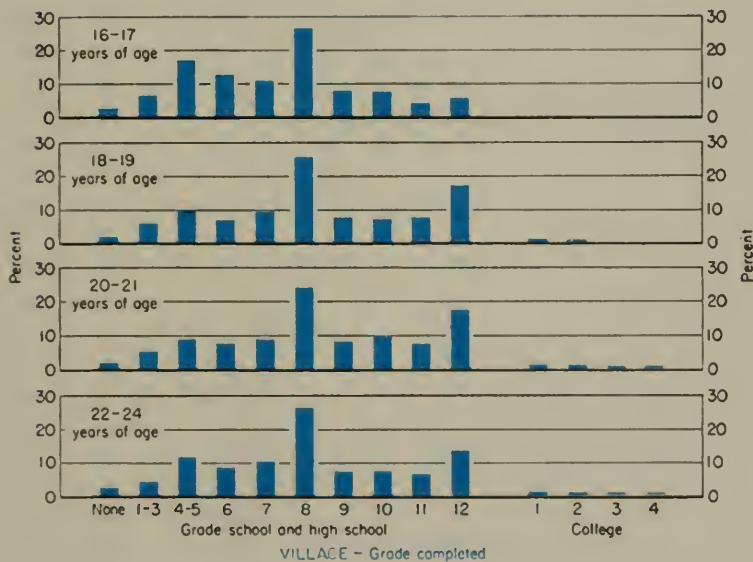
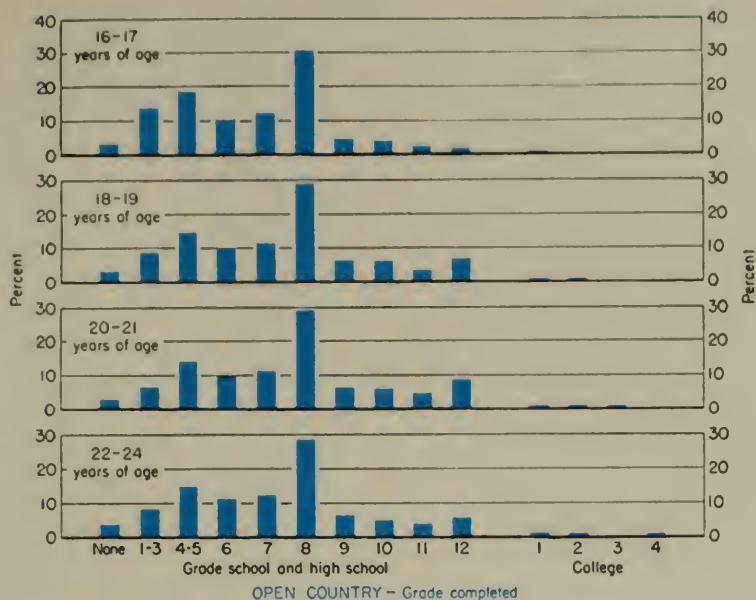
Redrawn from a Chart by Bureau of Agricultural Economics, U. S. Dept. of Agriculture.

SCALE .8

Average Weekly Carload Shipments of Peaches in the United States by States.

1. The average is of the years 1927-1930.
2. The copy from which this was redrawn was a photostat, and it was redrawn because the base lines of some of the charts were wavy. After the chart was finished, it was found that there was a definite optical illusion. When the chart is viewed from a distance, notice that the base lines seem to hump at the point where the bars are the highest.

FREQUENCY CHARTS



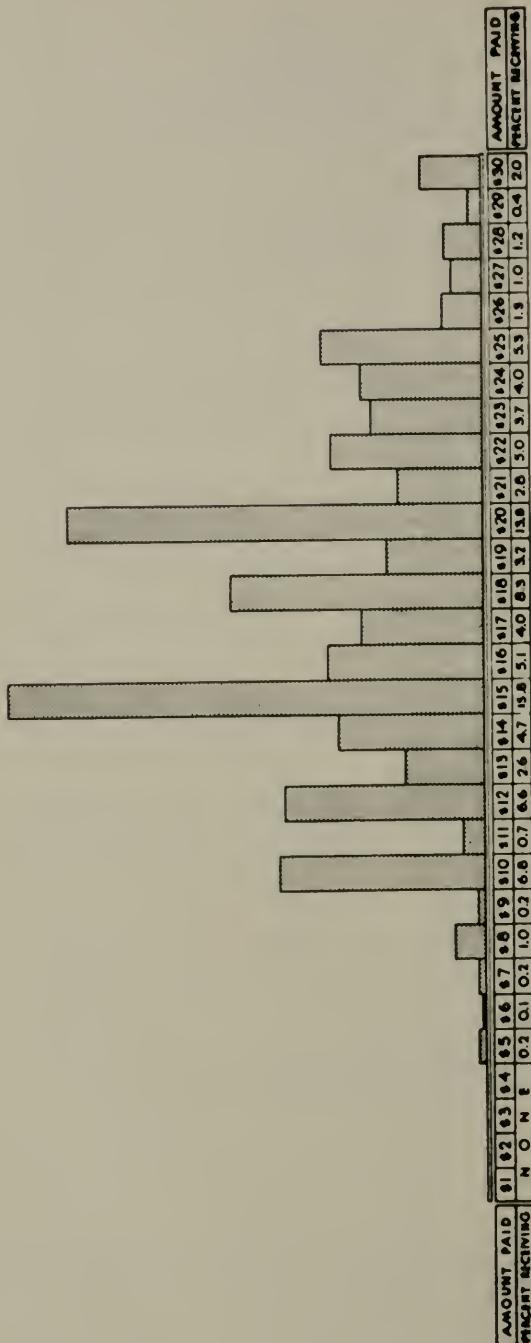
WPA, Division of Social Research, "Rural Youth on Relief," 1937.

SCALE .9

Grade Completed by Out-of-School Rural Youth on Relief, by Age and by Residence, in the United States, October 1935.

This may indicate a lower percentage of college graduates on relief, or only a lower percentage of college graduates in the community.

GRAPHIC PRESENTATION

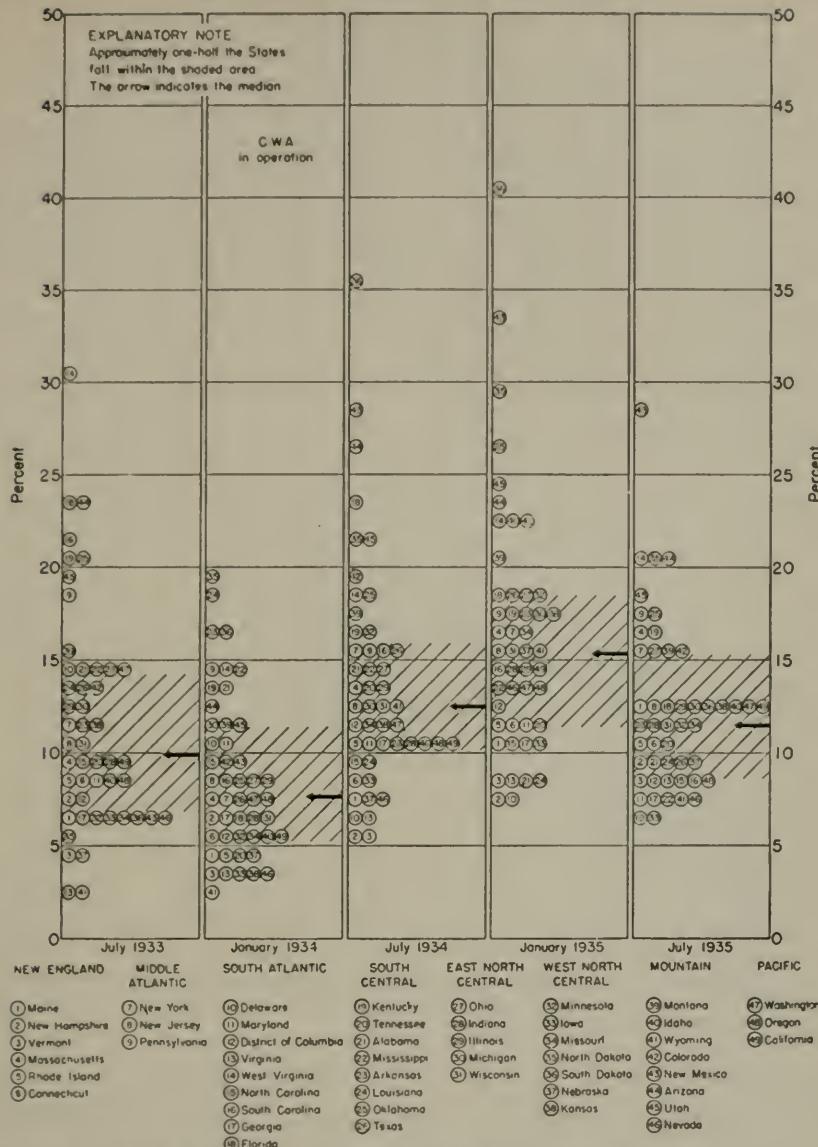


State of New Jersey, Department of Institutions and Agencies, Division of Old Age Assistance, June 1938.

Distribution of Persons Receiving Specified Grants under Old Age Assistance in New Jersey, December 1937.

- SCALE .8
1. Since there is no scale for the height of the bars, a tabulation of the percentage distribution is given at the bottom. Thus by consulting the table, it is easy to determine that 15.8% of the persons receiving specified grants under old age assistance in New Jersey were paid \$15.
 2. If groupings such as \$11 through \$15 and \$16 through \$20 had been selected, there might have been a truer distribution curve, since the \$10, the \$15, and the \$20 bars are so much higher than those immediately adjacent.

HALF-YEARLY INTERVALS, JULY 1933 – JULY 1935

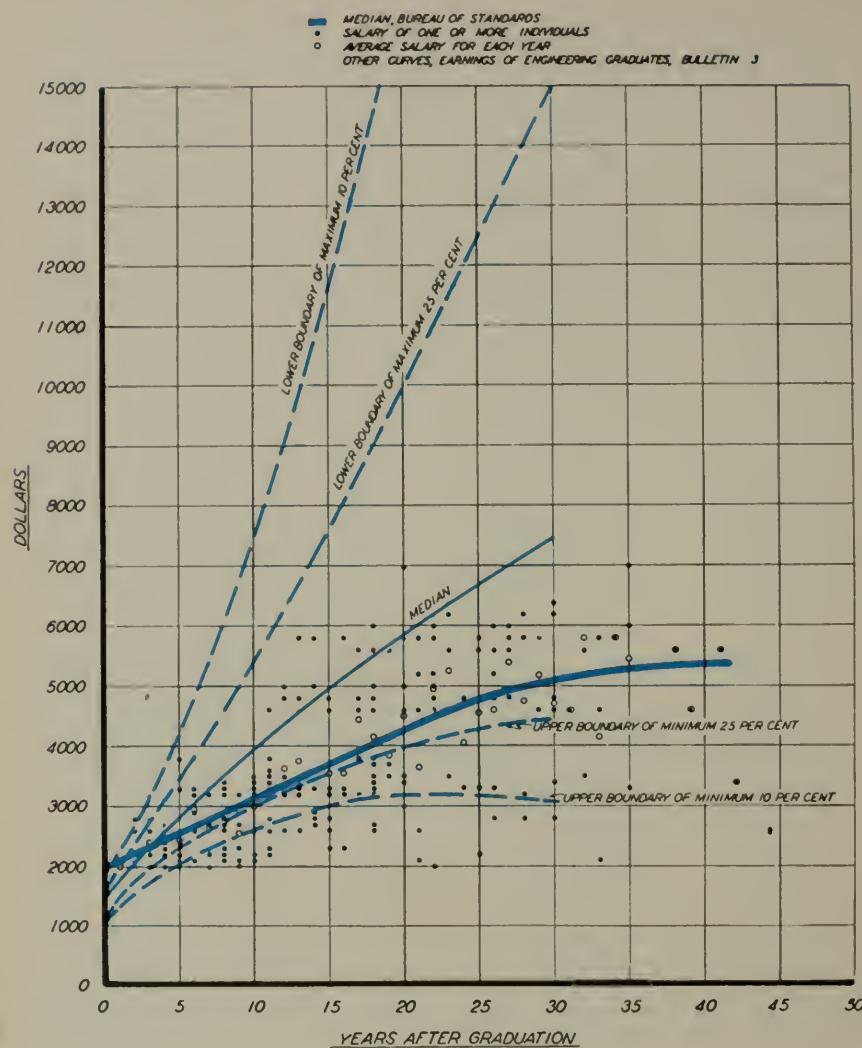


WPA, Division of Social Research, "Trends in Relief Expenditures, 1910-1935," 1937

Percent of Population Receiving Relief, by States, from the General Relief Program, F.E.R.A., from July 1933 through July 1935.

1. If this chart is turned so that the left side becomes the base line, the similarity between it and other frequency charts is more easily seen.
 2. The shaded areas and the use of numbers to give a key to the states are good techniques.

GRAPHIC PRESENTATION



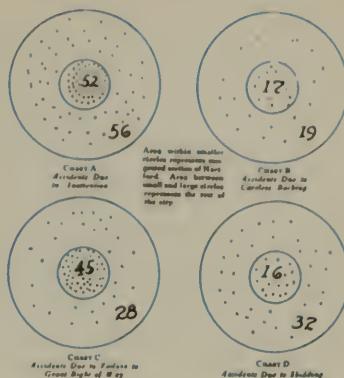
Washington, D. C., Section of the A.S.M.E., "The Economic Status of Engineers in the Federal Service," Mechanical Engineering, February 1930.

Comparison of the Salaries of the Professional Staff of the National Bureau of Standards in August 1928 With the Salaries of Persons Holding the Same Type of Position Outside the Federal Service.

The 5 curves labelled as follows: "lower boundary of maximum 10 per cent," "lower boundary of maximum 25 per cent," "median," "upper boundary of minimum 25 per cent," and "upper boundary of minimum 10 per cent" refer to the distribution of persons in a similar occupation outside the Federal Service. Only the heavy line represents salaries in the Federal service, as indicated by the key.

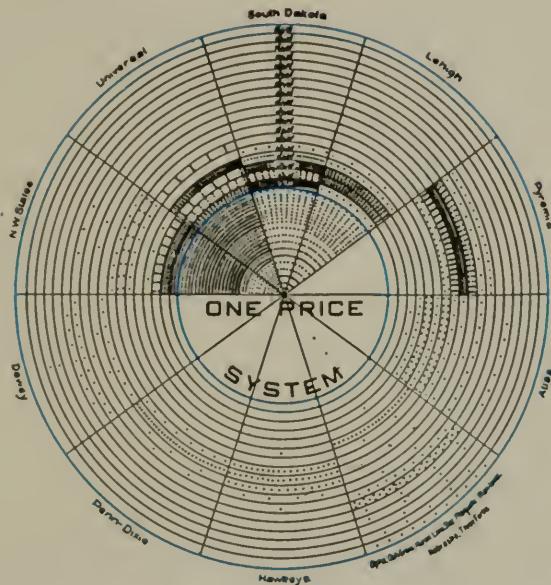
A. Distribution of the Causes of Accidents in Hartford, Conn.

Compare this method of showing the distribution of the causes of accidents with that used in 190A.



Travelers Insurance Co., Hartford, Conn.

SCALE .7



Burns, "The Decline of Competition," McGraw-Hill, 1936 (Source: Federal Trade Commission Price Bases, Inquiry).

SCALE .7

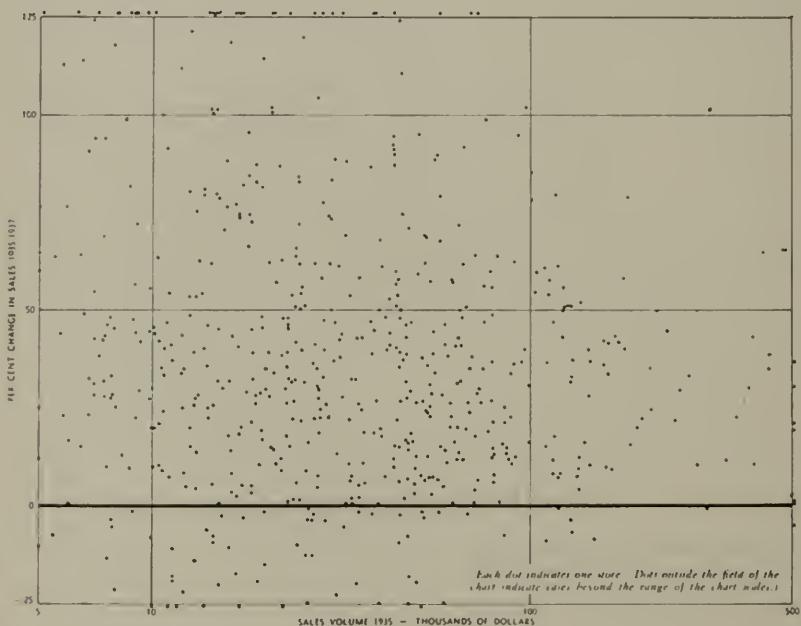
B. Net Yields on the Sale of 2,350 Carloads of Cement to Five Minneapolis Line Lumber Companies at 210 Destinations in Minnesota, Iowa, and North and South Dakota Between July 1, 1927 and June 30, 1929.

1. Each dot represents one carload of cement. Dots in the area marked "one price system" represent sales at prices yielding to the mill its "then current maximum mill net price."
2. Dots in successive outer zones represent sales yielding less than the mill's maximum mill net by an amount within the range of cents indicated within each zone on the chart. The guide for cents per zone is shown in the South Dakota section.

Chapter 39

CORRELATION CHARTS

THE purpose of correlation charts is to indicate the degree and type of relationship between variables. One form of correlation chart, the scatter diagram, also called the gun-shot or shot-gun chart and buck-shot chart, sometimes indicates that there is no relationship between two variables. See the chart below.



Dun's Review, August 1938.

SCALE .7

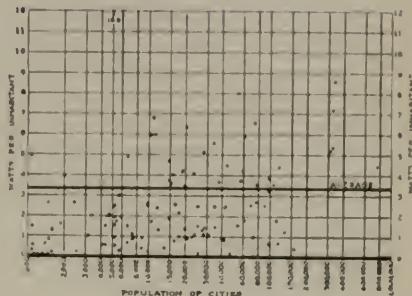
The Increase or Decrease of Sales for the Period 1935-37 for Individual Retail Stores in the United States According to Sales Volume in 1935.

1. According to the comments in Dun's Review, the wide scatter of individual cases indicates a "growth tendency in favor of small concerns" rather than indicating that "all large stores had built sales volume more rapidly than the small ones."
2. It should be noted that the vertical rulings are logarithmic.
3. The limited number of vertical and horizontal rulings was intentional—that is, they were limited to make it easy for the reader to notice the lack of pattern of the dots.

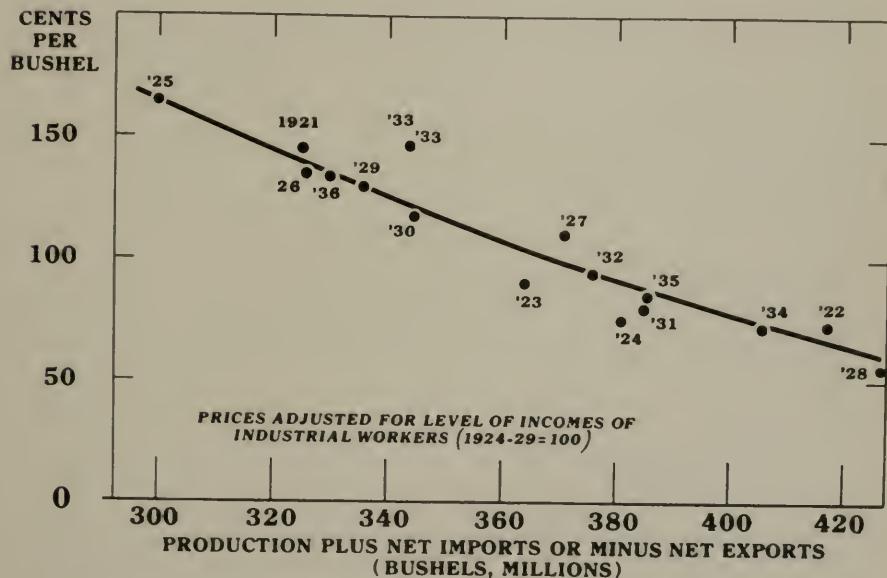
CORRELATION CHARTS

A. The Development of Electrical Advertising as Revealed by the Number of Watts Used per Inhabitant in 143 Cities in the United States in 1922.

1. This scatter chart is supplemented by an average line secured by computation.
2. The lack of pattern here indicates that there is little correlation between the two variables.
3. Aggregate population of the 143 cities was 6,300,000. The average of 3 1/3 watts per inhabitant was weighted according to population, not according to the number of cities.



National Electric Light Association Bulletin, Feb. 1923.



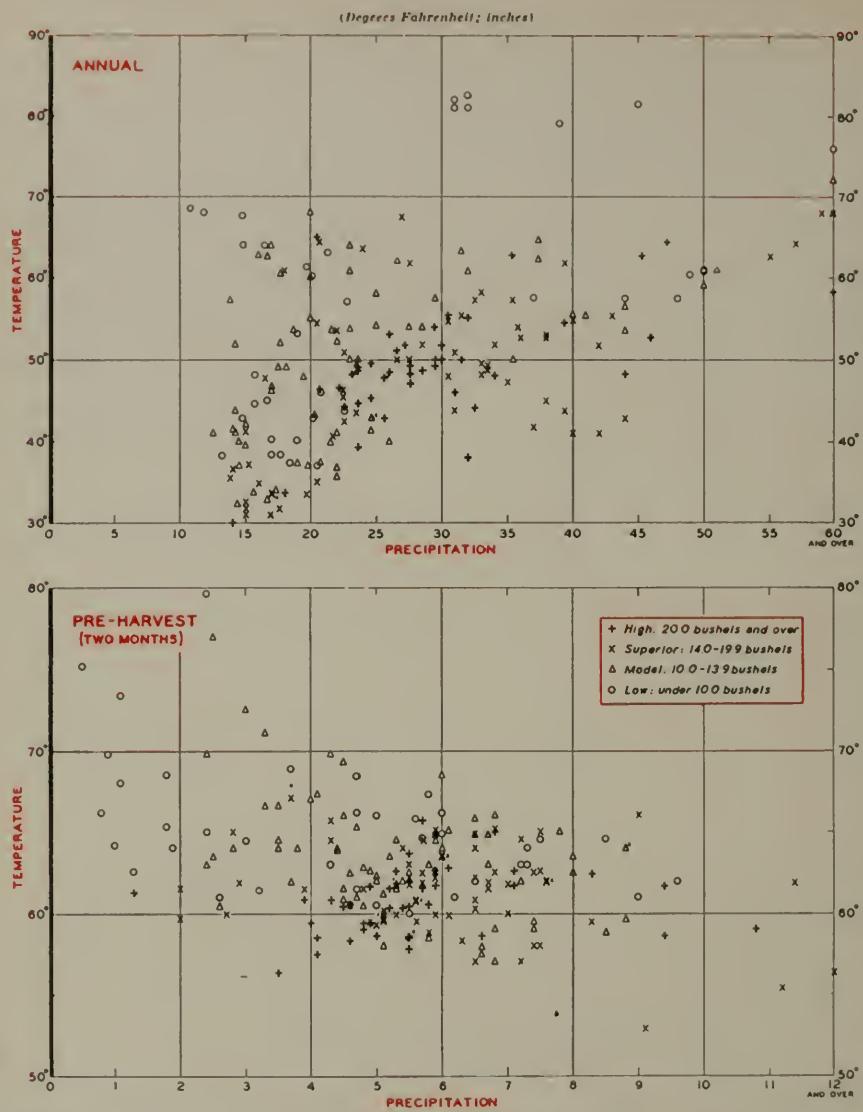
U. S. Department of Agriculture, Bureau of Agricultural Economics.

SCALE .9

B. The Relation of Adjusted Farm Price of Potatoes to Production in the United States from 1921 to 1936.

1. Since the scattered dots form a pattern, the relation of production to price can be determined. As the production of potatoes increases, the price per bushel goes down.
2. Compare this way of presenting relationships with the form shown in 282A.

GRAPHIC PRESENTATION



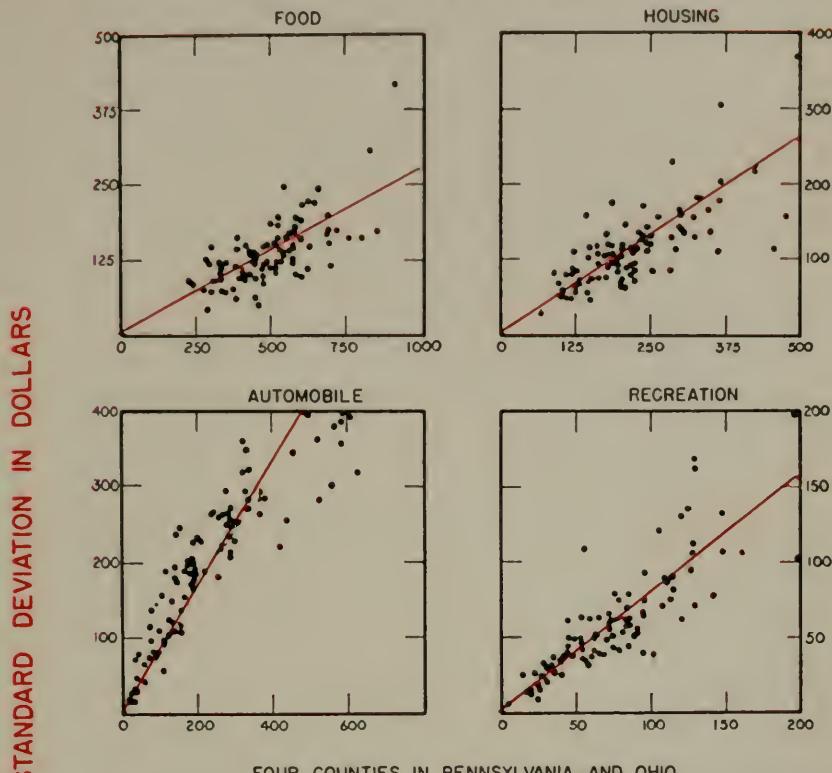
Stanford University, Palo Alto, California, "Wheat Studies of the Food Research Institute," March, 1937
SCALE .7

Distribution of 209 World Wheat Areas According to Annual and Pre-Harvest Precipitation and Temperature.

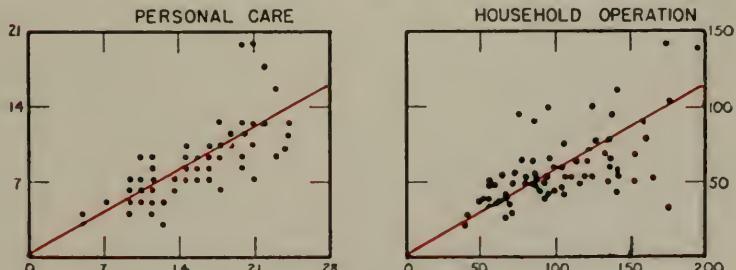
1. The most striking feature of this chart is the concentration of "high" and "superior" yields of wheat within the middle ranges of annual and pre-harvest precipitation and of annual temperature.
2. Of the 60 areas characterized by an annual precipitation of less than 20 inches, only 18 had long-time average yields of wheat above 14 bushels. These 18 are dry-farming areas in Canada and the western United States.

CORRELATION CHARTS

FOUR SMALL CITIES IN OREGON AND WASHINGTON



FOUR COUNTIES IN PENNSYLVANIA AND OHIO

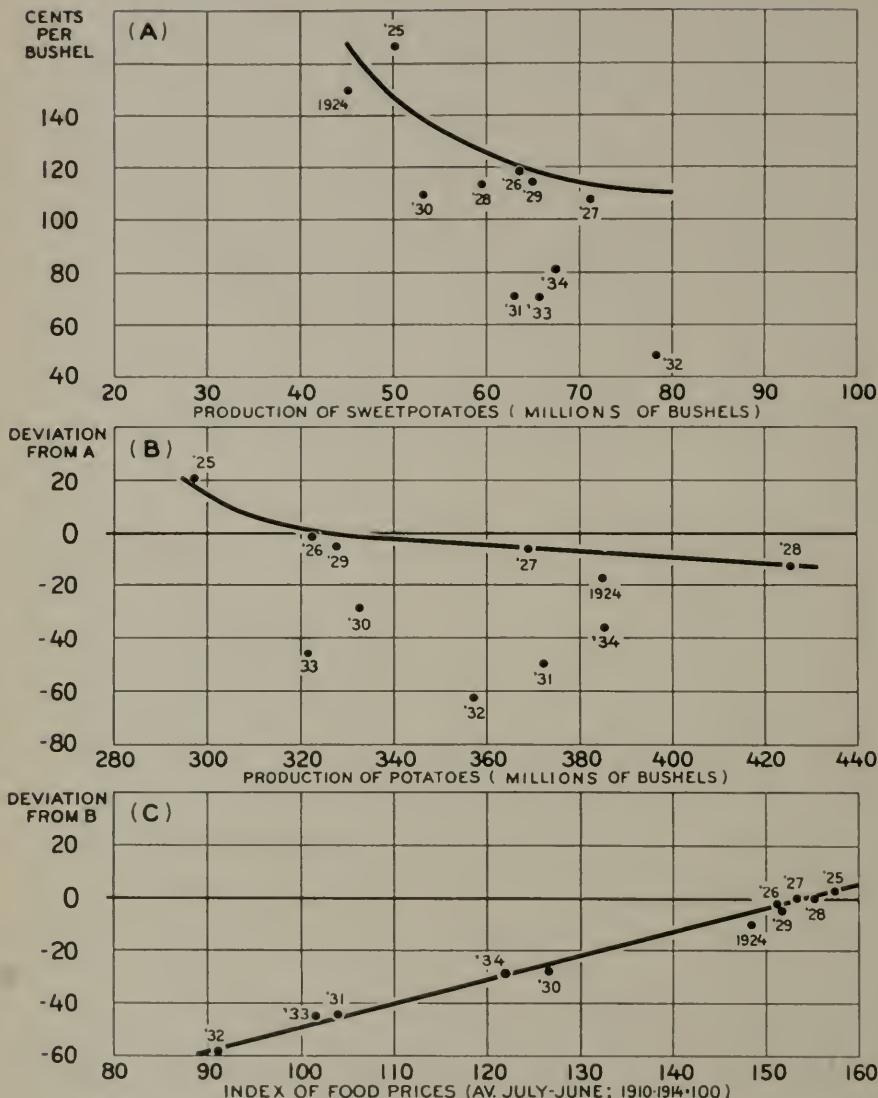


MEAN IN DOLLARS

Dorothy S. Brady, "Variations in Family Living Expenditures," Journal of the American Statistical Association, June 1938.

Standard Deviations of Family Expenditures in Relation to The Mean in Four Small Cities in Oregon and Washington, and Four Counties in Pennsylvania and Ohio, 1935-1936.

GRAPHIC PRESENTATION



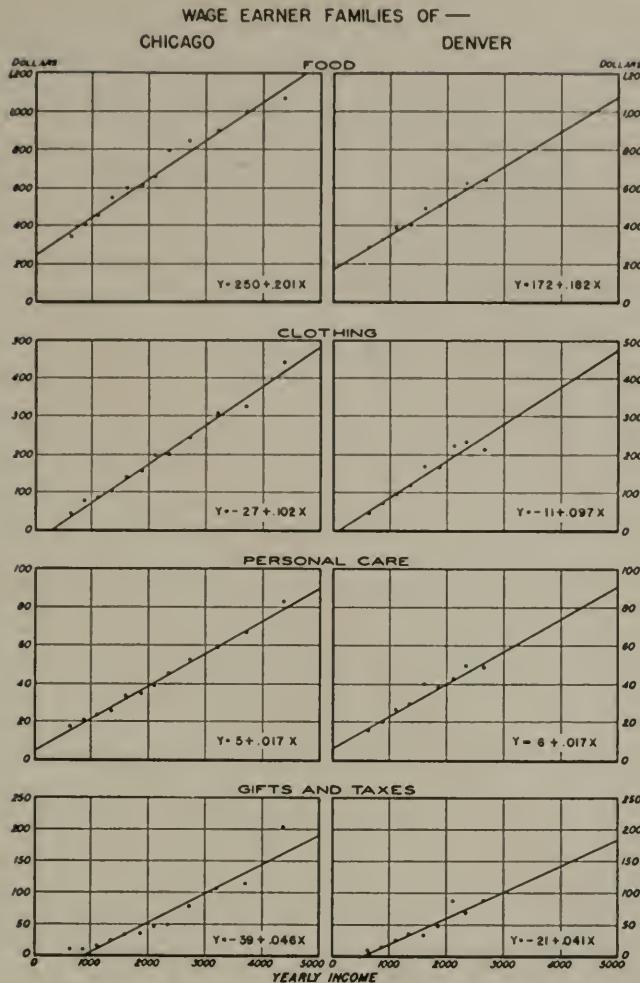
U. S. Department of Agriculture, Bureau of Agricultural Economics.

SCALE .8

The Relation of Sweetpotato Prices to Sweetpotato Production, Potato Production, and to Index of Food Prices in the United States from 1924 to 1934.

1. The small number of dots in these charts makes it possible to put the year which each represents beside the dot.
2. Note that the center chart shows deviation from the data in the first one, and the last one shows deviation from the center one.

CORRELATION CHARTS



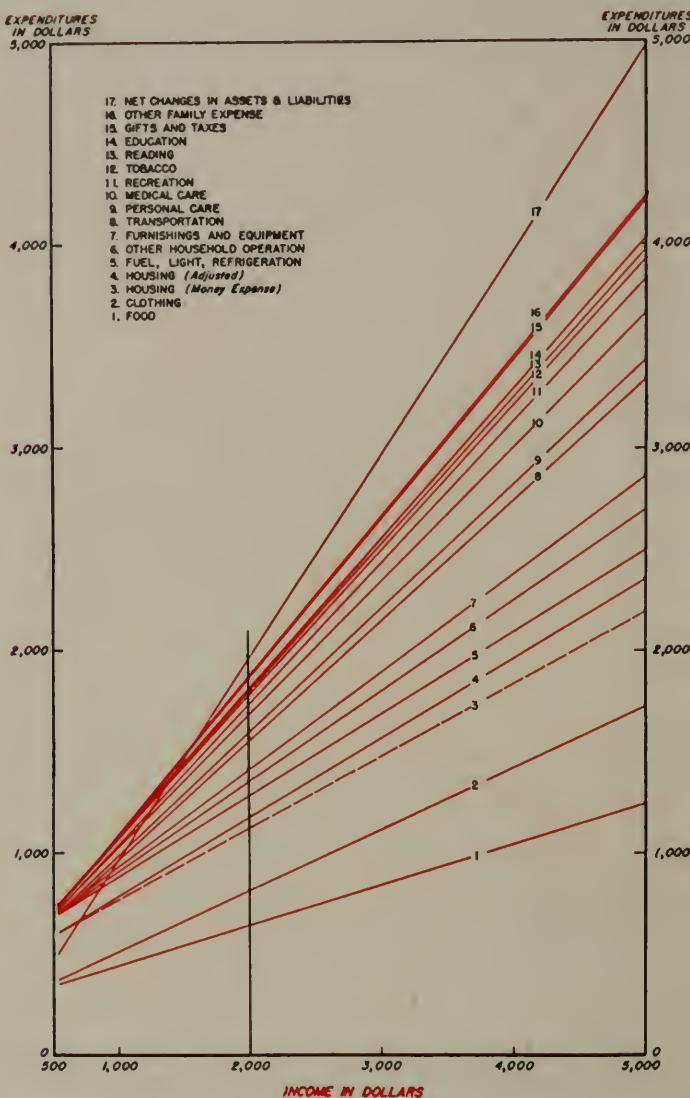
A. D. H. Kaplan, "Expenditure Patterns of Urban Families," Journal of the American Statistical Association, March 1938.

SCALE .8

Straight Line Fitted to Average Expenditures in Relation to Family Income in Wage-Earner Families of Chicago, Illinois, and Denver, Colorado, in 1935-1936.

1. Because wage levels generally run lower in Denver, the data for Denver wage earners stops at \$3,000 while the data for Chicago runs to \$5,000. Approximately thirty families were sampled for each dot or income band on the charts.
2. The method of reading these charts is as follows: in Chicago, a wage-earner family whose income was in the \$1,000 to \$1,200 income band would spend about \$420 for food, while in Denver, a family with the same income would spend about \$390. While \$420 was spent by the Chicago family for food, only \$90 was spent for clothing.

GRAPHIC PRESENTATION



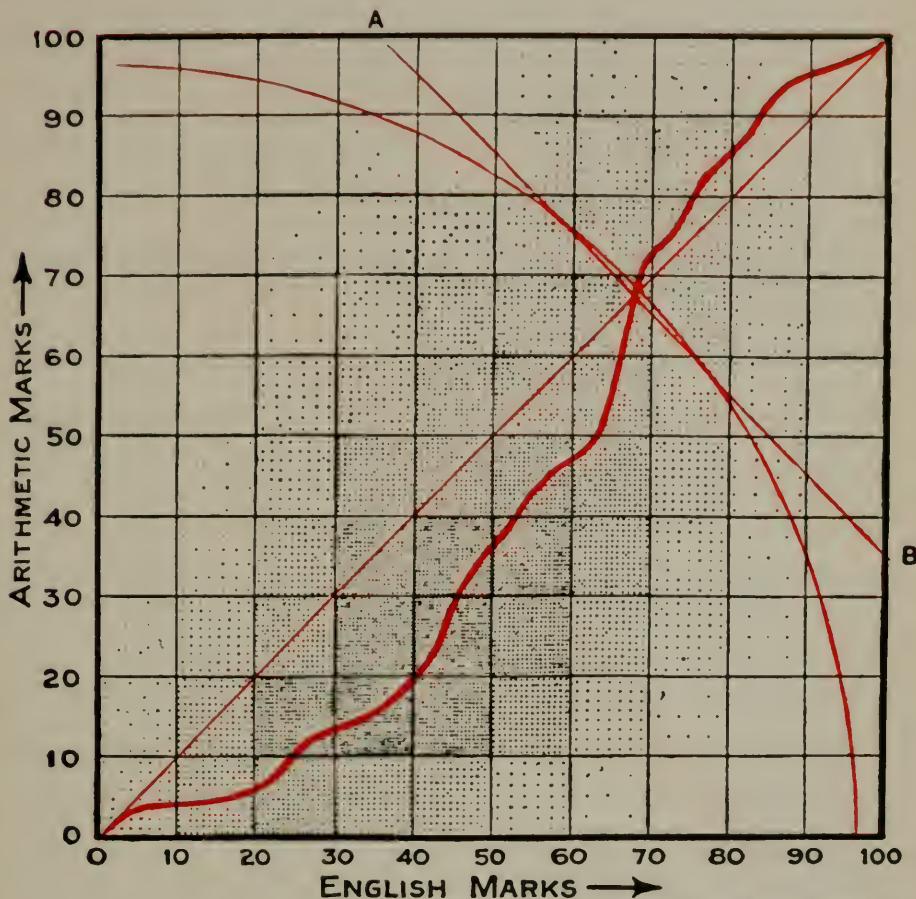
A. D. H. Kaplan, "Expenditure Patterns of Urban Families," Journal of the American Statistical Association, March 1938.

SCALE .9

Expenditure Pattern of Wage-Earner Families in Chicago, Illinois, in 1935-36.

1. It should be noted that these lines are cumulative. The line numbered 5 represents on the expenditure scale the amount spent for 5, 4, 3, 2, and 1. The difference between 4 and 5 is the amount spent for "fuel, light, and refrigeration."
2. If line 17 is above 16, the families in that income band were not in debt at the end of the year; if line 17 is below 16, the family income did not cover expenditures.

CORRELATION CHARTS



Data of W. Garnett in the Journal of the Royal Statistical Society, 1910

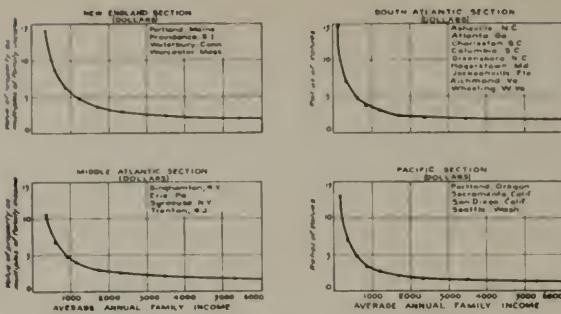
Brinton, "Graphic Methods," McGraw-Hill, 1914.

SCALE .9

Examination Marks Obtained by 9,396 English School Girls in English and Arithmetic.

1. Each girl is represented by one dot showing the grade in English and the grade in arithmetic. The dots are arranged uniformly inside squares formed by co-ordinate lines spaced ten units apart.
2. The straight diagonal line drawn from zero shows equal ability in the two studies. The heavy wavy line is drawn through points having an equal number of dots on either side of the line. Its position indicates that girls generally have more ability in English than in arithmetic.

GRAPHIC PRESENTATION

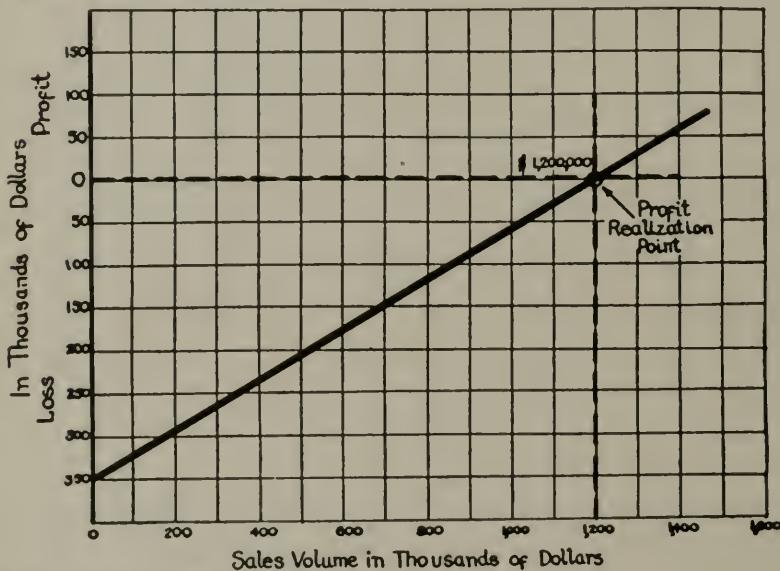


U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce.

SCALE .5

A. Ratio of Estimated Market Value of Property January 1, 1934, to Average Annual Family Income for 1933, by Income Classes in Four Geographical Divisions of the United States.

1. Five geographical divisions which were included in the original group have been omitted.
2. The method of reading these charts is as follows: in the Pacific section, represented by the four cities listed, the property of a family with an annual income of about \$1,200 would be equal in value to about three times the income.

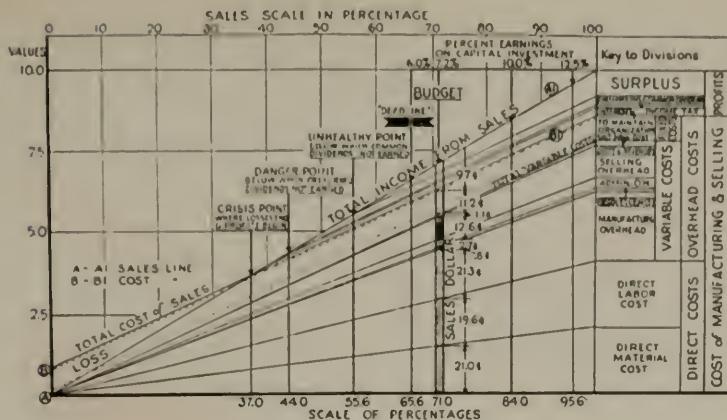


Prior Sinclair, "Budgeting," The Ronald Press Co., N. Y. C., 1937.

B. Profit Realization Chart.

1. The profit realization chart is often referred to as a "break even" chart or a "profit-graph."
2. The relation between sales volume and profit and loss is plotted in this simple profit realization chart. The diagonal line shows the profit or loss in dollars at various sales volume levels. The break-even point is at \$1,200,000.

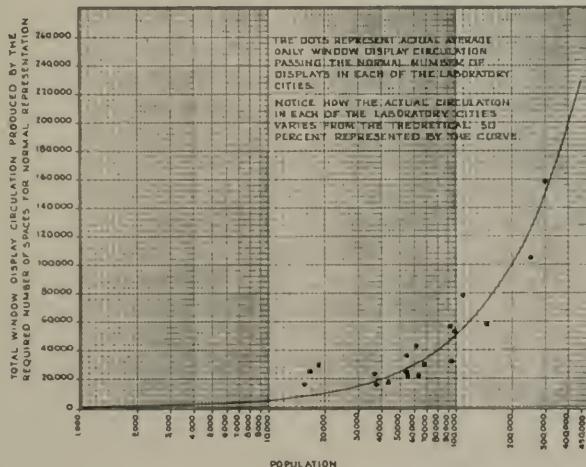
CORRELATION CHARTS



Prepared by E. S. La Rose, 1931 Year Book of the National Association of Cost Accountants, N. Y. C.
SCALE .7

A. Profit Chart Showing the Relation of Sales and Profit.

1. This is a detailed version of 328B.
2. The two lines around which the others are plotted are the ones labelled "A" and "B" at the lower left, which represent total income from sales and total cost of sales, respectively. So long as "B" is above "A" there is a loss.



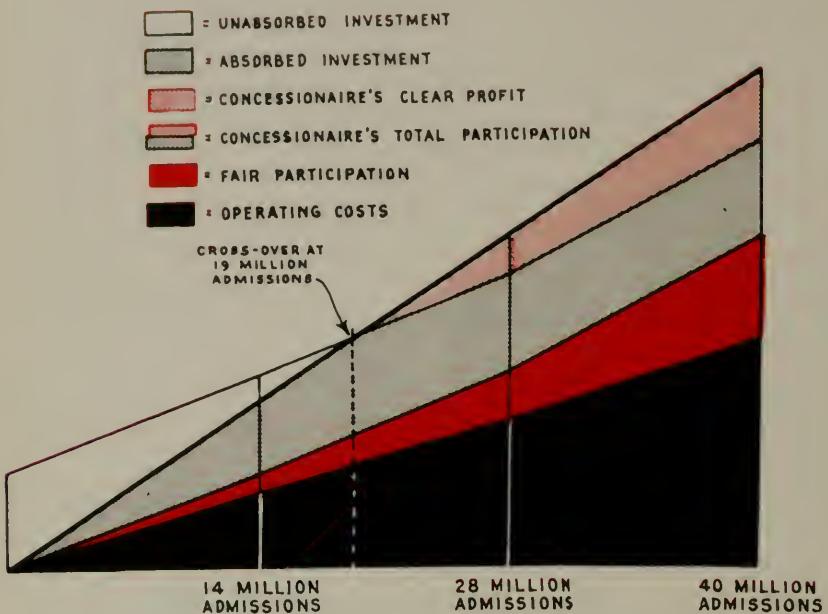
The Advertising Research Foundation, New York City, 1937.

SCALE .5

B. The Average Daily Circulation of the Number of Window Displays Required to Obtain Normal Distribution in Various Cities.

The dots represent actual average daily window display circulation passing the normal number of displays in each of the cities studied. It has been estimated that to produce normal display distribution, the average daily window display circulation passing a display should equal 50% of the population of the market. The curve represents that theoretical 50%.

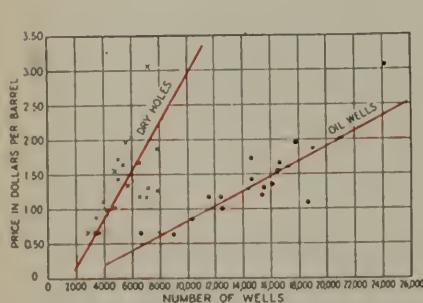
GRAPHIC PRESENTATION



New York World's Fair, 1939, Treasury Division, Methods and Planning Dept.

A. Break-down of Receipts in Percentages of the Ice Cream Stand at the New York World's Fair, 1939.

1. This includes also soda fountains, and carbonated beverages.
2. The Fair participation basis is 11½% at 14 million admissions, 20% at 28 million admissions, and 35% at 40 million admissions.



B. Correlation Between Weighted Average Price of Crude Oil and (a) Number of Dry Holes Drilled and (b) Number of Oil Wells Drilled. Data Are by Years, 1915 to 1935.

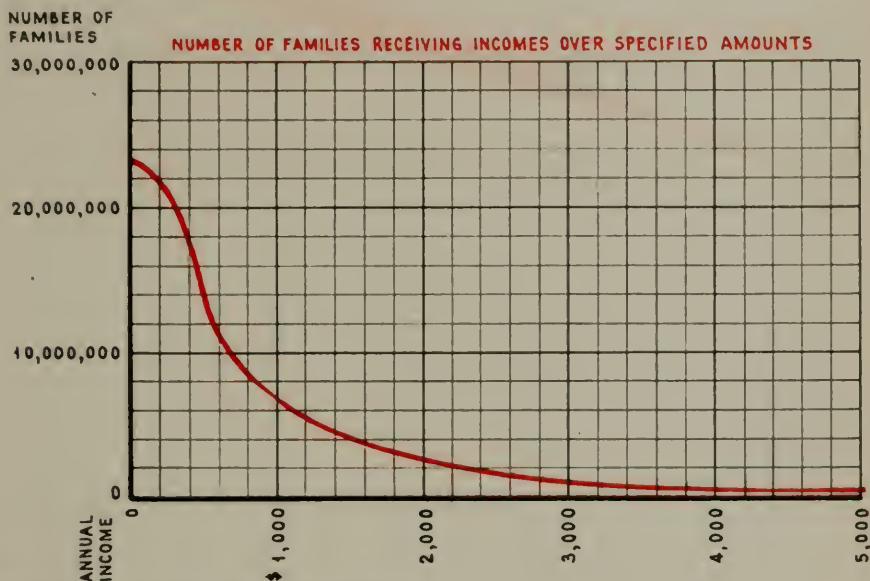
The relation between the average price of crude oil and the number of dry-holes drilled may be used as an index of wildcatting. The relation between the average price of crude oil and the number of oil wells drilled may be used as an index of development effort.

Joseph E. Pogue, "Economics of the Petroleum Industry," March 1939, The Chase National Bank of the City of New York. SCALE .6

Chapter 40

OGIVE AND LORENZ CHARTS

The Ogive chart is also called a cumulative frequency curve. Its definition is as follows: a frequency distribution in which "more than" or "less than" data are presented. One scale of the grid represents percentages and the other scale represents "more than" or "less than" values.



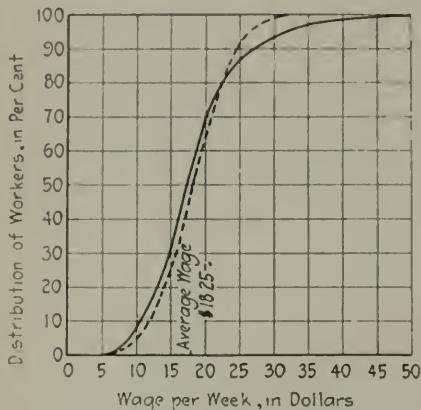
Redrawn from Advertising and Selling, January 1917.

Number of Families Receiving Incomes Over Specified Amounts in the United States in 1916.

1. In reading the above chart the amount of the income is read by the scale at the bottom of the diagram. The number of families is indicated by the scale at the left-hand side.
2. If you wish to learn how many families are receiving an income of \$1,500 and upwards, it is shown by the point where the curve crosses the middle vertical ruling between the \$1,000 and the \$2,000 lines. This is found to be at 3,750,000 according to the scale at the left. There are, therefore, approximately 3,750,000 families that are receiving an annual income of \$1,500. In the same way it is possible to estimate that there are 5,150,000 families that are receiving an income of \$1,200.

GRAPHIC PRESENTATION

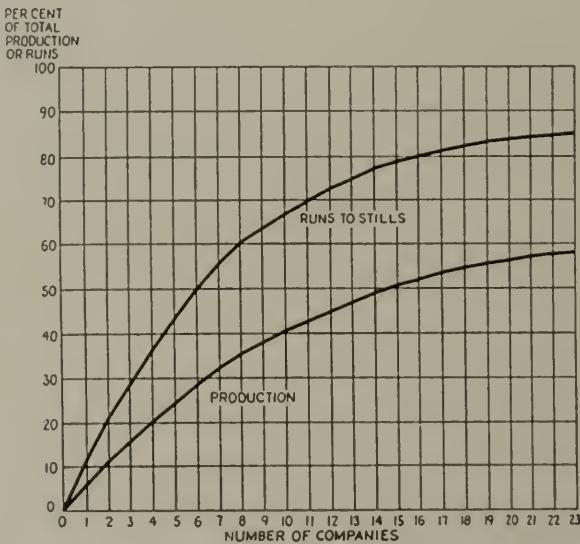
A Lorenz chart gives frequency distribution when both the variable and invariable quantities are reduced to percentages. The curve is plotted on a grid on which both the horizontal and the vertical scales represent 100%.



Charles N. Young, "Creative Ability and Its Compensation," *Industrial Management*, January 1920.

A. Actual Wage Distribution of 381,575 Workers in the United States in 1917.

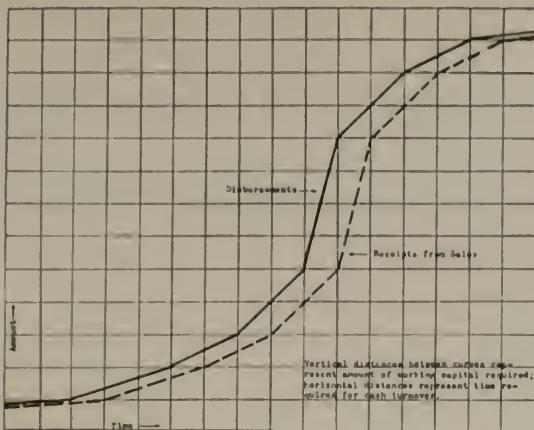
1. The dotted line in this chart represents the normal wage distribution based on the average wage for 1917.
2. An "ogive" chart is better known as a "more-than, less-than" chart. Cumulative frequency data is presented in such a curve.



Joseph E. Pogue, "Economics of the Petroleum Industry," March 1939, The Chase National Bank of the City of New York.

B. Concentration of Production and Refining in the United States in 1937; Chart Showing Cumulative Percentages of National Totals Represented by Largest Units.

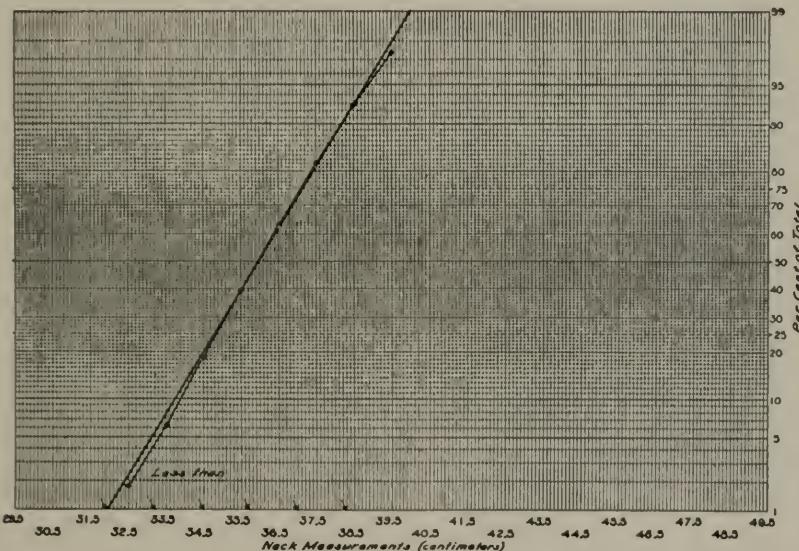
OGIVE AND LORENZ CHARTS



Henry S. Dennison, "Management and the Business Cycle," Journal of the American Statistical Association, Washington, D. C., March 1922.

SCALE .8

A. Relation of Disbursements to Receipts from Sales in the Upward Swing of the Business Cycle.



Brown, Bingham, and Temnomeroff, "Laboratory Handbook of Statistical Methods," McGraw-Hill, 1931.

B. An Ogive Curve Plotted on Probability Paper to Determine the Probable Distribution of 100,000 Shirts According to Neck Measurements.

- When an ogive curve is plotted on "probability" paper, assuming that the frequency curve is symmetrical, the curve is in the form of a straight line. For this reason it is possible to construct the curve for any particular problem with a small number of observations.
- For explanation of this chart, see 335.

GRAPHIC PRESENTATION

TABLE A.
Neck Measurements of White Troops at Demobilization

Neck Measurements, Centimeters	Number of Men	Upper Limit of Class Interval	Cumulative Frequency	Cumulative Frequency, Per Cent of Total
28.5-29.49	55	29.5	55	0.06
29.5-30.49	219	30.5	274	0.29
30.5-31.49	314	31.5	588	0.62
31.5-32.49	1,133	32.5	1,721	1.81
32.5-33.49	4,286	33.5	6,007	6.32
33.5-34.49	11,353	34.5	17,360	18.25
34.5-35.49	20,094	35.5	37,454	39.38
35.5-36.49	22,628	36.5	60,082	63.18
36.5-37.49	18,047	37.5	78,129	82.15
37.5-38.49	10,051	38.5	88,180	92.72
38.5-39.49	4,426	39.5	92,606	97.38
39.5-40.49	1,716	40.5	94,322	99.18
40.5-41.49	492	41.5	94,814	99.70
41.5-42.49	147	42.5	94,961	99.85
42.5-43.49	52	43.5	95,013	99.91
43.5-44.49	23	44.5	95,036	99.93
44.5-45.49	22	45.5	95,058	99.95
45.5-46.49	17	46.5	95,075	99.97
46.5-47.49	16	47.5	95,091	99.99
47.5-48.49	5	48.5	95,096	99.99
48.5-49.49	6	49.5	95,102	100.00
	95,102			

Source: *Reports of the Medical Department of the United States Army in the World War*, Vol. 15, Part I, page 538.

TABLE B.
Shirt Sizes
H. E. Mann, Incorporated

Shirt Bands, Inches	Shirt Bands, Centimeters	Shirt-band Length Less 3 Centimeters	Range of Neck Sizes for Given Shirt Sizes, Centimeters
13	33.02	30.02	29.4-30.69
13½	34.29	31.29	30.7-31.89
14	35.56	32.56	31.9-33.19
14½	36.83	33.83	33.2-34.49
15	38.10	35.10	34.5-35.69
15½	39.37	36.37	35.7-36.99
16	40.64	37.64	37.0-38.29
16½	41.91	38.91	38.3-39.49
17	43.18	40.18	39.5-40.79
17½	44.45	41.45	40.8-42.09
18	45.72	42.72	42.1-43.39

Brown, Bingham, and Tammmeroff, "Laboratory Handbook of Statistical Methods," McGraw-Hill, 1931.

OGIVE AND LORENZ CHARTS

TABLE A.
Determination of Number of Shirts
H. E. Mann, Incorporated

Shirt Bands, Inches	Upper Limit of Shirt Band Range Centimeters	Normal Cumulative Frequency Reading, Per Cent of Total*	Normal Non-cumulative Frequency, Per Cent of Total Centered	Number of Shirts Basis, 100,000 Shirts
13	30.7		0.2†	200
13½	31.9	1.0	0.5†	500
14	33.2	5.4	4.4	4,400
14½	34.5	19.0	13.6	13,600
15	35.7	44.1	25.0	25,000
15½	37.0	72.1	28.0	28,000
16	38.3	90.6	18.5	18,500
16½	39.5	98.0	8.4	8,400
17	40.8		1.0†	1,000
17½	42.1		0.3†	300
18	43.4		0.1†	100
				100,000

* This column has been read from graph.

† Frequencies at extreme ends of the curve cannot be determined from this probability paper. Marked values have been roughly estimated to make the total approach 100%.

Brown, Bingham, and Temnomeroff, "Laboratory Handbook of Statistical Methods," McGraw-Hill, 1931.

The three tables on this page and page 334, and 333B were used in a hypothetical case to figure out how to distribute 100,000 shirts according to neck sizes. The column at the extreme right of the table above gives the distribution as determined by the use of probability paper.

333B was plotted from the information in the extreme right column of the table 334A.

The third column (the one labelled "Normal Cumulative Frequency Reading, Per Cent of Total") in the table above was read from 333B.

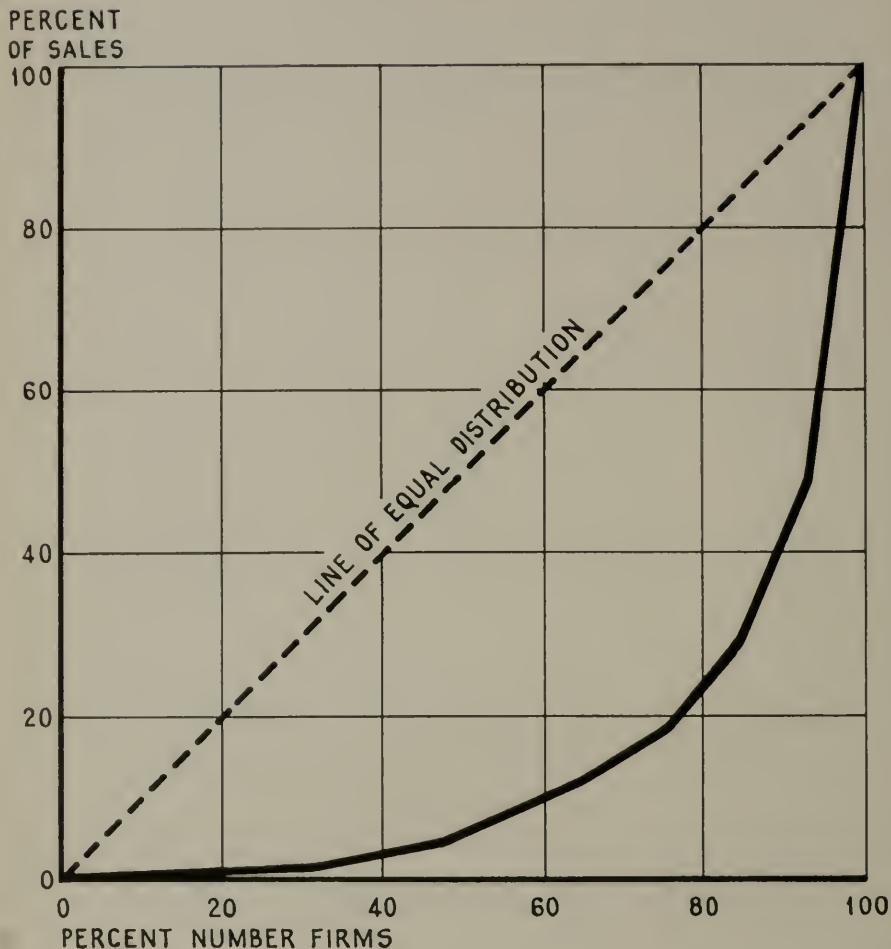
REFERENCES ON PROBABILITY PAPER

Haskell, Allan C., *Graphic Charts in Business*, Codex Book Co., Inc., New York, 1926.

Karsten, Karl G., *Charts and Graphs*, Prentice-Hall, Inc., New York, 1923.

Whipple, George C., "The Element of Chance in Sanitation," *Journal of The Franklin Institute*, July and August, 1916.

GRAPHIC PRESENTATION

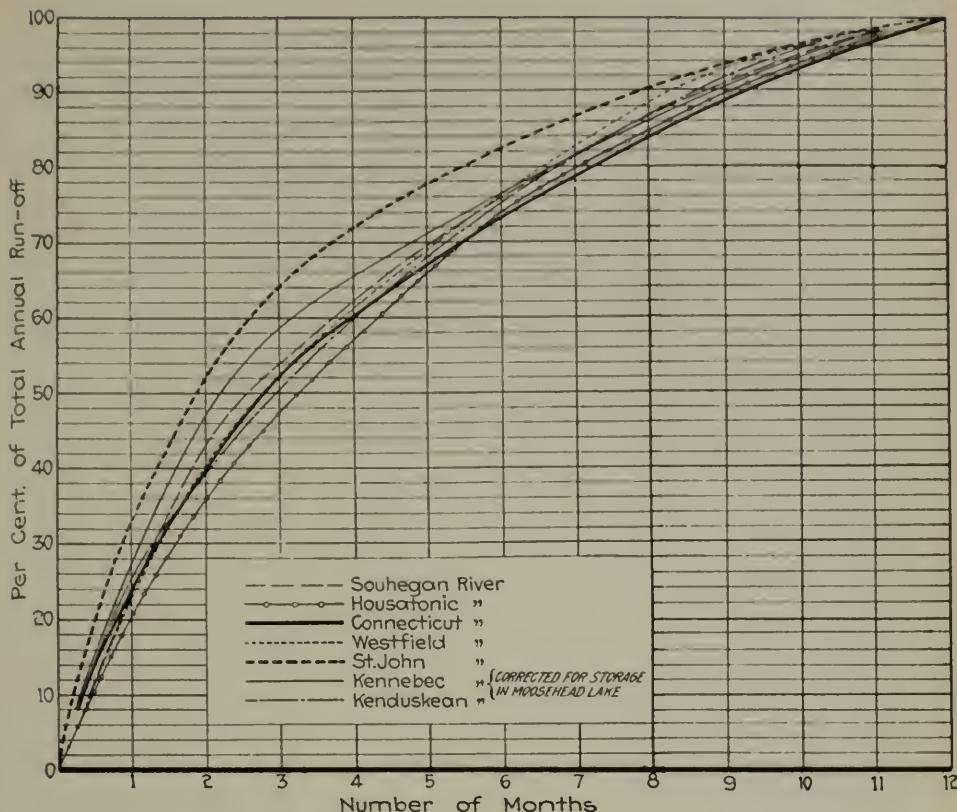


Redrawn from United States Department of Commerce.

SCALE .9

Distribution of Wholesale Sales by Size of Firm for the United States According to the 1930 Census.

1. The "line of equal distribution" is drawn in this Lorenz chart. The distance between the curve and the diagonal indicates the degree to which the data is removed from a perfectly uniform distribution. This feature statisticians call dispersion or scatteration.
2. If all firms for which data had been gathered were of the same size, the curve would appear as a diagonal line. The degree of concentration among the large firms is shown by the departure of the plotted curve from the diagonal, which is in this case quite marked.



Engineering News-Record, March 20, 1919.

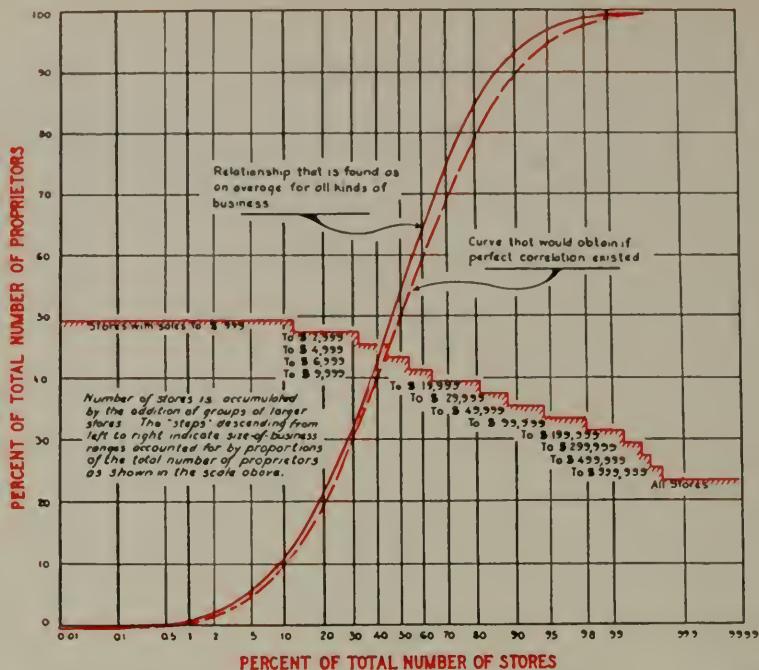
Distribution of Annual Run-off of Seven New England Rivers in a 12-Months' Period.

The method of reading this curve chart is as follows: at the end of six months, or 50% of the time period, there had been 82% of the total annual run-off of the St. John River. If the distribution was the same for every month, at the end of six months 50% only would have run off.

REFERENCES:

Lorenz, M. O., "Methods of Measuring the Concentration of Wealth," *Publications of the American Statistical Association*, Vol. IX, 1905. This issue of the *Journal* is so limited that the American Statistical Association cannot sell it. However, it is available in most libraries.

GRAPHIC PRESENTATION



U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce, "Small Scale Retailing," 1938.

Correlation of Proprietors and Number of Retail Stores in the United States in 1933.

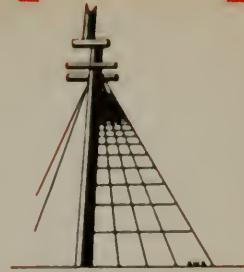
1. Because this chart is plotted on probability paper, the "line of equal distribution" assumes an "s" shape rather than a straight line.
2. It is clear from this chart that the number of proprietors of retail stores correlates closely with the number of stores. The figures and curves show that nearly 33 per cent of all stores are operated by nearly 35 per cent of the proprietors — who operate stores of less than \$3,000 annual volume.

When certain series of observations showing frequency data are plotted on arithmetic probability paper, the points do not fall in a straight line, but in a curve. Plotted on probability paper with a logarithmic scale as the ordinate, the points may fall approximately in a straight line or a gentle curve. In order to benefit from the use of probability paper, it is not necessary that the plotted points fall exactly in a straight line. If the curve is so gentle and uniform that it may be extended beyond the limits of the plotted points, it will usually be found sufficient.

SOURCES OF ARITHMETIC AND LOGARITHMIC PROBABILITY PAPER:

Codex Book Co., Norwood, Massachusetts.

Educational Exhibition Co., Providence, Rhode Island.



Chapter 41

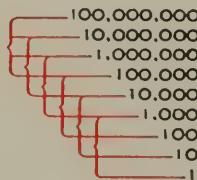
RATIO CHARTS

RATIO CHARTS, for identifier
Cross lines space closer
As you look higher.

A ratio chart is designed to indicate rate of change rather than arithmetic change. Although in many instances the spacing of the rulings clearly indicates to an experienced reader that the chart is plotted on ratio ruling, it is frequently desirable to indicate the ratio basis as shown in 345 and 346. This is especially necessary if the chart covers a comparatively short range of scale since the reader might not notice the difference in spacing of horizontal lines on the grid.

Synonyms for ratio chart are logarithmic chart, semi-logarithmic chart, rate-of-change chart.

The term "ratio chart" is short and expressive. There is need for a corresponding term equally expressive to designate charts planned on the usual arithmetic basis.



A. Arithmetic Scale and Ratio Scale.

- On the arithmetic scale, equal vertical distances represent equal numerical differences; that is, the distance from 1 to 2 is the same as the distance from 2 to 3 and from 3 to 4.
- On the ratio scale, equal vertical distances represent equal percentage differences; that is, the distance from 1 to 2 is the same as the distance from 2 to 4 and from 4 to 8.

B. Key for Assistance in Selecting the Proper Scale for Three - Deck Ratio Paper.

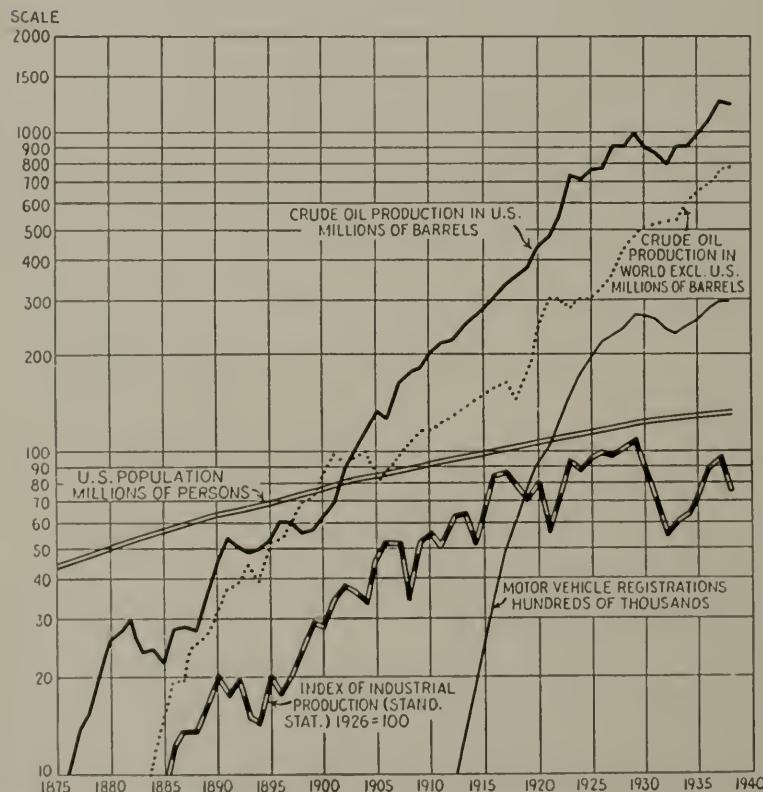
- If the figures of the data to be plotted on 3-deck ratio paper fall within the range of any one of these six brackets, the four figures within that bracket indicate the scale to be placed at the 4 points of the 3-deck paper.
- A similar key could be made for 4-deck and 5-deck ratio paper.

GRAPHIC PRESENTATION

REFERENCES:

Bivins, Percy A., *The Ratio Chart in Business*, Codex Book Co., Norwood, Mass., 1926.

Fisher, Irving, "The 'Ratio' Chart for Plotting Statistics," *Journal of the American Statistical Association*, Vol. XV, June, 1917. (May be obtained from ASA for 75c.)



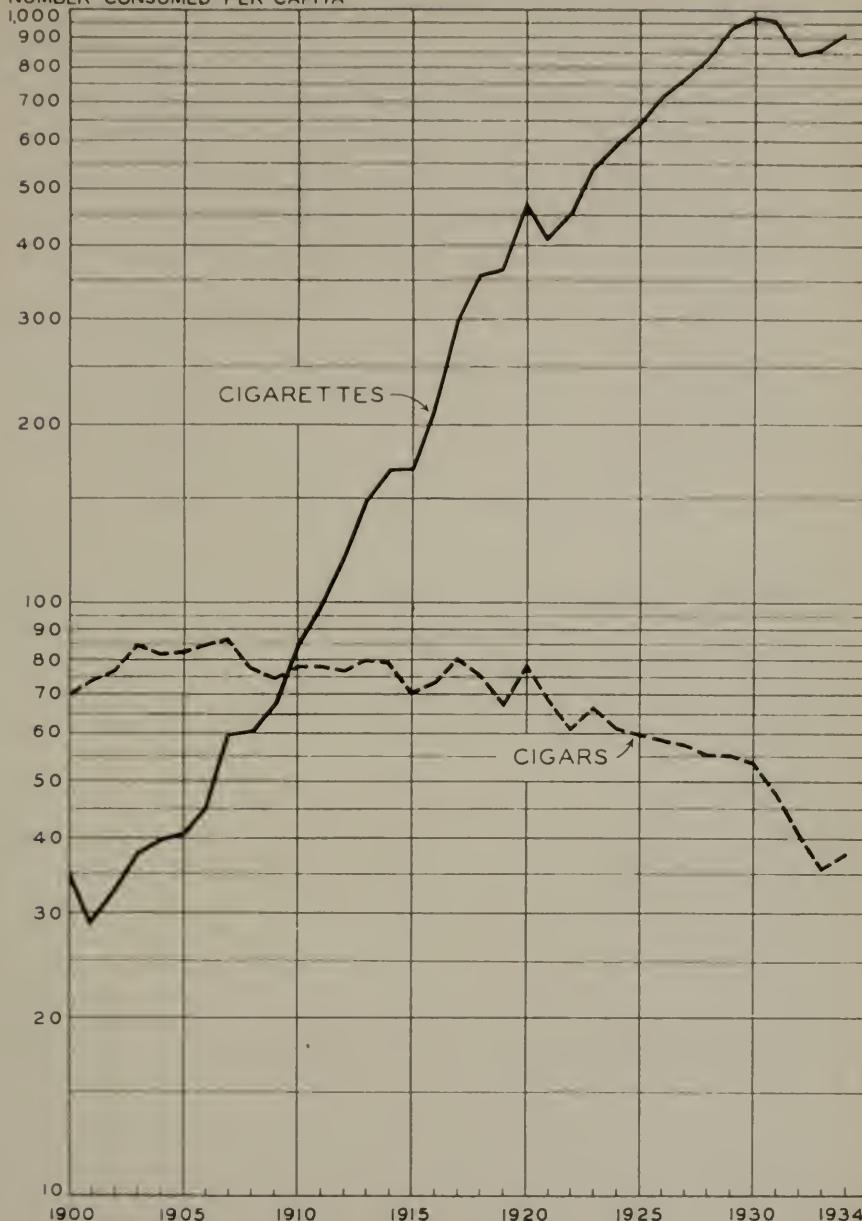
Joseph E. Pogue, "Economics of the Petroleum Industry," March 1939, The Chase National Bank of the City of New York.

Rate of Growth of Crude Oil Production in the United States, and in the Rest of the World by Years, 1876-1938, Compared With Other Significant Indexes.

RATIO CHARTS

(Semi-logarithmic scale)

NUMBER CONSUMED PER CAPITA

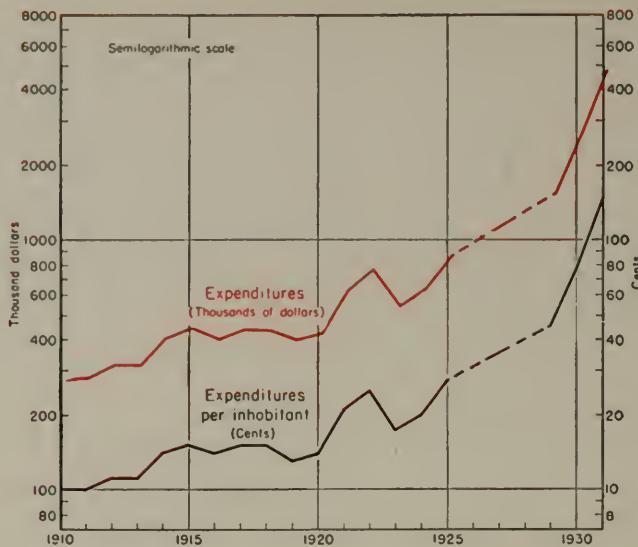


WPA, National Research Project, "Cigar-Makers—After the Lay-off," December 1937.

Per Capita Consumption of Cigars and Cigarettes in the United States from 1900 to 1934.

Compare this chart with 342B.

GRAPHIC PRESENTATION

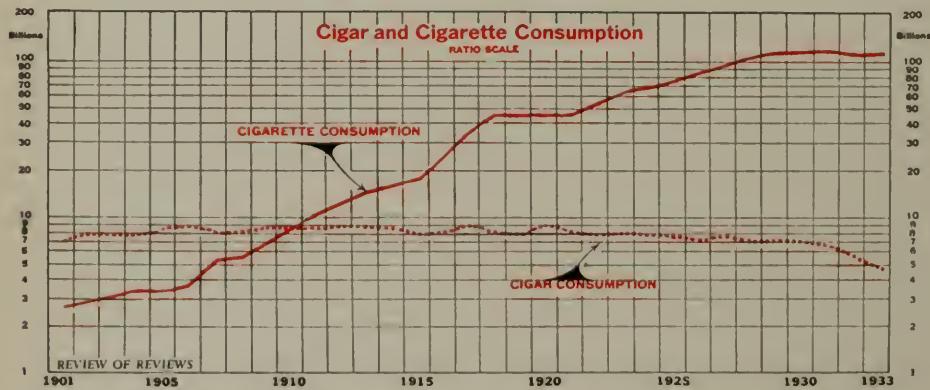


WPA, Division of Social Research, "Trends in Relief Expenditures, 1910-1935," 1937.

SCALE .8

A. Expenditures for Public Outdoor Poor Relief in Indiana from 1910 to 1931.

1. The broken lines indicate that the data were not available, or not available in comparable form for these years.
2. Since there is no zero line on a rate-of-change chart, there is no difficulty in presenting on the same grid two groups of data which have different scales. Compare with 276A.



Review of Reviews and World's Work, June 1934.

SCALE .7

B. Cigar and Cigarette Consumption in the United States from 1801 to 1933.

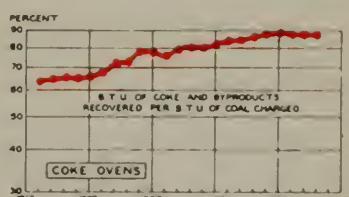
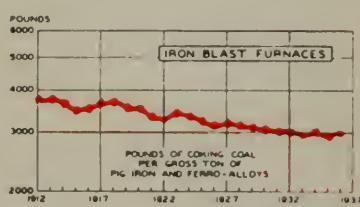
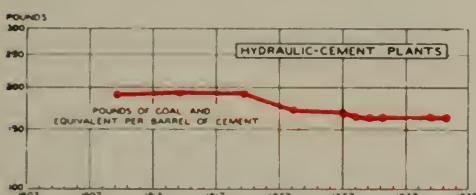
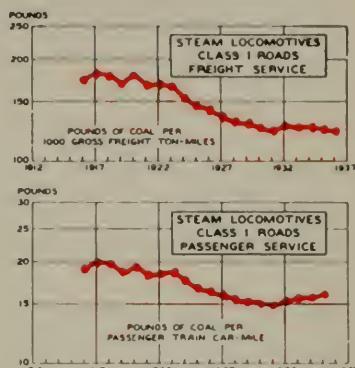
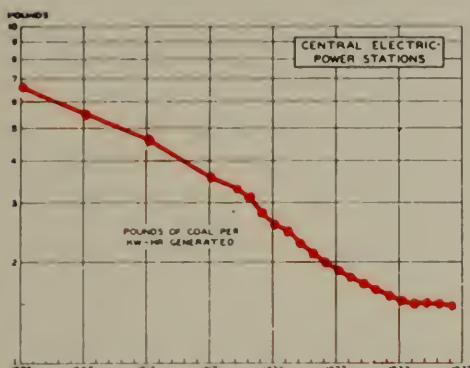
Although different scales may be used on the same chart, the same cycle must be used. That is, if a cycle two inches high is used for one scale, a cycle two inches high must be used for the other scale. It would not be possible to compare the "cigar consumption" curve in this chart with the "cigarette" curve in 341.

RATIO CHARTS

REFERENCES:

Karsten, Karl G., *Charts and Graphs*, Prentice-Hall, Inc., New York City, 1923.

Wenzel, J., "Graphic Charts; the Use of the Logarithmic Scale for Charting Statistics," *Scientific American*, 1917. This issue of *Scientific American* is so limited that copies are not for sale. However, it is available in most libraries.

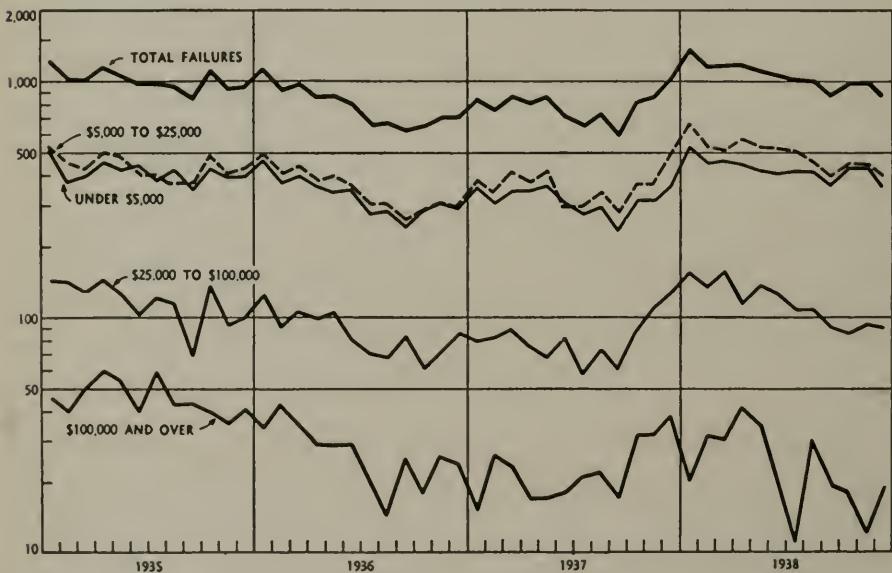
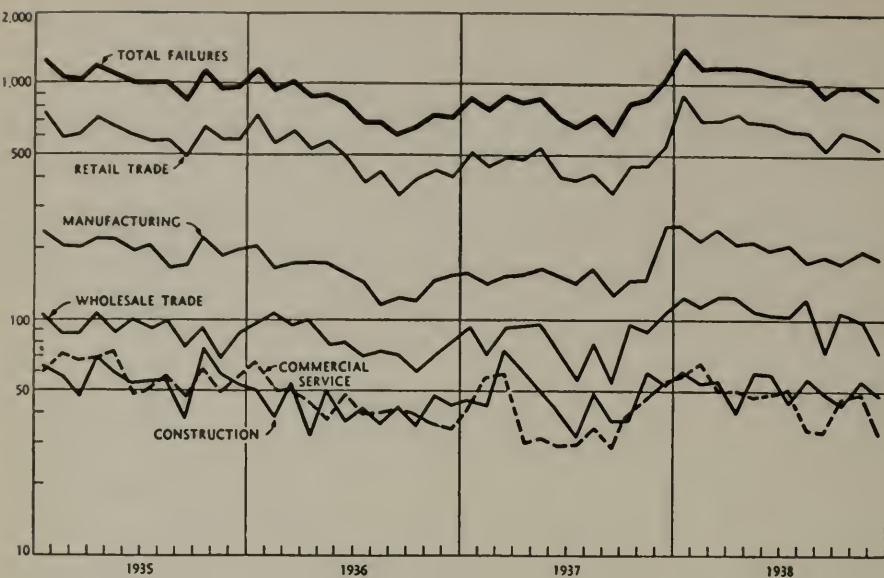


WPA, National Research Project, "Summary of Findings to Date," March 1938.

Progress of Efficiency in the Consumption of Fuel by Large Industrial Consumers in the United States.

Because all of these charts are plotted on the same logarithmic cycle, they are comparable even though the scales are different.

GRAPHIC PRESENTATION

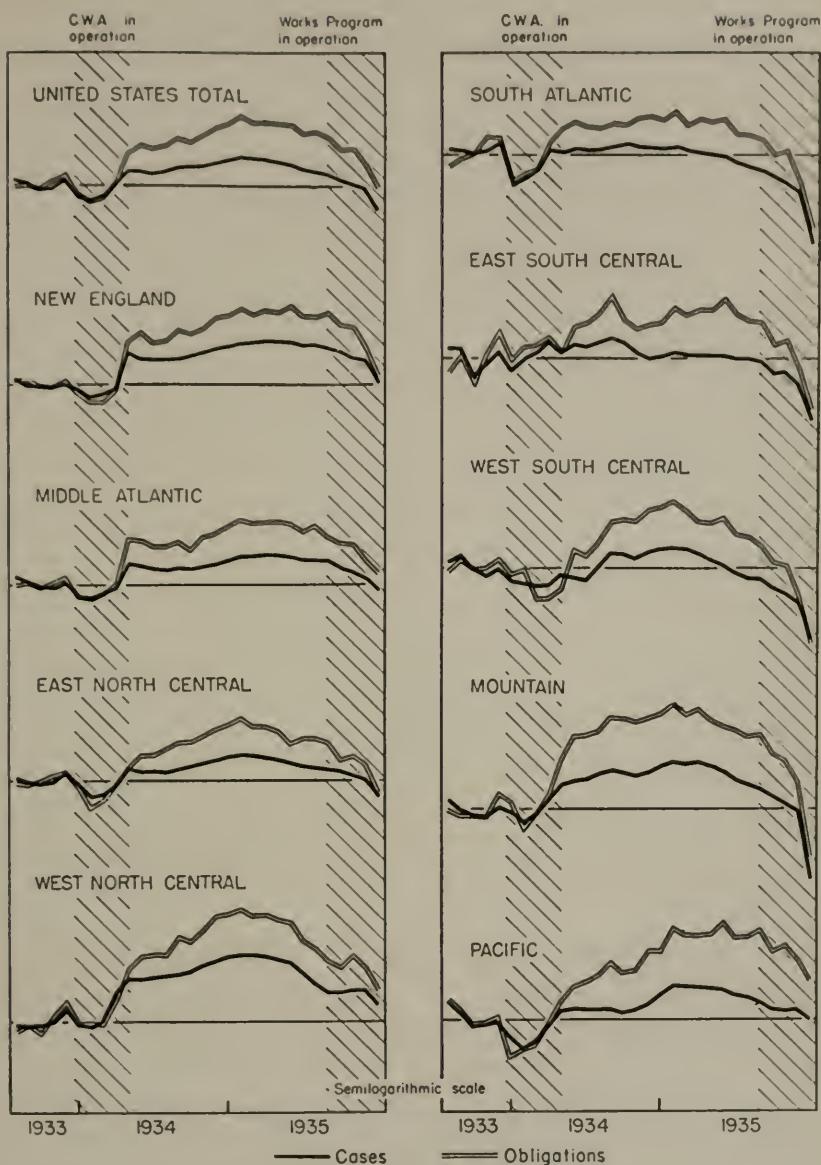


Dun's Review, February 1939.

Failures by Industrial Groups and Size of Liabilities in the United States from 1935 to December 1938.

There is a definite corollary to be derived from these two charts. In the upper one industries labelled "retail trade" have the largest number of failures. In the lower one, those industries whose liabilities are under \$25,000 have the largest number of failures. From these two facts, it may be deduced that the retail trade is in that category "under \$25,000."

RATIO CHARTS

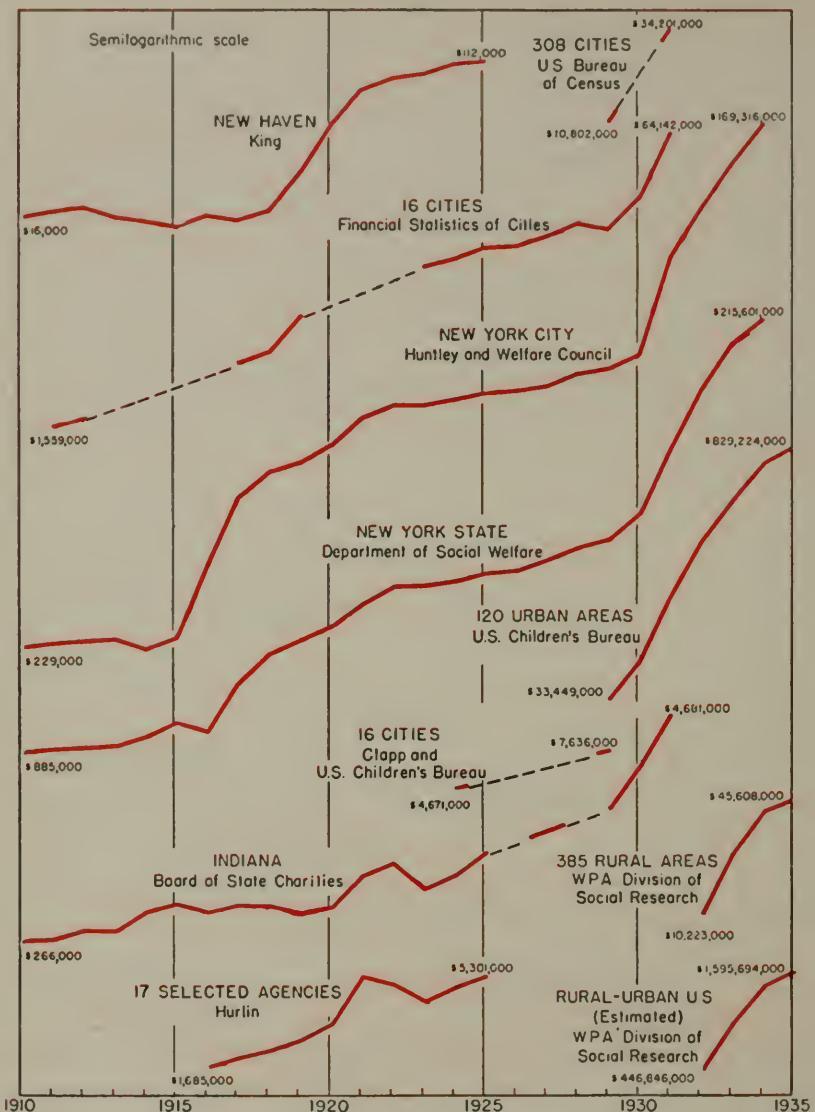


WPA, Division of Social Research, "Trends in Relief Expenditures, 1910-1935," 1937.

Trends of Relief Cases and of Obligations Incurred for Relief Extended to Cases in the United States from July 1933 to December 1935.

The horizontal line running through each pair of curves represents the average month, July to December 1933, for both cases and obligations.

GRAPHIC PRESENTATION



Note. Broken lines indicate data not available or not available in comparable form for these years.

WPA, Division of Social Research, "Trends in Relief Expenditures, 1910-1935," 1937.

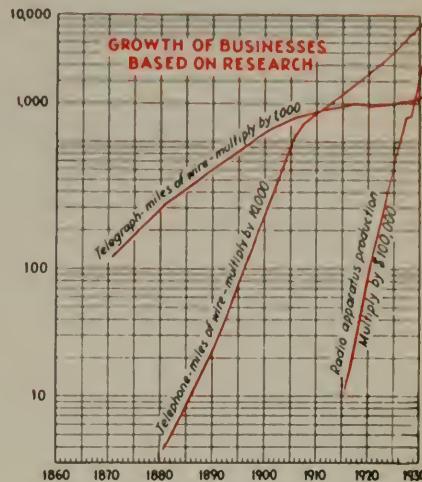
Trends of Expenditures for Public Outdoor Relief in Selected Areas from 1910 to 1935.

The scale may be omitted, as it is here, with only a notation that the chart is plotted on a rate-of-change scale. The curves have been moved together even though the scales do not coincide.

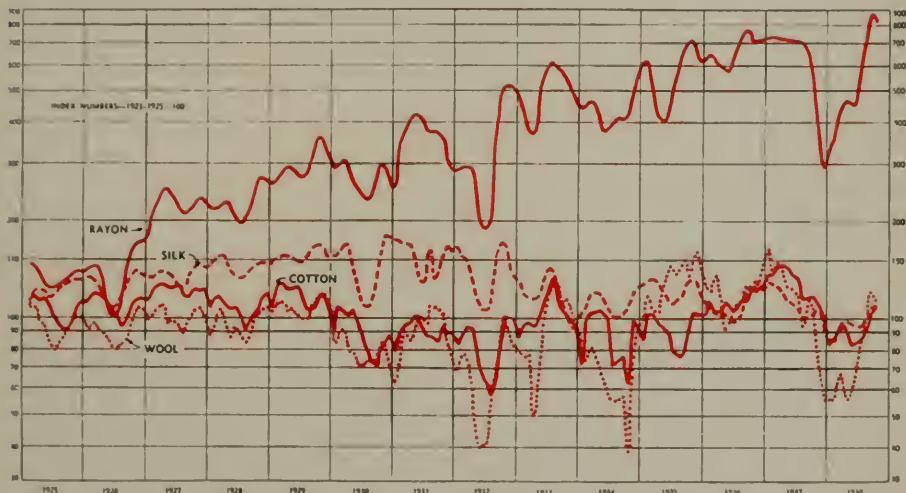
RATIO CHARTS

A. Growth of Business Based on Research, Showing Industrial Contributions of Research and Invention in the United States from 1860 to 1930.

The original of this was black with the lines and lettering in white. By reversing the original, black on white was obtained.



Electronics, October 1938, Part of an Editorial Entitled "Why a Public Relations Program?"
(Source: National Industrial Conference Board).



Dun's Review, December 1938 (Source: Textile Economics Bureau, Inc., N. Y. C., "Rayon Organon").
SCALE .7

B. Textile Fiber Consumption in the United States from 1925 to November 1938.

Index numbers may be plotted on rate-of-change paper, especially when there is a growth as great as rayon consumption.

GRAPHIC PRESENTATION

Abstracts from Time Series Charts. A Manual of Design and Construction, 1938, prepared by Committee on Standards for Graphic Presentation, under procedure of American Standards Association, with The American Society of Mechanical Engineers as sponsor body.

RATE-OF-CHANGE CHARTS

A. **DEFINITION.** The rate-of-change chart ("ratio" or "semi-logarithmic" chart) is a type used for picturing the percentage or relative change in values of a series over a period of time rather than the change in absolute amounts as shown by the arithmetic chart.

1. The picture of rate of change is achieved through the use of logarithms. Rate-of-change curves can be constructed either by plotting the logarithms of the values on an arithmetic scale or by plotting the actual values on a logarithmic scale. The latter is the more usual procedure.
2. The effective use of rate-of-change charts requires an appreciation of their limitations as well as their possibilities.

B. WHEN TO USE RATE-OF-CHANGE CHARTS:

1. When the interest is in relative movement of a time series and not in the differences between amounts.
2. When it is desired to compare the relative movements of several time series.
3. When the readers are likely to be familiar with this form of chart.
4. When the usual arithmetic chart would present a misleading picture of movement.
5. For occasions when there are no minus figures included in the time series.

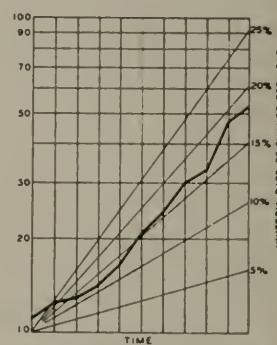
Note: If it is desired to present a complete picture of both rate of change and amount of change the data can be presented on companion charts, one with a logarithmic amount scale and the other with the usual arithmetic scale.

SCALE SELECTION. Logarithmic amount scales should be so selected that the curves will be well placed on the grid. As there is no zero line to serve as a base for comparing trends, considerations of the zero line are not applicable to rate-of-change charts.

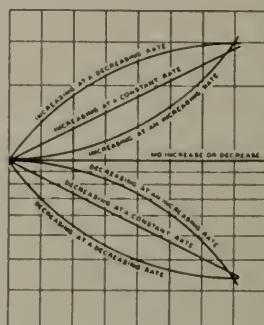
In rate-of-change charts, it is often helpful to provide a secondary scale indicating uniform rates of change. Such scales are constructed by means of straight diagonal lines radiating from some point of origin (as shown in the illustration at the right).

Multiple amount scales are more appropriate for rate-of-change charts than for arithmetic charts because in the former the movement of the curves is compared and not their position relative to a base.

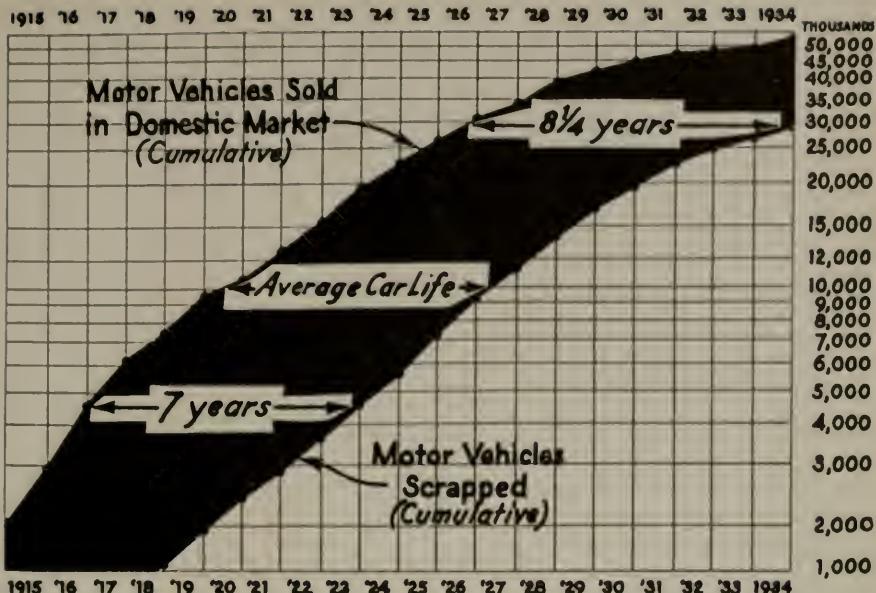
Note: In order to take full advantage of the scale range, the vertical scale numerals usually printed on a chart sheet may be multiplied by any constant factor but integers should be chosen so that the scale subdivisions will not indicate inconvenient fractions.



Secondary scale of uniform rates of change



Meaning of curve shapes on Rate-of-change charts



Automobile Manufacturers Association, "Automobile Facts and Figures," 1935.

SCALE .9

A. Average Life of a Car as Shown by Two Cumulative Curves.

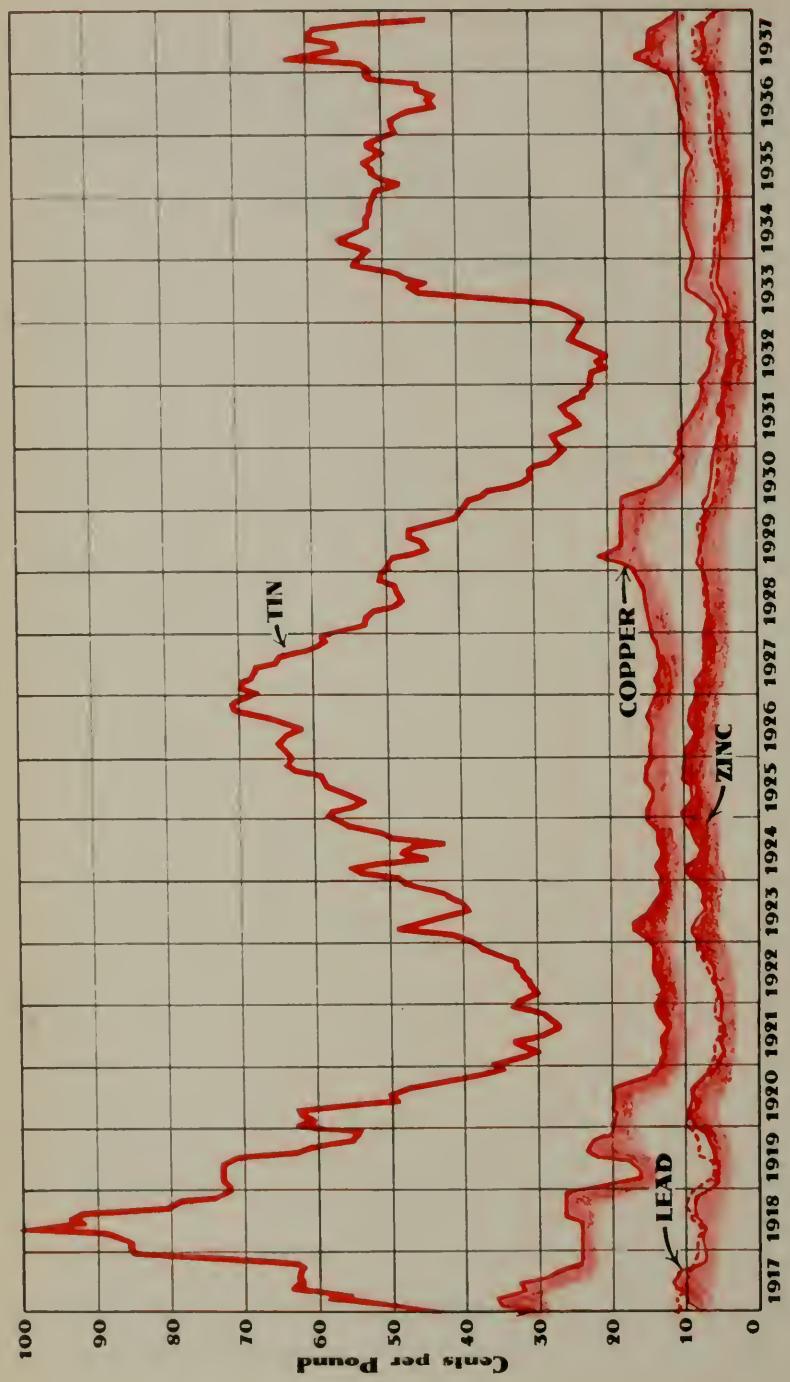
Two cumulative curves are plotted on the same logarithmic grid. The horizontal distance between the two lines thus gives the average life of the car. A cumulative curve may be shown on logarithmic scale as well as arithmetic. See 279.

Abstracts from *Time Series Charts. A Manual of Design and Construction*, 1938, prepared by Committee on Standards for Graphic Presentation, under procedure of American Standards Association, with The American Society of Mechanical Engineers as sponsor body.

CURVES. The plotting on rate-of-change charts requires considerable care because of the peculiar character of the logarithmic spacing. Where special grids are prepared without intermediate rulings, it is desirable to use a logarithmic plotting scale which may easily be made from printed commercial paper of the proper dimensions.

In general, rate-of-change charts call for simple lines connecting the points of value. Columns or surfaces, of course, should not be used to indicate values on a rate-of-change chart. Columns and surfaces may be used on an arithmetic chart to indicate changes in ratios, however.

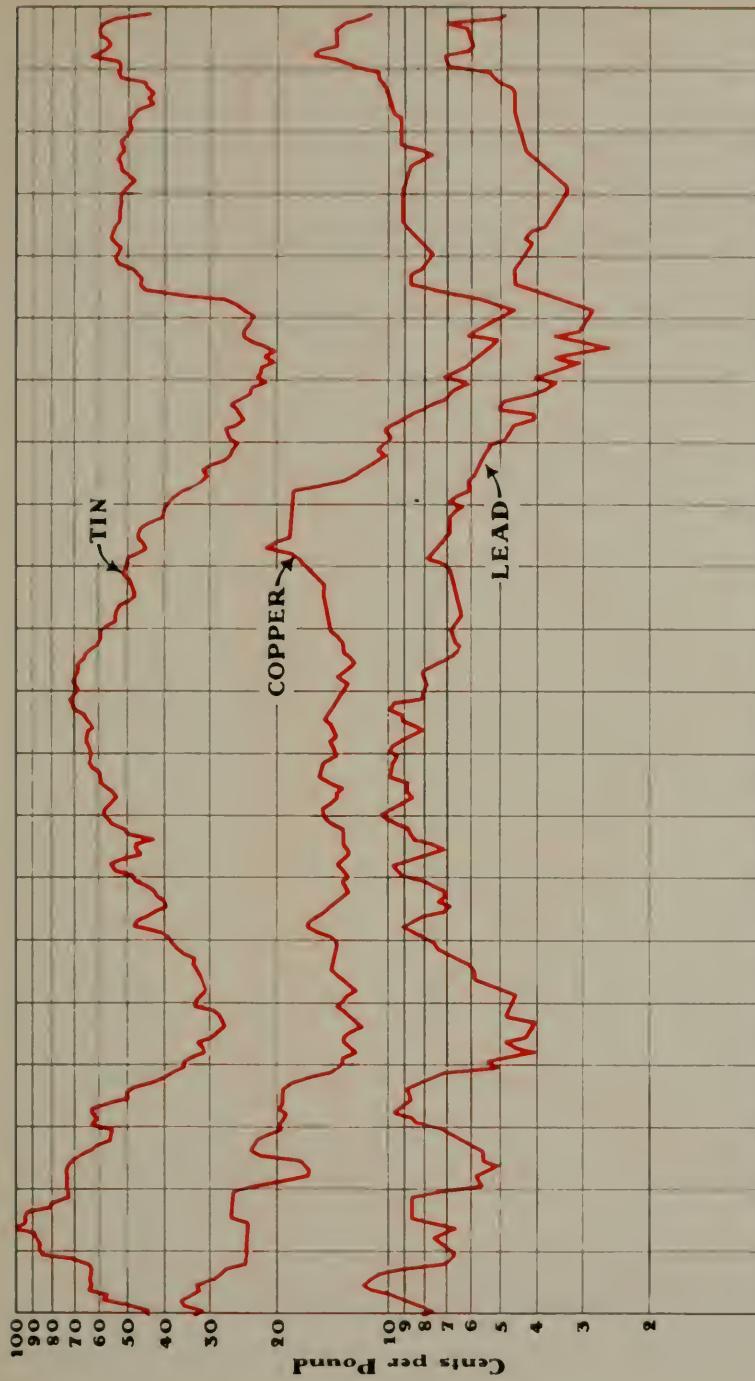
GRAPHIC PRESENTATION



Annual Review Number of "Iron Age," January 6, 1938.

An Arithmetic Chart Showing Prices of Non-ferrous Metals in the United States from 1917 to 1937.

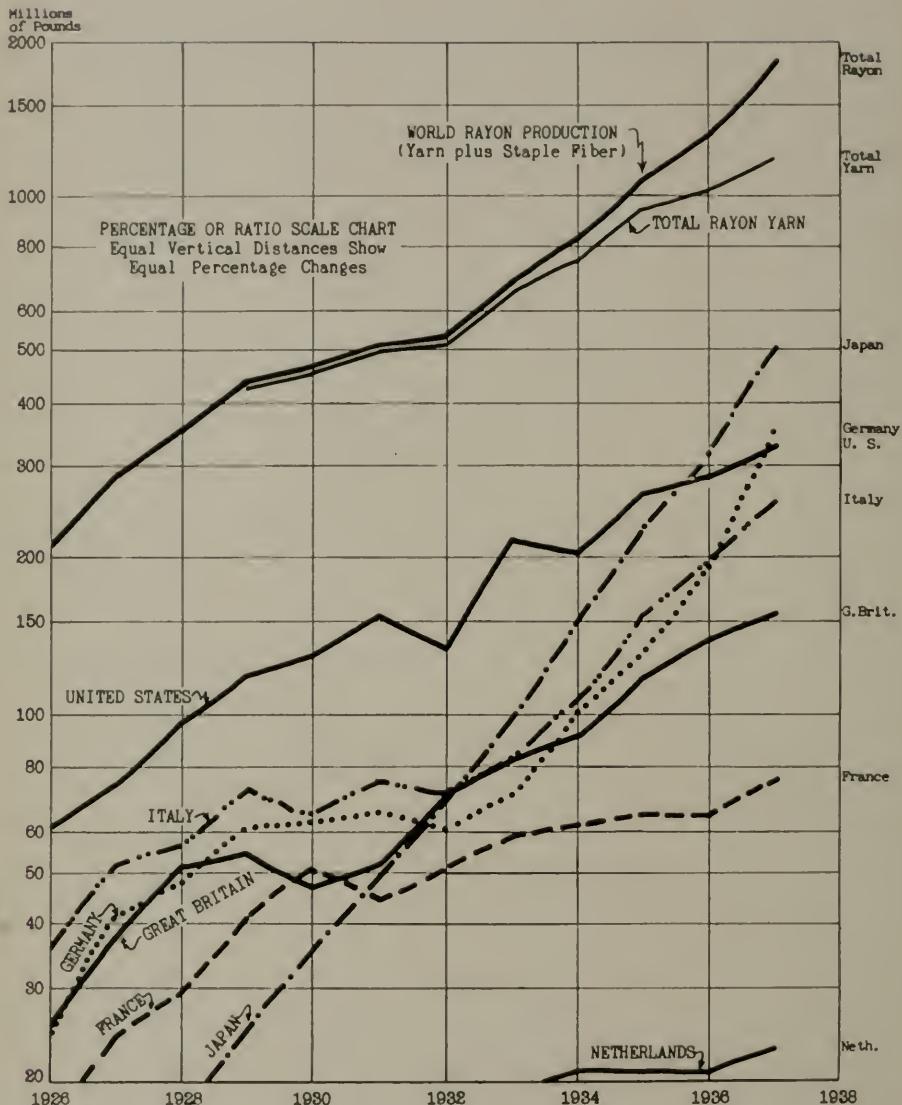
- SCALE .7
1. The gradations of shadings now showing below each of the three curves were in color in the original. In the process of photographing, the color became black, but the gradations still show.
 2. The shading was done with an air brush.



A Ratio Chart Showing Prices of Non-ferrous Metals in the United States from 1917 to 1937.

1. The data presented in this chart are the same as 350.
2. This ratio chart was plotted from the data given in Chart 350 to indicate the need for presenting information on a ratio scale rather than arithmetic. Note the difference in fluctuations of the "Lead" curve in this chart and 350.

GRAPHIC PRESENTATION

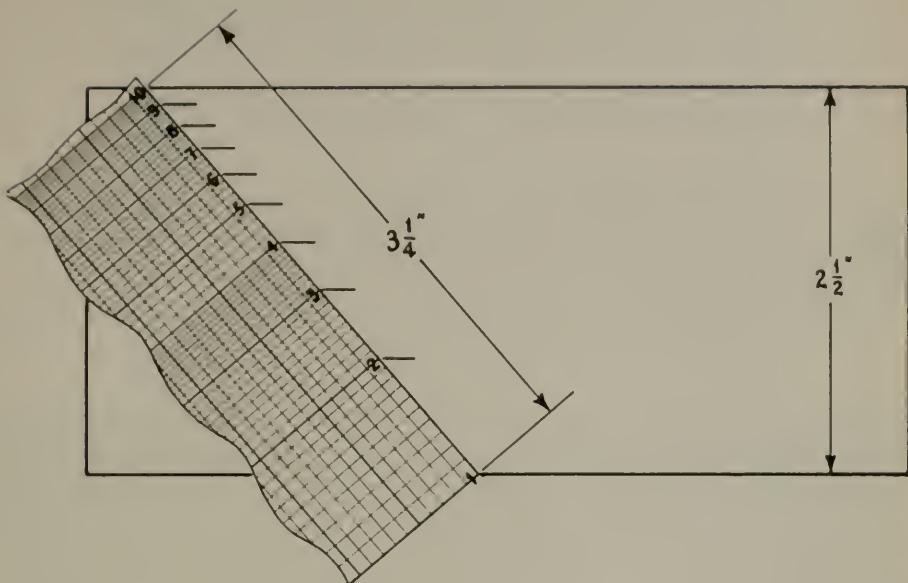


Textile Economics Bureau, Inc., N. Y. C., "Rayon Organon," June 1938.

World Rayon Yarn and Staple Fiber Production.

This chart shows a number of interesting items, among them the ranking of the principal nations of the world in the production of rayon.

RATIO CHARTS



SCALE .8

A. A Method of Ruling Logarithmic Paper.

- When logarithmic paper with cycles of the proper height is not available, it is fairly easy to rule paper using a cycle bigger or smaller than the space allotted. In the illustration above, a cycle from logarithmic paper is used for scale reduction.
- A statistician's scale may be an easier method.



Keuffel & Esser Co., New York.

- B. 1st edge, 2 complete logarithmic scales, one 25 cm. long, one $4\frac{1}{2}$ cm. long.
 2nd edge, 3 complete logarithmic scales, one $12\frac{1}{2}$ cm. long, one 10 cm. long, one $6\frac{1}{2}$ cm. long.
 3rd edge, 30 centimeters, subdivided to millimeters.
 4th edge, 12 inches subdivided to 40ths of inches.

This scale is for the statistician.



C. Triangular Scale, Engineer's,

Keuffel & Esser Co., New York.

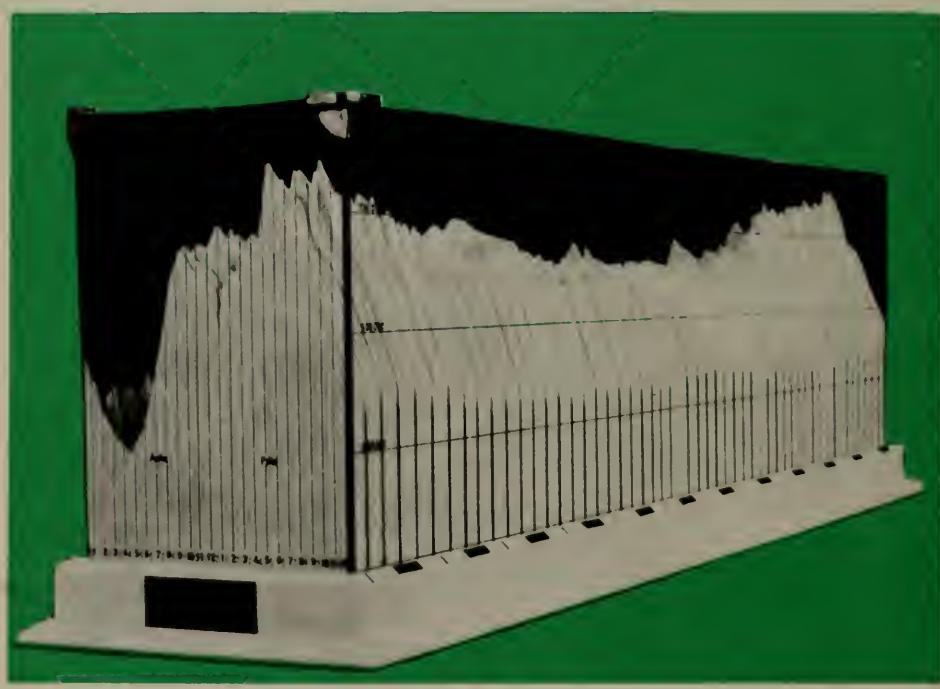
div. 10, 20, 30, 40, 50, 60 parts to the inch.

Chapter 42

THREE-DIMENSIONAL METHODS

BY MEANS of three-dimensional models, similar to those shown in 354, 355A, and 355B, it is possible to present three variables in the form of curves rather than the usual two.

Other methods of showing three dimensions are illustrated in the isometric block diagram in 356A and in the trilinear chart in 359B.

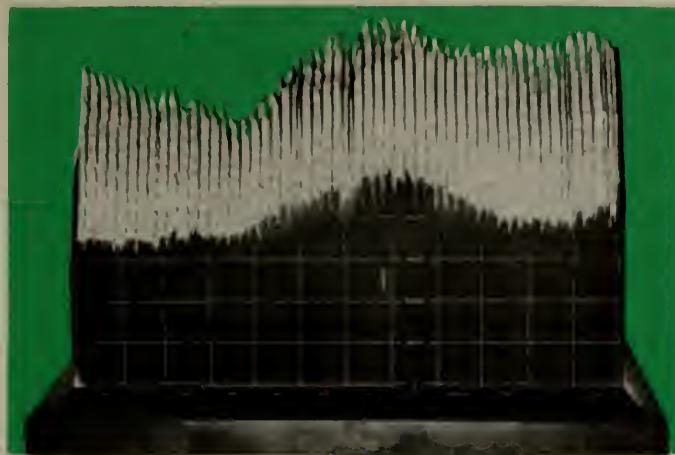


Commonwealth Edison Company, Chicago, Ill.

SCALE 6

Three-Dimensional Curve of the 1935 Load of the Commonwealth Edison Company.

1. Three-ply bass wood was used in the construction of this three-dimensional model. Each curve is a board which, before it was cut, measured $\frac{1}{8} \times 17 \times 11$ inches.
2. The glass case is ruled with a scale of kilowatts on the sides and with the 24-hour period from midnight to 12 midnight on each end. The third dimension is by days, the scale for which is on the base.
3. The exhibit is about 5 feet long and weighs approximately 300 pounds.

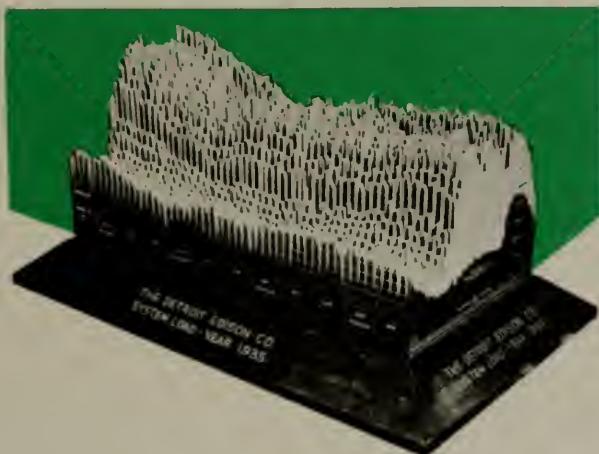


Pacific Gas and Electric Company, San Francisco, California.

SCALE .4

A. Three-Dimensional Curve of the 1935 Load of the Consolidated System of the Pacific Gas and Electric Company.

1. Dimensions of the model, excluding base, are 12" x 24" x 12" high.
2. The front black section represents a load curve showing variation from day to day throughout the year for the last half hour of each day. The clefts between the fifty-two sections are Sundays. Additional clefts are the holidays.



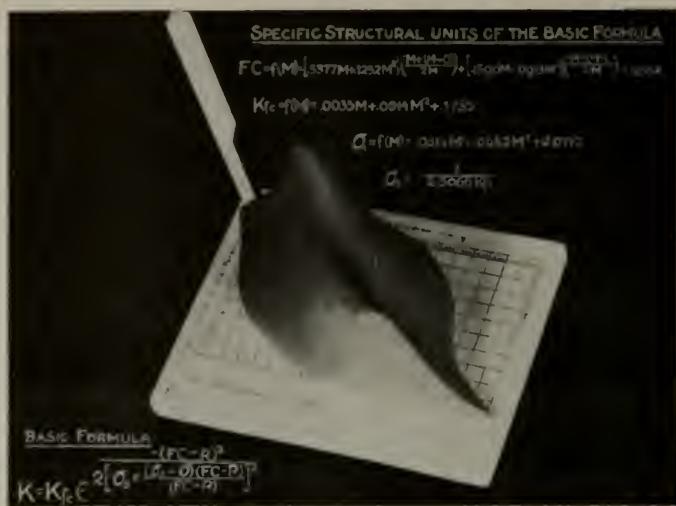
The Detroit Edison Company, Detroit, Michigan.

SCALE .5

B. Three-Dimensional Curve of the 1935 Load of the Detroit Edison Company.

Apparently the data for the entire year were gathered before this model was started. The load for the first half-hour of each day for the entire year was then cut out, and for each half-hour after that, making 48 curves. Compare this with 354 in which the load for each day was plotted, making 365 curves.

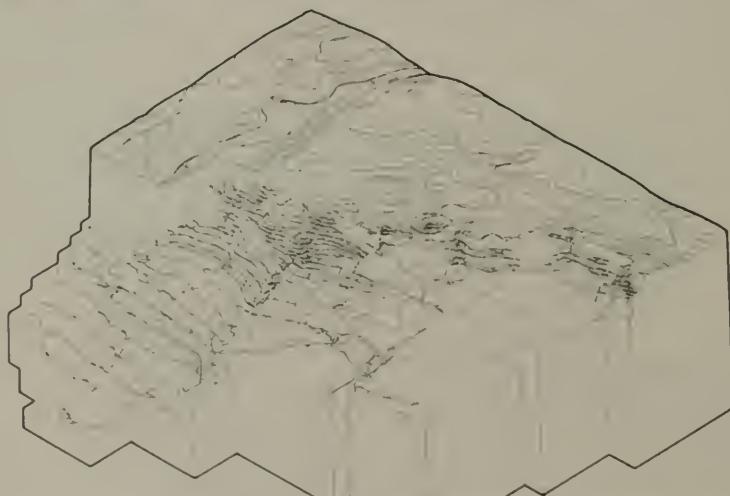
GRAPHIC PRESENTATION



Harry H. Laughlin, Department of Genetics, Carnegie Institution of Washington, Cold Spring Harbor,
Long Island, N. Y.

SCALE .7

A. The Mathematical Model for the Specific Formula of Heredity.

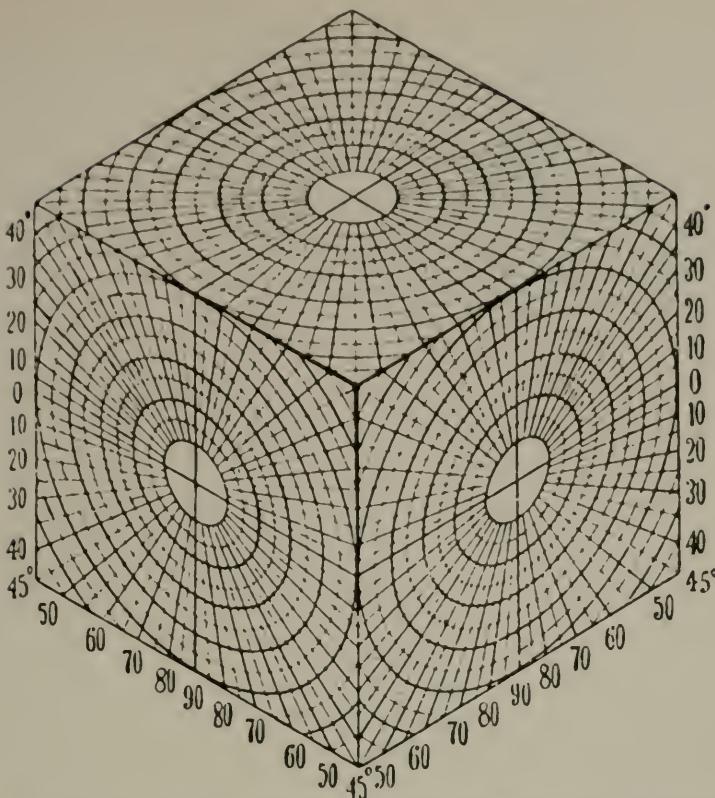


W. D. Johnston, Jr., and T. B. Nolan, "Isometric Block Diagrams in Mining Geology," *Economic Geology*,
August 1937.

SCALE .5

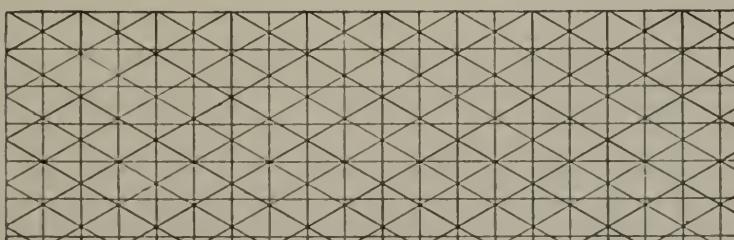
B. Block Diagram of a Large Mine Drawn by the Isometric Method. The Original Drawing Is Eight Feet Long.

1. The mine layout, shown isometrically in conjunction with contour lines of the surface areas adjacent, serves the general purpose of a three-dimensional model with huge saving in space and cost.
2. For fully illustrated description of methods, reference should be made to the Johnston-Nolan paper.



W. D. Johnston, Jr., and T. B. Nolan, "Isometric Block Diagrams in Mining Geology," *Economic Geology*, August 1937.

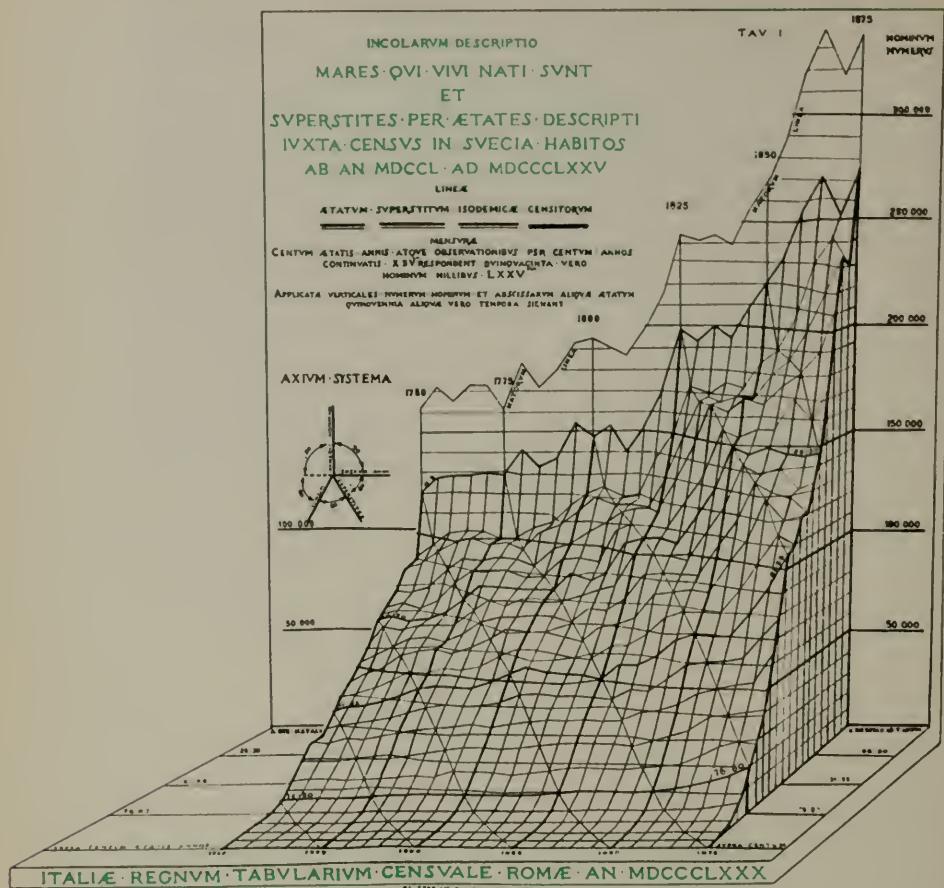
A. Isometric Protractor.



Keuffel & Esser Co., New York.

B. Isometric Cross Section Paper.

A drawing on isometric paper combines the principles of mechanical and perspective drawing. The principal lines are drawn vertically, horizontally, and 30 or 60 degrees to the horizontal. As a result all parallel lines of an object are drawn parallel and three faces of the object are shown.



Journal of the Royal Statistical Society of London, Jubilee Volume—1885, Chart by Luigi Perozzo in
1879.

Three-Dimensional Model Showing the Growth of the Population of Sweden from 1750 to 1875.

The picture of this model which appeared in the Journal of the Royal Statistical Society of London was in a brown half-tone with black, red, blue, and green lines. The three dimensions are the years from 1750 to 1875, the number of persons, and the age of the persons.

In this book, an illustration occupying a full page is referred to by page number. When there is more than one illustration on a page, each is identified by a letter of the alphabet. When there is more than one footnote beneath an illustration, each is numbered. Thus the cross reference 267B2 means page 267, illustration B, note 2.

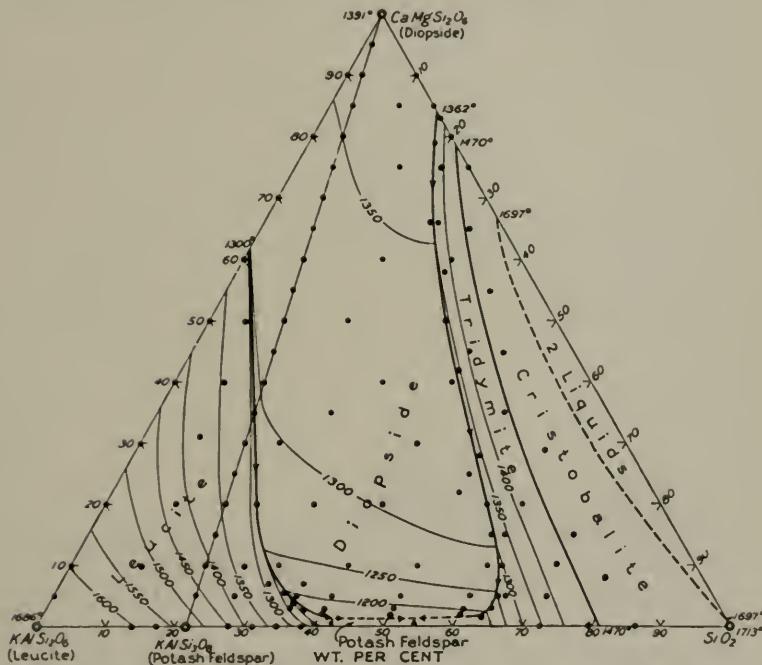
THREE-DIMENSIONAL METHODS

A. Triangular Coordinate Graph Paper.

The trilinear chart was first used for investigation on strength of concrete mixtures. This form lends itself to the demonstration of problems involving a mixture of three ingredients, such as alloys containing three metals and food rations containing three dietetic elements.



Keuffel & Esser Co., N. Y.



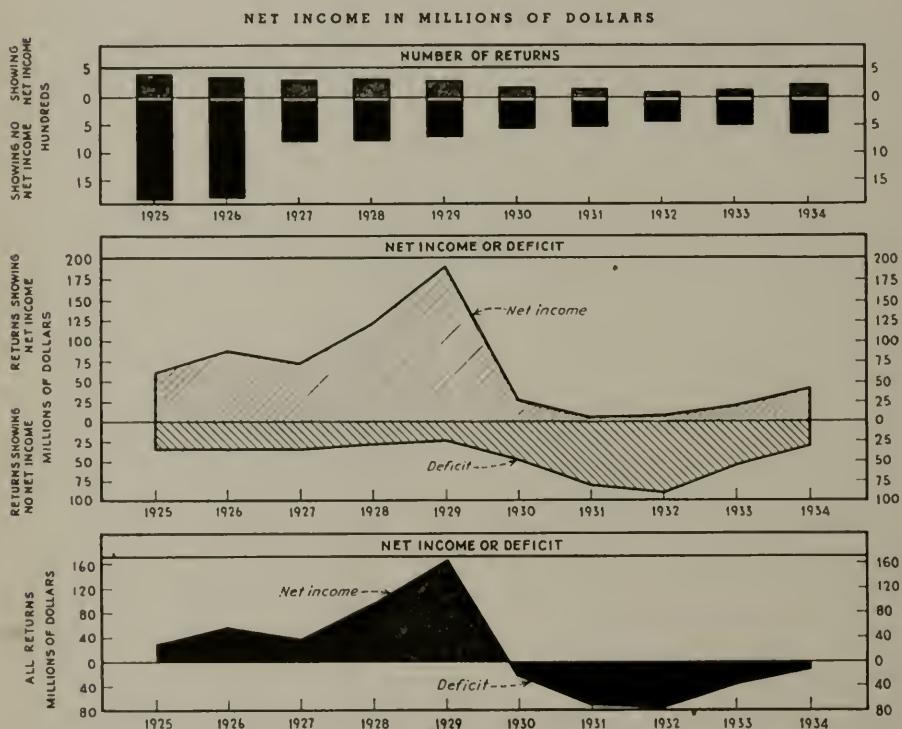
J. F. Schairer and N. L. Bowen, "The System, Leucite—Diopside—Silica," American Journal of Science, 1938, Geophysical Laboratory Carnegie Institution of Washington

B. Equilibrium Diagram of the Ternary System, Leucite—Diopside—Silica.

Chapter 43

COMPOSITE CHARTS

To present a more complete picture it is often desirable to combine several different types of charts. The charts in this chapter illustrate different methods of combining various charts.

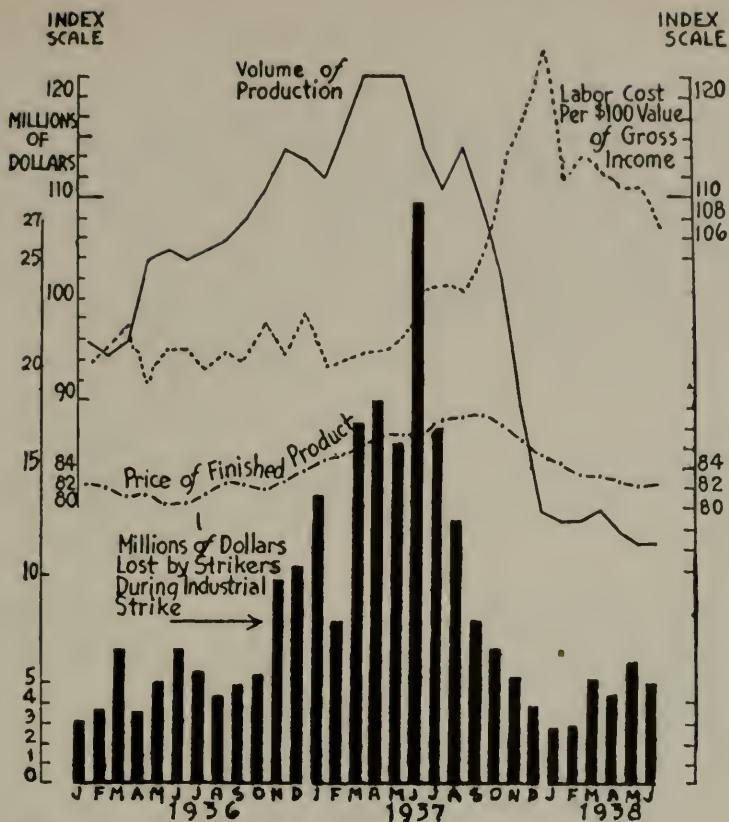


Engineering and Mining Journal, October 1938, Part of an Editorial on Public Relations Entitled "What Mining Means to the United States."

SCALE .9

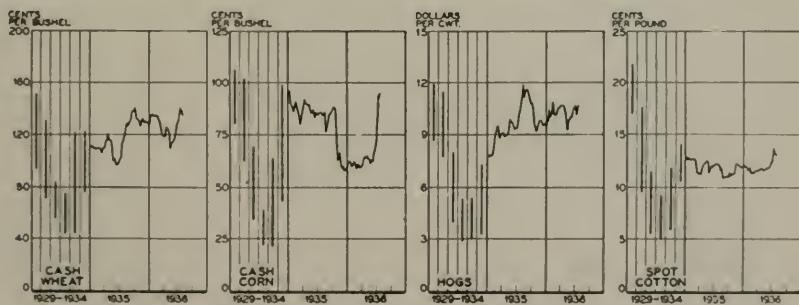
The Number of Mining Corporations in the United States Which Are in the "Net Income" and "No Net Income" Groups, Their Respective Incomes and Deficits, and the Net Results for Both Groups From 1925 to 1934.

These three charts give the complete picture of corporation income-tax returns in the metal-mining industry. They indicate that all mines are not "bonanzas." In fact, many mining corporations report no net income each year.



Gustav R. Stahl, J. T. Trenholm & Co., N. Y. C.

A. Effect of Walk-Outs in the United States on Business From 1936 to June 1938.



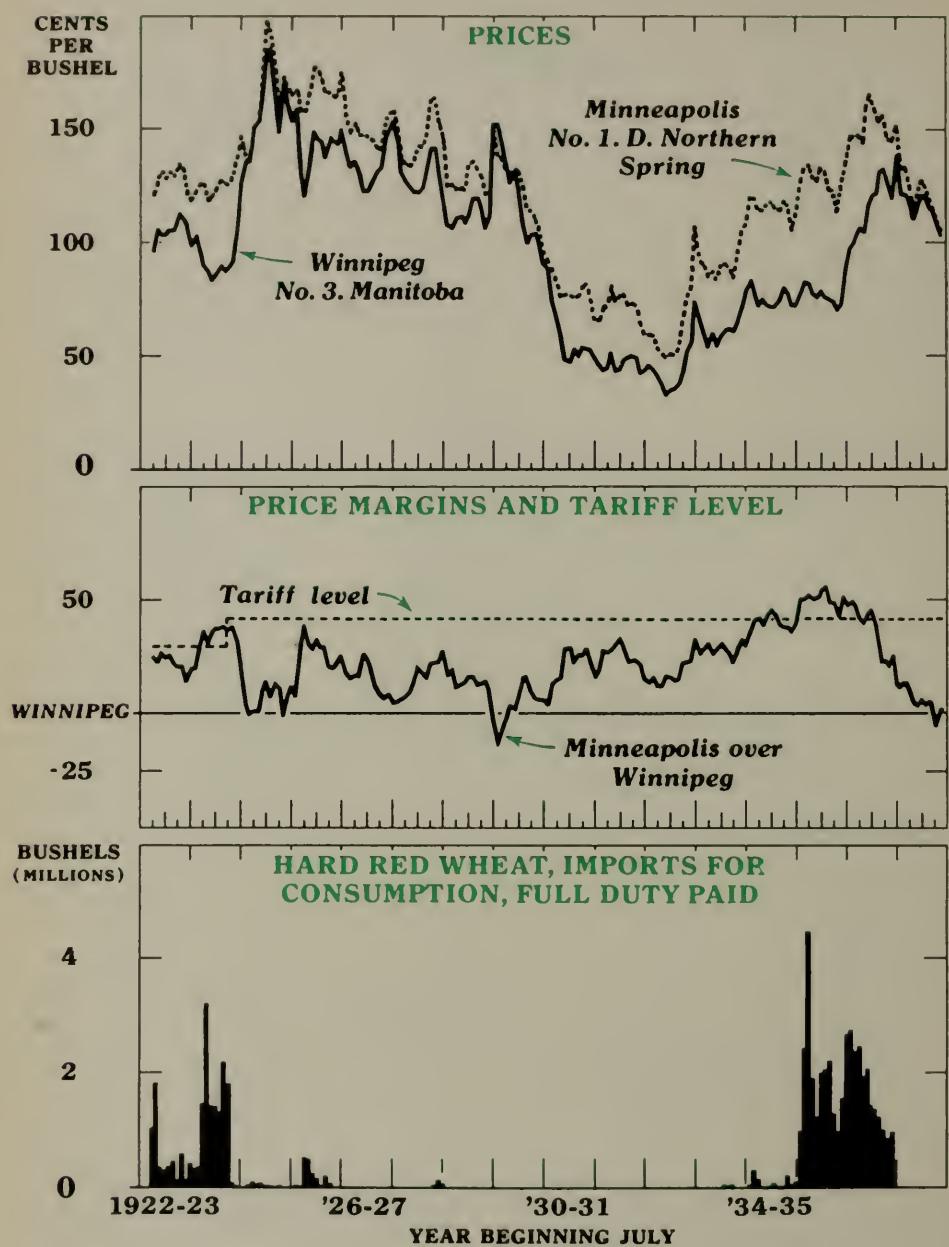
Federal Reserve Bank of New York, "Monthly Review," August 1, 1936.

SCALE .7

B. Movements of Prices of Leading Agricultural Commodities With Range of Prices for 1929-34 and Weekly Quotations Subsequently.

A change in the type of data resulted in this chart with range bars from 1929 to 1934 and a curve from 1934 to June 1936.

GRAPHIC PRESENTATION

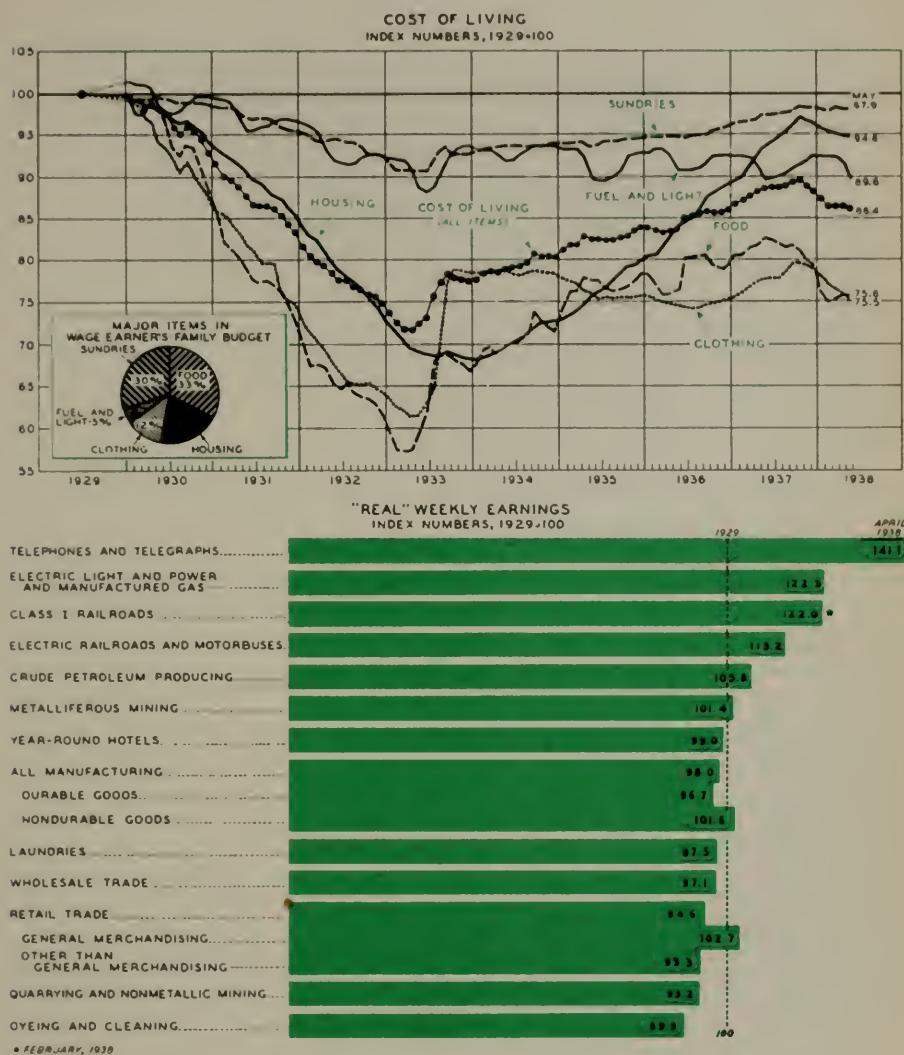


U. S. Department of Agriculture, Bureau of Agricultural Economics.

SCALE .8

Prices, Price Margins, Tariff Level, and Imports of Wheat in the United States From July 1922 to July 1937.

COMPOSITE CHARTS



National Industrial Conference Board, Inc., N. Y. C., June 17, 1938.

SCALE .6

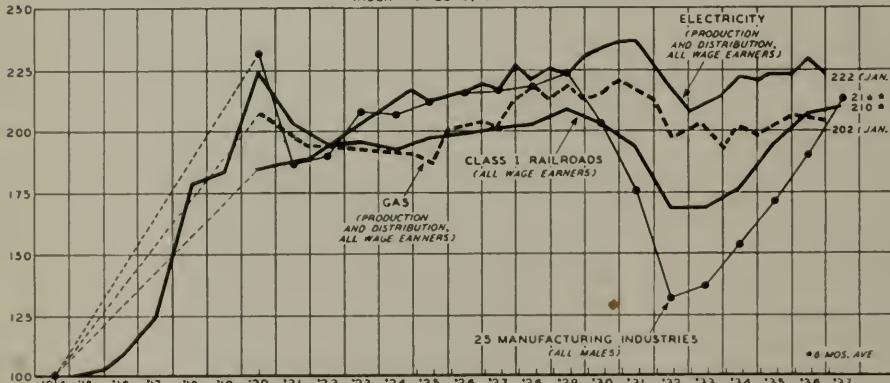
Cost of Living and "Real" Weekly Earnings in the United States From 1929 to 1938.

Curves, bars, and a sector chart combined give a clear, concise picture of a problem.

GRAPHIC PRESENTATION

BY CLASS OF SERVICE, 1929, 1933, 1937

	1929	1933	1937
ROAD PASSENGER ENGINEERS	\$66.71	\$66.22	\$60.35
ROAD FREIGHT ENGINEERS	\$62.11	\$61.13	\$64.09
ROAD PASSENGER CONDUCTORS	\$53.01	\$59.82	\$60.96
ROAD FREIGHT CONDUCTORS	\$46.44	\$55.82	-
YARD ENGINEERS	\$41.80	\$46.33	\$50.06
ROAD PASSENGER FIREMEN	\$40.20	\$48.06	\$50.23
YARD CONDUCTORS	\$40.65	\$47.55	\$49.00
ALL TRAIN AND ENGINE SERVICE LABOR	\$37.80	\$46.00	\$46.40
ROAD FREIGHT FIREMEN	\$33.11	\$40.64	\$45.66
ROAD PASSENGER BRAKEMEN	\$38.66	\$41.05	\$42.26
YARD BRAKEMEN	\$21.10	\$36.20	\$42.06
ROAD FREIGHT BRAKEMEN	\$30.92	\$38.51	\$41.63
YARD FIREMEN	\$28.90	\$34.68	\$38.36
SKILLED AND SEMISKILLED SHOP LABOR	\$27.64	\$37.20	\$37.54
ALL WAGE EARNERS (AVERAGE)	\$25.86	\$31.43	\$31.71
UNSKILLED LABOR	\$13.05	\$17.44	\$18.14

COMPARISON WITH OTHER UTILITIES AND WITH MANUFACTURING, 1914-1937
INDEX NUMBERS, 1914 = 100

National Industrial Conference Board, Inc., September 10, 1937.

SCALE .7

Weekly Earnings of Workers in Class I Railroads in the United States in 1929, 1933, and June 1937.

An index number comparison with wage earners of other utilities and with manufacturing from 1914 to 1937 gives a more complete picture than would be possible with the bar charts alone.

COMPOSITE CHARTS

PASSENGER CAPACITIES OF SURFACE STREETS

60 Ft. Pavement
3 Lanes Each Direction
No Parking



Automobiles Only

IN AUTOS

3,700

Autos & Buses

IN AUTOS

2,130

IN BUSES



Autos & Street Cars

IN AUTOS

2,130

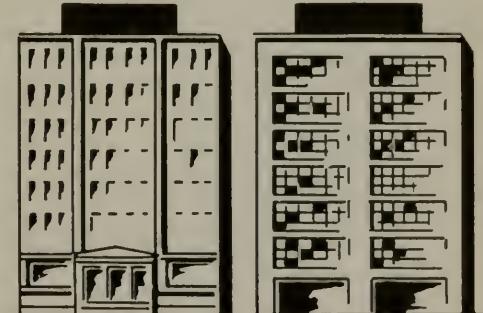
IN STREET CARS

Figures based by American Transit Association

COMPARATIVE PASSENGER CAPACITIES
OF MAJOR TRANSIT AND
TRAFFIC IMPROVEMENTS

One express-local subway will carry 100,000 passengers per hour in one direction on two tracks. Twenty-one four-lane elevated highways would be required to carry the same load in automobiles.

If everyone came to work by private automobile, each office building would need a garage of the same size for the storage of vehicles.



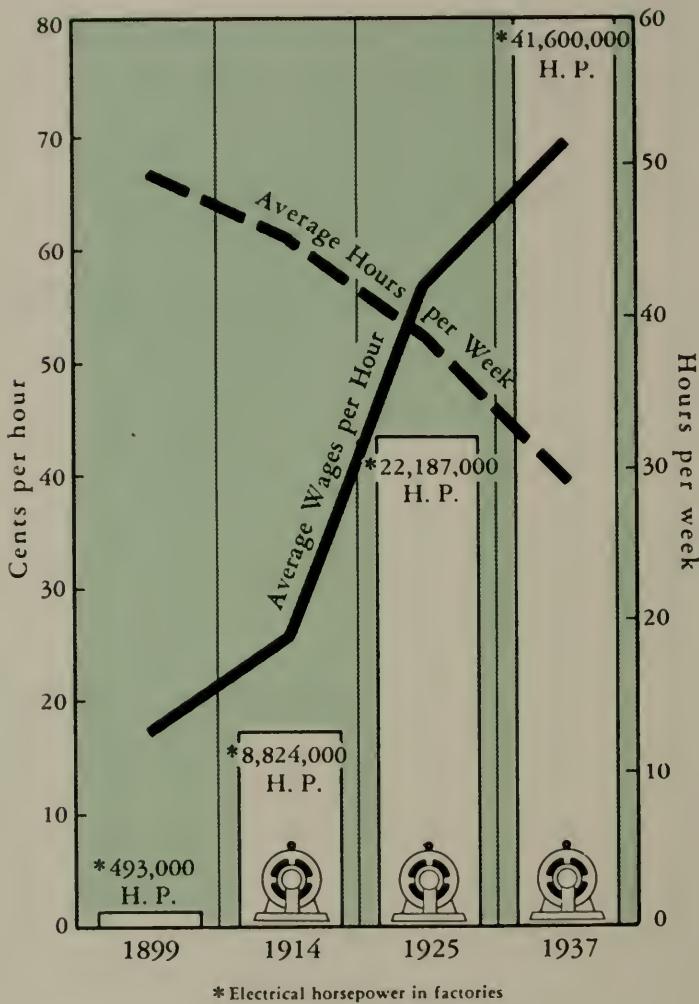
Transit Journal, September 26, 1938, Part of an Editorial Entitled "Transit's Job . . . Moving the Masses."

SCALE .7

A Picture of the Transit Problem in the United States.

1. The first chart presents graphically passenger capacities of surface streets.
2. The second one gives comparative passenger capacities of major transit and traffic improvements.
3. The third shows the amount of space that would be needed for garage if everyone came to work by private automobile.

GRAPHIC PRESENTATION



Electrical World, October 8, 1938. Part of an Editorial on Public Relations Entitled "What Electricity Means to America."

A Comparison of the Status of Labor in the Electrical Industry and the Increased Production in That Industry in 1899, 1914, 1925, and 1937.

1. The implication of this chart is that with the increase in use of electrical horsepower in factories, average wages per hour go up and average hours per week go down.
2. Note that the two curves and the bars have a common zero line, but the scales are different.

Chapter 44

SUGGESTIONS FOR MAKING A CHART

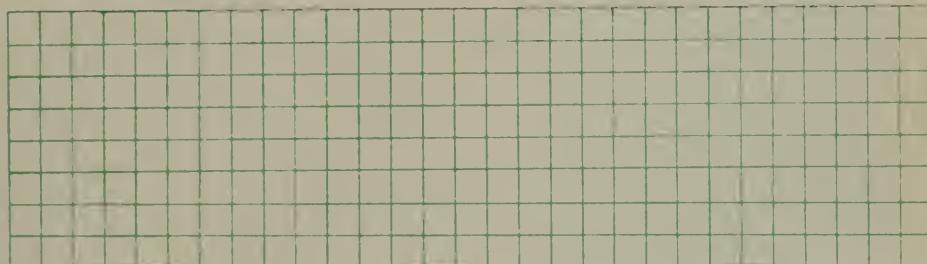
THE FIRST problem in producing a chart, assuming that the data have been gathered, is in the choice of materials to be used in drawing it. Often the materials at hand in the office or drafting room are sufficient. It is also possible to plan the production of a chart, basing all the plans on the materials at hand.

PAPER

The test for the selection of paper on which to draw is to try the drawing medium upon it; that is, the ink, pencil, paint, or crayon, and see the result. Cross section paper drawing materials may be secured from the following companies:

SOURCES:

Codex Book Co., Norwood, Massachusetts.



Educational Exhibition Co., Providence, Rhode Island.

Rectangular Coordinate Graph Paper.

1. The number of lines drawn on graph paper and the spacing of the lines may quite often indicate the use to which the paper will be put. For that reason, a wide choice of printed graph paper is offered the draftsman. The use of printed graph paper saves time and is comparatively inexpensive.
2. One type of rectangular coordinate paper, called utility paper, is shown above. It has 52 spaces on the long edge to represent one year by weeks, or 4 years by months. The 36 spaces may be used to represent one month by days, 3 years by months, or one year by months taking every third space.
3. This paper is so spaced that it may be put in the typewriter and the lines of type will fit into the space; that is, on the standard typewriter there are six lines of type to the inch, and on this utility paper, there are six spaces to the inch.

GRAPHIC PRESENTATION

Educational Exhibition Co., Providence, Rhode Island.

Eugene Dietzgen Co., New York City (and various other cities).

Keuffel & Esser Co., New York City (and various other cities).

Rubber cement is a "must" in the drafting room and copy room. It does not wrinkle paper and may be used for a temporary joining, as well as for a permanent one.

Transparent materials may be used to great advantage in comparing curves, bars, or other types of graphic charts. The charts are drawn directly on the transparent material. When placed over each other, a clear comparison is possible.

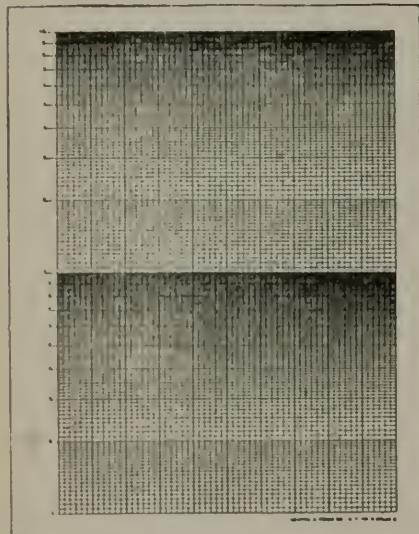
SOURCES OF TRANSPARENT MATERIALS:

Celluloid Corporation, Newark, New Jersey.

E. I. Dupont De Nemours & Company, New York City.

Eastman Kodak Company, Rochester, New York.

Monsanto Chemical Co., St. Louis, Missouri.

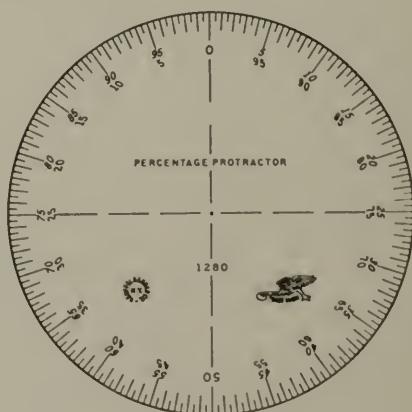


Eugene Dietzgen Co., New York City.

A. Ratio or Logarithmic Chart Paper.

Logarithmic paper is obtainable with the log scale in both horizontal and vertical rulings or with the log along only the ordinate.

Log paper is obtainable in various sizes and with various cycles or decks.



Keuffel & Esser Co., New York City. SCALE .6

B. Percentage Protractor.

The percentage protractor is of particular value to anyone making graphic charts, since it can be used in the construction and measurement of sector charts and similar graphs.

SUGGESTIONS FOR MAKING A CHART

A. Triangles, T-Square, and French Curve.

1. The triangle on the left is 30 x 60 degree, while the one on the right is a 45 degree triangle.
2. French curves are available in a great many shapes and forms. The one shown here is one of the simplest.
3. These drawing instruments are part of the equipment for a standard drawing board.



Eugene Dietzgen Co., New York City. SCALE .5

6B	HB	4H
5B	F	5H
4B	H	6H
3B	2H	7H
2B	3H	8H
B	ELDORADO GRADE CHART	9H

Joseph Dixon Crucible Co., Jersey City, N. J.

B. Grade Chart for the Lead of Drawing Pencils.

1. This chart gives the difference in the grades of lead in drawing pencils as seen from the end of the pencil.
2. In choosing a drawing pencil, the depth and width of line desired are among the various criteria.

REFERENCES

- Arkin, Herbert and Raymond R. Colton, *Graphs: How to Make and Use Them*, Harper & Brothers, New York City, 1937.
- Brinton, Willard C., *Graphic Methods for Presenting Facts*, McGraw-Hill Book Co., Inc., New York City, 1914.
- Brown, Theodore H., Richmond F. Bingham, and V. A. Temnomeroff, *Laboratory Handbook of Statistical Methods*, McGraw-Hill Book Co., Inc., New York City, 1931.
- Haskell, A. C., *Graphic Charts in Business*, Codex Book Co., Inc., Norwood, Mass., 1928.
- Karsten, Karl G., *Charts and Graphs*, Prentice-Hall, Inc., New York City, 1923.

CRAYONS

If you do not have crayons of the desired color on hand, try your nearest art dealer. If you are unable to secure the materials that you want there, write to the manufacturers. They will put you in touch with your nearest dealer.

A wide variety is offered. There are colored pencils, wax crayons, pressed crayons, water crayons, etc. If when using a wax crayon, the color tends to smear, scrape the surface with a razor blade. The excess crayon is thus removed. Lumber crayons may be used for extremely heavy color work.

Makers of crayons:

American Crayon Co., Sandusky, Ohio, New York City.

Art Crayon Co., Inc., Brooklyn, N. Y.

Binney & Smith Co., New York City.

Joseph Dixon Crucible Co., Jersey City, N. J., New York City
(and various other cities).

Eagle Pencil Company, Inc., New York City

Eberhard Faber Pencil Co., Brooklyn, N. Y.

Koh-I-Noor Pencil Co., New York City.

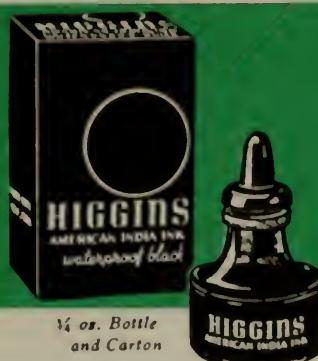


Eagle Pencil Company, Inc., New York City

Pencil Lengthener.

1. The pencil lengthener is used with a pencil stub. This makes it possible to use the entire pencil and yet not be uncomfortable while using the small length.
2. The pencil lengthener may also be fitted with a pencil which is made short especially for use in a lengthener.

SUGGESTIONS FOR MAKING A CHART



Charles M. Higgins & Co., Inc., Brooklyn, N. Y.

SCALE 8

Inks for Drawing and Lettering.

A good drawing ink should be smooth flowing and quick drying as well as permanent and waterproof. The stopper is usually equipped with a quill to be used in filling drawing and ruling pens.

PASTED COLORED PAPERS

The problem of putting color on a graphic chart is further simplified by the use of colored paper.

1. Plain colored paper may be pasted on with rubber cement.
2. Colored paper with a gummed back may be obtained either in tape form or in sheets.
3. Colored paper with a back which adheres to any clean, smooth surface and which requires no water may be obtained in a variety of widths and colors.

Sources:

Dennison Manufacturing Co., Framingham, Mass., New York City (and various other cities).

Industrial Tape Corporation, New Brunswick, N. J.

Minnesota Mining & Manufacturing Co., Chicago, New York City (and various other cities).

Poster Products, Inc., Chicago, New York City.

Van Cleef Bros., Chicago, New York City.

ERASERS

Erasers are necessary implements in the drafting room. They may be classified into the following types:

1. velvet—for erasing pencil
2. sandpaper—for erasing typewriter type
3. scrubbing—for erasing smudges, charcoal, pencil, etc.
4. roll-off—for cleaning up drawings
5. kneading erasers—for cleaning pencil, etc., from walls
6. ink erasers and ink eradicators
7. erasing machines

Sources:

Joseph Dixon Crucible Co., Jersey City, N. J.

Eagle Pencil Company, Inc.; New York City

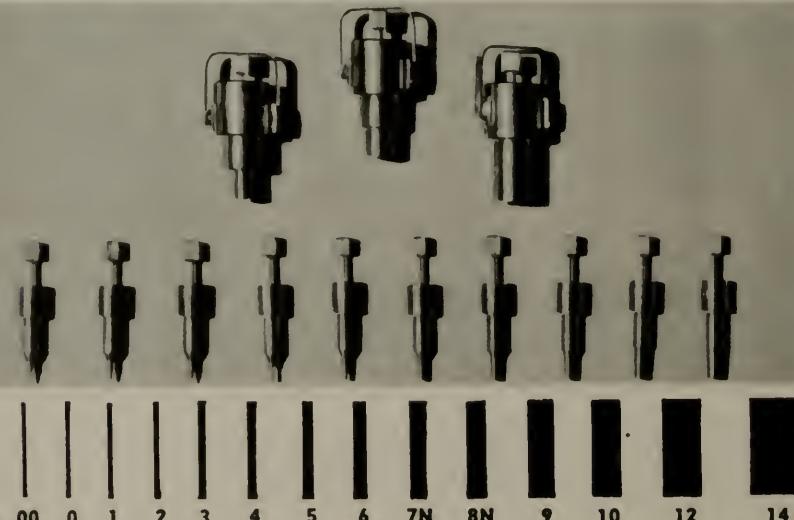
Eberhard Faber Pencil Co., Brooklyn, N. Y.

Weldon Roberts Rubber Co., Newark, N. J., New York City

Erasing Machines:

Chicago Wheel & Manufacturing Co., Chicago.

Charles W. Speidel & Co., Philadelphia.



Keuffel & Esser Co., New York City.

Leroy Lettering Pens and Width of Letters.

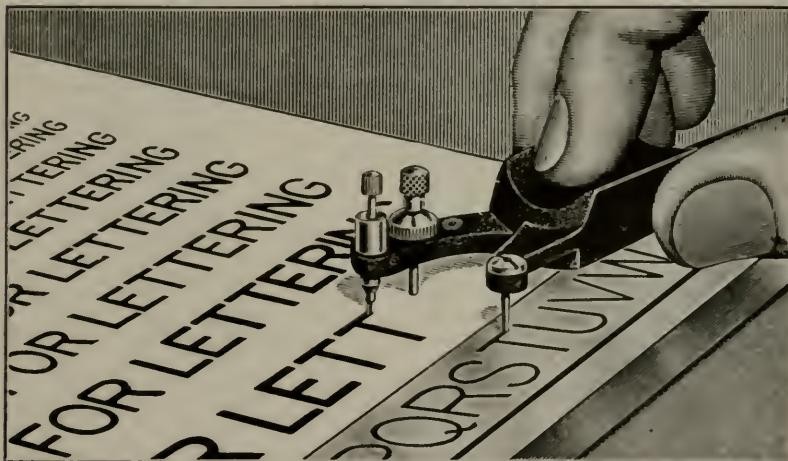
While these pens are designed primarily for use with the scribe and lettering guide shown in 373 they may also be used for free-hand lettering and line drawing. A special socket which fits into an ordinary pen holder is necessary for this.

INK

A good waterproof permanent ink is essential. Colored inks such as red and green are often standard equipment in an office. These may be used to color graphic charts and maps. See 371.

If there is a choice of colored inks, the following order of choice is recommended:

1. black
2. carmine red or scarlet
3. green
4. blue
5. yellow
6. brown
7. orange



Keuffel & Esser Co., New York City.

Leroy Lettering Guide and Scriber.

1. This lettering guide is of three-ply construction, two white sections, with one black center section. The letters are cut only in one white section, revealing the black one underneath.
2. There are two types of scribes: the adjustable one that produces both vertical and slanting letters, and the fixed scribe that produces vertical letters only.



Wood Regan Instrument Co., New York City.

SCALE .6

A. Wrico Lettering Pen and Lettering Guide.

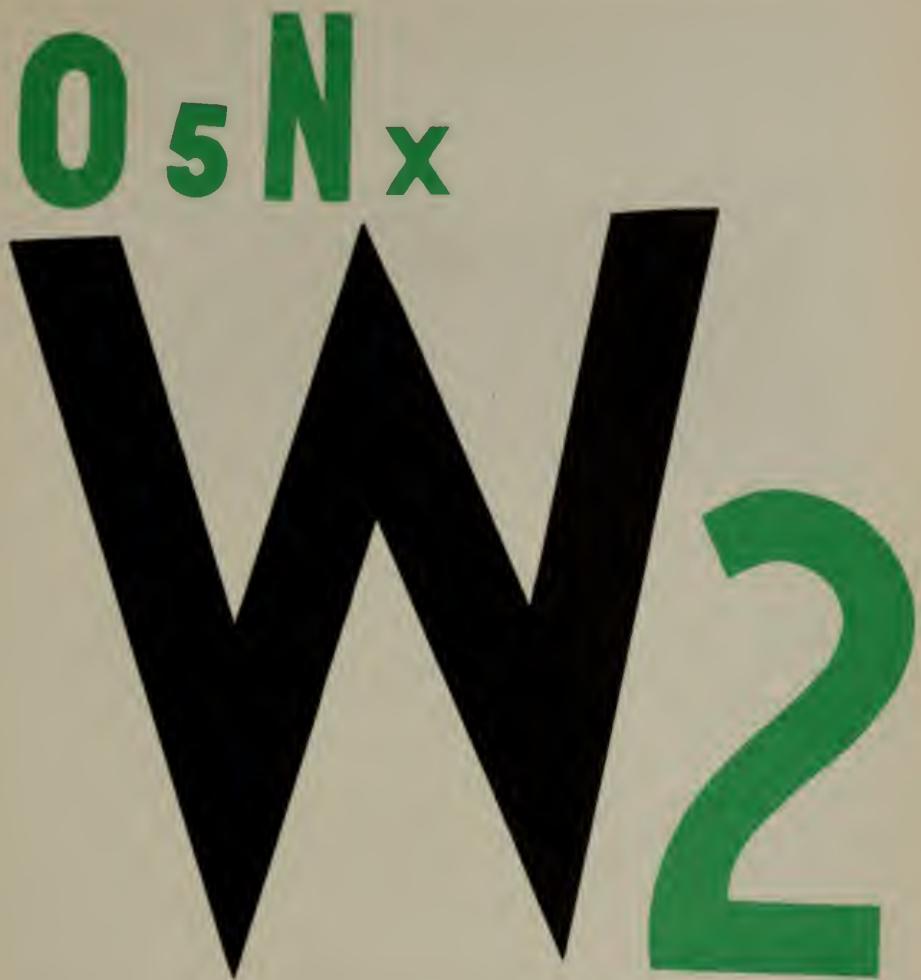
1. Tubular points on this pen prevent ink from getting on the edges of the openings of the guide. Steel needles regulate the flow of ink and prevent the points from becoming clogged with ink.
2. The under side of the guide is grooved so that ink will not be smeared when the guide is moved from one character to another. The guide is placed directly over the portion of the paper on which the lettering is to be done.



Theo. Alteneder & Sons, Philadelphia, Pa.

B. Ruling Pen of the "Hinged" Type.

1. The hinge arrangement of this pen makes the pen easy to clean. Ruling pens are available in a variety of sizes and shapes. This is the actual size of the pen.
2. The firm from whose catalogue this illustration was taken also handles a helpful device called a "Spacing Divider." This instrument consists of 11 teeth, numbered from 0 to 10, and so designed that they always divide the extreme setting of the dividers into 10 equal parts.



Poster Products, Inc., Chicago, and Tablet & Ticket Co., Chicago.

Cut-Out Letters.

1. Another method of lettering a chart is to secure cut-out letters and figures and then to put them on the chart. The letters come in a variety of styles and sizes and may be secured either with a gummed back or a back which adheres to any clean smooth surface and which requires no water. The latter are both removable and reusable.
2. The letters "O5NX" are gummed-back and come in sizes from $\frac{1}{8}$ to 2 inches in height (Tablet & Ticket Co.). The letters "W2" require no water. A white backing protects the adhering surface and is stripped off just before using. These letters come in sizes 13 16 to 9 inches in height (Poster Products Inc.).
3. A third company making letters from 1 inch to 18 inches in height is The Redicut Letter Company, Los Angeles, California.



The Kelsey Company, Meriden, Conn.

A. Small Portable Printing Press and Outfit.

1. The small press shown above prints a type space 6 x 10 inches. A downward pressure on the lever gives the impression. Ink is spread on the ink table, which may be removed for cleaning. From 600 to 2000 sheets may be run through per hour.
2. These small presses are available in a number of sizes.

Pica—No. 1 (10)

This is a sample of writing with No. 1 Pica type, the style most used for general correspondence.

1 2 3 4 5 6 7 8 9 10

Elite No. 6 (12 or 10 Special)

ELITE. Is used largely for personal correspondence. Much matter in small space without crowded appearance.

L. C. Smith Typewriter Co., New York City.

B. Pica and Elite Typewriter Styles.

1. Graph paper may be inserted in the typewriter so that the lettering and numbering may be typed. A standard typewriter makes a legible chart. The most commonly used type styles are the pica and elite.
2. There are ten letters to the inch on the pica type and six lines of type to the inch. On the elite type there may be either twelve or ten letters to the inch.
3. A large variety of type styles are available on typewriters today. A new machine makes it possible to use several styles of type on the same typewriter. See 379.

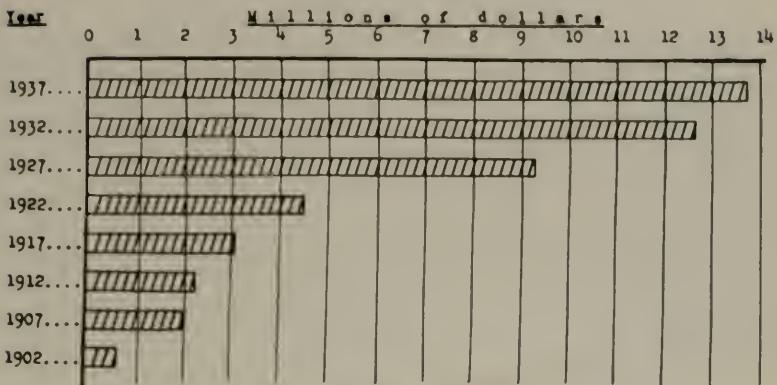
SUGGESTIONS FOR MAKING A CHART

377

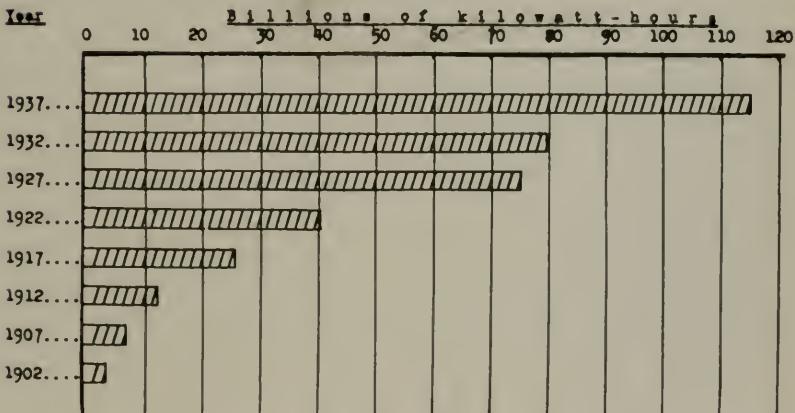
GROWTH OF THE ELECTRIC LIGHT AND POWER INDUSTRY -- 1902 TO 1937

VALUE OF PLANT AND EQUIPMENT

In Millions of Dollars



ENERGY GENERATED--BILLIONS OF KILOWATT-HOURS



International Business Machines Corp., New York City.

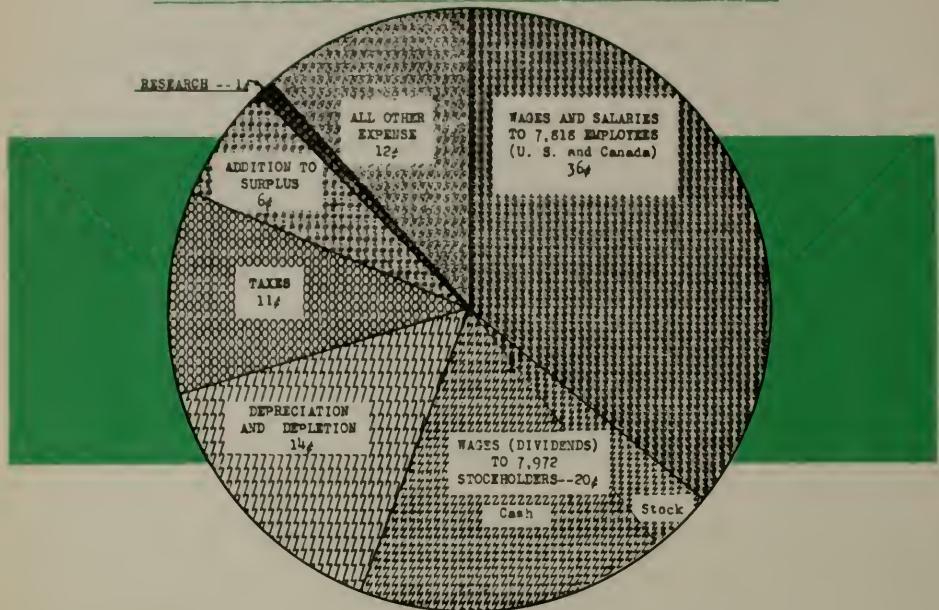
SCALE .7

Two Bar Charts Made on a Typewriter.

1. For the employee in a business office, lacking the tools and the skill in drawing and lettering of a draftsman, the typewriter offers an opportunity for quick and easy preparation of graphic presentation of data through charts and diagrams. It solves the problem of lettering and assures that vertical and horizontal lines will be at right angles without the use of a drawing board and T-square.
2. Making bar charts is a simple process. By letting one space on the machine represent a unit quantity, the character selected for a given bar can be struck the correct number of times to represent any specified amount. There are several characters which when written so that one row exactly touches the next one will make a very attractive "all over" pattern.

GRAPHIC PRESENTATION

DISTRIBUTION OF EACH DOLLAR OF INCOME (GROSS INCOME LESS COST OF MATERIALS)



International Business Machines Corp., New York City.

SCALE .5

A Sector Chart Made on a Typewriter.

A sector chart can be made quickly and easily on a typewriter by the following method:

1. Draw the circle of convenient size with any ordinary school compass.
2. Indicate the division of the circle into its parts by a protractor and draw the dividing lines in ink.
3. Type in the names of the sectors.
4. With the compass set as it was to draw the original circle, draw another circle exactly like it on a sheet of thin typewriter second paper. By running the sharp point of the compass around the circle several times on the thin paper, the circle will drop out and leave a hole in the second sheet.
5. Place the copy in the machine with the second sheet over it so that all of the copy excepting the circle itself is covered.
6. Roll the copy up in the machine and place a strip of second sheet along one of the dividing lines and another strip along the adjacent dividing line. The two strips of paper will cross at the center of the circle and will cover all of the circle but one sector.
7. Beginning at the bottom of the exposed sector, make rows of the desired character to make the "all over" pattern for that sector, allowing the rows to extend beyond the edge of the sector a few spaces. The excess typing will fall on the second sheets and a very sharp edge of the pattern will appear on the copy. Adjust the strips of paper each time to expose one sector and fill in each sector, running the pattern carefully around the lettering.
8. It takes as long to describe it as it does to do it.



The Vari-Typer Electric Composing Machine is manufactured by the Ralph C. Coxhead Corporation, with their main office at 17 Park Place, New York City, N. Y.

Vari-Typer, an Electric Typewriter with Interchangeable Type

The Vari-Typer Electric Composing Machine is used to "cut" stencils and to compose the master copy for reproduction by Photo-Offset. The machine features Interchangeable Type, Horizontal Spacing Control, Vertical Spacing Control, Uniform Impression Control, Bold Face Repeat Key, Margin Justification Mechanism, Open End Carriage, Standard Keyboard and Shadow Light. The machine is simple to operate.

The above was typed on the Vari-Typer.

GRAPHIC
GRAPHIC
GRAPHIC
GRAPHIC
GRAPHIC
GRAPHIC
GRAPHIC

GRAPHIC
GRAPHIC
GRAPHIC
GRAPHIC
GRAPHIC
GRAPHIC
GRAPHIC
GRAPHIC

Martin J. Weber, New York City.

Photographic Method of Securing Various Types of Lettering Effects.

1. All the above letter effects were made photo-mechanically by a special device on a camera from the same original line. The original is the top line of the left column.
2. The letters can be made to slant either to the right or left.
3. In addition to altering the letter effects, this process invented by Martin J. Weber, New York artist, will produce variations of the original which will register perfectly with that original for color registration work.

Green and red as favorable and unfavorable originated with railroad signals which were based upon the idea of red for danger and green for safety. Today, red and green are used in traffic signals for stop-and-go.

When there is to be a gradation from dense to least dense there is a question as to how the gradations should be crosshatched. Generally, black represents the unfavorable and white the favorable. Since the question is one of interpretation, the decision should be made relative to the particular problem.

Chapter 45

STANDARDS FOR TIME SERIES CHARTS

On the following pages are abstracts from *Time Series Charts. A Manual of Design and Construction*, 1938, prepared by the Committee on Standards for Graphic Presentation under the procedure of the American Standards Association, with the American Society of Mechanical Engineers as sponsor body.

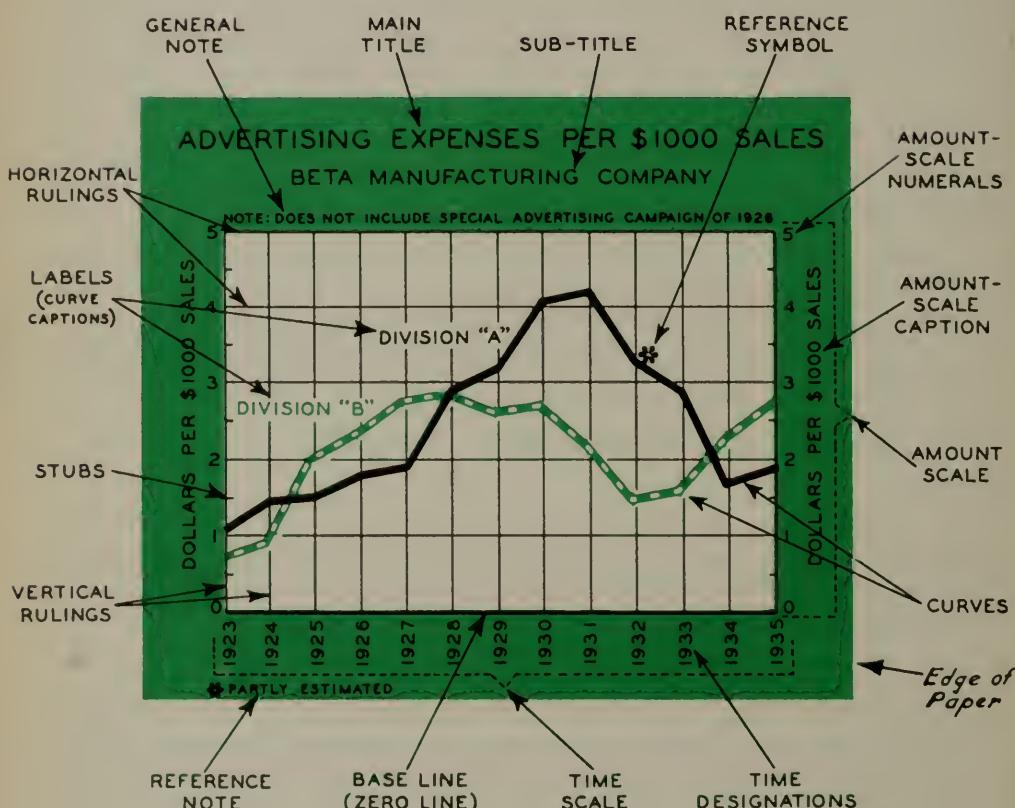
Other abstracts from this report will be found in the following chapters:

- Chapter 12. MULTIPLE BAR CHARTS
- Chapter 13. CONTRASTING BAR CHARTS
- Chapter 33. CURVE CHARTS
- Chapter 34. COMPARISONS WITH TWO CURVES
- Chapter 36. COMPONENT PARTS SHOWN BY CURVES
- Chapter 42. RATIO CHARTS
- Chapter 51. METHODS OF PRINTING

The pamphlet number of this report is ASA Z15.2 — 1938. It may be secured for \$1.25 from the Publications Department of the American Society of Mechanical Engineers, 29 West 39th Street, New York City.

The Committee on Preferred Practice for Time Series Charts, with Arthur H. Richardson as Chairman, prepared the report *Time Series Charts*. It is a subcommittee of the Committee on Standards for Graphic Presentation. Within the next year, it is expected there will be a report by the subcommittee on Engineering and Scientific Graphs, of which W. A. Shewhart is Chairman.

DESIGNATION OF CHART COMPONENTS



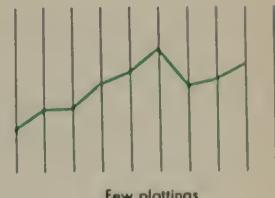
The arrow and designation "Edge of Paper" have been added to the original in order to indicate that the outside line is not a frame. The author believes it is undesirable to put a frame line around a chart because of the possibility of that line being falsely interpreted as a zero line.

STANDARDS FOR TIME SERIES CHARTS

GRIDS

Grid structure plays a controlling part in interpreting the facts. However, grid specifications should seldom if ever be determined without taking the scales into consideration. In the matter of influencing the behavior of the curve, the two are of equal importance.

The proper construction of a grid involves more than simply covering a convenient space with cross rulings. As in the matter of general layout, the nature of the data and purpose of the presentation must be considered. A grid unsuited to the data may be not only lacking in effectiveness but may actually be misleading.



Few plottings



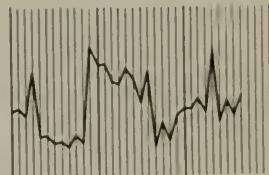
Many plottings

GRID DIMENSIONS

1. Grids should be so proportioned as not to distort the facts.
2. Grid proportions should not be rigidly standardized.
3. Grids should be of pleasing proportions.

FREQUENCY OF VERTICAL RULINGS

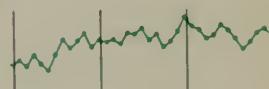
1. The number of rulings should be sufficient to indicate the frequency of plotting.
2. There should be a sufficient number of rulings to facilitate the reading of time values on the horizontal time-scale.



Emphasis on change

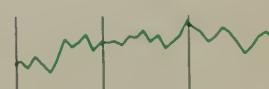
WEIGHT OF VERTICAL RULINGS

1. Vertical rulings should be of sufficient weight to guide the eye readily to the time-scale designations.
2. The weight of vertical rulings should be varied so as to indicate clearly the nature of the time intervals or the subdivisions of time for which data are shown.



FREQUENCY OF HORIZONTAL RULINGS

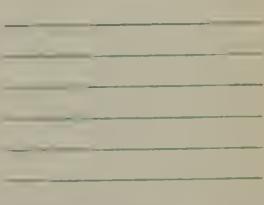
1. Horizontal rulings should be so drawn as to meet the requirements of their two-fold purpose: To assist in reading values on the vertical scale and to provide a series of horizontal bases of comparison.
2. The number of horizontal rulings should vary according to the closeness with which it is desired to read values of the vertical scale. Rulings should not be so frequent as to imply a greater accuracy of the data than actually exists.
3. In general, there should be no more rulings than are necessary to guide the eye to an approximate reading of the curve values.



Indicating omission of rulings

WEIGHT OF HORIZONTAL RULINGS

1. Horizontal rulings should be sufficiently heavy to guide the eye to the amount scale without conscious effort.
2. Horizontal rulings should be heavy enough to serve as supplementary "bases" of comparison for the curves.
3. Horizontal rulings should be light enough to contrast sharply with the curves.



Infrequent rulings generally desirable

GRAPHIC PRESENTATION

ROOT-TWO DIMENSIONS											
Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long
1.0	1.4	3.0	4.2	5.0	7.1	7.0	9.9	9.0	12.7		
1.1	1.6	3.1	4.4	5.1	7.2	7.1	10.0	9.1	12.9		
1.2	1.7	3.2	4.5	5.2	7.4	7.2	10.2	9.2	13.0		
1.3	1.8	3.3	4.7	5.3	7.5	7.3	10.3	9.3	13.2		
1.4	2.0	3.4	4.8	5.4	7.6	7.4	10.5	9.4	13.3		
1.5	2.1	3.5	4.9	5.5	7.8	7.5	10.6	9.5	13.4		
1.6	2.3	3.6	5.1	5.6	7.9	7.6	10.8	9.6	13.5		
1.7	2.4	3.7	5.2	5.7	8.1	7.7	10.9	9.7	13.7		
1.8	2.6	3.8	5.4	5.8	8.2	7.8	11.0	9.8	13.9		
1.9	2.7	3.9	5.5	5.9	8.3	7.9	11.2	9.9	14.0		
2.0	2.8	4.0	5.7	6.0	8.5	8.0	11.3	10.0	14.1		
2.1	3.0	4.1	5.8	6.1	8.6	8.1	11.5	10.1	14.3		
2.2	3.1	4.2	5.9	6.2	8.8	8.2	11.6	10.2	14.4		
2.3	3.2	4.3	6.1	6.3	8.9	8.3	11.7	10.3	14.6		
2.4	2.4	4.4	6.2	6.4	9.1	8.4	11.9	10.4	14.7		
2.5	3.5	4.5	6.4	6.5	9.2	8.5	12.0	10.5	14.8		
2.6	3.7	4.6	6.5	6.6	9.3	8.6	12.2	10.6	15.0		
2.7	3.8	4.7	6.7	6.7	9.5	8.7	12.3	10.7	15.1		
2.8	4.0	4.8	6.8	6.8	9.6	8.8	12.4	10.8	15.3		
2.9	4.1	4.9	6.9	6.9	9.8	8.9	12.6	10.9	15.4		

In preparing a chart to be of root-two proportions select one of the pairs of dimensions indicated above for a bordering rectangle and fit the material within it as compactly as practicable.

Measure the short dimension and if the corresponding long dimension from the table is greater than the long dimension of the layout, expand the latter to correspond. If the long dimension from the table is less than the long dimension of the layout, find the short dimension corresponding to the latter and expand the short dimension of the layout to correspond.

The proportions of a chart should be such that when reproduced or displayed it will fit harmoniously the medium of presentation.

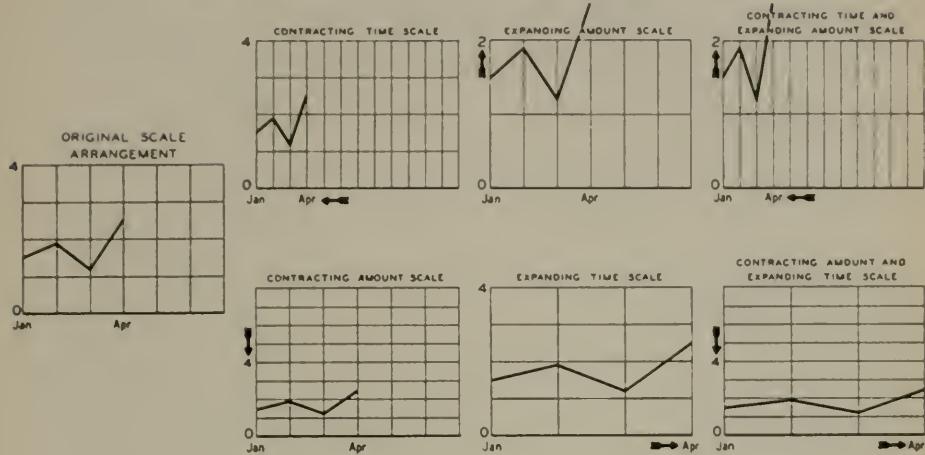
PROPORTIONS FOR LETTER SIZE. The ratio of 1 (short side) to 1.414 (long side) is particularly appropriate for correspondence size sheets (nominally 8½" x 11").

Note: A rectangle of this proportion is known as a "root-two" or "hypotenuse" rectangle, the long side of which is equal to the diagonal of a square constructed on the short side. This rectangle possesses the unique characteristic that when divided in half width-wise, each resulting rectangle is also of root-two proportions; a characteristic useful in grouping charts on a page.

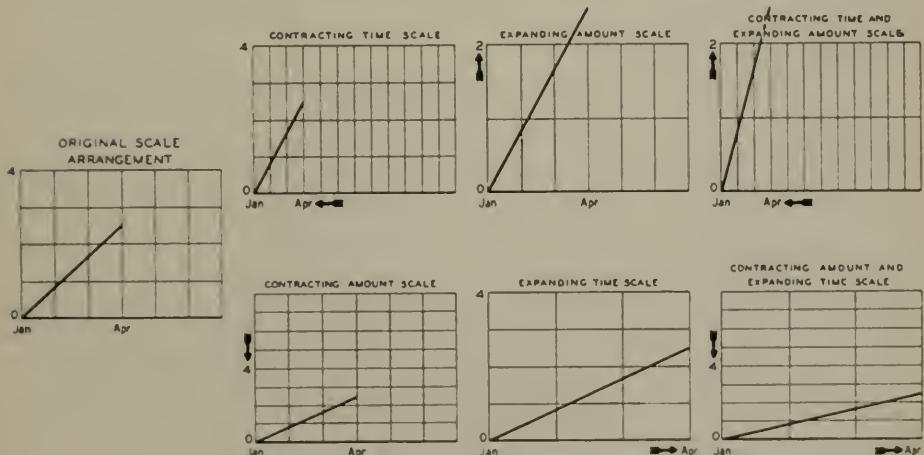
STANDARDS FOR TIME SERIES CHARTS

IMPORTANCE OF PROPER SCALE SELECTION

EFFECT OF SCALE ALTERATION - CHART SHOWING MOVEMENT



EFFECT OF SCALE ALTERATION - CHART SHOWING TREND



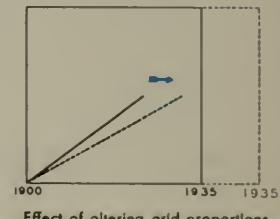
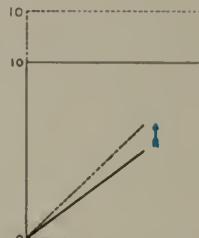
GRAPHIC PRESENTATION

RELATION OF TIME SCALE TO AMOUNT SCALE

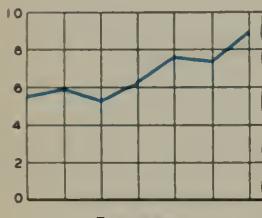
- The relation between the time scale and the amount scale has a determining influence on the movement of time-series curves.

Note: The movement of a curve is here understood to mean the graphic effect of the progressive changes in the quantity considered. The trend is the graphic effect of the overall changes in the quantity considered.

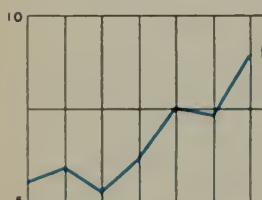
- Selection of both scales should be made to convey the correct impression of the trend and movement of the series.
- Manipulating the scales so as to picture a movement contrary to the facts is never justified.



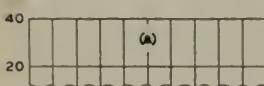
Effect of altering grid proportions



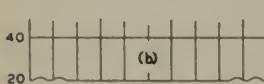
True picture



Distortion resulting from omission of zero value



(a)



(b)

Methods of Indicating omission of zero value

INCLUSION OF PRINCIPAL POINT OF REFERENCE

Principle

- The amount scale should normally include the zero value or other principal point of reference. Departure from this rule should never be made except where there is a special reason for so doing.

Procedures

- WHEN NECESSARY. The zero line or other base of comparison should never be omitted when the interest is in relative amount of change between points on the same curve.
- WHEN NOT NECESSARY. When the interest of the reader is in the absolute amount of change rather than in the relative amount of change, it may be safe to omit the principal point of reference and the accompanying horizontal line.
- OMISSION SHOULD BE INDICATED. When the zero value or other principal point of reference is omitted the fact should be clearly indicated in a manner that will attract notice.

Note: Since it is generally taken for granted that the base line is the zero line, it is not sufficient merely to show the base line as a light ruling instead of the customary heavy ruling.

- EFFECTIVE METHODS OF INDICATING the omission of the zero point and line:
 - A wavy line across the bottom of the grid.
 - A straight line waved at each end.

STANDARDS FOR TIME SERIES CHARTS

RANGE AND SPACING OF AMOUNT SCALE

Principles

1. Since the amount scale has a controlling effect on the movement of the curves it is highly important that a scale be selected which will result in a true picture of the facts.
2. The amount scale should be divided in a manner that will facilitate accurate reading of the curve values.

Procedures

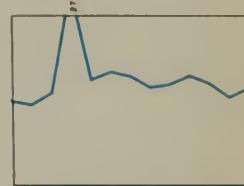
1. FULL RANGE DESIRABLE. Generally the amount scale should begin at zero. It should extend continuously to a point somewhat beyond the greatest value, to avoid crowding the grid. In cases of marked upward trends, curves generally should not point above the upper right-hand corner of the grid.



Placing the curve

2. AVOID WASTE SPACE. Unnecessary extension of the scale range should be avoided if blank space which serves no useful purpose is thus added.

Note. Extending the scale range reduces the fluctuation and separation of curves. When this is desirable it may be better accomplished by reducing the scale dimensions if the resulting chart can still be made at the desired proportions.



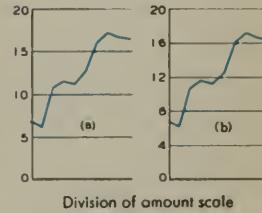
Method of showing "freak" values

3. "FREAK" VALUES. Where a series contains a few widely divergent points (unless they are really significant) it is often better not to attempt to select a scale that will include them all. Inclusion of these points will tend to depress the fluctuations of the rest of the curve.

4. DIVISION OF SCALE. It is desirable to select a scale range that is divisible into convenient scale intervals.

(a) For reading SCALE VALUES it is generally well to subdivide the scale into intervals that are familiar and easy to visualize (e.g., 5, 10, 15, 20).

(b) For reading CURVE VALUES for purposes of interpolation or reading between the main points on the scale, it may be desirable to divide the scale into even units rather than odd, as the eye can more readily divide the space into even parts than into odd.

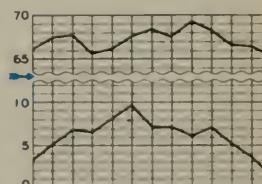


Division of amount scale

5. "BREAKING" AMOUNT SCALE. Although the amount scale should generally be continuous, it is sometimes permissible to omit an intermediate portion (1) when the curves on the grid are widely separated and it is desired to compare them more closely, or (2) to magnify the fluctuations of the different curves which may be widely separated on the amount scale.

6. INDICATING BROKEN SCALE. When there is any break in the amount scale or any intermediate portion is omitted, the fact should be clearly indicated by some accepted convention.

7. SPACING BROKEN SCALE. When the amount scale is broken, spacing in both resulting portions of the scale should remain identical.



Breaking amount scale
(See procedures 6 and 7)

GRAPHIC PRESENTATION

LOCATION OF AMOUNT-SCALE DESIGNATIONS

Principle

1. Amount-scale designations should be placed where they can be read most easily in conjunction with the curves.

Procedures

1. AT BOTH SIDES:

In general

- (a) To provide for any reading requirement.
- (b) To give balance to the chart.

Especially

- (c) When the grid is extremely wide.
- (d) When the horizontal rulings are close together.

2. AT RIGHT SIDE OF GRID ONLY.

- (a) When interest is definitely centered at the right
- (b) When a natural reading of the chart requires reading the curve before the scale.

Note The theory of placing the scale at the right is that a person will normally read the chart from left to right (that is, from the curve to the scale rather than from the scale to the curve).

3. AT LEFT SIDE OF GRID ONLY.

- (a) When interest is definitely centered at the left
- (b) When interpretation of the chart requires reading the scale before the curve.

4. NEITHER SIDE It is sometimes feasible to place amount designations adjacent to the plotted values on the curve (This treatment is most effective when grid lines are omitted, and is especially suited to charts for popular appeal.)

AMOUNT-SCALE NUMERALS

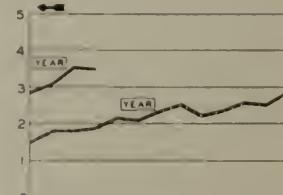
1. Amount scale numerals should be so written and placed that they will clearly and easily indicate the value of the horizontal rulings.



Scales both sides generally recommended (See procedure 1)



Interest at right

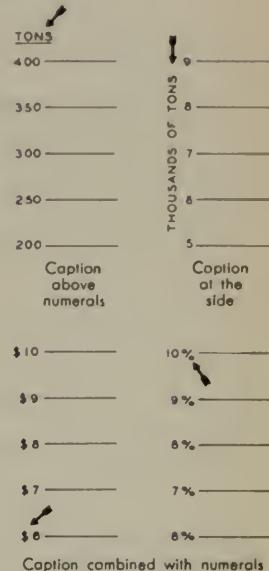


Interest at left

STANDARDS FOR TIME SERIES CHARTS

AMOUNT-SCALE CAPTIONS

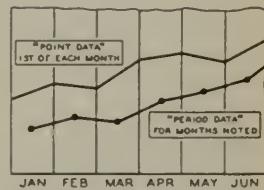
1. A scale caption should always accompany the amount-scale numerals unless the character of the scale units is otherwise indicated.
2. Amount-scale captions should be located where they will most effectively indicate the units of value.



Caption combined with numerals

RANGE AND SPACING OF TIME SCALE

1. The time scale should correspond to the characteristics of the data both in regard to the span of time covered and the frequency with which values are recorded.



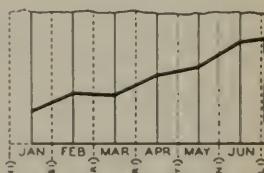
Point data on verticals. Period data midway between

RELATION OF TIME SCALE TO VERTICAL RULINGS AND PLOTTED POINTS

Note: Time scales consist of a series of successive equally spaced points of time (dates, time of day, etc.); the intervals between such points representing periods of time.

"POINT DATA" are values in a time series as of specific points of time.
"PERIOD DATA" are values in a time series for periods of time.

1. IN THEORY, vertical rulings should always indicate specific points of time on the time scale.
 - (a) Point data should be plotted on such point-of-time rulings.
 - (b) Period data should be plotted midway between point-of-time rulings.
2. IN ACTUAL PRACTICE, however, this principle may often be disregarded in showing period data.



Theory followed in showing period data on verticals

GRAPHIC PRESENTATION

LOCATION OF TIME-SCALE DESIGNATIONS

Principle

1. Time-scale designations should be placed where they can be read most easily in conjunction with the curves.

Procedures

1. USUALLY AT BOTTOM OF GRID BECAUSE:

- (a) The bottom of the chart is the conventional location.
- (b) The base line is ordinarily the principal line of reference to which the eye travels for a basis of comparison.
- (c) In many cases, the curve starts near the bottom of the grid, e.g., growth curves starting near the base line.
- (d) The scale designations at the bottom add to the appearance of the chart in balancing the weight of the composition.

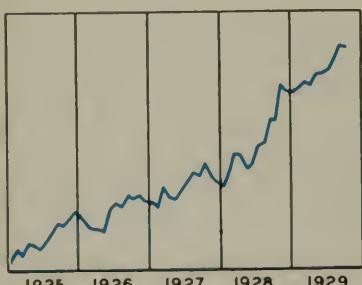
2. SOMETIMES AT TOP AND BOTTOM—

- (a) When the grid is unusually high.
- (b) When the vertical rulings are so numerous as to cause difficulty in following them to the scale at the bottom.
- (c) When a considerable portion of the curve lies near the top of the grid.

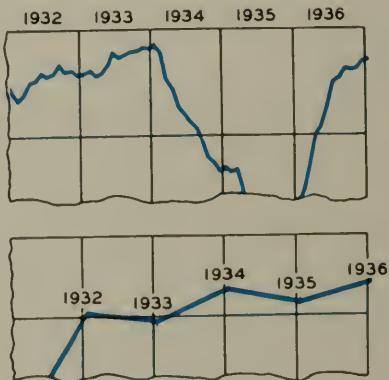
3. AT TOP ONLY, IN SPECIAL CASES—

- (a) When it is desired to emphasize the time periods in conjunction with the title.
- (b) When the space at the bottom is insufficient.
- (c) When the principal line of reference lies near the top of the grid.

4. WITHIN THE GRID. In very simple charts it is sometimes effective to place time designations within the grid directly under or over the plotted points. (This treatment is well suited to advertising or publicity charts, especially when the curve is shown without grid lines.)



Usual location of time-scale designation



Procedure for unusual cases

STANDARDS FOR TIME SERIES CHARTS

ARRANGEMENT OF TIME-SCALE DESIGNATIONS

Principle

1. Time-scale designations should be so arranged as to facilitate the reading of time values for all plotted points on the curves.

Procedures

1. DESIGNATION FOR EACH RULING. A time designation should normally accompany each vertical ruling.
2. OMISSION OF DESIGNATIONS. When vertical rulings are so numerous that designations cannot be shown in legible size for each ruling, it is well to omit some of them; e.g., every other ruling.
3. PLACING. Time designations should be centered under the vertical grid rulings or spaces to which they relate.
4. READING POSITION:
 - (a) Designations should, if possible, read horizontally.
 - (b) When there is insufficient space to place time designations in a horizontal position, it is generally desirable to place them in a vertical position reading upward.

Note. In some cases where it is important to retain horizontal reading it is possible to "stagger" captions.
5. SUBDIVIDED TIME PERIODS. When major divisions on the time scale are divided into minor divisions, it is normally desirable to indicate both, by means of primary and secondary scale designations. Major divisions should be indicated by captions placed under the minor designations to which they apply.

Note: Dropping secondary designations. As a means of retaining horizontal reading, designations for minor time divisions can often be dropped entirely where interest lies in the general trend rather than in specific points on the curve, e.g., for time series plotted weekly it is often satisfactory to show only monthly captions under the weekly rulings. (See illustration at the right.)

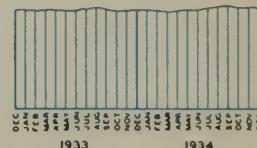
6. DESIGNATION FOR EACH PLOTTING. For series containing irregular time intervals, it is sometimes effective to designate on the time scale only those points for which there are plotted values.
7. TIME-SCALE CAPTIONS. If necessary to an understanding of time characteristics of a series, a descriptive caption should be placed below the time designation; e.g., "end of each month."



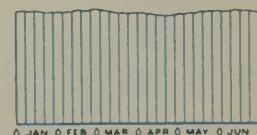
Arrangement for years



Arrangement for quarters



Arrangement for months



Arrangement for weeks
◊ indicates beginning and end of months!

GRAPHIC PRESENTATION

ABBREVIATION OF TIME-SCALE DESIGNATIONS

Principles

1. It is desirable to abbreviate time designations whenever the complete designations would be too crowded or require a size of lettering too small to be legible.
2. Only standard or recognized abbreviations should be used.

Procedures

1. IN GENERAL, time-scale designations should not be abbreviated until the possibilities of other methods have been considered (such as staggering or placing vertically).
2. DAYS. The days of the week should conform to the usual method of abbreviation except that Tuesday and Thursday should generally be written "Tue" and "Thu" in order that all may be of equal length and emphasis.
3. MONTHS. Months also should generally conform to three-letter abbreviations in order that all months may be of equal length.

Note: If it is important to retain horizontal reading but sufficient space for standard abbreviation is not available, the initial letters of the month can sometimes be used: J F M A M J J A S O N D. This form is not recommended for general use.

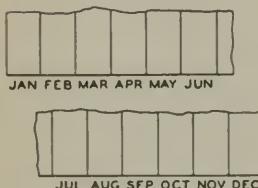
Another alternative sometimes used to retain horizontal reading is to indicate months by numerals: 1 2 3 4 5 6 7 8 9 10 11 12. This is not generally recommended because many people do not readily associate month numbers with month names.

4. QUARTERS. Designation of quarters can be 1, 2, 3, 4, or 1st, 2nd, 3rd, 4th, with the word "quarter" below, or, if space permits, first quarter, second quarter, etc.
5. YEARS. Where possible, years should be written out in full, whether horizontal or vertical, but if abbreviated, should be shown as—'28, '29, '30, etc. When abbreviations are used, it is well to have some of the years written out, as follows:

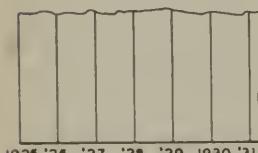
1920 '21 '22 '23 '24 1925 '26 '27 '28 '29 1930 '31



Abbreviations for days of the week



Abbreviations for months of the year



Abbreviated yearly designations

CURVE WEIGHT

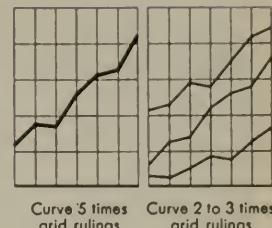
Note. Practices recommended in this section apply primarily to solid line curves.

Principles

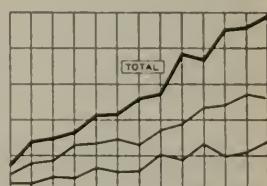
1. Curves should be sufficiently heavy to attract immediate attention and to impress a visual image on the mind of the reader.
2. In general, time-series curves should be heavier than is the practice in the case of engineering and scientific charts.

Procedures

1. RELATION TO WEIGHT OF RULINGS. Curves should be sufficiently heavy to be distinguished readily from the co-ordinate rulings.
2. RELATION TO WEIGHT OF REFERENCE LINES. Single curves should normally be heavier than the zero line or other principal line of reference. Multiple curves should normally be no lighter than reference lines.
3. RELATION TO NUMBER OF CURVES. Curves usually should be heavier when shown singly than when several are shown together (perhaps decreasing $\frac{1}{4}$ for each additional curve).
4. RELATION TO CHARACTER OF CURVES. Irregular curves should normally be lighter than relatively smooth ones (the greater the irregularity the lighter the curve).
5. RELATION TO OTHER COMPONENTS. Curves should not be so heavy as to appear crude or to overpower the other elements of the chart.
6. GENERAL PICTURE vs. CLOSE READING. The weight of curves should vary according to the use—from relatively heavy lines in charts for popular appeal to very light lines in charts used for close reading of values.
7. VARIATION OF WEIGHTS on the same chart:
 - (a) To distinguish one curve from another.
 - (b) To indicate the relative importance of curves.
8. OVERLAPPING CURVES. The more curves intersect or overlap on the same grid, the greater should be the contrast in weight (as well as pattern).



Curve 5 times grid rulings Curve 2 to 3 times grid rulings



"Total" curve 5 times grid rulings
"component" curves
2 to 3 times grid rulings

GRAPHIC PRESENTATION

LABELS

1. Labels should be brief.
2. Labels should be of sufficient size to be easily read.
3. Labels should be placed where they will clearly identify the curves to which each relates.
4. Labels should be so placed as to assist in effecting a balanced composition.

KEYS

Definition: A key in the case of a curve chart is a device for identifying curves by means of labeled "samples" of the curves placed apart from the curves themselves.

Principle

1. Keys should be so constructed and placed as to permit ready identification of the curves.

Procedures

1. **KEY WITHIN GRID.** If space permits, the key should be placed within the grid (but separated from the curves so as not to intrude upon the picture).

When the key is placed within the grid it should be placed apart from the curves in such a way as not to interfere with the proper reading of the curve values on the scale.

Scales and keys should be located in respect to each other so as not to interfere with the easy interpretation of the curves.

2. **KEY OUTSIDE GRID.** If the key is placed outside the grid, it may be either above or below, the choice depending upon which location permits easier reading in conjunction with the curves.

When placed above the grid, it is often feasible to incorporate the key in the main title. (See illustration at the left.)

3. **ARRANGEMENT.** Items in the key are normally placed one above the other in column arrangement.

When the available space is not suitable for column arrangement, items may be placed one after the other in horizontal lines.

4. **ORDER OF ITEMS.** Items in the key should follow a definite order; either the order in which the curves should be read or some natural order suggested by the data.

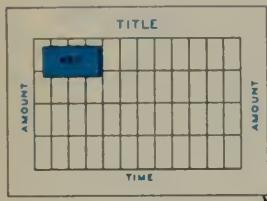
5. **CURVE SEGMENTS.** It is better to illustrate the curves referred to by showing sample segments rather than by merely describing them (e.g., is better than the description "dotted curve").

The curve segments should normally precede the designations.

It is permissible to enlarge the curve segments slightly to identify the design more easily.

The curve segments should be of sufficient length to show at least one complete unit of the design.

6. **USE OF COLOR.** Where color is used for curves it is effective to letter the curve designations in the same colors.



Key Inside grid
Edge of Paper



Arrangement of identifying captions



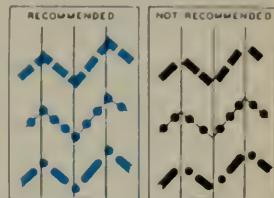
Suggested arrangement when above grid

The arrow and designation "Edge of Paper" have been added to the original in order to indicate that the outside line is not a frame. See 382.

RELATION OF CURVE TO PLOTTED POINTS

Note. Questions on this subject arise mainly in cases of very heavy curves where the difference in values of the upper and lower sides of the curves are sufficiently great to give significant differences of interpretation. Where extreme accuracy is required heavy or wide curves should not be employed.

1. Curves should be so drawn as to depict accurately the trends and relative values of the plotted points.
2. A uniform procedure should be followed in locating the curves in relation to the plotted points.



Relation of elements of curve design to plotted points

TITLES

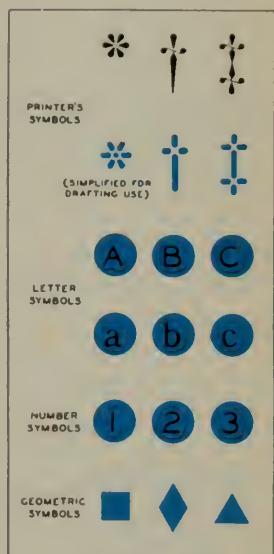
1. The main title should undertake to give the reader a quick understanding of what the chart is about.
2. Titles should be so worded as to be readily understood and so executed as to be pleasing to the eye.
3. Material serving to complete or supplement the main title should be placed in a sub-title.

NOTES

1. Explanatory notes should be included when they are necessary to a clear and accurate understanding of the chart.
2. The content of a note should anticipate questions which might arise in reading a chart.

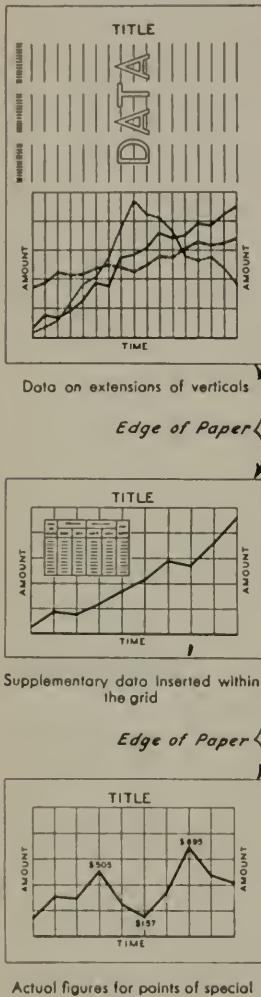
REFERENCE SYMBOLS

1. The purpose of a reference symbol is to assist in associating a particular part of the chart with a reference note.
2. Reference symbols should be so constructed that they will stand out clearly from the material to which they are related, and be distinguishable from one another.



Suggested reference symbols

GRAPHIC PRESENTATION



INCLUSION OF DATA

Note: In chart preparation it must be borne in mind that many people are not fully "graphic minded" and would prefer the facts in tabular form. Moreover, there are many occasions when supplementary figures will improve the value of a chart for everyone; and often the effectiveness of the presentation itself can be enhanced by the proper use of figures.

Principles

1. When figures are added, they should make some definite contribution such as—
 - (a) To provide the actual figures for the values shown in the chart.
 - (b) To provide data supplementing the values shown in graphic form.
 - (c) To give actual figures for points of interest in the chart.
 - (d) To emphasize amounts and differences shown on the chart.
2. The inclusion of figures on a chart should be done in conformity with the accepted principles of preferred practice in tabular presentation.

Procedure

1. INCLUSION OF SUPPORTING OR SUPPLEMENTARY DATA. A common method of including supporting data is to place the figures in the form of a table above or below the grid opposite the vertical rulings, reading upward as shown in the chart at the top of the page. This method has the advantage of closely relating figures to the plotted points.
2. TABULAR INSERTS. Supplementary or supporting data can often be shown as a tabular insert placed within the grid where adequate space is available. This procedure is particularly good where it is desired to include figures but at the same time subordinate them to the graphic picture.
3. COORDINATE TABLE AND CHART. Where the tabular presentation is of equal importance to the graphic, it is frequently a good plan to construct a separate chart and table, placing them side by side.
4. SIGNIFICANT DATA ONLY. Data added to clarify the picture should generally be restricted to the items in which the reader is most likely to be interested, such as high or low points on fluctuating curves or the values for recent dates. In cases where such values are included directly on the curves, the principles outlined under "Curve Designations," pages 52 and 53, should be observed.
5. A Grid with frequent horizontal rulings may often make the reading of amounts sufficiently precise to obviate the need for actual data.

The arrow and designation "Edge of Paper" have been added to the original in order to indicate that the outside line is not a frame. See 382.

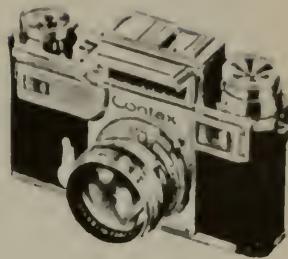


E. Leitz, Inc., New York.
A. Leica Camera.



Candid Camera Corp. of America, Chicago, Ill.

B. Perfex 44.



Carl Zeiss, Inc., New York.
C. Contax Camera.

Chapter 46

THE CAMERA AND ITS USE

REPORTS, publicity, etc., now consist largely of photographs and graphic charts. A camera is a necessity and some knowledge of photographic possibilities imperative.

For the inexperienced, a reflex such as E, below, showing a full size image in the focusing finder, is desirable. Imported miniature cameras like A and C above, of high quality, have interchangeable lenses and attachments covering the whole photographic field—if expertly handled. American miniatures are cheaper but only the Perfex 44, B above, approaches the Europeans in quality and flexibility.

For contact prints cameras of the Speed Graphic or Linhof type, D and F below, are widely used by reporters and professional photographers. Made in several sizes, they use film pack, cut film or plates, and can be fitted with lenses of different focal lengths.

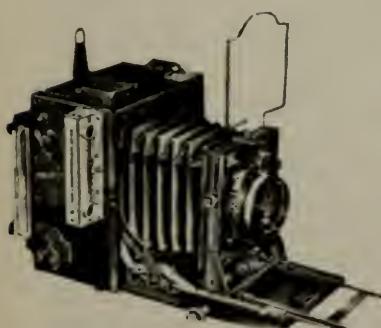
Folmer Graflex Corp.,
Rochester, N. Y.

Burleigh Brooks, Inc., New York, N. Y.

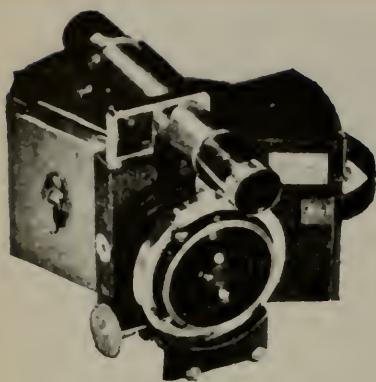
D. The Speed Graphic.

E. The Rolleiflex.

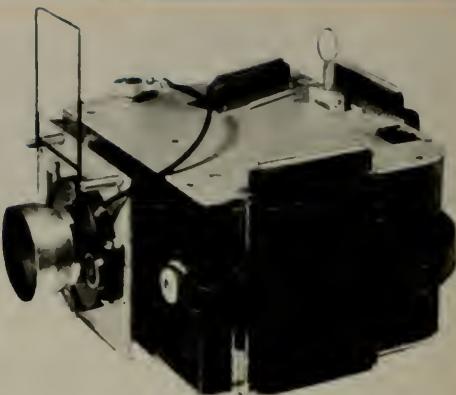
F. The Linhof.



GRAPHIC PRESENTATION



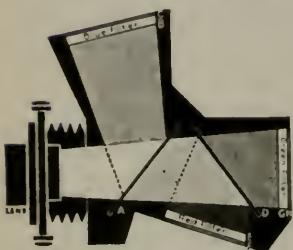
Devin Colorograph Co., New York, N. Y.



Thomas S. Curtis Lab., Huntington Park, Cal.

B. The Curtis Color Scout.

A. Devin Tricolor Camera.



**OPTICAL SYSTEM OF
DEVIN TRICOLOR CAMERA**

A portion of the light passing through the lens is reflected by the transparent pellicle mirror (1A) to blue filter (1B). All colors excepting blue are filtered out and this blue light passes on to expose a plate (1C), thus forming the "blue record."

The light remaining after passing through the first mirror is again reflected by the second mirror (1D) to the red filter (1E), thence to the plate (1F), to form the "red record."

The residual light passes to the rear of the camera, and through the green filter (1G) to form the "green record" at (1H).

Tricolor cameras come in several sizes and makes.

TWO METHODS of color photography are in general use. One requires a tricolor camera, A and B above, making simultaneously by one exposure three separate negatives on panchromatic plates, using color filters and mirrors. Process plates are prepared from these for three-color halftone or offset printing, or one of the photographic color printing processes such as Carbro or Wash-Off Relief. The other method uses color film or plates in an ordinary camera. Kodachrome and Dufay film, Lumiere and Finlay plates are examples. When developed they show the image as a color transparency which must be viewed by transmitted light, directly or by projection. For printing, three-color separation negatives are made from them by contact or enlargement. The Kodak exhibi-

THE CAMERA AND ITS USE

tion at the New York World's Fair, 1939, shows Kodachrome 35mm. film 1" x 1½" projected to 17' x 22' with perfect color rendering, clear definition, no grain, and a remarkable three dimensional effect. It is obtainable in 35mm. rolls and several sizes of cut film. Development at the Eastman plant in Rochester, New York, is included in the price.* Dufay color film, in both roll and cut film types may be used with almost any camera and developed anywhere. Lumiere and Finlay plates are used chiefly in lantern slide size or larger and are not difficult to develop.

Films and plates for black and white photography are too numerous and varied to mention. The manufacturer or an experienced photographer should be consulted as to the one best suited to your work.

* 35mm. Kodachrome film is also developed at Kodak, Ltd., Wealdstone, Middlesex, England; Akt. Fabrik, Friedrichshagener Strasse 9, Kopenick, Germany; Kodak-Pathe, S.A.F., Avenue Victor Hugo, Sevran, France.

A. How Various Lenses Are Constructed and the Approximate Speeds That Result.

1. It is easy to see why the price increases with the speed.
2. The illustration does not indicate the greater size of a fast lens, but it does suggest the added weight.

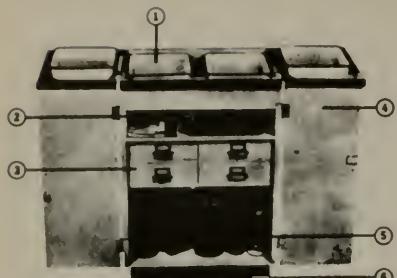
LENS	ELEMENTS OF LENS	RELATIVE SPEED
MENISCUS	1	1
DOUBLET	2	1½
F.7.7	3	4
F.6.3	4	6
F.4.5	5	11
F.3.5	6	18
F.2.8	7	28
F.2.0	8	56

Eastman Kodak Co., Rochester, N. Y.

The lens is the camera. In choosing a lens, sharp definition and good color correction are important. High speed is of value for only a few special uses. A set of lenses with different focal lengths is most advantageous.

Portable dark rooms, daylight loading developing tanks, and compact and efficient enlargers make it possible to do most photographic work in a drafting room or store room boasting hot and cold water. Opaque curtains or a wall board screen may be drawn when necessary to exclude light. Portable equipment appears in 400A.

GRAPHIC PRESENTATION



1—Working top large enough to take four (4) standard trays.
 2—Space for trimmer, blotters, squeegee plates, etc.
 3—Four (4) drawers for papers, films, negatives, etc.
 4—Folding doors fitted with lock and key.
 5—Section for storage bottles, chemicals, measuring glass, etc.
 6—Swivel castors.

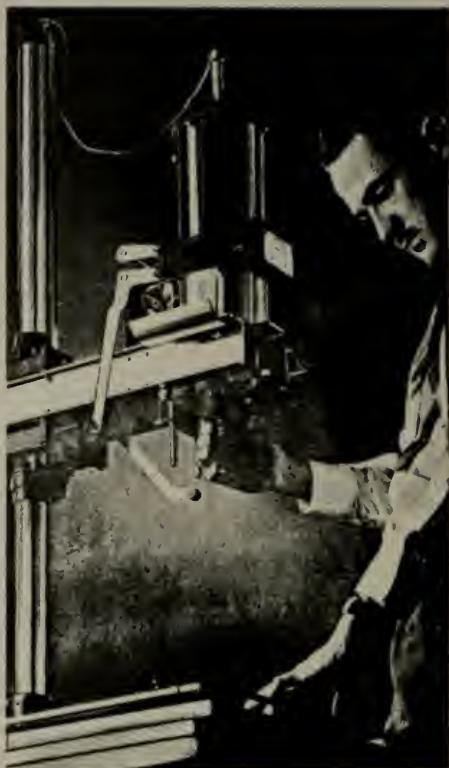
G. Gennert, New York, N. Y.

A. Portable Darkroom.

USING a variety of photographic techniques will add interest to a record or report. Photomontage, as seen in 401A, effectively presents much information in a small space by combining several negatives or parts of negatives in one print. Photomosaic is somewhat similar but combines several prints or portions of prints, drawings, etc., by cutting and pasting, using either photographic or other backgrounds.

Lines may be thickened as in 401B. Figures, lettering, models, etc., may be made to look taller or wider by photographic methods. Shading, bas-relief, etc., may be added photographically in copying quite simple designs as indicated in 380. Distortion can be practiced in photographic cartoons. Pagano, Inc., Ray Albert, and Martin J. Weber, all of New York, N. Y., specialize in this work.

A photograph of present conditions may be strikingly contrasted with a drawing of future plans or possibilities as in 402A and 402B, or a drawing made on the actual photograph of existing conditions may indicate the effect of suggested changes as shown in 404A and 404B.



Simmon Bros., Long Island City, N. Y.

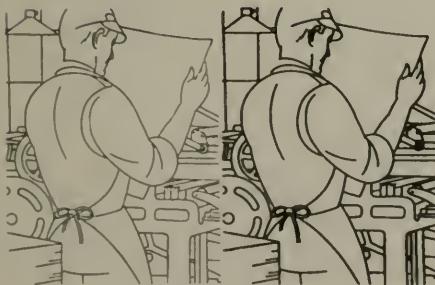
B. Omega Enlarger.



Analyzing the Facts

Walter P. Burn & Associates, New York, N. Y.

A. Photomontage—"Analyzing the Facts."



Martin J. Weber, New York, N. Y.

B. Lines Thickened by Photographic Reproduction.

This method is valuable in reproducing charts in which the lines are too fine as originally drawn.

LARGE collections of charts, maps, plans, etc., may be photographed on 35mm. film in either black and white or full color and stored in a small space. All government census records are being reduced to this form. Rare and valuable original documents, prints, maps, etc., in private or public collections may be copied and recorded in this way at small expense and with great accuracy. Ancient documents copied on infra-red film are often more legible than the original.



From a Booklet of the Civic Center Union Station Committee of Los Angeles, California, 1937.

**A. Panorama Made from Three Separate Photographs Taken from One Location,
New Union Railroad Station, Los Angeles.**



From a Booklet of the Civic Center Union Station Committee of Los Angeles, California, 1937.

**B. Architectural Perspective Drawing Accurately Representing the View That
Buildings in A Above Should Be Removed and Minimum of Landscaping**

1. The method of using three photographs as in A is one that can be applied anywhere
2. Though the Civic Center Buildings were mostly completed, an oblique aerial photo-majestic buildings so well as the perspective drawing looking upward rather than



Willard C. Brinton, Consulting Engineer.

Showing Buildings Blotting Out the Civic Center When Viewed from Site of



Willard C. Brinton, Consulting Engineer. Rendering by Austin Wittlesey, Architect, Pasadena, Cal.
Could Be Had from the New Union Railroad Station of Los Angeles if Added.

without special equipment. The street, really straight, appears to be elbowed. graph could not have illustrated the possibilities for an impressive vista toward downward.



New York City Tunnel Authority.

A. New York City from the Bay, Governors Island on the left.



New York City Tunnel Authority.

B. The Same View as Above with Superimposed Sketch Showing Proposed Bridge from New York to Brooklyn as It Would Appear, Cutting Off Most of the View of Lower New York as Seen from the Bay.

1. This is a somewhat different technique from that shown in 402A and 402B.
2. The possibility of exaggeration is always present in the use of this and similar techniques.

REFERENCES

Eastman Kodak Co., Rochester, N. Y. *How to Make Good Pictures.* Clear and concise.

Morgan and Lester, *The Leica Manual.* Wide technical and scientific field.

Scacheri, Mario and Mabel, *The Fun of Photography.* The best yet.

LANTERN SLIDES



Eastman Kodak Co., Rochester, N. Y.

A. Kodaslide Projector With Ready-Mount Changer in Place.

In this movie-minded world, photographic projection shows constant improvement in materials and methods. The rapid rise of color film for both moving pictures and lantern slides has brought projectors such as the Kodaslide in A above and the Spencer Delineascope in D below, with lenses and illumination corrected for accurate rendering of color. Several of the less expensive models give good results with audiences up to two hundred while the 750-watt Leica and Spencer machines are effective for two thousand. The Spencer is equipped to handle all sizes of slides.

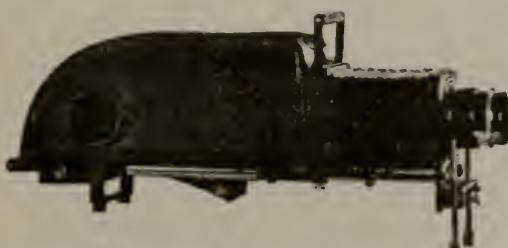


B. Kodaslide Ready-Mount for Ready-Mount Changer.

Red bordered side faces screen when in projector.



C. Kodaslide Ready-Mount in Metal Frame for Use in Other Projectors.



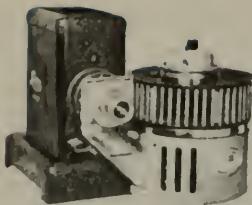
Spencer Lens Co., Buffalo, N. Y.

Lightness and convenience is pushing the 2" x 2" slide ahead of the 3 1/4" x 4"

D. Spencer Auditorium Color Slide Delineascope — 750 Watts.

Equipped to use any size slide.

GRAPHIC PRESENTATION

**A. The Selectroslide.**

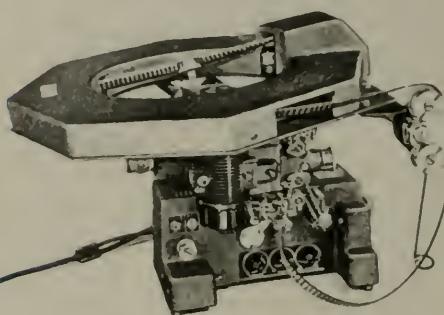
1. Holds 48 glass-mounted 2" x 2" slides.
2. May be operated by remote control.
3. Can be equipped for continuous automatic operation.

Spindler & Sauppe, Inc., San Francisco, Cal.

standard American lantern slide and the $3\frac{1}{4}'' \times 3\frac{1}{4}''$ used in Europe. Lightest of all is the cardboard Ready-Mount shown in 405B, now included in the development charge for Kodachrome film. Fifty of these in the Kodaslide Changer in 405 A are moved into position by working a small plunger. Glass-covered slides are mounted

B. 800 Foot Continuous Projection Attachment for 16 mm. Film.

1. May be attached to several sizes of Bell & Howell projectors either with or without sound.
2. With sound runs 22 min. without repeating.
3. Silent presentation lasts 33 min.



Bell & Howell, Chicago, Ill.

with tape or metal bindings. Projectors similar to the Selectroslide in A above require a glass-covered slide or one with a metal frame.

The recognized value of moving pictures and lantern slides for the effective presentation of facts and ideas has recently produced several easily operated machines for projection by remote control or continuous automatic action. Some of these are illustrated—the Selectroslide in A above, the Kodaslide in 405A, the Bell & Howell automatic machines in B and C, and the Contimovie in 407A. For advertising, exhibitions, and educational work some equipment of this type is almost a necessity.



Bell & Howell, Chicago, Ill.

C. 600 Foot Continuous Projection Attachment in Sound-Proof Case with Shadow Box and Screen in Place.

LANTERN SLIDES

SOURCES OF SCREENS

Da-Lite Screen Company, Chicago, Illinois.

Motion Picture Screen & Accessories, Inc., New York City. (See C below)

Raven Screen Corporation, New York City.

Sasco Photo Products, Los Angeles, California. (See B below)

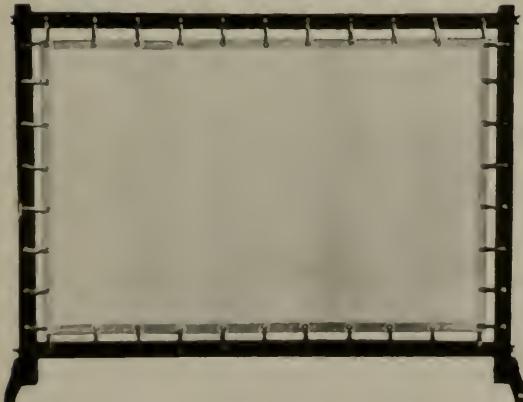
Eighteen Kodachrome films in Ready-Mounts 2" x 2" cost \$2.25, about 14 cents each if there are no failures. Glass-covered black and white slides of the same size may be made for about the same price. Some other types and larger sizes are higher. It is as easy now to use color as black and white, but the slides are not so durable. Heat and concentrated light affect color, especially the yellows, though the dyes are improving in this respect.



Contimovie Sales Co., New York

A. The Contimovie.

1. Can be used with any projector with or without sound.
2. 16 mm. 500-3000 feet.
35 mm. 500-3000 feet.
3. 2000 feet 16 mm. runs for one hour without repetition.



Sasco Photo Products, Los Angeles, Cal

B. The Sanders Screen.

28" x 42", - 28" x 50"

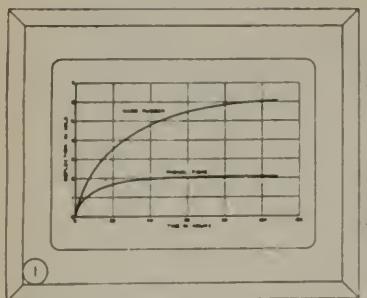


Motion Picture Screen & Accessories Co. Inc., New York N.Y.

C. Britelite - Truvision Crystal Beaded Screen.

30" x 40" and other sizes.

GRAPHIC PRESENTATION



"Engineering and Scientific Charts for Lantern Slides," Prepared by Subcommittee of Committee on Standards for Graphic Presentation, Sponsored by The American Society of Mechanical Engineers, New York City, 1932.

SIZE OF LETTERS

Designation	Sample Letters	Approx. Height, inches
H-1	A B C D E	0.175
H-2	A B C D E	0.140
H-3	A B C D E	0.120

Same Source as A Above.

B. Key to Lettering for Lantern Slides.**Valuable**

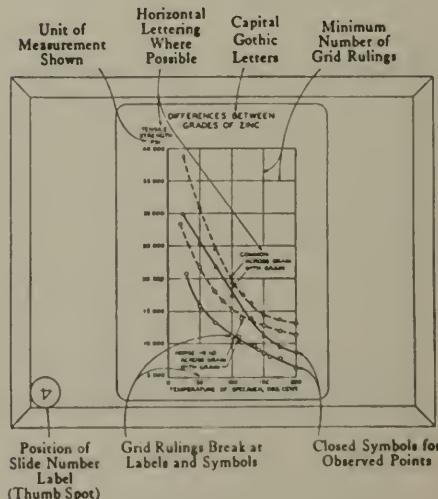
slides may be damaged if left on the screen too long. The Lynhoff Laboratories, Rochester, N. Y., makes a heat-reflecting glass, either clear or diffusing, which may be placed between the slide and the light source in the projector. As a further precaution, irreplaceable slides may be copied in full color at no great expense and with satisfactory results. Cardboard Ready-Mount Kodachrome slides are light and thin. They may be filed 19 to the inch, and are easily packed for mailing. The boxes in which they are returned, 18 to the box, fit well in a 3" x 5" card index file.

A. Chart Reduced to Lantern Slide Size.

1. The original chart was 6 3/8" x 9" including margins.
2. The cut from which this illustration was taken was standard lantern slide size 3 1/4" x 4", one-third reduction. The illustration above was reduced 1/2 from that to about the 2" x 2" slide size.
3. Directions on the right of the illustration refer to the dimensions of the original drawing.

LINE WIDTH OF LETTERS

Designation	Sample Line	Approx. Width, inches
W-1	—	0.025
W-2	—	0.017
W-2	—	0.017



Same Source as A Above.

C. Suggested Practices for Charts for Lantern Slides.

1. Reduced 1/2 from original cut.
2. Cut was reduced from drawing 6" x 8 1/4", including margins.

LANTERN SLIDES



Science Service, Inc., Washington, D. C.

Microfilm Reader.

1. For reading books or records photographed on 35 mm. film.
2. Turning the handle changes the pages either backward or forward.
3. The image is magnified 12 diameters.
4. The Reader may also be used as a projector for ordinary screen.
5. It may also be used as an enlarging printer, making enlarged paper print copies of any microfilm material.

The American Documentation Institute, Washington, D. C., in cooperation with the United States Department of Agriculture, public libraries, and other research institutions, acts as a clearing house for much of this Biblioform Service.

Publication by this film method is also coming into use for research material which does not require a large edition. The economy and convenience of this can easily be seen. The use of Micro-color film by Biblioform Service adds to the scope and value of research extract copying, since colored specimens and objects as well as illustrations may be reproduced and used either for individual reading or projected on a wall screen for class or lecture use.

REFERENCES:

- Morgan, Willard D., and Henry M. Lester, *The Leica Manual*, Morgan & Lester, New York City, 1937.

Reading by projection is of increasing importance in the larger public libraries, universities, scientific institutions, and business organizations where research is carried on. A typical machine for this purpose is illustrated at the left.

Through the cooperation of the more important libraries throughout the world, immense resources are rapidly being made available to the research worker by this cheap and convenient method. Prices vary somewhat but complete books may usually be copied for from one to three cents a page. Work in color is slightly more expensive, but sometimes invaluable. The photographing of old documents and manuscripts on infra-red film frequently brings to light erasures, changes, and sometimes forgeries hitherto unsuspected.

Chapter 48

PREPARATION OF ILLUSTRATIONS

THE preceding chapters have shown the many ways in which information may be presented in graphic chart form as well as information on how to read a graphic chart. Choice of the form in which material will be best presented, while an important step, is not always the first or last step. The following chapters will show



Bausch & Lomb Optical Co., Rochester, N. Y.

A Reducing Glass.

1. The diameter of this glass is three inches. It will reduce in the ratio of about two to one. The reducing glass is made with a double concave lens of white ophthalmic glass, protected by a wide chromium rim.
2. A criterion in reducing an illustration might be that an area measuring about 3" x 6" is about all the eye can hold at one time.

In planning page lay-outs, a reducing glass may be used to determine whether reduction to fit a given space will cause loss of detail. It is possible to see how an illustration will appear when it is reduced by adjusting the distance between the illustration and the glass until the correct ratio between the original and the reduced image is obtained.

some of the problems involved in the actual presentation of the chart.

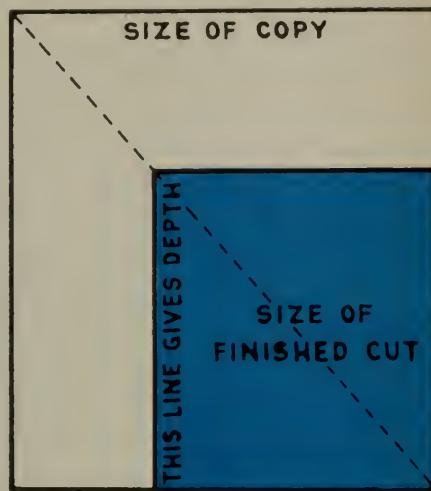
When presenting material in a pamphlet or book, it is possible and sometimes a good policy to use only graphic charts. Illustrations of other types may be included and many times should be included. The choice of illustrations will depend upon a number of factors. The material to be presented will be the most important criteria.



E. W. Pike & Company Cranford, N. J.
SCALE 8

A. Illuminated Hand Magnifiers.

Any magnifier may be used to secure an idea of the appearance of an illustration when it is enlarged. The same method suggested in 410 may be used for this also.



B. Scaling Copy.

1. Since the original drawing or photograph seldom fits the allotted space, it is necessary to "scale the copy," that is, to figure out the height and width it will be when one side is reduced or lengthened.
2. A diagonal line drawn from corner to opposite corner will be the diagonal of a larger or smaller illustration made from that copy. Use a tissue overlay paper for drawing the diagonal.
3. A slide rule is also a useful device to determine the reduction of a photograph or drawing.

A photograph which is to be printed or reproduced should never be rolled. If it is absolutely necessary, roll the photograph with the picture outside. Then if the surface should crack the cracks may close up when the photograph is flattened out.

Instructions written on a photograph or picture will often appear in the halftone. A paper clip often cracks the photograph and appears in the finished picture. Writing should never be put directly on a photograph or drawing. Instructions should be written on a separate piece of paper and folded over the margin.



Wrong Way to Make Crop Marks.

See 413 for remarks.

To determine whether a cut is already a halftone, look at it through a small magnifying glass. If the shaded portions appear as many dots, it is a halftone. Halftone screens are designated as fine or coarse, depending upon the number of lines of dots to the inch.

A rotogravure illustration when looked at through a small magnifying glass appears as many small squares, less clearly than a halftone.



Right Way to Make Crop Marks.

Put crop marks in the margin of a photograph or drawing. If you MUST mark the copy, use a China marking pencil for this purpose. The reason for this is simple:—crop marks drawn on the photograph oblige the engraver to make the plate smaller than the size indicated by them.

Reproduction Media for Art Work

ART MEDIUM	REPRODUCTION METHODS USUALLY EMPLOYED	UNSUITABLE REPRODUCTION METHODS	COMMENTS
Pencil, Charcoal, Pastel, Chalk, Square Stick, or Lithograph Print.	Highlight or regular fine- screen copper halftone re- quired to secure fine gradation of tone. If to appear on newsprint, use a coarse- screen halftone.	Line engraving not suited un- less tones are solid, showing no gradation.	If technique is bold, coarse screen can be used.
Pen-and-Ink, Wood Cut, Scratch Board, Reverse Drawing, or Black Crayon on Pebbled Board, or Proof from Coarse-Screen Halftone	Line engraving; on copper for very fine work, or long runs, on zinc where work is not extremely fine in shading, and run is relatively short.	Halftone is unsuited, as it "breaks up" the solid black lines and areas.	If later to be duplicated by electro, stereo, or mat, spec- ify when the original plate is made.
Dry Brush, Air Brush, Wash Drawing.	Highlight or regular fine- screen copper halftone if to be used on smooth paper; coarse-screen halftone if on newsprint.	Line engraving will not re- produce tone values.	If use of dry brush produces solid black stippled dots, line engraving can be used.
Water Color or Oil Painting to reproduce in Black-and- White	Highlight or regular fine- screen copper halftone if to be used on smooth paper; coarse-screen halftone if on newsprint.	Line engraving will not re- produce tone values.	In certain cases, use of color filters is required to pre- serve tonal relations of original.
Combination Line and "Flat" Tones (i.e., tones which have no gradation of value).	Line engraving used with Ben Day, or other shading me- dium for flat toned areas.	Halftone is unsuited as it would make a "pattern." Line engraving alone unsuited unless tone is on original art work by use of Bourge screens, Craft-tint, Pres-a-Tint, or other method	Stippling or ruling can be done by hand, rather than by a mechanical shading method.
Print from "Dry Point" or Acid-Bitten Etching.	Where lines and tone effects (as in mezzotint) are fine, use a fine-screen copper halftone.	Line engraving unsuited un- less technique is quite bold and simple.	Use coarse-screen halftone only if to be used on news- print or rough paper.
Photograph, Photo-Montage.	Halftone: Coarse screens for rough papers; fine screens on copper for smooth papers.	Line engraving will not re- produce tones.	If photograph shows only solid areas of black-and- white, or lines and no tones, a line engraving may be used.
Colored Drawings, Water Color and Oil Painting, Colored Photos, Crayon or Pastel Drawing (to be re- produced in color).	Two-, three-, four-, five-, etc., color process, depending upon nature of copy and fineness of work required.	Line engraving will not re- produce tones.	Color process plates may be used in conjunction with additional flat tints for spe- cial effects.
Drawings of more than one color, using solid color areas or shadings done with lines or dots.	Line engravings for each of the 2, 3, or more colors will produce a great variety of tones by overprinting of areas, either solid or shaded to different degrees.	Halftones unsuited, as they form an undesirable "pat- tern" and break up the solid areas.	Costs can often be reduced by having an artist make a separate black-and-white drawing on tissue (so as to secure register) for each color. Separate line engraving are then made from each.

The Colton Press, New York City, "Production Yearbook," Vol. V, 1939.

SCALE .7

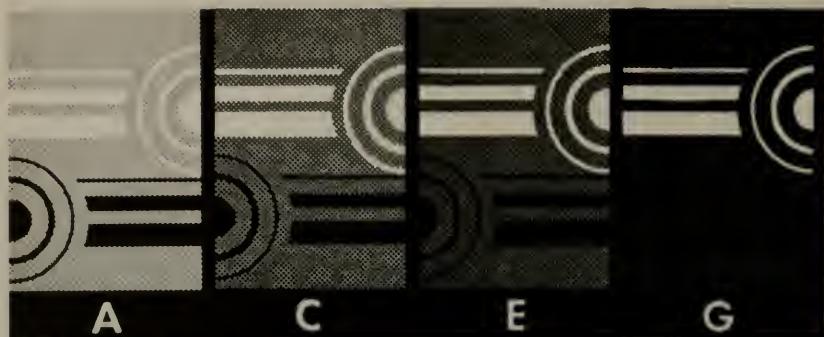
Reproduction Media for Art Work.



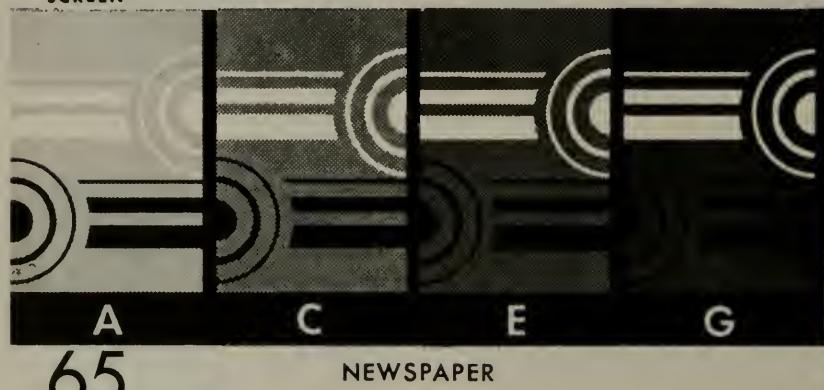
Lawrence W. Draeger, "The Art of Linoleum Cutting," 1938. Published by Government Printing Office
Apprentice School, Washington, D. C.

A Linoleum Block Cut.

1. Linoleum or wood blocks may be used for the actual printing. In fact, the first printed letters were wood-cut type carved into pictorial wood-cut blocks in explanation of the picture. Its wide use and the ease with which it is cut have made linoleum one of the best known and best liked materials in the reproduction of decorative designs, silhouettes, and the simpler illustrations.
2. In a great many printing plants, linoleum blocks, which are supplanting wood, are cut for tint blocks, second-color plates, for use in graphs and charts, for indicating zones or routes on maps, and for all kinds of work ranging from advertising blotters to letterheads. The block prints best on an antique finish paper, and inks of a heavy body should be used.



NEWSPAPER



NEWSPAPER



MACHINE FINISH PAPER

Photo-Engravers Board of Trade, New York City.

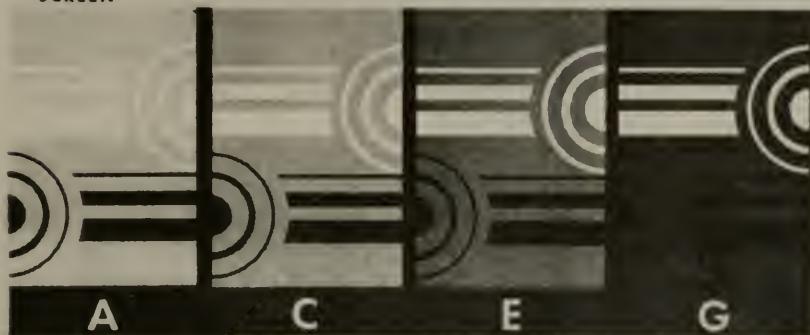
Halftone Screen Tints.

The purpose of the half circles in this illustration and the one on page 417 is to indicate how curves will appear when the various screens are used.



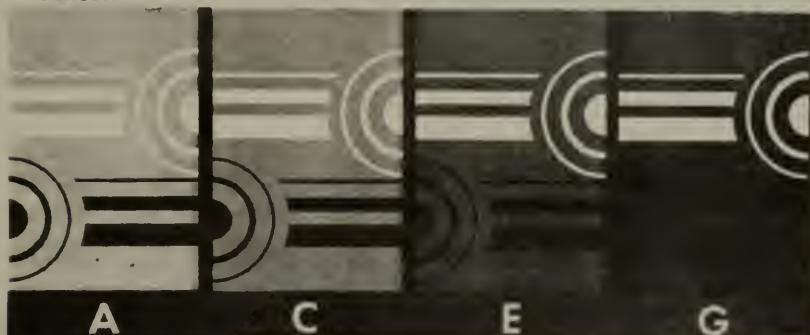
100
SCREEN

MACHINE FINISH PAPER



110
SCREEN

SUPER PAPER



120
SCREEN

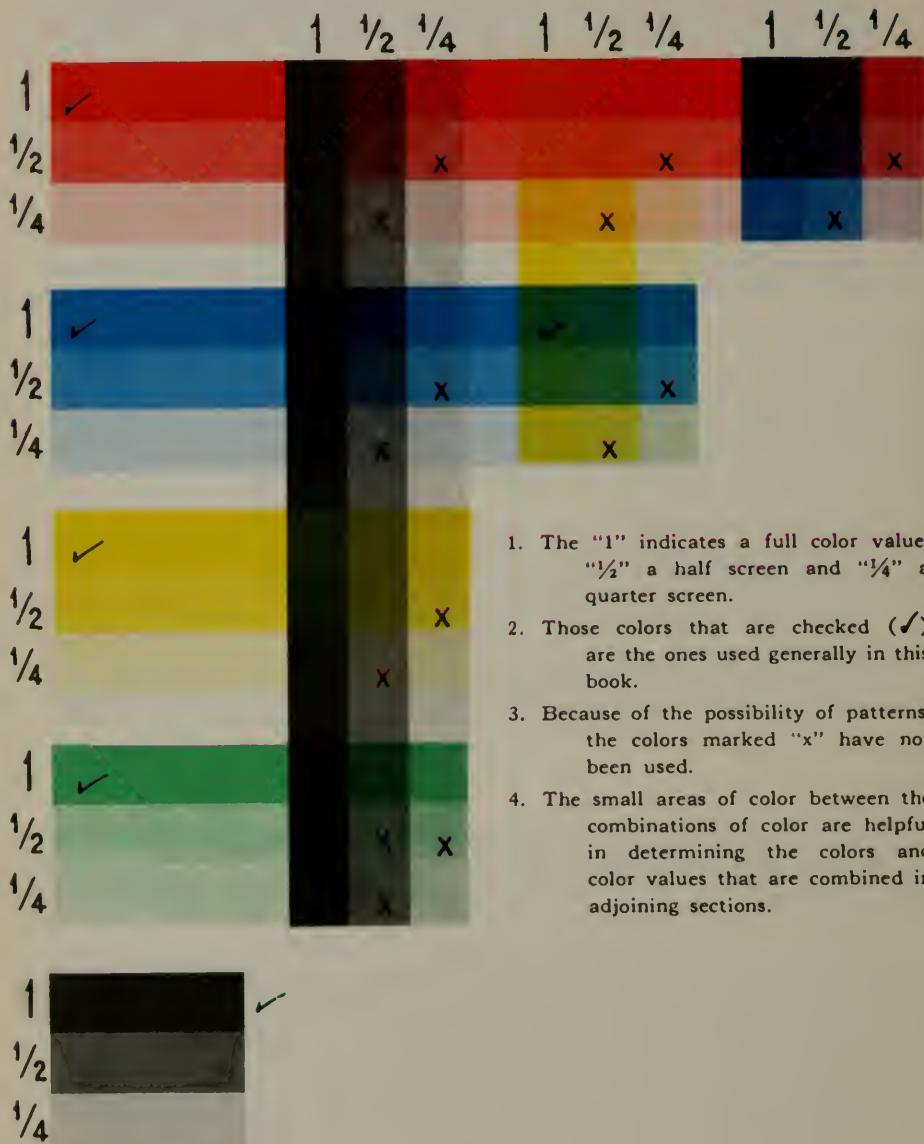
SUPER PAPER

Photo-Engravers Board of Trade, New York City.

Halftone Screen Tints.

There were eight halftone screen tints in each of these series, but only every other one is reproduced here.

GRAPHIC PRESENTATION



1. The "1" indicates a full color value, " $\frac{1}{2}$ " a half screen and " $\frac{1}{4}$ " a quarter screen.
2. Those colors that are checked (✓) are the ones used generally in this book.
3. Because of the possibility of patterns, the colors marked "x" have not been used.
4. The small areas of color between the combinations of color are helpful in determining the colors and color values that are combined in adjoining sections.

Colors and Possible Combinations of the Colors Used in This Book.

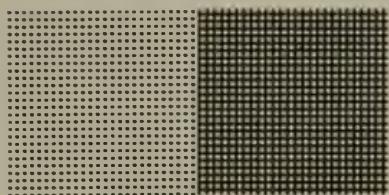
Because enough tints and shadings of color may be obtained by using half screen and quarter screen colors, the combinations of colors shown above that would require a double screen have not been used in this book.

For an example of color combinations, see 186.

When color is used in printing a pamphlet or book, "tints" of the color or colors may be used to secure shading instead of using cross hatchings. However, because the areas for color tints usually are irregular in shape and require more skill in applying them, the cost of color tinting may be greater than the cost of the halftones.

One definite problem arose regarding the use of the color "green." As shown opposite, green may be secured from a combination of full yellow and full blue. If this "combination" green were used, both blue and yellow color plates and an extra press run would have been necessary, whenever green was wanted. As a result, a green ink was used instead of the "combination" green in some chapters.

The subject "Color and Its Use" is discussed on pages 423 to 428.



DS-25



DT-60

Transograph Corporation, New York City.

Shading Film.

1. A transparent film on which cross-hatchings and halftones are printed in ink has been developed by several firms. This shading film is placed over the original drawing on those sections to be shaded and a photograph is taken of the combination. The halftones available in this film are those used for newspaper work, that is, from a 25-line to a 60-line screen. Perhaps in the future, they may also be made with a finer screen. Film is made for light or dark background.
2. A modification of the transparent film is also available in the form of illustration board, which when treated with a chemical solution brings out the shadings in the desired sections. A screen as fine as 80-line may be secured in this form. This may be secured from The Craftint Manufacturing Company, Cleveland, Ohio.
3. Other companies from which a similar film may be obtained are as follows:
Arthur Brown & Bros., New York City. (Artist Improved Shading Sheet.)
Grafa-Tone Co., New York City.
Zip-A-Tone, Chicago, Illinois.

GRAPHIC PRESENTATION



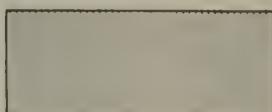
Courtesy of Charles J. Ross Company, Philadelphia.

A. Drawing Boards for Securing Halftone Effects.

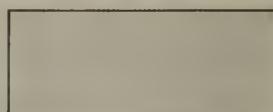
1. These drawing boards and many others may be used to secure halftone effects. Before a pencil is applied to the board, it is perfectly white with slight indentations on the surface. The pencil touches only the high spots, and the effect desired is thus secured.
2. A charcoal drawing on rough paper also secures a halftone effect.
3. Whenever any drawing material which may smudge is used, spray of liquid "fixative" will prevent any possibility of smudging.



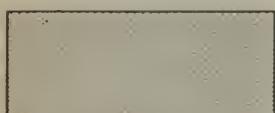
No. 523.—9 $\frac{1}{4}$ x 14 $\frac{1}{4}$.



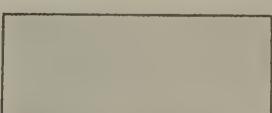
No. 509.—9 $\frac{1}{4}$ x 14 $\frac{1}{4}$.



No. 526.—9 $\frac{1}{4}$ x 14 $\frac{1}{4}$.



No. 527.—9 $\frac{1}{4}$ x 14 $\frac{1}{4}$.



No. 512.—7 x 7.



No. 518.—6 $\frac{3}{4}$ x 7 $\frac{1}{2}$

Courtesy of Ben Day, Inc., New York.

B. Ben Day Shading Films.

1. The Ben Day process is used to make crosshatchings and shadings on charts, maps, and pictures. The shading medium consists of a transparent film stretched taut upon a wood frame. This film bears a design in relief on the outer side. The work is done on the drawing, on the negative, or directly on the plate before it is etched for printing. If done on the negative, the finished plate will show the tint in reverse as to black and white. When a particular shading and the sections in which it is to appear have been decided upon, all other sections are protected by French folio paper, gum, or gamboge (a semi-transparent solution). The inked film upon which the particular pattern appears in relief is then placed face down upon the drawing, negative, or plate. The top side of the shading medium is rubbed with a stylus or rubber roller, and the pattern is thus transferred to the copy.
2. Various shadings are available, as well as textile tints.
3. See 419 and 422 for other methods of securing shadings.

PREPARATION OF ILLUSTRATIONS

Photoengraving and Electrotyping

by Otto Kleppner

SPECIFICATIONS	CHIEF ADVANTAGES	CHIEF LIMITATIONS	COMMENTS
<i>Half-tone Screens</i> 50, 55, 60, 65,	Prints on news stock on fastest presses.	A Only the very coarsest screens can be used on antique trough line etched paper. B The finer the screen ruling, the lower the cost.	I 60-65 line used for most daily newspapers. 65-100-110 line by farm papers 120 or 130-line by trade publications 135 line by general magazines.
85, 100, 110,	Prints on machine finish super smooth cover and coated stock.	C The coarser the quality of the printing paper, the coarser the screen ruling. Fine screen halftones are apt to fill up and smudge on rough surfaced papers.	II Half-tone is more expensive than line.
120, 135,	Prints well on enamelled and other smooth finished stock.		III Halftones coarser than 100 line are usually made on copper lines usually on copper but zinc plates cannot be etched as well as those made on copper.
150, 175.	Prints on finest papers only.		

Line Plates

SPECIFICATIONS	CHIEF ADVANTAGES	CHIEF LIMITATIONS	COMMENTS
BLACK AND WHITE (Also known as "Line Cut")	<ul style="list-style-type: none"> 1. Inexpensive. 2. Can be made quickly. 3. Can be printed on any grade paper provided reduction in size does not bring lines too close together. 	<ul style="list-style-type: none"> A Illustration must be in sharp black lines or masses. B Cannot reproduce photographs with drawings or paintings. 	<ul style="list-style-type: none"> I The most frequently used form of reproduction. II Broken lead effects in ret black possible. III Usually of zinc. When minute detail is to be held, plate is made on copper.
BEN DAY (In various styles as shown in pattern book)	<ul style="list-style-type: none"> 1. Provides more tone and life to a line subject. 2. Approaches a halftone in appearance. 3. Provides uniformity of line. 4. Usually less expensive to use than hand drawn shading work. 5. Screen fineness of Ben Day tint should be selected with same thought of paper and presswork as for half-tones. 	<ul style="list-style-type: none"> A Laying Ben Day charged extra. B Cost is used extensively within one plate. C Very fine patterns print poorly on coarse papers. 	<ul style="list-style-type: none"> I All that is necessary is clear drawing with indication where Ben Day is to appear. II Broken lead effects in ret black possible. III Especially popular drawings are frequently required for the quiet elaborate groups of Ben Day.
COLOR BEN DAY PLATES	Inexpensive form of color reproduction	Limitations similar to those of above plates.	<ul style="list-style-type: none"> I Original illustration is sent to engraver in black and white, with color scheme on overlaying tissue. II Attractive effects in 2, 3, and 4 colors can be obtained readily. III No limitation to the number of colors that can be used.

From "Production Yearbook," Adapted from a Chart in "Advertising Procedure," by Otto Kleppner, Copyright 1938 by Prentice-Hall, Inc.

1. Duplicates of the original plates may be made either as electrotypes—a direct process—or as stereotypes—an indirect process through the use of mats.
2. Three forms of electrotypes are copper wax molds, steel wax molds (both of which can be made from type setups, cuts, or combinations of these), and lead or steel molds. The copper wax mold is the least expensive of the three.
3. Stereotypes are plates made by pouring melted type metal into a paper mold called a "mat."

Wotman illustration board is available at almost any art supply house in the following four surfaces:

1. Hot-pressed—pen and ink drawings, water colors, and pastelles.
2. Cold-pressed—water colors and pastelles. Pen and ink may be used, but best results are obtained on hot-pressed.
3. No. 1 Rough Surface—rough illustrations.
4. Rough—drawings where detail is not essential, such as landscaping.

GRAPHIC PRESENTATION

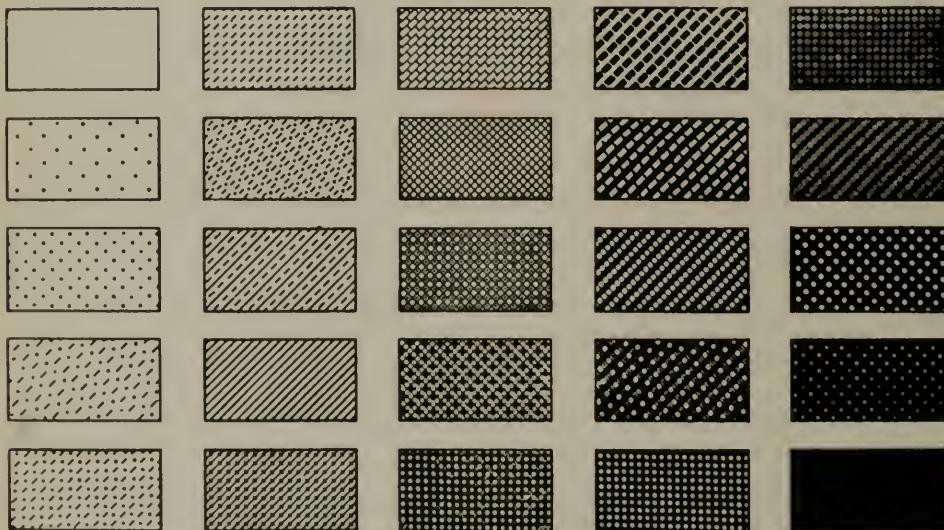
Charles T. Bainbridge and Sons, Brooklyn, New York, make a Coquille Bristol that may be used in the same way as the board illustrated in 420A. This company also makes an illustration board for general artwork and a board that is used for work requiring fine detailed drawings. Samples may be secured upon request.

Sunray scratchboard, handled by the Steiner Paper Company, New York City, may also be used in the same way as the board illustrated in 420A.

Chicago Cardboard Company, Chicago, Illinois, manufactures a colored art poster board calendered so that both lettering and printing may be done on it.

REFERENCES

Wallace, C. E., *Commercial Art*, McGraw-Hill Book Co., Inc., New York City, 2nd edition, 1939.



U. S. Department of Agriculture, Bureau of Agricultural Economics.

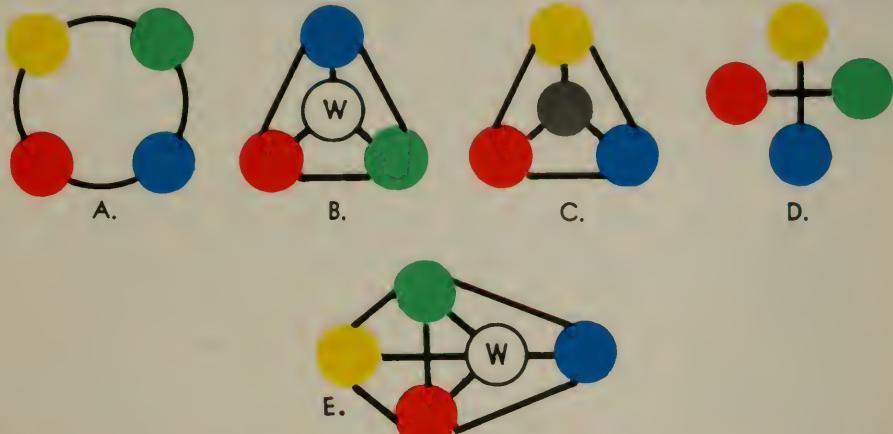
A Series of Density Distinctions.

1. These cross-hatchings were made on sheets of paper by the Bureau of Agricultural Economics. It is possible for any individual using a great many hachures and desiring a large variety, to design several and have sheets of them printed.
2. To secure the greatest variety in shadings, every fourth or fifth one beginning with black might be selected.

Chapter 49

COLOR AND ITS USE

Recent years have seen the dawn of a new era in the use of color. An outline of certain color facts and theories may prove helpful.



The above colors are approximate. The correct hues, vermillion, emerald green, pale cadmium yellow, and light ultramarine blue, may be obtained generally in high grade tempera or show card colors.

A. The Primary Colors as Used and Described by Early Artists.

Color study was based on human vision alone until Newton made the first physical analysis of light about 1672.

B. The Primary Frequencies of Vibration in the Radiant Energy Called Light.

Young, 1773-1829; Helmholtz, 1821-1894; Maxwell, 1831-1899, and Konig, 1832-1901, proved these three frequencies of light vibration can produce all light colors.

C. The Primary Colors in Pigments as Taught During the 18th and 19th Centuries.

1. Green was considered a secondary color during this period.

2. The pure emerald green of Leonardo da Vinci and other early artists, however, cannot be produced by mixing pigments.

D. The Two Pairs of Primary Color Sensations in Human Vision.

Hering, 1834-1918, based his color studies and theory on color sensations in the human brain instead of on the physical properties of light.

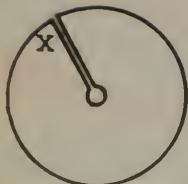
E. The Three Primary Frequencies of Light and the Four Primary Color Sensations Which They Produce in the Human Brain.

1. Through studies in color blindness, Ladd-Franklin in COLOR AND COLOR THEORIES, 1929, showed that color vision has developed from the power to see yellow and blue only, into the ability to differentiate red and green from the yellow rays.

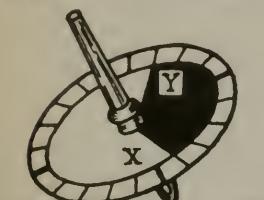
2. It was clearly shown that for normal human vision, the three primary color frequencies of light produce four primary color sensations.

3. This reconciles apparent contradictions in earlier theories and is now generally accepted.

GRAPHIC PRESENTATION



A. Maxwell Discs of Slit Paper or Cardboard.

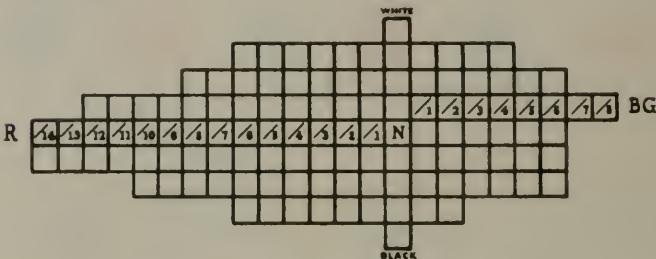


Milton Bradley Co., New York City

B. Color Top.

1. Maxwell discs of slit paper or cardboard, for studying primary and other color relations, can be obtained with small color tops, and larger color wheels, from Milton Bradley Co. and the Abbott Educational Co., New York City.
2. These discs are easily made from water-color paper painted with tempera or show card colors. They should be slit from the edge to the center, so that they can overlap as desired when superimposed.
3. When spinning rapidly, the colors of the overlapping discs merge.
4. Light reflected from the surface of revolving discs creates the sensation of colored light, not colored pigments. Light ultramarine blue and pale cadmium yellow spun together look almost pure white, not green. Vermilion and true emerald green produce a darkish yellow, not neutral gray.

As the idea of the spectrum band of colors invaded the field of practical use, it was made into a circle by adding the purple hues between blue and red, for which there is no spectral wave length. Scientists and artists divided this circle of hues to suit their needs, usually at regular intervals around the circle, with complementary colors opposite each other. Complementary colors are those producing neutral gray when mixed in correct proportions. Unmixed they tend to intensify each other.



Allcolor Company, New York City, "An Explanation and Use of Allcolor Papers," Courtesy of Munsell Color Company.

C. The Horizontal Scale of Chroma.

1. This shows the practical advantage in numbering chroma steps beginning at gray.
2. Hues differ in the number of their chroma steps.
3. As new pigments of greater intensity become available, new chroma steps can be added. Some hues have acquired four new chroma steps since this system came into use.



D. Contrasting Colors in Even Balance.

Strongly contrasting or complementary colors, repeated in equal quantities, are confusing and hard on the eyes.

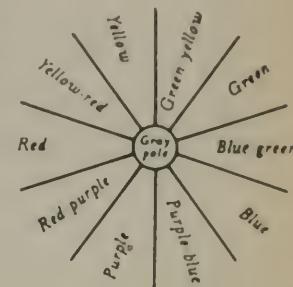
COLOR AND ITS USE

These diagrams illustrate the Munsell System of Color Notation, and are reproduced through the courtesy of the International Printing Ink Corporation from *Three Monographs on Color*, a publication of unusual interest and beauty.

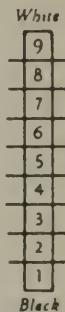
The countless hues, and their modifications, used in science, art, and industry required orderly arrangement, and some method of accurate identification. This need produced several color systems, of which A. H. Munsell's *A System of Color Notation* is the most widely used commercially.

- A. 1. Hue indicates the spectral wave length of a color and its position in the color circle.
2. In Munsell's notation, hue is indicated by its initial letter.
- B. 1. Value, or brightness, indicates a color's approach to white or black.
2. In this system, it is indicated by a number written above a diagonal line.
- C. 1. Chroma, intensity, saturation, are here shown as a number of steps away from neutral gray toward full chroma, on the hue at its greatest intensity or saturation.
- D. 1. The three qualities of color, hue, value, and chroma, are clearly shown in this diagram.
2. R 4/14 indicates a brilliant, intense red, and G 8/13 a light, gray green.

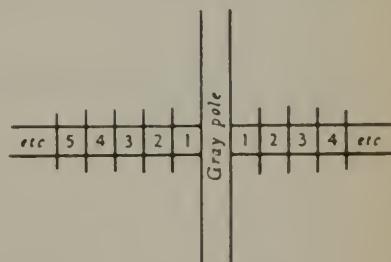
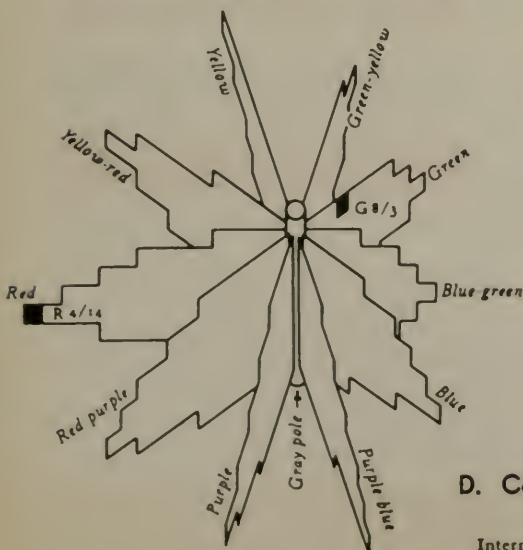
Another version of these relationships is found in 427B.



A. The Hue Circuit.



B. The Value Scale.



C. Chroma Steps.

D. Correlation of Three Dimensions of Color.

VISIBILITY

Adapted from Whiting-Plover Paper Co., Stevens Point, Wisconsin, "The Use of Color," Founded on Studies Originally Published in "Le Courier du Livre."

RELATIVE VISIBILITY OF COLORS AT A DISTANCE

A. To the Color Blind.

B. To Normal Sight.

1. Dr. Edward A. Ayers says in "Color and Color Blindness," *Century Magazine*, April 1907, that one man in twenty and one woman in about two hundred are unable to see red and green normally.
2. The use of black on yellow for motor road signs and for advertising in poorly lighted telephone booths may be traced to this investigation.



Grace Cornell, "Color," Carter's Ink Company, Boston, Mass., 1934.

A. Use of One Color with Black and White.

The use of red for emphasis on a black and white page is effective because of brightness, intensity and high contrast combined with a wave length on which the eye can focus easily at about reading distance.

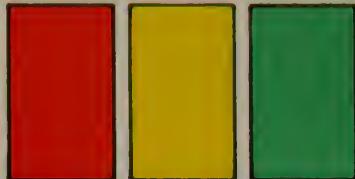
A very fine summary of Ostwald's (1853-1932) color theory and system appeared in "The Science of Color," *More Business*, * November, 1937, written by Egbert G. Jacobson, President, Association for Color Research. The interrelation of hues is beautifully shown throughout the color solid with unusual accuracy and richness.

Faber Birren follows Ostwald with modifications, using a 13-26 hue circle instead of Ostwald's 12-24, or Munsell's 5-10 circles. His chart gives the natural intervals between hues as seen by the human eye. Printing inks[†] and tempera colors[‡] in these hues are available commercially. All color charts are good if used intelligently.

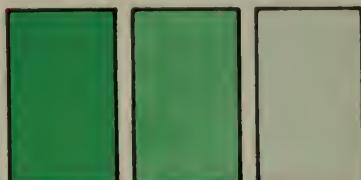
*Published by American Photo-Engravers Association, Chicago, Illinois.

[†]General Printing Ink Corporation, New York.

[‡]E. William Berg, 5510 Warwick Avenue, Chicago, Illinois.



These colors differ in hue.



These colors differ in value.



George Welp, "Color for Packaging," 1938 Courtesy of International Printing Ink Company, New York City.

B. All Colors Differ in These Three Ways.



The Allcolor Company, Inc., New York City.

A. The Allcolor Cabinets Containing Colored Papers of 362 Hues.

Each paper shows its Munsell Notation number on the back; also the number of the International Printing Ink Corporation's ink with which it was printed.

A yellow green is the brightest color in a dim light. Yellow green light is used in photographic dark rooms whenever possible. In a large garden, light blue flowers can be seen against a dark green background farther than any other color. A light yellow is next in visibility. Green and blue look brighter in a dim light than orange or red, which require full illumination.

Effective color schemes may be composed of black and white and another color, different values of one color, adjacent colors in the color circle, near complements rather than exact complements, a color and split complementaries—that is the colors on each side of its complement in the color circle, triads or three colors equally distant in the color circle.

REFERENCES

- Birren, Faber, *Monument to Color*, McFarlane, Ward, McFarlane, New York City, 1938.
- Luckiesh, Matthew, *Color and Colors*, D. Van Nostrand Co., Inc., New York City, 1938.
- Sargent, Walter, *The Enjoyment and Use of Color*, Charles Scribners Sons, New York City, 1923.
- Others also are referred to in the text.

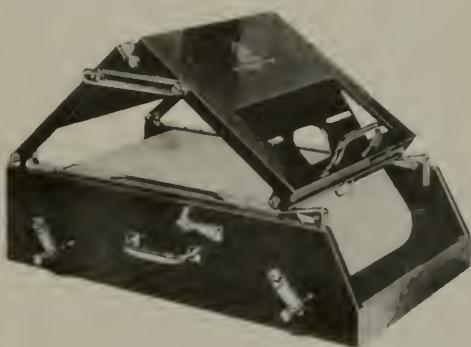
Chapter 50

METHODS OF REPRODUCING

THE materials on hand may be used in some instances, but in others the work must be done outside the office. If you have only certain equipment, your process of publication is limited by the need for other equipment.

Carbon paper is one of the simplest methods of securing a number of copies. If the original is made by hand (pencil or ink), a special type of carbon paper should be purchased. Best results will be obtained by using a pencil with hard lead, or a manifold pen.

Tracings in pencil or ink may be made by placing tracing paper over the copy. Thin paper can be used for small tracings, while for large ones a tracing cloth, which comes in a larger size than the paper, should be used.



Dausco Products Co., New York City, and Ditto, Inc., Chicago.

Gelatine Process Duplicating Machines.

1. These duplicators are equipped with continuous bands or films of gelatine duplicating material. The original or master copy may be prepared either by a typewriter or may be drawn with pen and ink or a copy pencil.
2. The process of duplicating is very simple. The master copy is placed face down on the moistened surface of the film for two minutes. Blank sheets of paper one at a time are then put on the film from which the master copy has been removed. From 50 to 100 copies may be made from one master copy. A turn of the handle brings a new gelatine surface.
3. The machine on the right is a portable that can easily be carried around if necessary. It will copy a sheet as large as $8\frac{1}{2}$ by 14 inches.

GRAPHIC PRESENTATION

**A. Arc Lamp.**

Today it is possible to secure a continuous blue printing, washing, developing, and drying machine with either electrically heated or gas dryer.

The C. F. Pease Company, Chicago, Illinois, and New York City.



Charles Bruning Co., Inc., New York City.

B. Developing Machine for Making a White Print.

1. After the print, whether black and white, blue line, or a blue print, has been exposed in a blue print machine, the print must be developed in a developing machine. The machine shown above develops a positive black and white print.
2. The Ozalid Corporation, New York City, makes a machine which exposes and dry-develops a positive print from a positive original.

The principle of the blue print, white print, and blue line print machine is that chemically treated paper is first exposed to a chemical light action, which prints the design. The print is then developed, that is, treated so that the design will appear clear and remain semi-permanently. The first method of exposure was by means of blue print frames placed in the sunlight. The next step in the development of the present machines was the use of a single arc lamp. Later a bank of arc lamps placed side by side was employed. Since the convenience of operation seemed to fit into the reproduction field, mercury vapor tubes were utilized. It was later found that such tubes did not compare with arc lamps in the efficiency of printing.

Makers of Blue-Print Machines:

The C. F. Pease Company, Chicago, Illinois, and New York City

Paragon Revolute Corporation, New York City

Shaw Blue-Print Machine Company, Newark, New Jersey

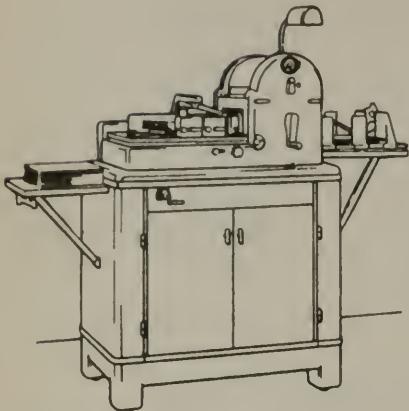


Photostat Corporation, Providence, Rhode Island.

Photostat Machine with Engineering Board.

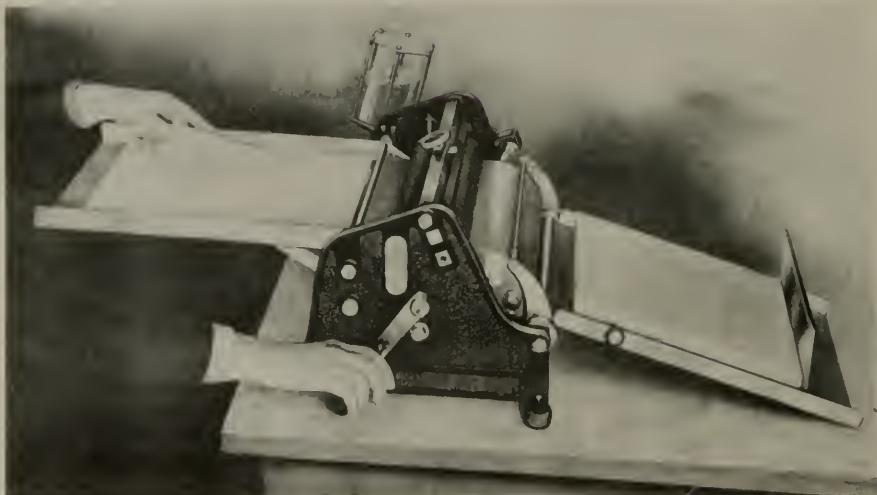
1. The Photostat is a machine designed for the rapid production of copy by means of photography.
2. The subject matter is photographed directly upon sensitized paper without the intervention of any plate or film negative. Printed or written documents, drawings, blue prints, records, maps, fabrics, small tools, machinery parts, etc., may be copied in a few minutes at the cost of a few cents.
3. In addition to copying at original size, enlargements or reductions may be made in any desired size. If enlargements required are larger than the maximum size sheet of the Photostat used, they may be made in sections and pieced together. Transfer negatives for reproduction by other processes are easily made on this apparatus. Standard models produce, on a single sheet, prints up to 18" x 24".

GRAPHIC PRESENTATION

A. Mimeograph Machine.

A. B. Dick Company, Chicago.

1. Mimeograph stencil duplicating can reproduce large numbers of copies in black ink or colors at a low cost. This process is widely used for reproducing graphic material of many kinds.
2. When enlargement or reduction of an original chart or graph is necessary to effect conformity with Mimeograph duplicating size limitations, Mimeograph photochemical stencils will be found useful. The photochemical stencil is frequently used where graphic structures are too complex to be conveniently drawn with a stylus on a stencil sheet.



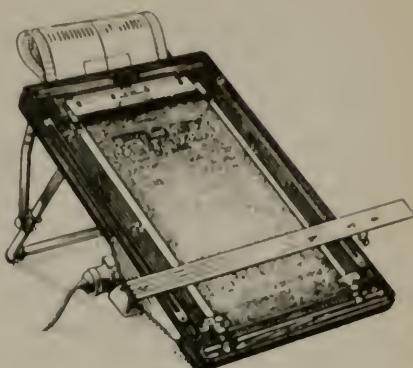
Standard Mailing Machines Co., Everett, Mass.

B. Liquid or "Fluid" Process Duplicator.

1. The original or master copy for this duplicator is made with a "spirit" hectograph carbon in such a way that a reverse or negative impression is made. This master copy is inserted in the drum. While proceeding through the machine the copy paper is moistened with a thin film of an alcoholic duplicating fluid. When this inserted copy paper is brought in contact with the negative impression of the master copy, it dissolves sufficient dye to produce a copy. This process will make from 200 to 300 clear copies from one original.
2. Type of copy may be printing, handwriting, or typewriting.
3. The master copy can be stored and reused if less than the maximum number of copies is made from the original. The life of the master copy is from ten to fifteen years.

A. MimeoScope for Illuminated Drawing Board.

1. With the aid of the MimeoScope and styli, both straight and curved lines, either broken or solid, are obtainable. Thus, ruled forms specially designed to suit current needs can be quickly and economically produced on the MimeoGraph duplicator.
2. Triangle guides, beam compasses, and circle guides, manufactured especially for the preparation of MimeoGraph stencils, are also available.



A. B. Dick Company, Chicago.



Lithoprint Company of New York, Inc.

B. Two Steps in the Lithoprint Process.

The lithoprint process is a simplified form of lithography. A plate coated with special composition replaces the lithographer's stone and the copy is obtained by a simple process of contact printing. Lithoprint reproductions duplicate the original drawings.



Addressograph-Multigraph Corp., Cleveland, Ohio.

A Multilith Plate for Use in a Multilith Machine.

1. The Multilith process is "offset" in miniature. The paper-thin Multilith plates may be placed in the typewriter. By using a special typewriter ribbon, typing can be done on the plate just as it is done on paper. Writing, lettering, or drawing may be done directly on the plate with a special type of crayon having a grease content.
2. However, the photographic method of transferring an image from the copy to the plate is usually used. The photographic film is placed in contact with a sensitized Multilith plate and the negative image is "burned into" the plate by exposure to light.

REFERENCES

Binkley, Robert C., *Manual on Methods of Reproducing Research Materials*, Edwards Brothers, Inc., Ann Arbor, Michigan, 1936.

Colton Press, New York, N. Y., *Production Yearbook*, Volumes 3, 4, and 5, 1937, 1938, 1939.

Chapter 51

METHODS OF PRINTING

THE three basic methods of printing are—relief (raised surface), planographic (surface), and intaglio (subsurface).

In relief printing, also referred to as letterpress, the design is raised in relief from the surrounding surface and only the raised surface portions print after being inked. Examples—newspapers, magazines, booklets, circulars printed from type, electrotypes, stereotypes, halftone plates, line cuts, etc. Relief printing is adaptable to all finishes of paper for type work. Where the screen is coarse enough it is adaptable on rough-surface papers, but the best results for halftone printing are obtained with a fine screen halftone on a coated paper surface.

REFERENCES ON RELIEF PRINTING

- Hoch, Fred W., *Handbook for Pressmen*, Published by Author, New York City, 1937.
- New York Employing Printers Association, Inc., New York City, *How to Buy Printing Profitably*, 1927.



Hamilton Manufacturing Co., Two Rivers, Wisconsin.

California Job Case for Type.

1. In setting type by hand, individual letters of type are picked from a job case and placed into a composing stick in which they are arranged and spaced as desired. Each line is removed as it is set and placed on a flat tray called a galley. When the page is complete, corrected, etc., it is locked up for the printing press. Simple corrections are made by removing the letter or whatever is in error and changing it.
2. The illustration above is a California Job Case, which is the universal case. About 95% of the cases used for typesetting by hand are California Job Cases.

GRAPHIC PRESENTATION

In planographic printing, which includes lithography (both direct and offset), the design is in the same plane as the surrounding or non-printing portions of the plate. The design, however, is grease-attracting, while the non-printing portions are treated so as to make them grease-repellent. On the press, the non-printing portions are dampened with water between impressions to keep them in that condition. It follows that when the greasy ink is applied by the rollers to the plate only the design takes ink and prints. In direct lithography, the design is printed directly upon the paper. In offset lithography, the design is printed upon a rubber blanket which in turn transmits the design to the paper. Practically all lithography is now of the offset type. While both coated and uncoated papers are being successfully used for lithographing purposes, the latter is chiefly used. Blanket resiliency makes it possible to secure excellent results in halftones on uncoated (rough) stock. Examples—displays, posters, books, book covers, booklets, circulars, labels, wrapping papers, calendars, inserts, etc.

REFERENCES ON LITHOGRAPHY

Rhodes, Henry J., *Art of Lithography*, Scott Greenwood & Son, London, 2nd edition, 1924.

Miles, Russell N., *The Encyclopedia of Lithography*, Published by Author, Chicago, Illinois, 1938.



Intertype Corporation, Brooklyn, New York.

Slug Cast by a Typesetting Machine of the Line Type.

1. Type may also be set by composing or typesetting machines.
2. One of three types of machine is the intertype. It composes with matrices, small brass dies, which have the forms of various characters indented in their sides. The individual matrices are assembled in the desired order for each line of the material, and a type-high metal slug with the letters in relief is cast in one piece from these matrices.
3. Another typesetting machine which operates on the same principle as the intertype is the linotype.
4. Corrections in linotype and intertype matter are made by resetting the complete line in which an error occurs.

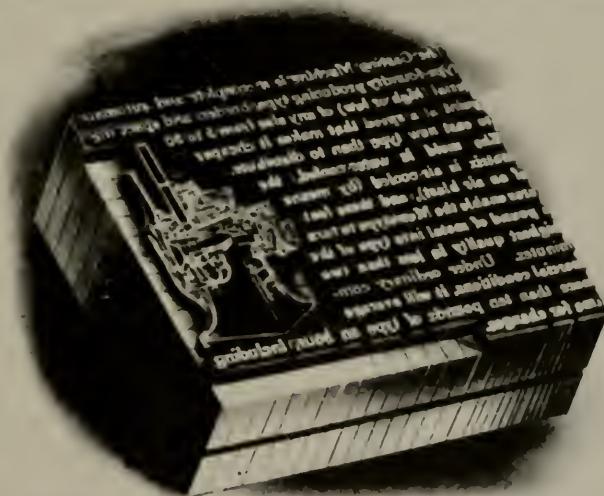
METHODS OF PRINTING

Soderstrom, Walter, *Photolithographers Manual*, Waltwin Company, New York City, 1937.

Lithographers National Association, Inc., New York, N. Y., "Books on Lithography" reprint from *Bookbinding and Book Production*.

Lithographic Technical Foundation Publications, 220 East 42nd Street, New York, N. Y.

In intaglio printing (also referred to as rotogravure, photogravure, and sheet-fed gravure) the design is etched into the surface of a copper plate or cylinder, thus producing sub-surface recesses. Ink is applied to the plate or cylinder in sufficient volume to fill the recesses following which the surface proper is wiped clean. In rotogravure, the surface is cleaned by a thin steel blade known as "doctor blade" which fits tightly against the surface of the plate as the cylinder revolves. The paper is brought into direct contact with the copper plate or cylinder by means of a rubber roller. As a result, the ink is lifted out of the recesses thereby



Lanston Monotype Machine Co., Philadelphia, Pennsylvania.

Type Set by the Monotype Machine.

1. The third kind of typesetting machine is the monotype. It casts and assembles individual letters automatically. As soon as each letter is cast, it is moved into the proper place in the line of type. When the line is completed, it is moved out on the form that holds the lines of type.
2. On monotype forms, corrections are made by removing the letter or whatever is in error, and replacing it from a case of type of the same style.
3. This illustration shows how the monotype machine may be utilized in making "run-arounds." The operator of the machine sets "quads" in the space of each line in which the illustration is to be set. The cut is mounted in position on the quads.

transmitting the printed design to the paper. Examples—rotogravure newspaper supplements, magazine inserts, booklets, circulars, etc., usually printed from copper cylinders at high speed. A wide range of papers from the finest grade down to newsprint—all from the original roll of paper as delivered by the mill—is used for this type of printing. A substantial percentage, possibly two-thirds, of the gravure printing being done today is done at newspaper speed on both sides of the sheet and folded on the press ready for delivery.

The Monotype Typesetting Machine sets type in all measures up to 60 picas in all sizes from 4 to 18 point. Straight matter, tabular and intricate work, ruled forms, rule and figure work—in fact, all kinds of typesetting—are done with unequalled facility and speed. No other machine embodies within the scope of its operation so wide a range of

4 Point Modern, No. 8 Series

Under The Monotype System New Type, Decorative Material, Leads, Rules, Slugs and metal furniture are provided in unlimited supply for the use in hand composition and at a cost so low that non-distribution becomes an economy as well as a convenience

6 Point Binny Old Style, No. 21 Series

The Monotype Typesetting Machine Sets Type In All Measures Up to 60 picas wide in all sizes from 4 to 18 point for straight matter work

8 Point Binny Old Style, No. 21 Series

Monotype Versatility Is Known By Every Printer Using Monotype machines for composing room needs and supplies

10 Point Binny Old Style, No. 21 Series

The Monotype Unit System Makes It Possible to fit copy accurately to the space to be occupied

12 Point Binny Old Style, No. 21 Series

Type-&-Rule Caster Supplies Your Needs

14 Point Binny Old Style, No. 21 Series

Cut Mounting Base

30 Point Binny Old Style, No. 21 Series

Artistic Designs

36 Point Binny Old Style, No. 21 Series

TYPE FACE

36H4 Point Kennerley, No. 268 Series

Lanston Monotype Machine Company, Philadelphia.

Range of Type Sizes.

1. These are only a few of the sizes of type available.
2. The four point type is the smallest that can be set on the Monotype machine, and eighteen point is the largest. Larger sizes may be set by hand.

REFERENCES ON ROTOGRAVURE

Cartwright, Mills H., *Photogravure*, American Photographic Publishing Company, Boston, Massachusetts.

Bennett, Colin N., *Elements of Photogravure*, American Photographic Publishing Company, Boston, Massachusetts, 1935.

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Colton Press, New York, N. Y., *Production Yearbook*, Volumes 3, 4, and 5, 1937, 1938, 1939.

Hackelman, Charles W., *Commercial Engraving and Printing*, Commercial Engraving Publishing Company, Indianapolis, Indiana, 1924.

University of Chicago Press, *A Manual of Style*, Chicago, Illinois, 10th edition—1937.

Century Oldstyle 61 18 point

6 to 24 point

PACK MY BOX WITH FIVE|

Pack my box with five doz|1234

Gothic No. 344-263 18 point

(6 to 36 point)

PACK MY BOX WITH FIVE|

Pack my box with five do|123

Geromeod Bold 474 18 point

6 to 72 point (16, 32 to 120 point)

PACK MY BOX WITH FIVE D|

Pack my box with five dozen|1234

Scotch Roman 379 18 point

(6 to 24 point)

PACK MY BOX WITH FI|

Pack my box with five doze|123

Bodoni Book 27 18 point

6 to 36 point (42 and 48 point)

PACK MY BOX WITH FIVE DOZE|

Pack my box with five dozen jug|123

American Type Founders, Elizabeth, New Jersey.

Five Different Type Styles.

For comparison of type styles, write to American Type Founders, Elizabeth, New Jersey.

GRAPHIC PRESENTATION

Abstracts from *Time Series Charts. A Manual of Design and Construction*, 1938, prepared by Committee on Standards for Graphic Presentation, under procedure of American Standards Association, with The American Society of Mechanical Engineers as sponsor body.

LETTER SIZES

Elite Type - 12 characters per inch
 Pica Type - 10 characters per inch
 SMALL GOTHIC - 9 CHARACTER
 LARGE GOTHIC - 9 CHARACTER
 .120" TEMPLATE LETTERING
 .140" TEMPLATE LETTERING
 .175" TEMPLATE LETTERING
 .240" TEMPLATE LETTERING

LINE WEIGHTS

4 POINT	
3 POINT	
2½ POINT	
2 POINT	
1½ POINT	
1 POINT	
¾ POINT	
½ POINT	

Original Size

Note: A point, in printer's measure, is approximately 1/12 of a pica, which, in turn is 1/6 of an inch. Therefore, a printer's point is approximately 1/72 inch.

LETTER SIZES

Elite Type - 12 characters per inch

Pica Type - 10 characters per inch

SMALL GOTHIC - 9 CHARACTER

LARGE GOTHIC - 9 CHARACTER

.120" TEMPLATE LETTERING

.140" TEMPLATE LETTERING

.175" TEMPLATE LETTERING

.240" TEMPLATE**LINE WEIGHTS**

4 POINT	_____
3 POINT	_____
2½ POINT	_____
2 POINT	_____
1½ POINT	_____
1 POINT	_____
¾ POINT	_____
½ POINT	_____

Reduced to two-thirds of original size



Courtesy of The Regensteiner Corporation, Chicago, Illinois.

A. Relief Printing—Halftone Cross Section.

In relief or letterpress printing, the image to be printed is *above the surface*. The raised portions of the plate represent the image to be printed; they are inked by the rollers and give off the ink by contact with paper.

The illustration to the left is a reduction of the material on the opposite page.

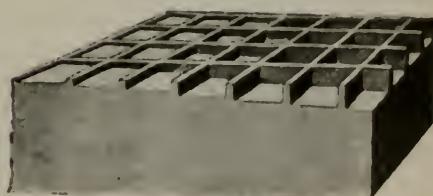
See key to lettering for lantern slides on page 408.



Courtesy of The Regensteiner Corporation, Chicago, Illinois.

B. Planographic Printing—Lithographic Plate.

In planographic printing the image is *on the surface*, it is ink attracting, while the non-printing areas are made chemically ink-repelling.



Courtesy of The Regensteiner Corporation, Chicago, Illinois.

C. Intaglio Printing—Enlarged Gravure Plate.

In intaglio or gravure printing the image is *below the surface*.

PROOF-READERS MARKS



It is imperative that corrections should be marked on the margins of a proof sheet opposite the indicated errors. Do not attempt to make a correction by writing over the print or between the lines. Errors marked in this way are in danger of being overlooked and are generally illegible.

Proofs read by authors or department readers should be marked to conform to the style as illustrated at the right.

●	Period.
,	Comma.
-	Hyphen.
:	Colon.
;	Semicolon.
‘	Apostrophe.
“	Quotations.
□	Em quadrat.
‘‘	One-em dash.
‘‘‘	Two-em parallel dash.
˘	Push down space.
○	Close up.
✓	Less space.
^	Caret—left out, insert.
⑨	Turn to proper position.
#	Insert space.
← or →	Move to left or to right.
↑ or ↓	Move up or move down.
tr.	Transpose.
— or stat.	Let it stand.
○	Delete—take out.
ꝝ	Broken letter.
¶	Paragraph.
No ¶	No paragraph.
w.f.	Wrong font.
✓ or eq. #	Equalize spacing.
≡ or caps.	Capitals.
= or s.c.	Small capitals.
l.c.	Lower-case.
ꝝ or 1	Superior or inferior.
— or italic.	Italic.
rom.	Roman.
〔〕	Brackets.
()	Parentheses.

Proof-Reader's Marks.

Use a good black pencil for proofreading and make the marks legible. So far as possible, a line of type should break on an idea. For divisions of words, use a dictionary.

Chapter 52

SELECTION OF PAPER

AFTER the method of copying or printing has been decided upon, paper suitable to the process chosen should be selected. In some cases a preference for a certain type of paper may be a determining factor in the selection of the copying or printing method. However, the usual procedure is to decide upon a method of reproduction and then to select the paper. For that reason, this chapter on Selection of Paper is placed immediately following the chapter on Methods of Printing.

REFERENCES

Wheelwright, William Bond, "Choosing the Right Paper. What an Author Should Know About Paper." (*Paper and Printing Digest*, Dec., 1939).

Production Yearbook, The Colton Press, Inc., New York, N. Y., Volume IV—1938.

The term "paper" covers a great many articles and products and no attempt will be made to cover all of them. This discussion will be confined to those types of paper which would be used most in presenting graphic charts in annual reports, pamphlets, text-books, and similar publications.



The Mead Corporation, Kingsport, Tenn.

Paper Machine With "Wet End" in the Distance, and Drying Rolls, Finishing "Stacks," and Reel in Foreground.

GRAPHIC PRESENTATION

CONSIDERATIONS IN THE SELECTION OF PAPER:

1. Reader comfort

Paper with a minimum gloss and reflectance of light is a factor for easy reading. When using the letterpress process, however, a high finish or levelness of surface is vital to the sharp reproduction of cuts. English Finish and semi-dull Coated papers give the maximum of reproduction without objectionable reflectance. For the lithographic process high finish is not necessary, but again, tends to increase the sharpness of detail. For the gravure process the same is true.

2. Opacity

Good opacity is desirable, and in the medium and heavy weights should be no problem. In the lighter weights much depends upon the type of paper selected. The introduction of special materials to increase opacity has produced special papers for this purpose.

3. Grain direction

In all Book paper made on a paper machine, the majority of the fibers run in one direction. Hence we have the terms "with" and "against" grain. Such paper is stronger when torn cross-grain and folds smoother with grain. In general, paper is ordered with the grain running the length of the sheets for all purposes. In the folder, booklet, or bound book the grain should run parallel to the fold or binding. This gives a smoother folded edge and the pages, being more flexible, lie flatter.



Perkins Pressure Bulker to Measure the Bulk of Sheets of Paper.

1. The diameter of the pressure foot is three square inches and the pressure is figured in pounds per square inch of paper.
2. There is no fixed standard for the amount of pressure. The amount is intentionally flexible to meet current requirements.
3. The pressure bulker is used chiefly to measure a specified number of sheets of paper to ascertain how thick a book with that many pages would be. The number of inches is recorded on the scale on the left.

4. Physical durability

The physical strength of paper may best be tested by tearing it with and against the grain.

5. Permanence

Book papers are generally made of rag, chemical wood pulp, mechanical wood pulp, or a combination of these. Chemical wood pulp is wood cellulose extracted by chemicals from the wood. In the process, gums, resin, and lignin are eliminated. In the better grades such fiber has much of the characteristics and permanence of rag paper. On the other hand, mechanical pulp is merely the crushing of wood into pulp with nothing eliminated. These fibers deteriorate in strength and color just as wood does under exposure. Mechanical pulp is used only in the cheapest grades of Book paper, which are classified as Groundwood papers whether they contained a large amount, as in news paper, or a small amount. All Book papers free from Groundwood are classified as free sheets, indicating that they contain only chemical wood pulp or rag, or both. In recent years, the improvement in chemical wood pulps has given us papers of fine strength.

Trimmed Page Size	Booklets on Book Paper
$3\frac{3}{4} \times 5\frac{1}{8}$ inches	Cuts without waste from 32x44 (128 pages out) when run 4, 8, 16, 32, or 64 up
$4\frac{1}{2} \times 6$ inches	Cuts without waste from 25x38 (64 pages out) when run 4, 8, 16, or 32 up
$4 \times 9\frac{1}{8}$ inches	Cuts without waste from 25x38 (48 pages out) when run 4, 6, 12, or 24 up
$5\frac{1}{4} \times 7\frac{5}{8}$ inches	Cuts without waste from 38x50 when run 4, 8, or 16 up
$5\frac{1}{2} \times 8\frac{3}{8}$ inches	Cuts without waste from 32x44 (64 pages out) when run 4, 8, 16, or 32 up
6×9 or $6 \times 9\frac{1}{8}$ inches	Cuts without waste from 35x45 (64 pages out) when run 4, 8, 16, or 32 up
$7\frac{3}{4} \times 10\frac{5}{8}$ inches	Cuts without waste from 25x38 (32 pages out) when run 4, 8, or 16 up
$8\frac{1}{2} \times 11$ inches	Cuts without waste from 32x44 (32 pages out) when run 4, 8, or 16 up
$9\frac{1}{4} \times 12\frac{1}{8}$ inches	Cuts without waste from 35x45 (32 pages out) when run 4, 8, or 16 up
	Cuts without waste from 25x38 (16 pages out) when run 4 or 8 up

Guide in Determining Size of Sheet to Use to Secure a Desired Page Size

It is desirable that the page sizes of booklets, etc., permit the printer to use standard sizes of paper which are regularly carried in stock. The booklet size should cut without waste from such standard size sheets rather than require special size sheets or waste. Much depends upon the size of the printing press and the arrangement of the printing form. Therefore, the printer can best advise on this question.

color, and permanence. As a result, the majority of Book paper today is made from chemical wood pulp. Rag fibers are still used in the highest grades for certain characteristics, although it has been demonstrated that by using the best chemical wood pulp such paper has much of the characteristics and permanency of rag paper. No matter what the material used, paper cannot be permanent in color and strength unless carefully made, and acids or other deleterious materials eliminated.

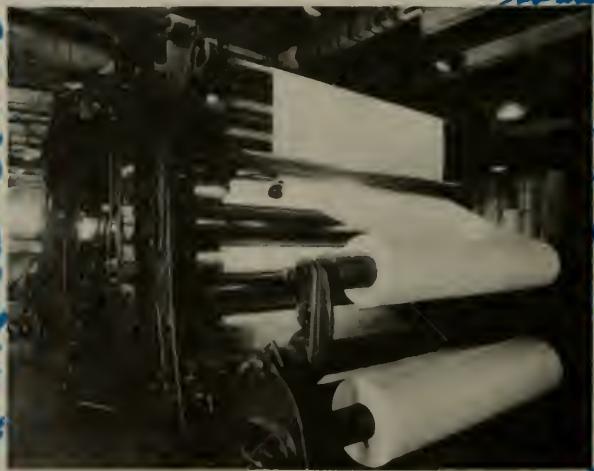
6. Type of illustration, or printing process, to be used.

It is vitally important that the paper be selected with this in mind. For the type of paper to use most effectively with various line screen halftones, see 416 and 417.

Machine Finish Book paper has a medium smooth finish suitable for ordinary printing where the cuts used are not too fine and the requirements, from a printing standpoint, not too exacting.

A better grade of similar paper is called English Finish, which, having a more level surface, gives a better printing result than Machine Finish.

Both of the above papers are finished on the paper machine, but Supercalendered paper is polished after being made, giving a higher shine to the surface for sharper reproduction of the details in the cuts when desired. However, the polishing of Uncoated paper has some effect on color, hence Supercalendered papers are not so bright in color as Machine Finish or English Finish and are also somewhat lower in bulk.



The Mead Corporation, Kingsport, Tenn.

Calender Stacks Which Give Paper a Smooth Finish, and Winding Roll.

SELECTION OF PAPER

Other types of paper finished on the paper machine are called Antique, Eggshell and Text. These papers have a rough or semi-rough finish suitable for use where only type or line cuts are used, but have good bulk and color. In general, the terms Antique and Eggshell are used for the medium and low grades, and Text is used for higher grades.

The term Offset paper implies paper made for use in the lithographic process, namely, hard sized or water resistant. Uncoated Offset paper has good color, strength, and bulk. The finish varies from fairly smooth to medium because the lithographic process does not require an absolutely level surface for the reproduction of cuts. Almost any paper can be run offset if sufficiently hard sized.

Coated paper is produced by the application to a special paper of a considerable amount of coating material, which is then polished. This coating material is generally composed of clay, casein, and other materials which will impart brightness or color to the final sheet. Either a high glossy finish or a semi-dull finish may be secured, depending upon the composition of the coating material used. Both are suitable for fine, detailed cuts, and the glossy Coated gives sharpness where semi-dull Coated gives softness. Coated paper is used for the best reproduction of halftone illustrations. Good strength and folding quality are implied when the

BOOK PAPER

Bulking Table showing the Approximate Number of Pages Per Inch of Various Types of Papers According to the Various Weights Available

WEIGHT OF ONE REAM (500 SHEETS)
25x38

	40	45	50	60	70	80
Supercalendered	960	852	768	640	548	480
Machine Finish or English Finish	844	778	700	584	500	438
Antique or Eggshell			442	372	314	274
Offset				534	466	400
	60	70	80	90	100	120
Glossy Coated	670	574	500	450	400	334
Semi-Dull Coated	640	548	480	426	384	320

1. The weights of all Book paper, including Offset paper, are figured on the basic weight of one ream (500 sheets) size 25x38 inches. Thus, the term 80 lb. Book paper is the weight of one ream, size 25x38 inches. Note the headings of the columns above.
2. Writing paper, known as Bond paper, is figured on a basis of one ream (500 sheets), size 17x22.
3. In using this table, it should be remembered that the figures refer to pages, not leaves or sheets. One leaf or sheet represents two pages.

GRAPHIC PRESENTATION

paper is called Folding Coated. Also Coated Offset paper has been developed and when so termed is suitable for the lithographic process.

Writing or Bond paper as differentiated from Book paper indicates a sheet made for hardness, crackle, and strength for letter-heads, forms, etc., rather than for printing surface and opacity. In other words, Book paper is a "filled" sheet to secure printing quality and opacity, whereas Bond paper is not "filled." These qualities are not as important as the other requirements desired in Bond Paper.

In the selection of paper, samples of various suitable papers should be obtained from the printer, who best knows the problem and can best advise on the selection. The final appearance of the finished job should be determined by the making of a dummy to demonstrate bulk, opacity, color, strength, etc. Paper sold under the manufacturer's brand implies full value, uniformity, and availability.

A more detailed explanation of the factors in selection of paper may be found in booklets published by various paper companies:

S. D. Warren Company, Boston, Mass., "A Workbook for Planning Printing" and "Estimator's Book."

Hammermill Paper Co., Erie, Pennsylvania.

Champion Paper & Fibre Co., Hamilton, Ohio.

American Writing Paper Co., Holyoke, Mass.



The Mead Corporation, Kingsport, Tenn.

Examination and Inspection of Each Skid Lot of Paper.

Chapter 53

BINDING TECHNIQUES

THE TYPE of binding to be used for a pamphlet or book depends not only on the size of the pamphlet, but also on the final appearance of the binding. If a permanent binding is not needed, a simpler binding than that for a reference book might be selected. See 451.

Whether the binding job is large or small, the following specifications should be given to the binder:

BINDING SPECIFICATIONS

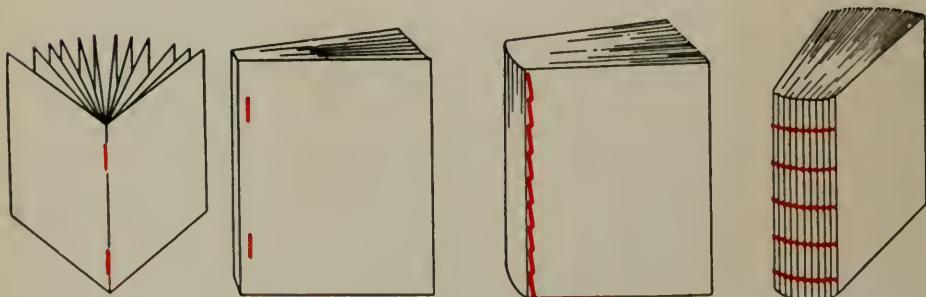
Title.....	Headbands.....
Quantity.....	Cloth.....
No. Pages.....	Leather.....
Plates:	Boards.....
Single Tips.....	Stamping.....
To Jacket.....
Tissues.....
Maps.....	Wraps.....
Whipstitch } Reinforce }	Boxes.....
Tapes.....	Deliver to.....
Linings.....	When Required.....
Trimmed Size.....	Charge to.....
Edges.....	Special Instructions.....
Round and Back.....

GRAPHIC PRESENTATION

If the book is to have an edition binding, there are a number of features that should be considered. See below.

- 1. Imposition.** See 452A. The binder should be consulted in determining whether the imposition should allow for folding in 16- or 32-page units (signatures) before the book goes to press. From a binding standpoint, it is important that the bulk of the paper be considered in determining the method of folding and that the grain of the paper run the way of the fold.
- 2. Inserts.** Pages that are printed on different paper from the body of a book, such as illustrations, maps, etc., constitute inserts. They are commonly pasted to the text pages.
- 3. Reinforcements.** The first consideration for strength in the joints of the cover is the end papers (the papers pasted to the inside of the cover and forming the first page of the book). The strength and durability of the binding depend largely upon the tearing strength of this paper. Other means of reinforcing are "turned ends," "muslin guards," and "cloth joints."

To secure "turned ends," the end papers are cut about half inch larger in width than usual to allow a quarter of an inch stub. These stubs are placed around the first and last signatures and then pasted down. In sewing, the threads pass through the stubs of the end papers as well as the first and last signatures.



A saddle wire
stitched book

A side wire stitched book
(with cover omitted)

A side Singer sewed book
(cover omitted)

A Smyth sewed book

Four Forms of Edition Binding.

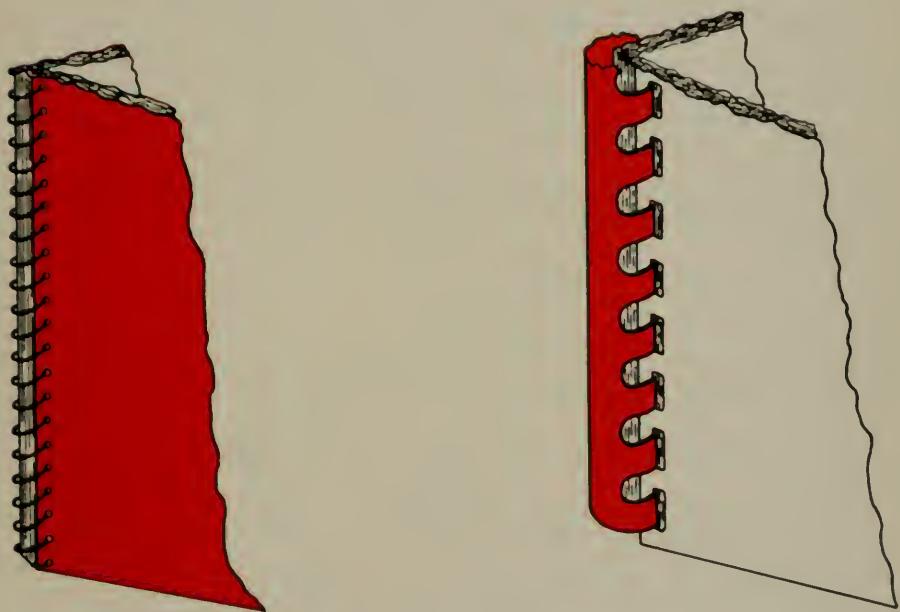
The choice of binding depends somewhat on the size of the book or pamphlet. Pamphlets and small catalogs require the saddle wire stitching. Books of 64 pages or more require the sewed types.

BINDING TECHNIQUES

"Muslin guards" are strips of muslin pasted around the first and last signatures. The threads pass through the first and last signatures as well as the muslin, preventing the threads from cutting through the paper.

"Cloth joints" are obtained by cutting the end paper in two and joining it with a strip of harmonizing book cloth.

4. **Covers.** The front and back of a cover (or cases) are made of two pieces of binders boards. A strip of manila or bogus forms the backbone. These are covered with cloth or leather. When paper is substituted for cloth, the style is commonly known as "bound in boards."
5. **Stamping.** This term covers lettering or finishing the cases.



Flat Bindings.

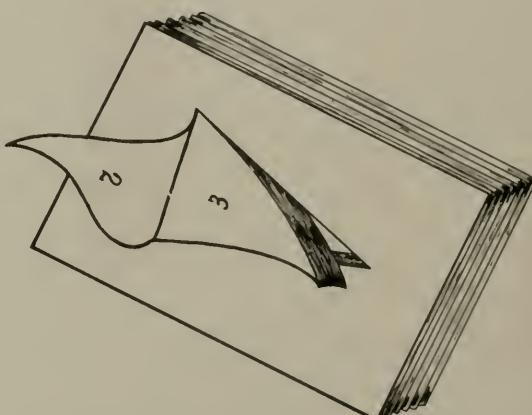
1. The advantage of using this type of binding is that every page is 100% visible and all pages lie flat.
2. Various sizes and shapes of inserts may be used, and no special imposition of page form is necessary.
3. The binding on the left is metal; the one on the right is plastic. A variety of shapes, forms, and styles are available. These two were drawn from samples obtained from Spiral Binding Company of New York City and Brewer-Cantelmo Co., Inc., of New York City.

GRAPHIC PRESENTATION

Front Side Guide

A. Printed Imposition Showing the Position of the Numbered Pages.

1. The first step in binding is to fold the sheets that come from the printer. Because folding techniques vary with the binders, before the printing plates are made or planned, an imposition showing the position of the pages on one sheet of paper should be secured from the binder.
 2. By a "work and turn." type of imposition, one plate is used to print both sides of the sheet of paper. Out of one sheet of paper two groups of the same 64 pages are obtained.



B. Folding and Numbering the Page Form for a Book or Pamphlet.

If a printed imposition is not available, a sheet of paper may be folded and numbered by the binder. By cutting a "V" through all the folded pages it is possible for the binder to number the pages without unfolding the sheet, as shown in the illustration. Unfolded you have the imposition of form. The numbering of the pages when folded is not necessarily in 1-2-3 order. The binder, therefore, should be the one to do the numbering.

PROBLEMS IN THE CREATION OF THIS BOOK

As this book may be revised, any suggestions from the reader relative to possibilities for improvement, either in make-up or content, are invited.

The aim of this book was to secure the greatest possible number of illustrations and to reduce the text to the minimum.

A majority of the charts presented in this book were reduced to fit our page plan. The scale notation should therefore be considered if a chart seems too small to be read easily. It may be advisable in some instances to use a reading glass.

Color has been introduced on many charts in which the original was black and white. If this has resulted in an accentuation of a part of the chart not intended by the producers, we hope they will understand our difficulty, since enough charts with color were not available.

In our attempt to secure a book of about 500 pages, we found that by printing 32 pages on one 25" x 38" sheet of paper—16 pages on each side—we could secure a book of 512 pages with a 6" x 9" page. There would be 16 such sheets.

By printing color on one side of each of these 16 sheets, there would be two pages of color alternating with two pages of black print. In order to have more than one color on several color forms, 24 colorplates were distributed throughout 16 forms. One form, the color form of the 14th sheet (pages 417 to 448) has all four colors. The color form of the 3rd sheet (pages 65 to 96) has three colors. All the others have either one or two colors.

The four colors used—red, yellow, blue, and green—were selected as the ones that could be used to the best advantage in "dressing up" graphic charts. This necessitated colors that were strong enough to be used alone and that could also be combined effectively with others. Printing was done by Gray Photo-Offset Corporation, New York City.

The following offset inks of The Fuchs & Lang Manufacturing Company, 100 Sixth Avenue, New York City, were used: Red NY-10876, Green # 4697-A6690, Yellow #41 Litho Ink, Blue #26 Litho Ink, Domino Black Litho Ink. The ink for the end paper was Fuchs & Lang Offset Brown #60 Litho Ink.

The paper was furnished by Mead Sales Company, New York City. It is Moisrite Offset 70#. The paper for the end papers is Weycroft Ivory 100#, manufactured by W. C. Hamilton & Sons, Miquon, Pennsylvania.

The illustration for the end papers was redrawn from a photostat of the original, measuring 19½" x 11".

The topical index (1st half on page 1, 2nd half on page 247), should be noted. The tabs on the pages of the book were planned to overlap in order to give a large thumb space and yet divide the topical index into only two parts. Bleed-outs on the outside edge of the pages were eliminated in order not to conflict with the tabs.

The flexible covers are Red #700 Fabrikoid. The stamping on the backbone and front cover is in Peerless Gold Leaf. The book was bound in 16-page signatures in order that the pages would open as flat as possible.

The color lines at the top and bottom of the pages were designed to differentiate the various chapters and to suggest possible borders for use by anyone reading this book.

The effect of shading on the borders was secured on pages 34, 35, 42, 43, 92, and 93 and several others, by using Transograph Shading Film DT-60, manufactured by Transograph Corporation, 30 West 15th Street, New York City. Transograph Shading Film DT-60 was also used in the following charts: 47, 82B, 90A, and 366.

The first letter of the first paragraph in many of the chapters is in one of the following forms:

See Page 194

DOTS, cir
base ma
When used in
applied. Syn

See Page 354

GENER
maps
Interio
photographs a

See Page 263

The term "c
divided into
ponent bars in

See Page 286

One well
graphic distri
numerical val

The following type faces and sizes were used in this book: Credit Line—6 point Bookface, Title Line—10 point Vogue Bold, Comment—8 point Bookface, Text—12 point Bookface. The type was set on Intertype machines by Allied Typographers, Inc., New York City.



Chapter 54

From Letterhead of Sharp
Advertising Agency, Seattle, Wash.

GRAPHIC CHARTS IN ADVERTISING

Since graphic charts present an idea clearly and concisely, their use in advertising should be encouraged. The utility of graphic charts in advertising is clearly demonstrated in this chapter.

REFERENCES

Carlyle, Paul, and Guy Oring, *Layouts and Letterheads*, McGraw-Hill Publishing Co., Inc., New York City, 1938.

Kleppner, Otto, *Advertising Procedure*.

Prentice-Hall, Inc., New York, 1938.

O Yeah!



The Electric Storage Battery Company, Philadelphia, Pa. SCALE .4

A. The Use of 100% Bar Charts in Advertising.



Success

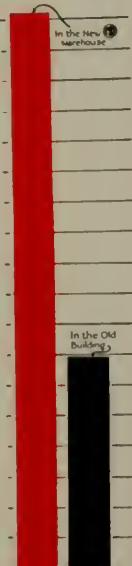
THE proportions of the two columns represent the comparative profits of our average client before and after occupying the warehouse we designed for him.

The same success may attend your business when housed in a building of our design.

This success does not depend upon "times," "general prosperity," or other "circumstance beyond control". It is deliberately planned for, and so deliberately attained. Every feature that long study and experience has proven profitable to the client is put into the building. Every available space is used to the greatest advantage. Original ideas developed from the client's requirements, that make his warehouse more profitable than the old.

BE CONVINCED that you can do no better, when you think of building anew, or expanding, than consult

Moores & Dunford
Warehouse Engineers
744 First National Bank
Chicago, Ill.



Moores & Dunford, Chicago, Ill. SCALE .3

B. A Proportion Comparison.

Since the figures in each individual case would differ, these bars have no scale, but their heights indicate the comparison. The ratio is about 19 to 7.

THE STORY OF THREE LITTLE MINKS



This Little Mink Went to Jaeckel



This Little Mink Stayed at Home



This Little Mink Got too Much Heat



and now there is only ONE



JAECKEL Fur Storage costs no
more than ordinary storage and
protects you against every risk

Telephone BRyant 9-8720
and we will call for your furs immediately

Jaeckel Fur Storage, New York

SCALE .6

Graphic Narrative.

This simple graphic narrative which was printed in a small folder tells its story convincingly,
chiefly because of the use of the illustrations.



Stevens Hotel, Chicago, Ill.

A Guide Map.

Note that just enough points of interest are given on this map to locate the hotel.

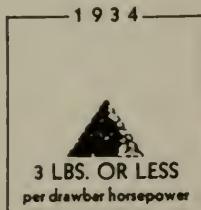
WHY

Any 10-Year Old Locomotive is inadequate

WHAT HAS HAPPENED TO
HORSEPOWER



WHAT HAS HAPPENED TO
FUEL CONSUMPTION



So rapid has been the advance of locomotive design that not a single locomotive in this country over ten years old can begin to hold its own with the really up-to-date power plant on wheels known as the Super-Power locomotive.

LIMA LOCOMOTIVE WORKS
INCORPORATED



Lima Locomotive Works Inc., Lima, Ohio.

SCALE .6

Volume Representations.

GRAPHIC PRESENTATION



CHART A



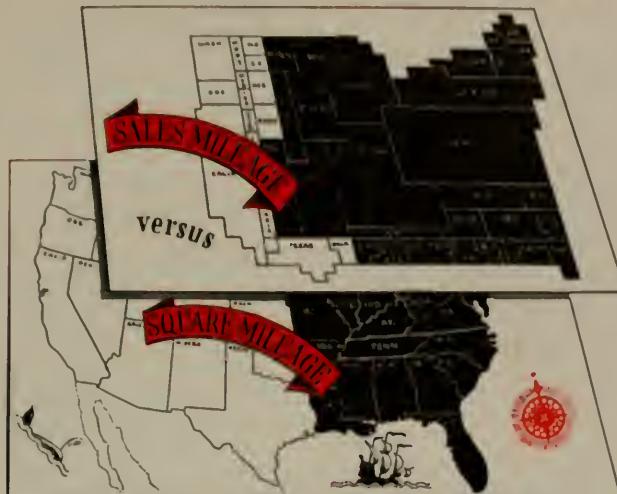
CHART B

PERSPECTIVE

CHART A appeared in a recent advertisement advocating advertising in Washington, D. C. Chart B is our own chart based on exactly the same figures. Both are correct as far as arithmetic is concerned. The only difference, but *what* a difference, is the vertical scale. If Chart A went down to zero at the bottom, as does Chart B, it would be sixty inches high, but the exaggerated scale makes good advertising copy. By the same process, even a payroll increase of .00001 per cent could be made to look like the side of the Washington monument.

The problem is not limited to statistical charts. The scale or standard against which one measures events makes a tremendous difference. The optimist compares present standards of living with those a century ago, and glories in the gains. The next man sets the present against 1929, or even 1936, and is subject to moderate melancholia. The pessimist takes our potentials as his standard, and weeps over our great failures to realize them. Each one starts with the same facts but sets them in a different perspective. It is the old struggle against exaggeration or depreciation. Perhaps the best one can do is to try to keep always in mind which end of the telescope he is looking into.

Willard L. Thorp
E D I T O R



LOOK TO YOUR SALES MILEAGE

The topmost map represents America as it looks when states are drawn in proportion to business transacted. Mutual's effective coverage area (shown in black) swells double in terms of sales—quick yardstick of productive broadcasting.

In the concentrated area east of the Mississippi valley, 40% of the country's square mileage yields 80% of the nation's business (and encircles 78% of the nation's radio listeners). Here, deep in Mutual territory, is by far the richest sales mileage in America.

The Mutual Broadcasting System is the only major network deliberately organized for low-cost coverage of this highly profitable area. Mutual is the only network whose basic stations are all of super-power and whose station locations assure freedom from costly over-lapping coverage.

The resulting economies, for coverage of the richest sales mileage in America, explain why advertisers use Mutual, both alone and in conjunction with other network activities—why

47 sales-scientists in the past nine months have invested \$1,180,722 in Mutual facilities.

And Mutual expands at a touch. You may enlist as many, or as few, extra stations as you may require for sales emphasis or market extension.

We shall be glad to tell you of results achieved by clients who have looked to Mutual for *sales mileage* . . . Costs? Mutual's comprehensive planning makes available these low basic rates unparalleled in major network history.

One half hour night for 52 weeks \$90,000

Five quarter hours day for 26 weeks \$75,000

Three quarter hours night for 13 weeks . . . \$50,000

One half hour night for 13 weeks \$25,000

THE MUTUAL BROADCASTING SYSTEM

America's Newest Major Network

OFFICES: CHICAGO, TRIBUNE TOWER—WGN • NEW YORK, 1440 BROADWAY—WOR • CINCINNATI, RADIO STATION WLW
DETROIT—WINDSOR, RADIO STATION CELW • BOSTON, YANKEE NETWORK • PITTSBURGH, RADIO STATION WCAZ

The Mutual Broadcasting System.

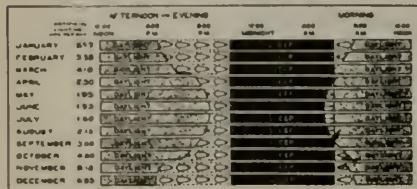
SCALE .6

A Comparison of a Distorted Map and an Actual Map.

GRAPHIC PRESENTATION

Why Your Electric Light Bills Vary

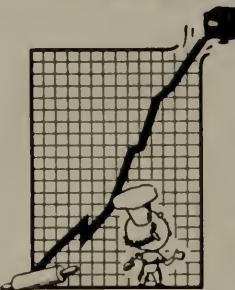
The Reason Why Residential Lighting Bills
are Higher in December than in June



People Use Electric Light Nearly Four and One Half Times as Long in December as They Do in June

This chart divides the 24 hours of a day into three periods—the period of sleep, the period of using Electric Light and the period of daylight.

Public Service Company of Northern Illinois.
SCALE .5

A. A Component Part Chart.**UPHILL—
WITH DOWN-HILL SPEED!**

In almost every case the number of small retail grocery bakeries has increased over 300%. Naturally the location on the graph has gone up hill with a road to take the load. The bakers have graduated from the rolling pin to dough rollers and moulding machines.

Of all industries using electric motors in their baking operations the top Census figures show there are over 100,000 motors in use in bakeries and these are increasing approximately 10% annually. Motors of 1/4 h.p. and up to 50 h.p. are the daily work.

Replacement necessarily creates a ready market for motors. Because they are in use day after day without essential maintenance, the average service life of this replacement business Advertising will induce bakers to specify your power units on new machinery.

BAKERS' HELPER will tell your story among volume producing wholesale, retail and home-bakers. The Color Pictures that tell the story go 82½% of the industry's audience—so use **BAKERS' HELPER** with circulation paralleling this buying power.

Send for your copy of "The Baker's Helper" and advertising rates.

BAKERS' HELPER **50**
THE FIRST

320 South Wells Street
CHICAGO
BAKERY PAPER

Bakers' Helper, Chicago, Ill. SCALE .5

B. A Growth Curve.**BUSH TERMINAL isn't a building It's a CITY**

— An industrial city where manufacturers and distributors can cut costs in half and where efficiencies multiply sales opportunities

NO Bush Terminal is not a building any more than New York is a street. Imagine ten million square feet of floor space devoted completely to the manufacture, warehousing and distribution of merchandise. If you find it difficult to picture that much floor space, think of it as a twenty-foot strip of floor that would reach a hundred miles.

Bush Terminal is not a building...but a city of buildings. Not ordinary lots—but new types of industrial buildings. They may well be called industri-

al apartment houses, for they provide economies and conveniences for manufacturing or distributing merchandise that are as carefully planned and executed as the economies and conveniences of your dwelling apartment house.

To tell all the story of Bush Terminal would be to tell hundreds of stories about hundreds of prominent manufacturers and distributors who have used Bush Terminal to meet hundreds of real problems. In each of these instances the results were economy,

efficiency or enlarged sales.

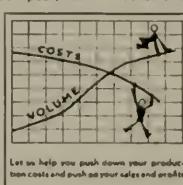
You are interested only in your business—your economies—your efficiencies and your enlarged sales. Bush

Terminal maintains a staff of industrial engineers who are constantly fitting Bush Terminal facilities to individual and specific needs. Why not talk about your business to one of these trained men, and let us help you determine the extent to which you can effect economy,

and efficiency at Bush Terminal? There is no cost, no obligation. At your request but on our own responsibility we will conduct a free Industrial

Survey of your business. If our suggestions are of value, adopt them, if you wish. If not, discard them.

WRITE FOR DESCRIPTIVE LITERATURE on Manufacture, Warehousing or Distribution or set a time at which a Bush Industrial expert may interview you.

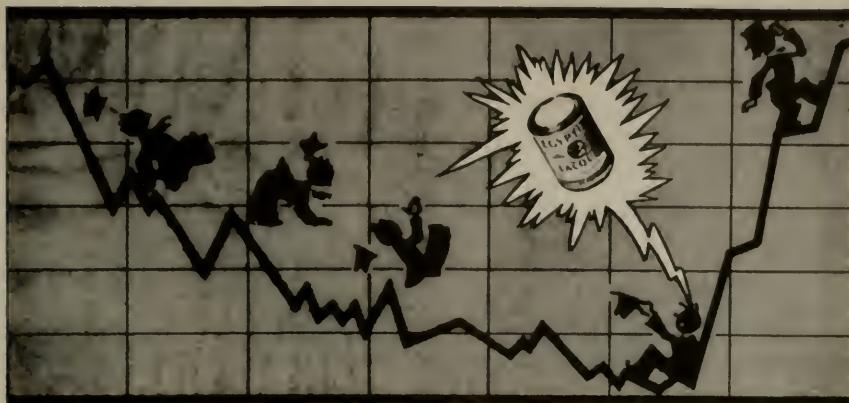
**BUSH TERMINAL COMPANY**

Metropolitan facilities for DISTRIBUTION, WAREHOUSING AND MANUFACTURING
Executive Offices: 100 Broad Street,
New York
Piers, Sidings, Warehouses, Truck Depot and Manufacturing Lofts on New York Bay

Bush Terminal Company, New York City.

C. An Inverse Relationship Curve.

Sometimes we're glad there's been a DEPRESSION



HONEST, we are! Here's why. Falling sales shake people up. They're willing to do things differently. They'll listen to new, sales-building ideas.

It's actually a great time to forge ahead. Some of our customers have been doing just that. Here's how:

By careful research they discover the need for new selling points in their product. They redesign. We are asked for new and more attractive finishes. A better product emerges. And it SELLS — sells today!

Of course business right now is not all it might be. But you should see the small orders pouring in here! They're samples, really . . . Experiments . . . Progress! There are good times and better sales ahead for those people who are thinking out and working out better ways of finishing their products.

Are you going to get your share in the next period of prosperity? Will you be glad for the depression? Maybe we can help you to be. Call in the nearest Egyptian man and get his advice. No obligation, of course. It may turn the tide for you.

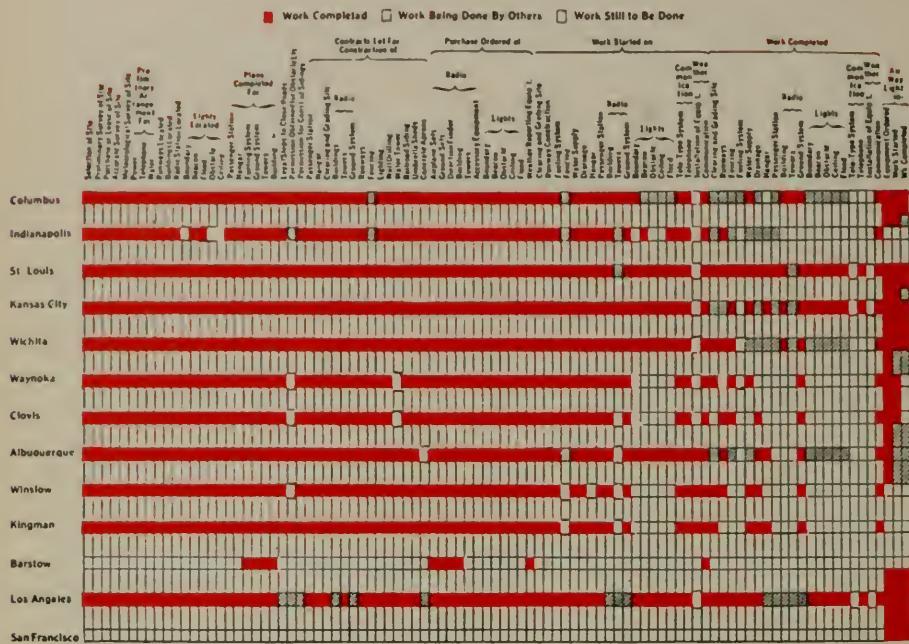
"Egyptian Lacquer" is listed in the phone books of the following cities:

ATLANTA	KANSAS CITY
BOSTON	LOS ANGELES
BUFFALO	PHILADELPHIA
CHICAGO	PORLAND, ORE.
CINCINNATI	SAN FRANCISCO
CLEVELAND	SEATTLE
DALLAS	SPOKANE
DETROIT	ST. LOUIS

In New York, call the Advertising Dept. at the home office.

THE EGYPTIAN LACQUER MFG. CO.
90 West Street - New York City

GRAPHIC PRESENTATION



Airports—A Market

EVERYTHING that goes up has to come down. So airports are quite essential to the aviation industry. But if you think of an airport as a nice muddy field offering a soft landing spot for airplanes, or even if you know what an airport really looks like, you ought to be interested in the accompanying chart. It shows the progress made on a baker's dozen of flying fields undertaken by municipalities or private airport operators.

A glance at this chart should convince almost any manufacturer that the airport is a field—not a muddy field, but a field

for his products—perhaps a field which he has completely overlooked in his search for new markets.

Reproduced from "Plane Talk", which is published by Transcontinental Air Transport, Incorporated, the chart shows the various steps all the way from selection of site to completed airport. And it gives more than an inkling of the airport's demands from the manufacturer. Incidentally, when all the units can be shown in black TAT will begin operations.

Are you, as a maker of equipment adapted to airports, missing any bets?

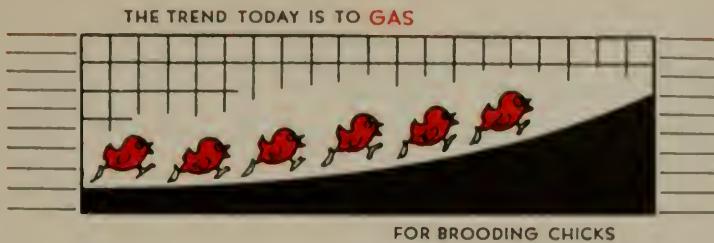
Transcontinental and Western Air, Inc., N. Y. C.

A Progress Chart.

Seldom does one find a chart as complicated as this in an advertisement. This one was found in a technical journal.

SCALE .7

GRAPHIC CHARTS IN ADVERTISING



American Gas Assn., New York City.

Two Methods of Presenting the Same Trend Curve for Different Types of Advertising.

The curve at the top was used as part of an advertisement for promoting the use of gas for brooding chicks. The one at the bottom was used in a beauty shop "ad."

BLACKBOARDS

Blackboards may be used to display graphic charts. White blackboards on which black chalk is used are now available. Swinging panels and easel blackboards also aid in exhibiting information.

Sources:

New York Silicate Book Slate Company, New York City.

Weber Costello Company, Chicago, Illinois.

White Blackboard Company, Elgin, Illinois.

Bulletin boards are especially useful since material may be tacked up temporarily. Two manufacturers of bulletin board material are:

Armstrong Cork Company, Inc., Lancaster, Pennsylvania.

The Celotex Corporation, Chicago, Illinois.



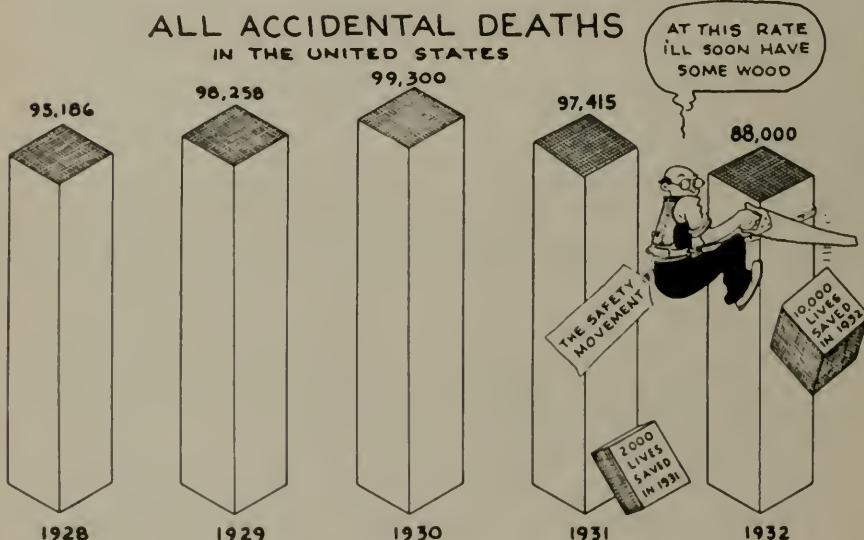
Chapter 55

QUANTITATIVE CARTOONS

Graphic charts may be used effectively in cartoons.

REFERENCES

- Briggs, *How to Draw Cartoons*, Harper edition, 1926. Garden City edition, 1937.
- Byrnes, Gene, *How to Draw Comics and Commercial Art*, Bridgeman, Pelham, New York, 1939.
- Thorndike, Chuck, *The Secrets of Cartooning*, House of Little Books, New York, 1936.
- Thorndike, Chuck, *The Art of Cartooning*, House of Little Books, New York, 1937.



American Mutual Liability Insurance Co., Boston.

The Safety Movement Sawing Off Accidental Deaths in the United States.

QUANTITATIVE CARTOONS

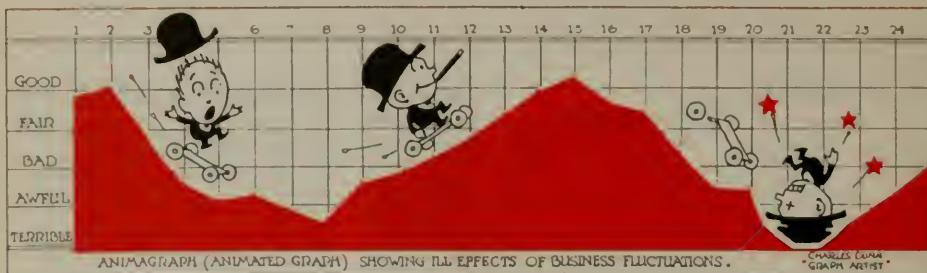


"During this period we couldn't even afford ink"

Copyright, April 1938, by Esquire-Coronet, Inc.

A New Low.

SCALE .7



Nation's Business, Cartoonist—Charles Dunn.

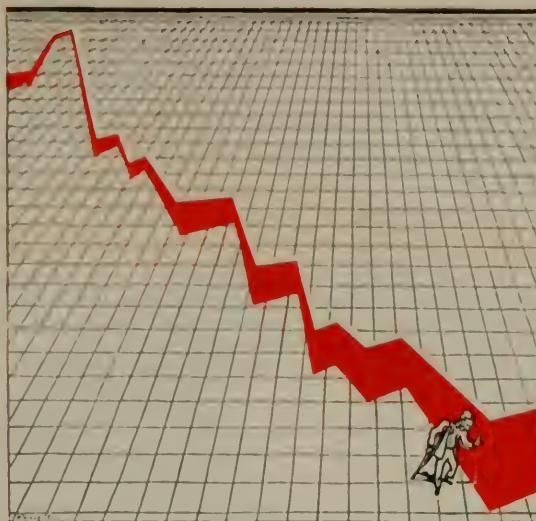
SCALE .6

A. The Effects of Business Fluctuations.



Redrawn From New Yorker, February 20, 1933. Original by Richard Decker.

B. The Universality of the Graphic Chart Language.

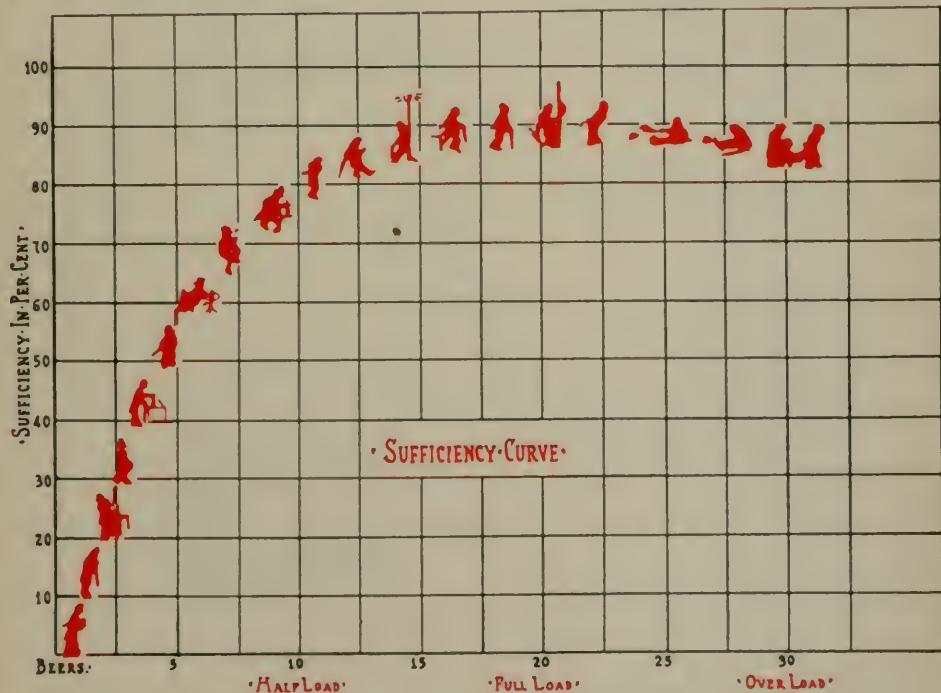


Just around the corner.

The New Yorker.

SCALE .7

A. The Search for Prosperity.



B. A "Sufficiency" Curve.

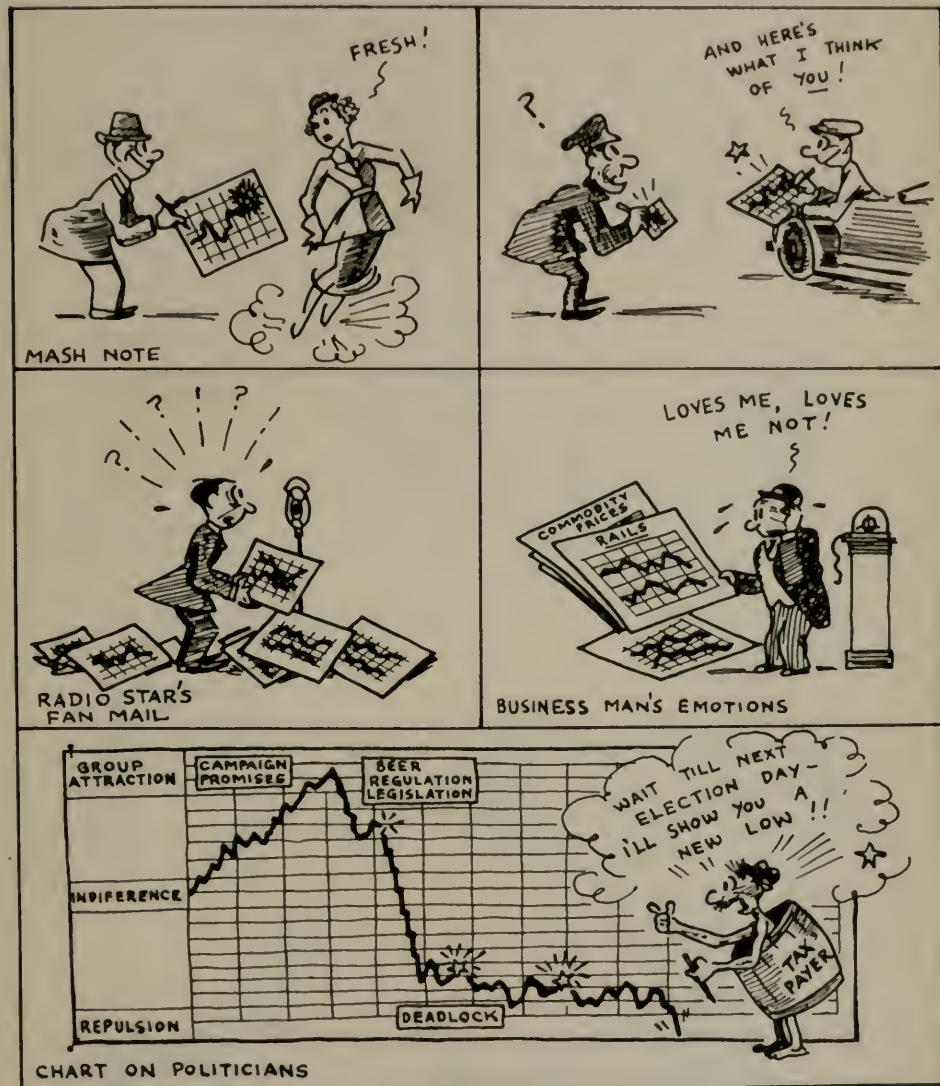
The Professional "Liberal"



New York Herald Tribune, Cartoonist—Darling.

How Our Dollar Would Look If Indirect Taxes Were Actually Removed.

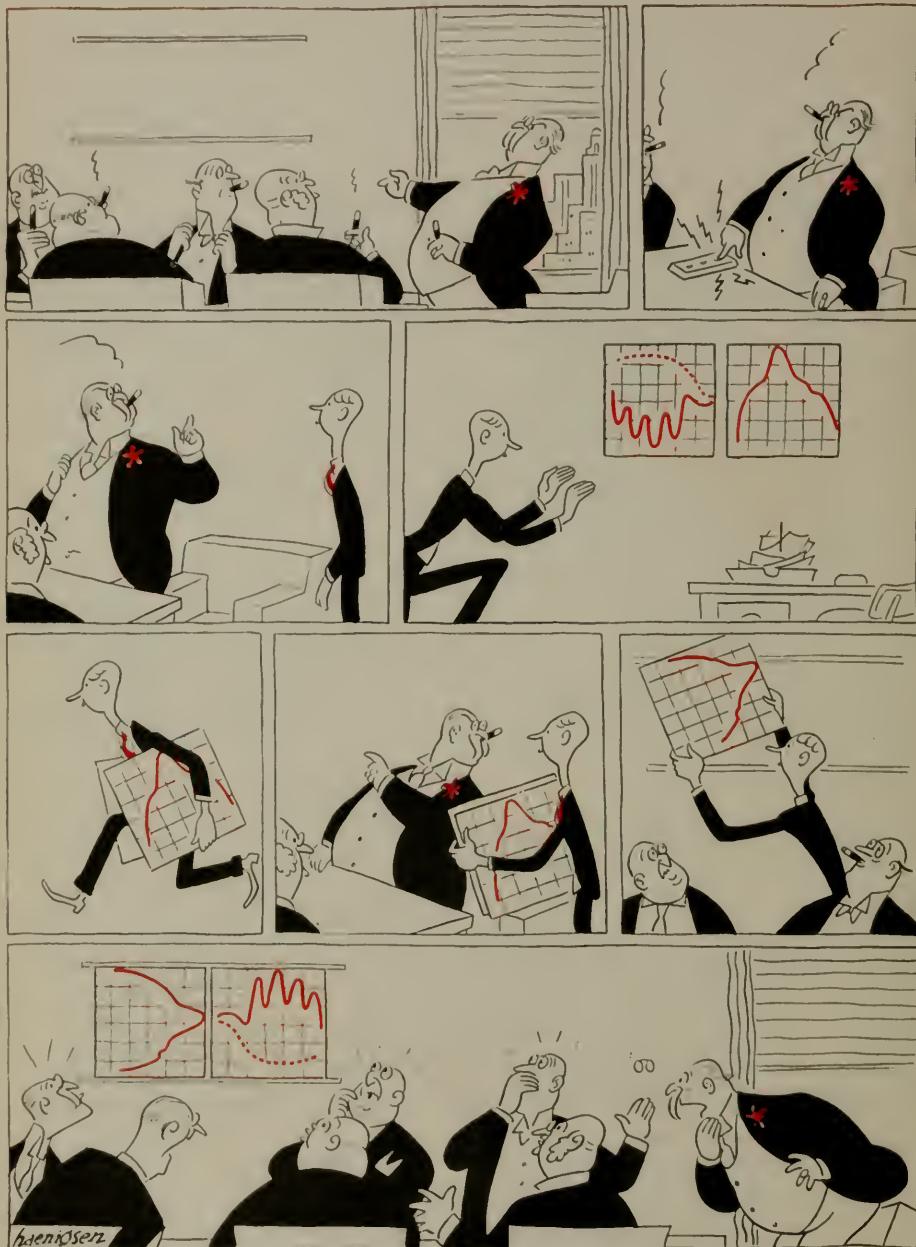
SCALE .8



New York World-Telegram, Cartoonist—Will B. Johnstone.

Curves of Emotions.

The news item which accompanied this cartoon read: "Emotions mapped by new geography, charts of colored lines show likes and dislikes of individuals and groups for each other."



Life.

SCALE .7

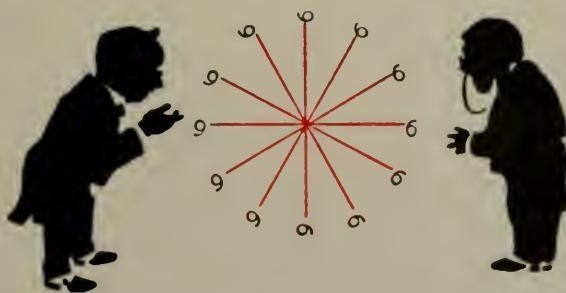
It's All in How You Look at a Thing.

SPECIMEN AT THE WASHINGTON ZOO



The Los Angeles Times—Cartoonist—Russell.

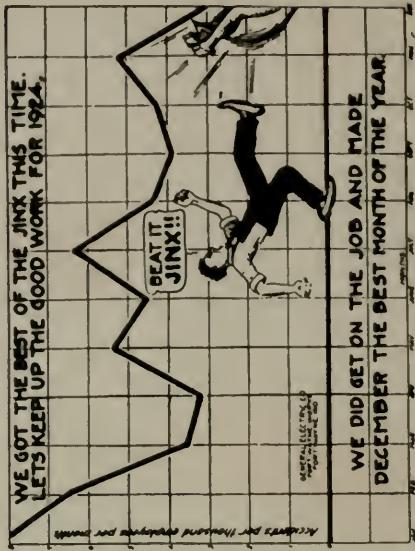
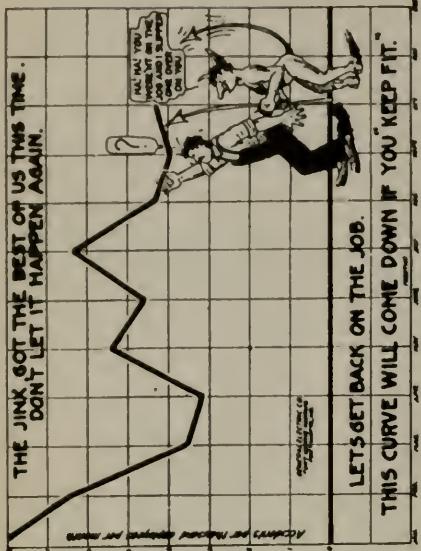
A. Big and Little Business View With Alarm a New Species of Industrial Curve.



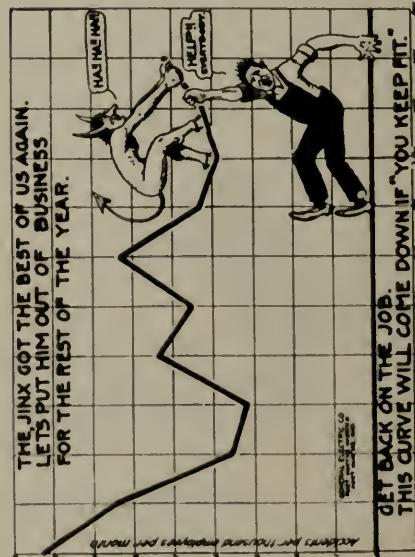
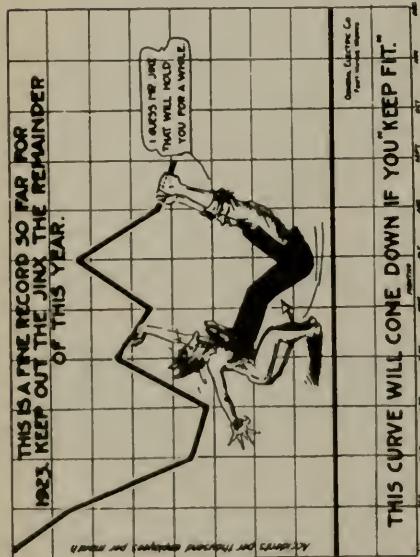
B.

PERPETUAL MOTION AT LAST

GRAPHIC PRESENTATION



SCALE .7

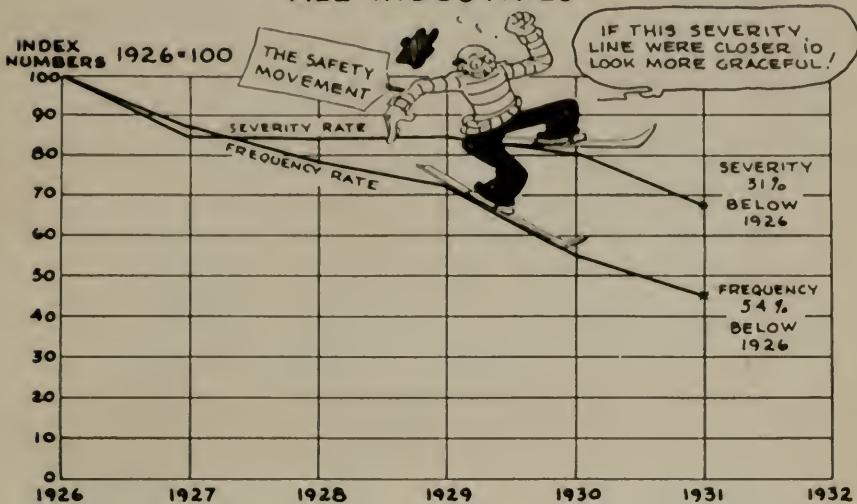


General Electric Co., Fort Wayne Works, Fort Wayne, Ind.

A Monthly Cartoon Used to Prevent Accidents

QUANTITATIVE CARTOONS

INJURY FREQUENCY AND SEVERITY RATES IN ALL INDUSTRIES



American Mutual Liability Insurance Co., Boston.

A. A Cartoon Showing the Importance of Keeping the Lines Representing "Injury Frequency" and "Severity Rates" in Industry Close Together.



This Week, Cartoonist—Henry Boltinoff.

B. The Use of Charts in "Business."



"It's only a crack in the wall, but it looked
so good I had a frame put around it"

LAWRENCE LARIAR

Collier's Magazine

The Efficiency Expert.

Chapter 56

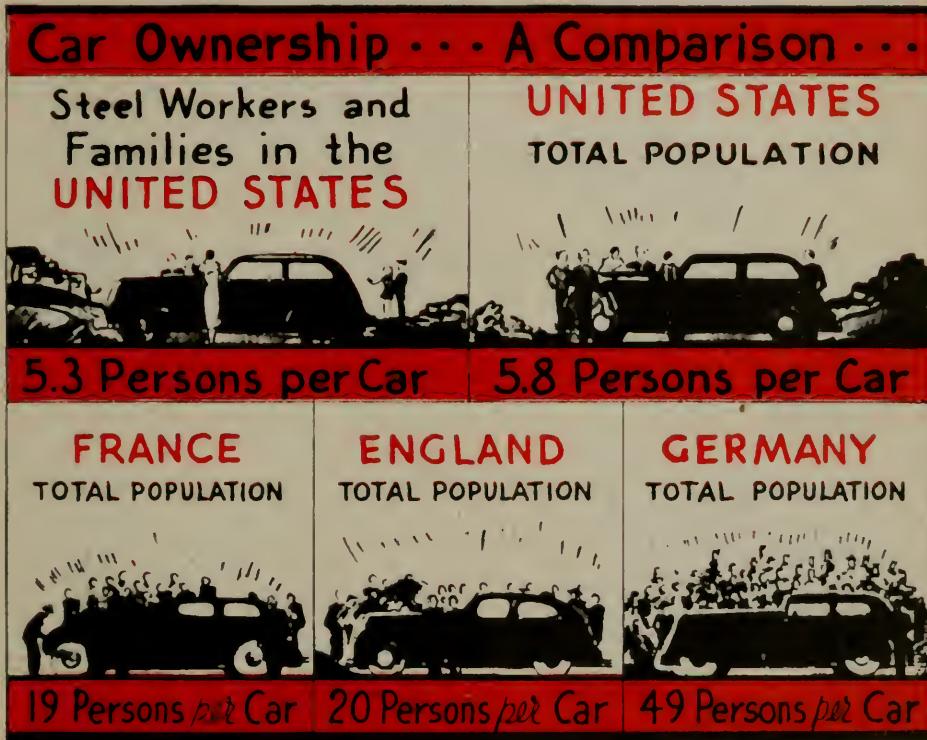
QUANTITATIVE POSTERS



ALTHOUGH all the charts in this chapter did not appear in their original form as posters, the construction and layout of the charts are such that they could be used as posters.

REFERENCES

Richmond, Leonard, *The Technique of the Poster*, Isaac Pitman & Sons, New York and London, 1933.



American Iron and Steel Institute, N. Y. C.

A Quantitative Poster Showing a Comparison of Car Ownership in 1937.

Quantitative material may be presented in posters with great success. Although the quantitative presentation in this poster is not absolutely correct, the general idea that steel workers and families in the United States have more automobiles is easily obtained.

UNDERWOOD ELLIOTT FISHER SUPPLIES

Will Speed Your Business—and Reduce Cost

COST of CORRESPONDENCE

First Quality Ribbons & Carbons per 1000 Letters = $\frac{6}{10}$ of 1% of \$301.63

PROVEN COST OF 1000 LETTERS

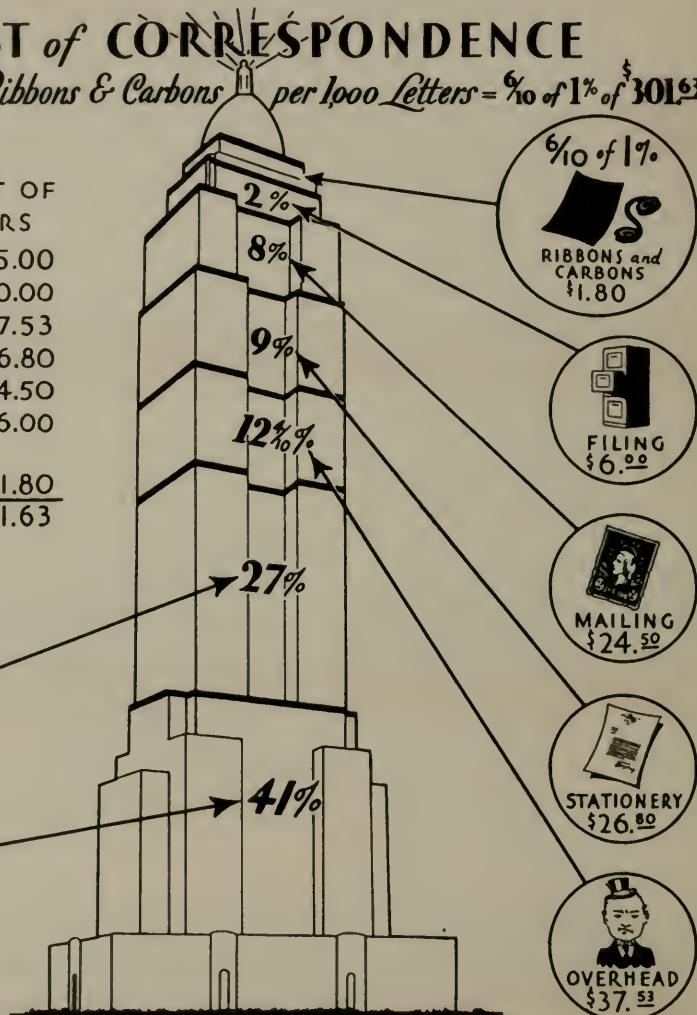
Dictation	125.00
Shorthand	80.00
Overhead	37.53
Stationery	26.80
Mailing	24.50
Filing	6.00
Ribbons & Carbons	1.80
	<u>\$301.63</u>



STENOGRAPHIC
\$80.00



EXECUTIVE
\$125.00



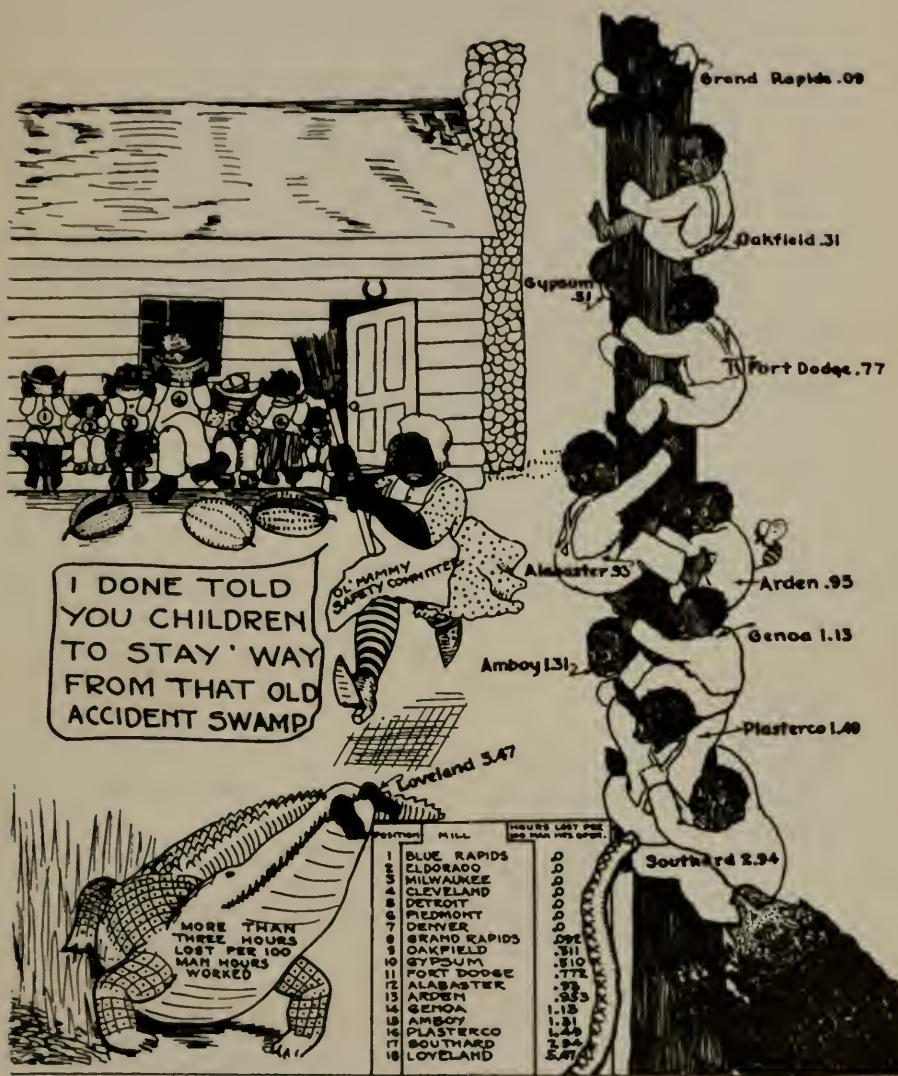
This Chart Tells the Story — Look at It NOW!

Underwood Elliott Fisher Company, New York City.

SCALE .6

A Building Used as a 100% Bar Chart.

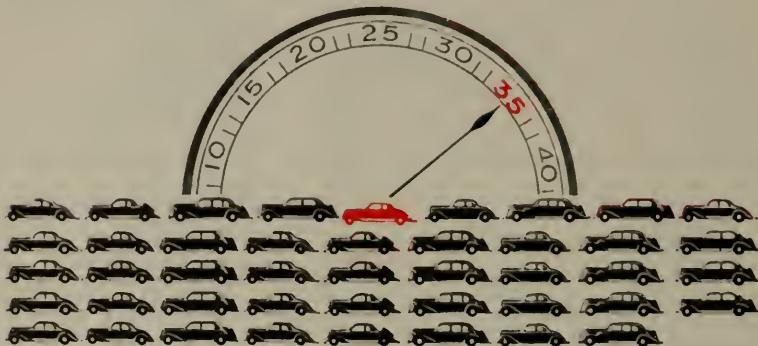
The danger in using a building for a 100% bar is that the eye compares volume as well as height. Thus while the height of the 41% area in this building is correct in relation to the height of the 27% area, the volume of the first makes the proportion wrong.



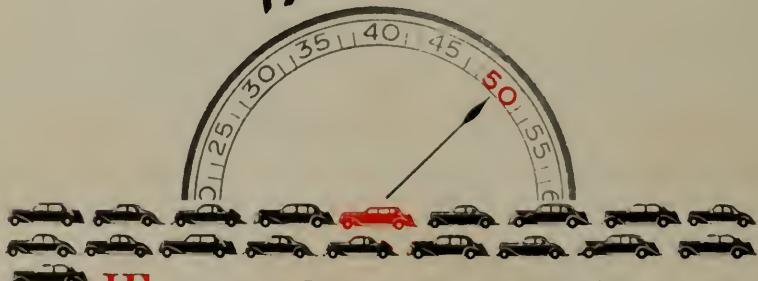
United States Gypsum Co., Chicago, Ill.

A Home Made Bulletin Giving a Comparison of the Accident Rates in Eighteen Mills in 1924.

IF an accident occurs while your car is traveling **under 40 MILES AN HOUR** there is only **ONE CHANCE IN 44** that someone will be killed....



But-



IF an accident occurs while your car is traveling **over 40 MILES AN HOUR** there is **ONE CHANCE IN 19** that someone will be killed ...

DEATH Begins at 40!

Travelers Insurance Company, Hartford, Conn.

SCALE .7

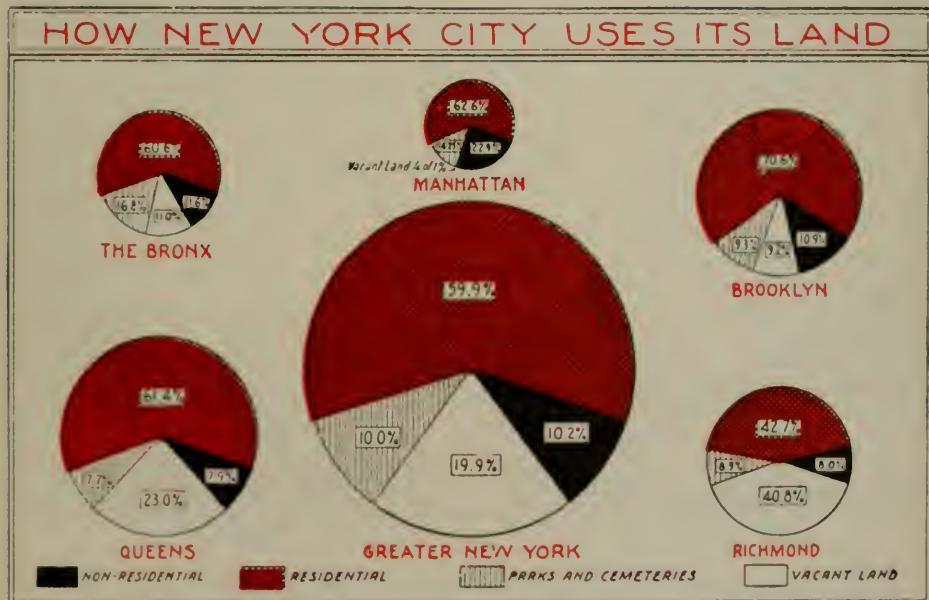
Death Begins at Forty.

The combination of color with the automobiles and speedometer make this an effective method of presenting the idea that "death begins at forty."



Automobile Manufacturers Association, New York.

- A. The Use of a Broken Dollar in a Poster to Indicate the Portion of the Dollar Which Was Diverted from Highway Taxes in 1937.



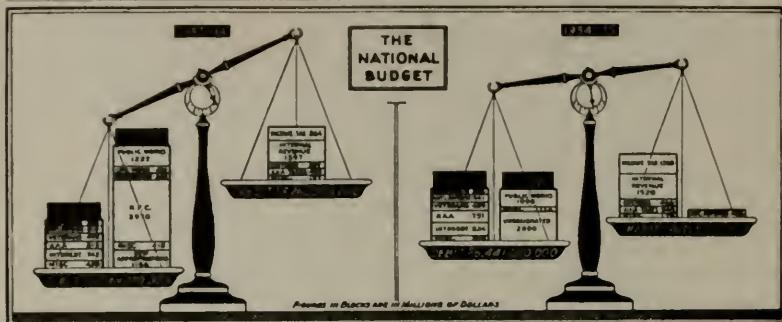
The New York Times

SCALE 8

- B. How New York City Used Its Land in 1936.

GRAPHIC PRESENTATION

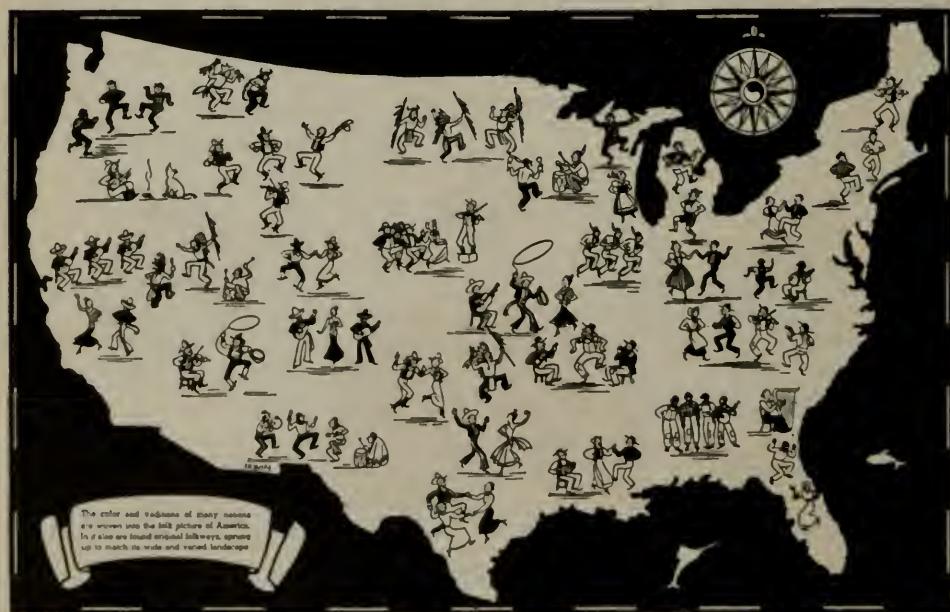
Ordinary and Emergency Needs That Call For an Outlay of Ten Billions This Year and Six Billions Next—The Revenues Expected, the Borrowing Required, and the Effect on the National Debt



The New York Times.

SCALE .8

A. Balancing the Budget for the Fiscal Years 1933-34 and 1934-35.



National Folk Festival Association, Washington, D. C.

SCALE .8

B. A Folk Festival Bulletin.

This map was used in various forms as an advertisement for the fifth annual Folk Festival held in Washington, D. C., in May 1938. Twenty-seven states participated.

QUANTITATIVE POSTERS

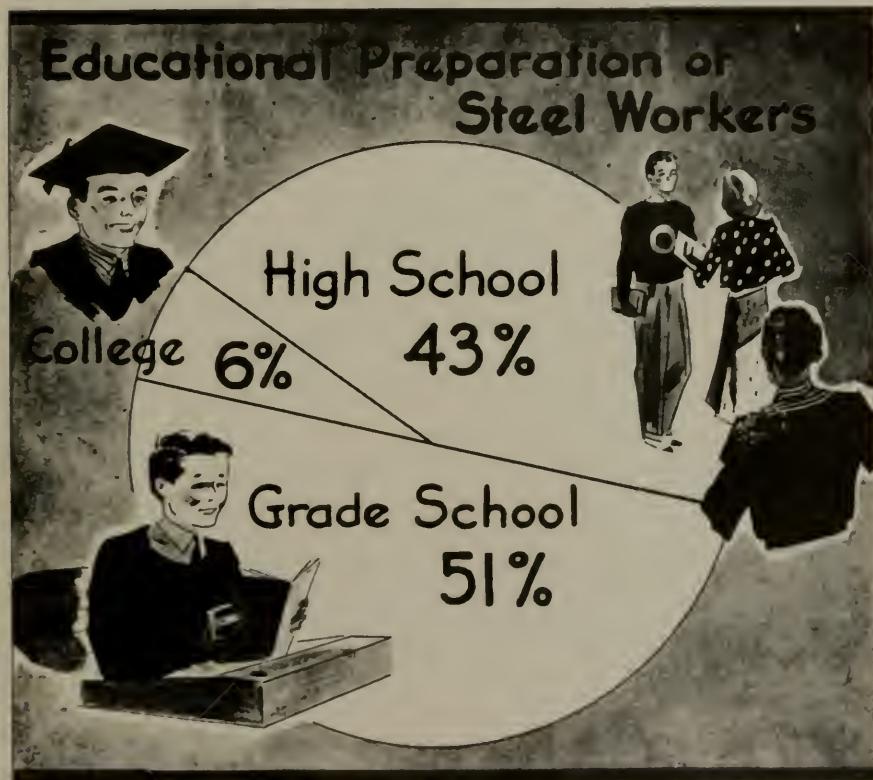
FARM PURCHASING POWER NEARS '29 TOP



The Chartmakers, New York City.

SCALE .5

A. Farm Purchasing Power From 1929 Through 1937.

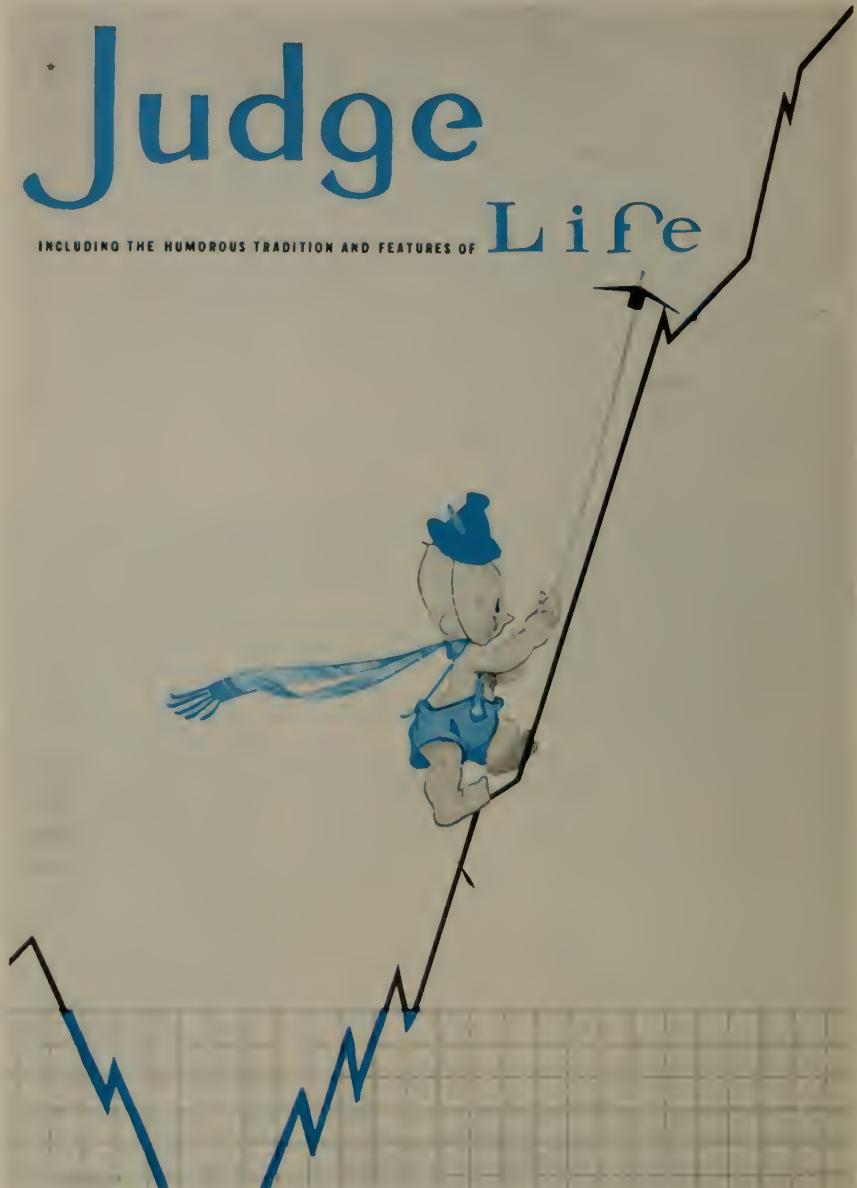


American Iron and Steel Institute N.Y.C.

B. Educational Preparation of Steel Workers in 1938.

Judge Life

INCLUDING THE HUMOROUS TRADITION AND FEATURES OF



Judge and Life Magazine.

A Mountain Made Out of an Increase.

A curve chart is easily imagined as a series of hills and valleys. By putting the points in a curve, a mountain can be formed as in this cartoon. The original of this cartoon was in colors.

THE SATURDAY EVENING POST



Reproduced by Special Permission of The Saturday Evening Post. Copyright 1932, by The Curtis Publishing Company.

The New Year Forecasts the Future.

At a time when the public is thinking in terms of increase or decrease of business, a cartoon utilizing curves attracts attention and carries meaning. This drawing capitalized on that fact.



American Mutual Liability Insurance Co., Boston, Mass.

A Simple Curve Used in a Poster.

The idea that curves represent man's actions is vividly portrayed here. According to correct procedure in a poster, there are few details given, and the lines are heavy. The original poster was in black, red, and white, and measured 11" by 17".

CHARLESTON

THE PORT OF NO DELAY.

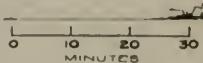
MINIMUM HOURS OF FOG

AN AVERAGE OF
ONLY 38 MINUTES
OF FOG PER DAY
FOR TEN YEARS



PROXIMITY TO OPEN SEA

30 MINUTES
FROM BAR TO
BERTH



STRATEGIC LOCATION

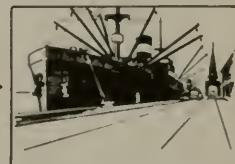
SHORTEST AVER-
AGE OCEAN HAUL
TO PRINCIPAL
KEY PORTS



HARBOR FREE FROM ICE



SPECIALIZED SERVICE



TO SHIP THROUGH CHARLESTON IS TO SHIP WITH EXPEDITION

Bureau of Foreign Trade and Port Development, Charleston, South Carolina.

A Poster Used in a Campaign to Secure Greater Use of the Port of Charleston,
South Carolina.

Chapter 57

DISPLAYS AND EXHIBITS



WHEN properly planned, a display becomes a salesman for its sponsor. The value of a good display is tested by its ability to draw buyers to it and in turn tell them a complete and convincing sales story. Graphic charts make an effective tool to use as part of a display.

Interesting problems in large scale displays were brought to the fore during the construction of exhibits at the New York World's Fair, 1939. The turntable in the Ford Building weighing 152 tons with its exhibit was so heavy that a major foundation problem was involved. The solution was to float the turntable on a circular moat filled with 20,000 gallons of water. The turntable is revolved by a two horsepower electric motor.

The "futurama" of General Motors is the largest scale model animated diorama ever constructed. The 35,538 square-foot panorama is a conception of America and its highways in 1960



Gardner Displays Company, Pittsburgh, Pennsylvania

Mechanical Exhibit of the National Tube Company.

This display tells how seamless pipe is pierced from solid steel. The rolling and piercing operation is shown in the center of the display.

DISPLAYS AND EXHIBITS



Gardner Displays Company, Pittsburgh, Pennsylvania.

A. Scale Model of a Plant.

This model of a Bethlehem Steel heat treating plant was built for industrial shows. A synchronized voice explains operations of the model.

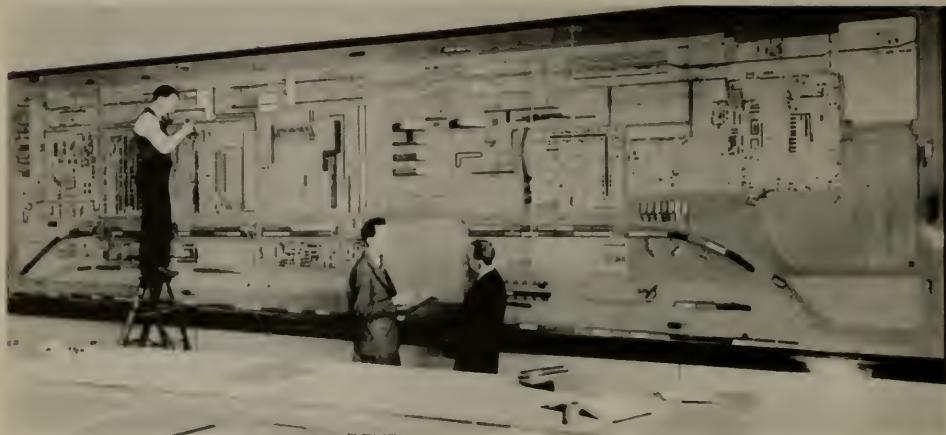


Gardner Displays Co., Pittsburgh, Pennsylvania.

B. Exhibit of the National Cash Register Company at the Business Show of 1938 in New York City.

This small stage was six feet ten inches wide, six feet five inches high, and four feet seven inches deep. The characters were approximately twenty inches high. A sound mechanism controlled the action and voice of each of the five men. At the Business Show, an eight minute playlet was re-enacted.

GRAPHIC PRESENTATION



Factory Management and Maintenance. July 1938.

SCALE .7

A. Big-Scale Model of the Plymouth Motor Corporation Plant at Detroit.

Even drinking fountains are shown on the big board where Plymouth lays out to scale its 1,110,620 square feet of plant.



New York Herald Tribune

B. The Use of a Model Fighter to Familiarize British Students at the Royal Naval College, Dartmouth, with Sea Terms.

DISPLAYS AND EXHIBITS

Luminous paint first used as a medium for magic is now being used by industry for display and exhibit purposes. At the New York World's Fair, 1939, this paint, which is luminous only under ultra-violet light, gives the effect of illumination in the night scene in the Perisphere, is on the stars and underground cable lines in the Consolidated Edison "City of Light" and illuminates the night scene in the General Motors Building. These are just a few of the many places at the Fair in which this ultra-violet paint has been applied.

Sources:

Stroblite Company, New York City



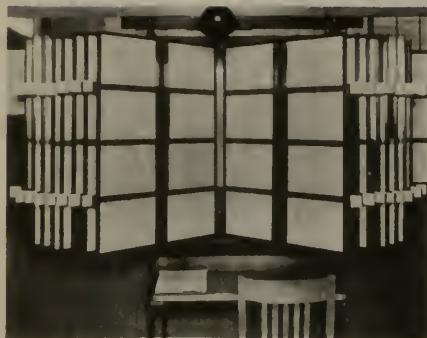
Baltimore and Ohio Railway Company, Baltimore, Md.

SCALE .6

Photomural Covering the Entire Wall of the B. & O. Ticket Office and Travel Bureau in Rockefeller Center, New York City.

1. This picture is 35 feet long and 16 feet high. It was enlarged from a panoramic 20 inch negative and required 12 forty-inch strips, each strip 17 feet long in order to avoid horizontal seams.
2. The picture shows B. & O.'s streamline Royal Blue crossing Thomas Viaduct, nine miles west of Baltimore, on the route to Washington. In the foreground is the little "grasshopper" locomotive—the Atlantic (built in 1832)—hauling the Imlay coaches.

GRAPHIC PRESENTATION



Factory Management and Maintenance, February, 1938.

SCALE .5

A. Schedule Board.

This display fixture is in production control headquarters of the Pneumatic Scale Corporation, Ltd., Quincy, Massachusetts. Charts are lifted out by the production clerk for day-by-day posting.



Installing photomurals in the Ford Rotunda building at Dearborn, Michigan—the largest photographs in the world.

Kaufmann & Fabry Co., Chicago.

SCALE .7

B. Photomurals.

Photomurals are enormous photographic enlargements which are hung to walls much in the same manner as wall paper.

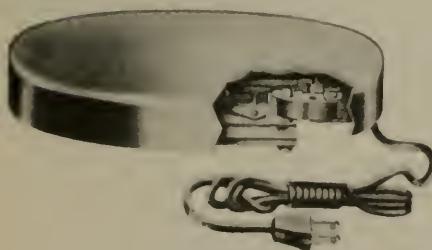
DISPLAYS AND EXHIBITS



Multiplex Display Fixture Company, St. Louis, Missouri.

A. Wall Pivot Display.

1. This display fixture has twenty-four display surfaces, each with six-square feet of display area. Material may be either fastened to the board with thumb-tacks or posted permanently.
2. Multiplex displays work on the principle of a loose-leaf book except that the swinging wing-panels are considerably larger. Material may be posted on each side. In this way charts, graphs, etc., are shown in full. They are smooth, flat, and always available for quick reference.
3. If necessary any display wing-panels may be removed from the fixture, taken to a desk where work may be done on the posted material. The entire display is easily returned to its place in the fixture.



Speedway Manufacturing Co., Cicero, Illinois

B. Electric Motor Driven Turntables.

1. The turntable on the left operates on an A.C. line and has a five-pound capacity. The platform measures $11\frac{3}{4}$ ".
2. The turntable on the right may be obtained for either A.C. or D.C., and has a 500-pound capacity. No platform is provided.
3. These tables may be used for every type of display.

GRAPHIC PRESENTATION

**A. Battery-Driven Turntable.**

This turntable when equipped with three batteries will turn fifteen pounds of display material for 700 hours. The table has interchangeable discs, one $5\frac{1}{2}$ " and the other $8\frac{1}{2}$ ".

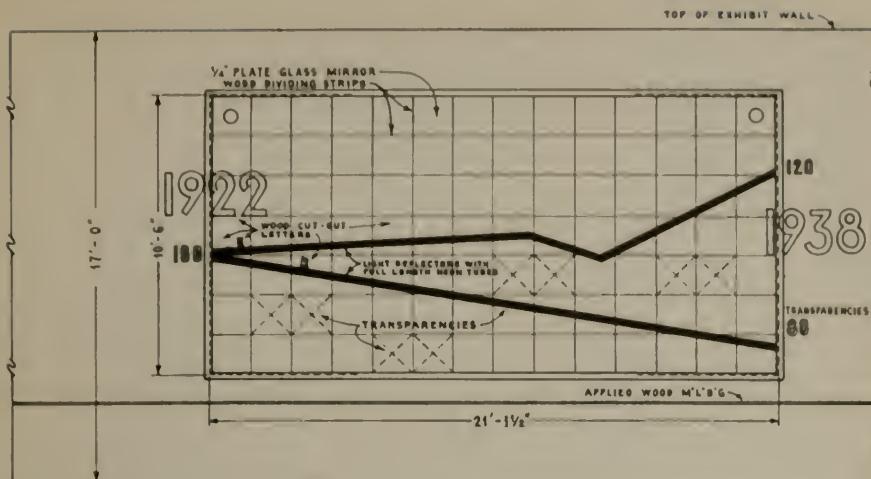
Fleischer & Co., and Aristo Import Co., Inc.,
New York City, Distributors.



Diorama Corporation of America, Long Island City, New York.

B. Plastic Relief Map in the Exhibit of the Pan American Union at the New York World's Fair, 1939.

1. This map is constructed of transparent plastic, phenolic resin base, and is lighted from beneath. The map is made in twenty-nine individual panels, modeled from United States topographical maps.
2. The size of the map is 27 feet deep and 20 feet wide. It slopes from a height of 10 feet from the Canadian portion in the rear to 8 inches to South America in the foreground.
3. This map was designed to show primarily the interdependence of North and South America in regard to transportation and communication.
4. There is approximately six hundred feet of neon tubing, nine-tenths of which is underneath the map. Over one hundred principal cities are shown by lights.



Courtesy of Raymond Loewy, Designer, New York City.

A. Sketch of the Service Exhibit of the Eastern Presidents' Conference Division of the American Association of Railroads, in the Railroad Building at the New York World's Fair, 1939.

1. This exhibit will be a graphic chart in the form of a huge mirror showing the decline of revenues in comparison with rising expenditures of the American Railroads. The following title will appear on the chart: "Revenues are constantly decreasing and taxes, wages, and overhead are constantly increasing."
2. Starting at 1922 a neon light will move to the right and up along the face of the chart up to 1938. This line represents the increase in expenditures. When this line is completed, pictures will emerge from the back of the mirror in the sections marked "transparencies," showing the improvement in services on the railroads.
3. Following this the contrasting neon line will move down, and two "transparencies" will emerge on the face of the mirror—the comparison of old and new service.



Designed and Built by Victor M. Clark & Staff, New York City.

B. An Exhibit of the National Machine Tool Builders' Association, Cleveland, Ohio, at the Museum of Science and Industry in New York City.



Chapter 58

DIORAMAS

Adiorama is a life-like, three-dimensional representation in miniature. It is capable of reproducing any scene, sometimes employing sound and motion. The general visual effect of a diorama is similar to that which the observer gets when looking in or out of a window onto the actual scene.

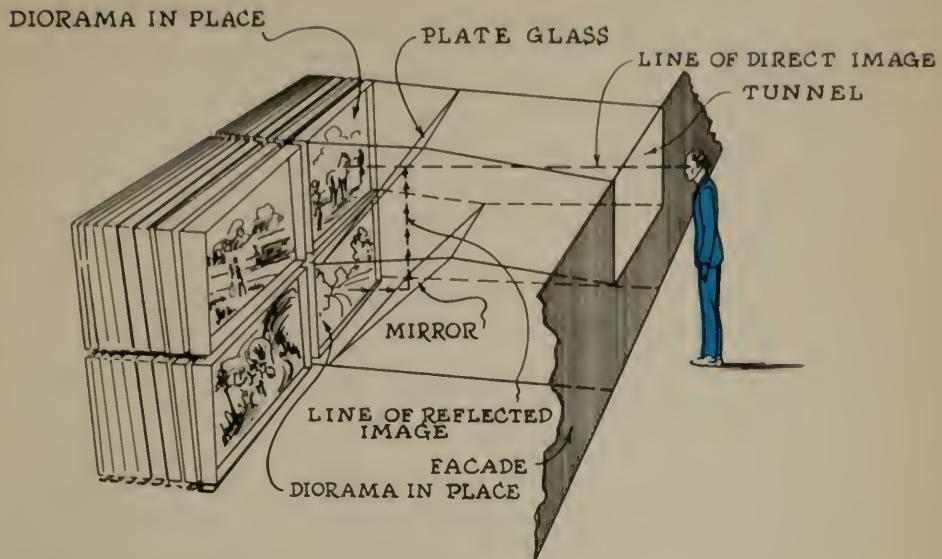
A diorama, or a series of dioramas, is used principally as the focal point of an exhibit, such as a world's fair exhibit, traveling display, window or industrial museum.



The Marchand Diorama Corp., Mt. Vernon, N. Y.

Diorama of the Columbia Steel Company, Subsidiary of the U. S. Steel Company,
Under Construction in the Marchand Studio.

This diorama was part of an exhibit at the Golden Gate Exposition in San Francisco.



U. S. Department of Agriculture, Bureau of Public Roads.

A. Sketch Illustrating the Reflecting Device for the Historical Dissolving Diorama Exhibit Illustrating 400 Years of Highway Development in America from 1539 to 1939.

Each of the dioramas is six inches in depth. To secure the appearance of a third dimension in this small space, the figures were molded on the face of a curved piece of tin.



United States Steel Corporation, New York City.

B. Chart in the Entrance of the United States Steel Subsidiaries' Exhibit at the New York World's Fair, 1939.

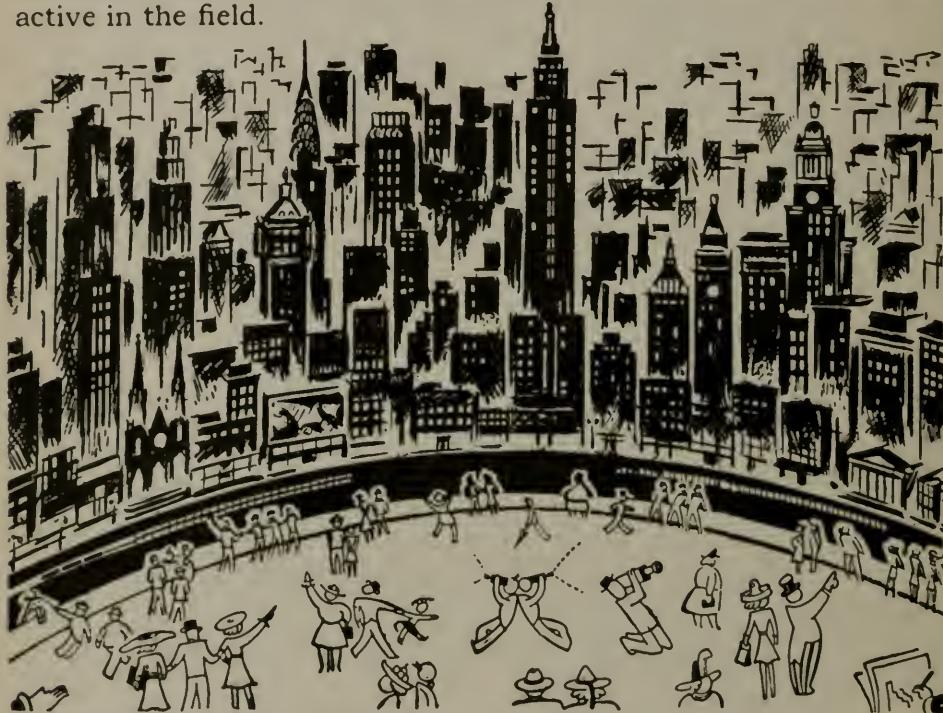
1. This chart shows the growth in the use of steel per capita in the United States from the time of George Washington. In 1789, the use per capita was one-half pound. In 1939, the use per capita is 19,000 pounds or $9\frac{1}{2}$ tons.
2. The indispensability of steel in modern times is the theme of the huge mural seen in the background. Thin sheets of steel were hammered into miniature buildings, bridges, tools, horses, tractors, streamliners, airplanes, and automobiles, and were mounted on a background of plain blue steel.

GRAPHIC PRESENTATION

Dioramas can be constructed to almost any size. The average would probably run between four and eight feet in length, two and four feet in depth, and four and eight feet in height. The depth, therefore, is usually half the length.

About 3,600 dioramas including cut-outs, models, and other forms giving the three dimensional effect were used in exhibits at the New York World's Fair, 1939. The price range is from \$50. to \$150,000.

Due probably to the impetus of business from the New York World's Fair, 1939, the diorama business has expanded tremendously. Two years ago there was one company specializing in diorama design and construction. Today there are twenty-five active in the field.



Consolidated Edison Company of New York, Inc.

The "City of Light" Diorama at the New York World's Fair, 1939.

1. This diorama is the exhibit of the Consolidated Edison Company of New York. It is almost a city block long and is taller than a three-story building. Four thousand buildings with more than 130,000 lighted windows are included. An eight-foot space beneath the street level demonstrates the city's network of subways and electric, gas, and steam mains.
2. In the illustration above, the semi-circular wall of the building is quite apparent. It was especially constructed to house this diorama.



Chapter 59

GRAPHIC CHARTS IN CONFERENCE ROOMS

The display characteristic of graphic charts makes them valuable for use in conference rooms. In some cases, the conference room is



Automobile Manufacturers Association, Washington, D. C., "Automobile Facts," February 1939.

The Use of a Pin Map to Indicate Changing Tastes by States in Automobile Colors Month by Month in the United States.

1. Differences in color preferences over a period of time and in different sections make it necessary for color experts to study fashion trends in order to anticipate changing demand.
2. More than 40% of the New England drivers and only 16% of the motorists in the Southwest elect black cars.
3. Light hues predominate in California, while Washington and Oregon go in for dark tones.
4. Blue is No. 1 choice in the prairie states, although black tops that color in the states immediately to the east.

GRAPHIC PRESENTATION

constructed so that graphic charts may become a part of the general plan. In others, the display of graphic charts is made possible by means of lantern slide projectors. The display fixtures explained in the preceding chapter could well be used in any board room.



Burroughs Adding Machine Co., N. Y. C., "The Burroughs Clearing House," September 1938.

Board Room of the Bowery Savings Bank in New York City.

1. The wall maps show all sections where the Bowery Savings Bank has or will have real estate loans.
2. The projection machine shown in the lower photograph can throw enlarged photographs, layouts, charts, and other pertinent information on a large screen placed at the far end of the room.
3. On the west wall of the room is a 35-foot photomural, an aerial photograph of New York City.



New York Herald Tribune January 1, 1939

- A. Mayor F. H. LaGuardia of New York City, and Dr. John L. Rice, Health Commissioner, Before a Chart Showing New York City's Death Rate from 1898 to 1938.



U.S. Department of Justice, Federal Bureau of Investigation

- B. John Edgar Hoover, Director of the Federal Bureau of Investigation, Before the Map of the United States on Which Are Tabbed the Location of the Bureau's Investigative Personnel.

GRAPHIC PRESENTATION



Copyright by Harris and Ewing, Washington, D. C.

A. Board Room of the New Federal Reserve Board Building in Washington, D. C.

The star holders on the walls of this room and the charts that hang on them are a definite part of the decoration of the room.



B. Sketch of the Lay-out of the General Motors Conference Room Showing the Position of the Projector and Screen.

The solid black line indicates the screen. The projector is directly behind the screen.



C. The Use of Projectors in Conference Rooms.

The illustration shows the general lay-out for the use of a lantern slide projector in a conference room.

Chapter 60

GLOSSARY



SINCE there has been little organized work on vocabulary, the wordings in this glossary should be considered as suggestions, and not in any way officially sanctioned.

Absolute Bar Chart.—See *component bar chart*.

Aerial Map.—A photograph or drawing giving a bird's-eye view of buildings, roads, trees, mountains, cities, etc.

Area Bar Chart.—A bar chart in which at least one dimension is in percentages, resulting in a comparison of the areas of the sections of the bar.

Arithmetic Scale.—An amount scale on a grid with equal numerical values represented by equal special intervals.

Band Chart.—See *component curves chart*.

Bar Chart.—Presentation of data in the form of bars whose lengths and divisions indicate values.

Bell Curve Chart.—A frequency chart in which the distribution assumes the shape of a bell. See *frequency chart*.

Bilateral Bar Chart.—A bar chart in which the bars extend both above and below, or both to the left and to the right of, a common line.

Bleed-Out—An illustration on a printed page which extends as far as the edge of the page, leaving no white space between the edge of the illustration and the edge of the page.

Buck-Shot Chart.—See *scatter chart*.

Cartogram.—See *statistical map*.

Chronology Chart.—The presentation of data with the emphasis on time rather than quantity or quality.

Circle Chart.—Presentation of data in the form of a circle. The area may be proportional to the corresponding facts, or the circle may be divided into sectors. See *sector chart*.

Classification Chart.—A chart in which facts, data, etc., are so arranged that the place of each in relation to all is readily seen.

Column Chart.—A bar chart in which the bars are arranged vertically. See *bar chart*.

Compound Bar Chart.—A bar chart with several contrasting bars.
See *bar chart*.

Component Bar Chart.—A bar chart in which each bar is divided into two or more parts.

Component Curves Chart.—A curve chart in which the total is shown graphically divided into parts.

Contour Map.—A map in which lines indicate the topography of the land. The contour method may also be used to show erosion, precipitation, climatic conditions, etc.

Correlation Chart.—A chart showing degree and type of relationship between two variables.

Cosmograph.—Trade name for a flow chart made from black and white strips of paper, and presenting numerical information or percentages.

Crosshatched Map.—See *statistical map*.

Cumulative Curve.—A curve in which each value, except the first which is zero, is a total or accumulation of all preceding values.

Curve Chart—A chart in which a line is plotted on a grid.

Dependent Variable.—The data presented in a chart or table which varies according to a change in the independent variable. The amount scale on a time curve chart is the dependent variable.

Disc Chart.—See *circle chart*.

Distorted Map.—A map in which the areas of states, countries, etc., are proportional to quantitative data.

Divided Circle.—See *sector chart*.

Dot Map.—See *statistical map*.

Extrapolation.—Projection of the data beyond known points.

Flow Chart.—Graphic representation of movements geographically or through an organization or structure.

Flow Map.—A map in which either or both qualitative and quantitative flow of goods, persons, automobiles, etc., is shown.

Form.—One side of a printed sheet.

Frequency Chart.—A chart in either bar or curve chart form showing distribution of items according to kind, size, location, or time of occurrence.

Gantt Chart.—A specialized type of production chart. See *progress chart*.

Genealogy Chart.—A chart used as a method of showing ancestry and heredity traits.

Genetics Chart.—See *geneology chart*.

Graphic Narrative.—A story told by means of pictures.

Grid.—The surface or field composed of coordinate rulings on which data are plotted or graphed.

GLOSSARY

Guide Map.—A detailed map on which highways, railroad routes, or other methods of transportation are indicated together with cities, etc. See *route map*.

Gun-Shot Chart.—See *scatter chart*.

Halftone.—A method of reproducing on a printing plate the details of a photograph, drawing, painting, etc., including all the gradations of color.

High-Low Chart.—A chart in which the difference between two curves is the center of interest.

Independent Variable.—The data presented in a chart or table which does not vary because of some influence within the data. The time scale on a curve chart is the independent variable.

Index Numbers Chart.—A chart in which all items are expressed as percentages relative to a base figure.

Interpolation.—Process of locating data between two known points.

Key.—See *legend*.

Lag.—The condition that exists when two curves are not concurrent, but one "lags" behind the other to some extent.

Legend.—An explanation or identification of symbols, etc., used in a chart.

Logarithmic Chart.—See *ratio chart*.

Logarithmic Scale—A scale of numbers on a grid so arranged that the spacial intervals are proportional to the differences between the logarithms of the numbers.

Lorenz Chart.—A chart giving frequency distribution with both the variable and invariable quantities reduced to percentages. Both scales represent 100%. See *frequency chart*.

Map Chart.—See *statistical map*.

Moving Average Curve.—A curve in which each value is the average for an overlapping period of time. A *moving average* for a period of time "centered" is the average for half the time before the specified date and half the time after the specified date.

Moving Total Curve.—A curve in which each value is the total for an overlapping period of time.

Ogive Chart.—A frequency distribution in which "more than" or "less than" data are presented. One scale of the grid represents percentages and the other scale represents "more than" or "less than" values. See *frequency chart*.

100% Band Chart.—See *percentage curve chart*.

GRAPHIC PRESENTATION

100% Bar Chart.—A chart in which a single bar represents 100% and the divisions of the bar represent percentages of the whole.

100% Block Chart.—See *100% square chart*.

100% Square Chart.—An area bar chart in which both dimensions are in percentages. See *area bar chart*.

Organization Chart.—Graphic explanation of the structure of a business, government, school, or other unit of operation.

Percentage Band Chart.—See *percentage curve chart*.

Percentage Bar Chart.—See *100% bar chart*.

Percentage Curve Chart.—A component curve chart in which data is presented on the basis of 100%. See *component curves chart*.

Pictogram.—See *graphic narrative*, and *pictorial unit bar chart*.

Pictorial Map.—See *statistical map*.

Pictorial Unit Bar Chart.—A bar chart in which comparisons are made by using a number of symbols, each of which represents a specific value.

Pie Chart.—See *sector chart*.

Pin Map.—See *statistical map*.

Plate.—The composition, whether zinc, lead, etc., which is used to make the printed impression on paper.

Plotting (Plotted).—Placing a curve or other representations on a grid.

Procedure Chart.—A time study by which procedure in production may be planned and recorded. See *progress chart*.

Process Chart.—A time study by which production may be analyzed, planned, and recorded. See *progress chart*.

Production Control Chart.—A time study by which production may be planned, controlled, and recorded. See *progress chart*.

Progress Chart.—A time study by which production and transportation movements may be planned and recorded.

Progressive Average Curve.—A curve in which each value is the average of all the items previously shown.

Proportional Map.—See *distorted map*.

Range Bar.—A bar form of high-low chart in which the range of prices of stocks or commodities may be indicated. See *high-low chart*.

Rank Chart.—See *rating chart*.

Rate-of-Change Chart.—See *ratio chart*.

Rating Chart.—The presentation of the rank of items as determined by the quantitative value of each item.

Ratio Chart.—A curve chart in which the amount scale rather than an arithmetic scale is so spaced that a straight line diagonally

across the grid represents a uniform percentage increase or decrease.

Relationship Chart.—A diagram in which facts, information, etc., are arranged to emphasize their relation.

Relative Bar Chart.—See *100% bar chart*.

Relief Map.—Map showing elevations and surface undulations of a geographical unit. Relief maps may also be used to present statistical data.

Route Map.—A map on which point to point movements of ships, airplanes, railroads, electricity, etc., are given.

Scatter Chart.—A chart on which the data has been plotted or distributed as dots on a grid.

Schedule Chart.—See *progress chart*.

Screen.—A cross-lined screen, usually glass, through which copy is photographed for reproduction as a halftone.

Sector Chart.—The presentation of data in the form of a circle divided so that each sector is proportional to the corresponding facts.

Semi-Logarithmic Chart.—See *ratio chart*.

Shot-Gun Chart.—See *scatter chart*.

Signature.—A folded printed sheet ready to be assembled with other folded sheets to be bound together. A signature usually consists of 16 pages, but it may be 4, 8, 32, or even 64 pages.

Stair Chart.—A chart in which a line plotted on a grid resembles stairs.

Staircase Chart.—See *stair chart*.

Statistical Map.—A map on which dots, circles, bars, curves, symbols, or crosshatchings have been placed to give the geographic location in accordance with statistical data.

Tabulation.—The recording of statistical data in the form of tables.

Three-Dimensional Chart.—A graphic presentation with three variables. Three-dimensional charts may be drawings in perspective or models.

Two-Directional Bar Chart.—See *bilateral bar chart*.

Traffic Map.—A flow map showing the flow of automobiles or persons on streets and highways. See *flow map*.

Two-Way Bar Chart.—See *bilateral bar chart*.

Zee Chart.—A curve chart presenting periodic (day, week, or month) data, cumulative data, and a moving total on one grid. The positions of the curves form a "Z."



INDEX

A

Abbott Educational Co.	423
Absolute bar chart	501
Addressograph Multigraph Corp.	434
Advertising chart	454
Advertising and Selling	331
Area bar chart	149-152, 501
Aerial:	
Map	170-177, 501
Photograph	160, 498
Agricultural Economics, Bureau of	160
Air brush	350
Air route map	156
Alexander Hamilton Institute	215B, 294B, 302A
Alteneder, Theo. & Sons	374B
Allcolor Co.	424D, 428A
American Association of Landscape Architects	171, 235
American Association of State Highway Officials	89B
American Aviation	167
American Business	38C
American Crayon Co.	370
American Documentation Institute	409
American Gas Association	463
American Genetics Association	54B, 55
American Geographical Society of New York	153
American Iron & Steel Institute	38A, 215A, 243, 475, 481B
American Machinist	158
American Map Co.	154
American Mutual Liability Insurance Co.	464, 473A, 484
American Petroleum Institute	195A
American Rolling Mill Co.	108B
American Schools of Oriental Research	170
American Society of Mechanical Engineers (See also Time Series Charts and Committee on Engineering and Scientific Graphs)	89A, 318
American Standards Association (See Time Series Charts.)	
American Statistical Association	323, 325, 326, 333A
American Telephone & Telegraph Co.	218
American Type Founders	139
American Writing Paper Co.	448
Ancestral Publishing & Supply Co.	57
Area bar chart	119-152
Area comparison (See also Area bar chart)	85A, 238, 457
Aristo Import Co.	492A
Arkin, Herbert	24, 370
Armstrong Cork Co.	117B
Arnold, Bion J.	74A, 223
Art Crayon Co.	370
Atom chart	52A, 52B
Australia, Commonwealth	159
Automobile Manufacturers Association	28B, 94A, 98, 102B, 131A, 298A, 349A, 479A, 497
Automotive Industries	50A, 299A
Average	107B
Moving	209, 286, 288B, 289, 291B, 503
Progressive	286, 288A
Aviation	45
Ayers, Dr. Edward A.	426
Ayres, Leonard P.	86A, 258, 273, 303B
Azimuthal projection	176

B

Bambridge, Charles T., & Sons	422
Bakers' Helper	460B
Baltimore & Ohio Railway Co.	489
Band chart	501
100%	293, 297B, 503
Bar chart	106-114, 115-120, 363, 364, 404, 501
Absolute	501
Area	149-152, 501
Bilateral	142-148, 501
Column	106, 501
Component	99, 132-141, 294, 502
Compound	502
Cumulative	94B
Made on typewriter	377
100%	51, 88, 92-97, 98-105, 123A, 128A, 132, 137A, 139A, 144B, 145A, 152, 291, 297B, 454A, 460A, 476, 504
On map	200, 207
Pictorial unit	121-131, 211, 365, 504
Relative	505
Range	285A, 285B, 504
Two-directional	505
Two-way	505
Baseline	382
Base map	154
Basic English	26, 27
Bausch & Lomb Optical Co.	410
Beads	192B, 193
Bell curve chart	310, 501
Bell & Howell	406B, 406C
Bell Telephone Laboratories	192A
Ben Day	186, 420B
Bennett, Colin N.	439
Bethlehem Steel Co.	487A
Bibbins, James R.	74A, 223
Biblofilm	409
Bilateral bar chart	142, 148, 501
Binding	449-452
Covers	451, 453
Edition	450
Flat	451
Imposition	450, 452A
Inserts	450
Reinforcements	450
Smythe-sewed	450
Stamping	451
Wiresstitched	450
Bingham, Richmond F.	24, 309B, 333B, 334, 335, 370
Binney & Smith Co.	370
Birren, Faber	427, 428
Bivins, Percy A.	340
Bleed-out	501
Block classification chart	49, 50A, 50B
Block cut:	
Linoleum	415
Wood	415
Block diagram	172, 356B
Bolginoff	473B
Bolton, Joseph R.	259A
Borgia map	153
Boston Globe	29B
Bowen, M. L.	359B
Bowery Savings Bank	498
Bowman, Isaiah	162A
Brady, Dorothy S.	323
Break-even chart	328B
Brewer-Cantelmo Co.	451
Briggs	464
Brinton, Willard C.	24, 49, 73B, 124A, 161, 186, 192B, 254, 261, 288A, 293A, 327, 370
Brooks, Burleigh	397E, 397F
Brown, Arthur & Brothers	419
Brown, Bertrand	123A, 124B, 128A
Brown, Theodore H.	24, 309B, 333B, 334, 335, 370
Buck-shot chart	501
Bureau of Agricultural Economics	160
Bureau of Chemistry & Soils	160
Bureau of Foreign Trade & Port Development, Charleston, S. C.	485
Bureau of Public Roads	160, 495A
Bureau of Reclamation	156
Burn, Walter P., & Associates	242, 401A
Burns	319B

INDEX

Burroughs Cloning House	49B	Iso-metric	357B
Bush Terminal Co.	460C	Iratio	368A
Byrnes, Gene	464	Triangular coordinate	359A
C		Croston, Frederick E.	21, 286
California Job case	435	Crum, William L.	21
Camera	397-404	Cumulative:	
Contax	397C	Bar chart	94B
Curtis Color Scout	398B	Curve chart	275, 279, 281A, 326, 319A, 502
Devlin Tricolor	398A	Frequencies chart	331, 332A
Leica	397A	Sector chart	91
Linhof	397F	Curtis Color Scout Camera	398B
Perforx	397B	Curtis, Thomas S., Laboratory	398B
Rollerflex	397E	Curtis Publishing Co.	483
Speed Graphic	397D	Curve chart	263-359, 502
Tricolor	398	Hell	310, 501
Candid Camera Corp.	397B	Comparisons	275, 293
Carlyle, Paul	454	Component	294-300, 393, 502
Carnegie Institute of Washington	153, 356A, 359B	Correlation	320-330, 502
Carter's Ink Co.	427A	Cumulative	275, 279, 281A, 326, 349A, 502
Cartogram	501	Frequency	310-319, 502
Cartoons, quantitative	464-474	Gantt	256-262, 502
Cartwright, Mills H., —	439	High-low	275, 276B, 285A, 285B, 304B, 503
Causal relationship	275, 282A, 288B	Index numbers	114B, 132, 301, 309, 347B, 363, 361, 503
Cellophane Corp.	368	Lorenz	331-338, 503
Central Statistical Board (See Federal Chart Book.)		Moving average	209, 286, 288B, 289, 291B, 503
Chaddock, R. E.	24	Moving total	503
Chamber of Commerce of the United States	109, 246	Ogive	331, 338, 503
Champion Paper & Fibre Co.	448	On map	208, 210, 263, 274
Chart, suggestions for making	367, 380	Percentage	501
Chartmakers	481A	Progressive average	286, 288A, 503
Chase National Bank	— 284B, 330B, 332B, 340	Ratio	339-353, 503
Chemistry & Soils, Bureau	160	Cut-out letters	375
Chicago Cardboard Co.	422	D	
Chicago Tribune	121, 265A, 265B, 276B	Darling	468
Chicago Wheel & Manufacturing Co.	372	Dartnell Corp.	239B
Chroma (See also Color)	424D, 425C, 427B	Dauseco Products Co.	429
Chronology chart	248, 255, 501	Davis, Harvey N.	39B
Churchill Engineering Corp.	— 145B, 150	Day, E. E.	34
Cincinnati, Ohio, City Manager	38B, 65, 125A	Decker, Richard	466B
Circle chart (See also Sector Chart)	251, 501	Dennison, Henry S.	333A
On map	194-199	Dennison Manufacturing Co.	371
Civilian Conservation Corps	61A	Dependent variable	263, 502
Clark, Victor M., and Staff	493B	Detroit Edison Co.	355B
Clark, Wallace	262	Deviation	142, 271B, 324
Classification chart	43-52, 501	Devin Colorograph Co.	398A
Block	49, 50A, 50B	Devin Tricolor camera	398A
Coast & Geodetic Survey	156, 158	Dirck, A. B., Co.	432A, 433A
Codeix Book Co.	56A, 367	Dietzgen, Eugene, Co.	368A, 369A
Collars	474	Dimensions	384
Color	418, 419, 423-428, 453	Diorama Corp.	492B
Color-blind	426	Dioramas	494-496
Colton Press	414, 439, 443	Disc chart	502
Colton, Raymond R.	24, 370	Displays	293B, 486-493, 497
Columbia Steel Co.	494	Distorted map	238-242, 459, 502
Column chart	106, 501	Ditto, Inc.	429
Commercial Engraving Publishing Co.	439	Divided circle	502
Committee on Engineering and Scientific Graphs	381, 408A, 408B, 408C	Divine, J. J., Associates, Inc.	169
Committee on Standards for Graphic Presentation (See Time Series Charts.)		Dixon, Joseph, Crucible Co.	369B, 370
Commonwealth Edison Co.	354	Domani, D. F.	81
Component:		Dot map	187-193, 502
Bar chart	99, 132-141, 294, 502	Draeger, Lawrence W.	415
Curve chart	294-300, 393, 502	Drawing:	
Compound bar chart	502	Board	420A
Composite chart	360-366	Instruments	369A
Conference rooms, charts	497-500	Pencils	369B
Consolidated Edison Co.	496	Dunn, Charles	466A
Contax cameras	397C	Dun's Review	116A, 117A, 143A, 143B, 145A, 282B, 287C, 297B, 320, 344, 347B, 458
Continovac Sales Co.	407A	Duplicating machine (See also Reproduction)	429
Contour map	231-237, 502	Dupont De Nemours, E. I., & Co.	368
Control chart (See also Progress chart)	504	Durost, Walter	35
Cornell, Grace	427A	E	
Corps of Engineers	156	Eagle Pencil Co.	370, 372
Correlation chart	320-330, 502	Eastern Air Lines	163A
Cosmograph	73, 78A, 78B, 79, 80A, 80B, 502	Eastern Railroad	91, 193A
Covers (See also Binding)	451, 453	Eastman Kodak Co.	368, 399A, 401, 405A, 405B, 405C
Cowden, Dudley J.	24, 286	Eberhard Faber Pencil Co.	370, 372
Coshend, Ralph C., Corp.	379	Economic right price	145B, 150
Craftsmen Manufacturing Co.	419	Edition binding	450
Crayons	37D	Educational Exhibition Co.	154, 193, 367, 368
Crosshatched map	178-186, 270, 502	Egyptian Lacquer Manufacturing Co.	461
Crosshatching (See also Shading)	115A, 178	Electrical World	239A, 366
Cross-section paper	367	Electric Storage Battery Company	73, 255, 454A
		Electronics	58, 263, 347A

GRAPHIC PRESENTATION

Electrotyping	421	H	Haftstone	113, 116, 417, 419, 420A, 503
Elgin National Watch Co.	90A	I	Hamilton Manufacturing Co.	435
Elite type	376B	Hamilton, W. C., & Sons	453	
Emery, Brooks	51, 206	Hammill Paper Co.	448	
Encyclopedia Americana	153, 154, 155	Hammond, C. S., & Co.	154	
Engineering & Mining Journal	118, 138, 360	Harris, & Ewing	500A	
Engineering News Record	77, 85B, 166B, 259H, 261	Haskell, Allan C.	24, 370	
Engineering & Scientific Graphs, Committee	381, 408A	Hectograph	432B	
	408B, 408C	Heimholz	423	
Frasers	372	Heredity chart	356A	
Frigure-Coronet, Inc.	465	Hering	423	
Eugenics Record Office	53, 51A	Higgins, Charles, & Co.	371	
Evans, W. Sanford	122	High-low chart	275, 276B, 285A, 285B, 304B, 503	
Exhibits (See also Displays)	486-193	Hinks, A. R.	171	
Extrapolation	502	Historical map	204, 205	
F		Hoch, Fred W.	435	
Factory	257	Holden, Arthur C.	141	
Factory Management & Maintenance	82B, 83A, 83H, 87,	Hlover, John Edgar	499B	
	134H, 488A, 490A	House and Garden	31	
Federal Bureau of Investigation	499B	Hulshard, Henry D.	2, 52A, 52B	
Federal Chart Book	93A4, 93A, 93B, 93C, 270, 296B, 305	Hue (See also Color)	425A, 427B	
Federal Power Commission	35A, 97, 173B	Hurricane map	218	
Federal Reserve Board	500A	Hydrographic:		
Federal Reserve, New York	106A, 114B, 132A, 132B, 142,	Map	156	
	269A, 285A, 285H, 287A, 287B, 301B, 500A	Office	156	
Field, R. M.	68A, 68B, 72, 144A	Hypotenuse rectangle	384	
Film (See Camera)		I		
Kodachrome	399	Illustration board, Wotman	421	
First National Bank of Boston	179A	Illustrations, preparation	417-422	
Fisher, Irving	340	Imposition (See also Binding)	450, 452A	
Fixative	420A	Independent variable	263, 503	
Flat binding	451	Index numbers	114B, 112, 301-309, 347B, 363, 364, 503	
Fleischer & Co.	492A	India ink	371	
Florence, P. Sargent	56	Industrial & Engineering Chemistry	71	
Flow chart	73-80, 216-230, 502	Industrial Management	63B	
Flow map	216-230, 502	Industrial Tape Corporation	371	
Foisie, F. P.	37B, 250, 251	Ink	373	
Former Graftex	397D	India	371	
Food Industries	47	Inserts (See also Binding)	450	
Footnote	101	Intaglio printing	435, 437, 441C	
Ford Motor Co.	160, 490B	International Boundary Commission	156	
Forest Service	156	International Business Machines Corp.	40, 78A, 78B, 79,	
Form (See also Printing)	453, 502		80A, 80B, 377, 378	
Fortune Magazine	30, 94B, 177B	International Printing Ink Corp.	425, 427B, 428A	
French curve	369A	Interpolation	503	
Frequency:		Intertype:		
Bell chart	310	Corporation	436	
Curve chart	310-319, 502	Machine	436	
Distribution	101, 118, 180	Inverse relationship	282A, 460C	
Frisbee, Ira N.	24, 263, 292	Iron Age	276A, 350	
Fuchs & Lang Manufacturing Co.	453	Isometric	356B	
Funkhouser, Gray H.	24	Paper	357B	
G		Protractor	357A	
Gantt chart	256, 262, 502	J		
Gantt, Henry L.	262	Jaekel Fur Storage	455	
Gardner Displays Co.	486, 487A, 487B	Johnston, W. D., Jr.	356B, 357A, 469	
Gelatine duplicating machine	429	Jonas, S. Theo.	32	
Genealogy chart	53-58, 502	Jones, Victor O.	29B	
Genealogical chart sheet	56A, 57	K		
General Electric Co.	472	Kaplan, A. D. II.	325, 326	
General Land Office	156	Karsten, Karl G.	24, 263, 286, 343, 370	
Genetics chart	53-58, 502	Kaufmann & Fabry Co.	490B	
Geographic map	156	Kelsey Co.	376A	
Geologic map	156	Kenffel & Esser	156, 357B, 359A, 368B, 372, 373	
Geological Survey	155	Kep	302B, 394, 503	
Georgian Bay Canal	122	Map	155	
Gerard, Dave		Kleppner, Otto	421, 454	
Glossary	501-505	Knoepfel, Charles E.	262	
Golden Gate Exposition	494	Kodachrome film	399	
Goodyear Tire & Rubber Co.	266A	Kodak	398	
Government maps	155, 156, 160	Koh-I-Noor Pencil Co.	370	
Grade chart, pencil	369B	Konig	423	
Grafa-tone Co.	419	L		
Grain (See also Paper)	444	Labels	394	
Graphic narrative	25-32, 455, 502	Ladd-Franklin	423	
Gravure printing	441C	Lang	276A, 503	
Gray, Russell T., Inc.	72, 471	LaGuardia, Fiorello H.	499A	
Grid	383, 386, 502	Lanston Monotype Machine Co.	437, 438	
Guide map	161, 169, 156, 503	Lantern slides	405, 409	
Gulick, Luther	62, 70	La Rose, E. S.	329A	
Gun-shot chart	503	Laughlin, Harry H.	356A	
H		Legend	302B, 503	
Hackelman, Charles W.	439			

- | | | | |
|--|--|--|---|
| Leica: | | Mercator projection | 155 |
| Camera | 397A | Mereditin Publishing Co. | 123B |
| Manual | 401 | Metropolitan Life Insurance Co. | 18, 59A, 59B, 293B |
| Lewis, E., Inc. | 397A | Mirrofilm | 409 |
| Leyov lettering pens | 372, 473 | Miles, Russell N. | 416 |
| Lester, Henry M. | 101, 309 | Milton Bradley Co. | 121B |
| Pens: | | Mimeograph machine | 132A |
| Leyov | 372, 473 | Mimroscope | 133A |
| Wrico | 374A | Minnesota Mining and Manufacturing Co. | 371 |
| Photographic | 380 | Minnesota Valley Canning Company | 115A |
| Letterpress printing | 135, 411A | Mississippi River Commission | 156 |
| Letters, cut-out | 375 | Monotype | 117 |
| Liberty Magazine | 26 | Monsanto Chemical Co. | 368 |
| Life | 470 | Moores & Dunford | 154B |
| Lima Locomotive Works, Inc. | 457 | Morgan, Willard D. | 101, 109 |
| Linhof camera | 397F | Motion Picture Screen and Accessories Co. | 107A |
| Linoleum block | 415 | Moving average | 209, 286, 288H, 289, 291B, 503 |
| Linotype | 436 | Moving total | 503 |
| Literary Digest | 39A, 238 | Mudgett, Bruce D. | 35, 36 |
| Lithographers National Association, Inc. | 437 | Multidit | 431 |
| Lithographic printing | 436 | Multiple Axis chart | 309B |
| Lithographic Technical Foundation | 437 | Multiplex Display Institute Co. | 191A |
| Lithoprint Company of New York, Inc. | 131B | Munnell, A. H. | 423, 427 |
| Loewy, Raymond | 493A | Mutual Broadcasting Co. | 459 |
| Logarithmic scale | 503 | | |
| Lorentz chart | 331-338, 503 | N | |
| Lorrens, M. D. | 337 | National Association of Cost Accountants | 329A |
| Los Angeles: | | National Association of Motor Bus Operators | 182A |
| Times | 471 | | 281B, 286 |
| Union Railroad Station | 102A, 402B | National Automobile Chamber of Commerce | 190A |
| Luckiesh, Matthew | 428 | National Cash Register Co. | 407B |
| Luminous paint | 489 | National Educational Association | 133B, 275 |
| | | National Festival Association | 400B |
| M | | National Electric Light Association | 321A |
| MacElwee & Crandall, Inc. | 131B | National Industrial Conference Board | 111, 119, 136, 147, |
| Machine tabulation | 40 | 151, 307, 363, 364 | |
| Magazine of Wall Street | 111A, 301A, 308B | National Resources Board (See also Federal Chart Book) | 75, 95, 127B, 110, 161, 165, 166A, 168, |
| Magnifier | 411A | 171, 175, 183, 185, 198, 199, 210, 214, | |
| Manning, Warren H. | 171, 235 | 219, 222, 234A, 267, 291B | |
| Map: | | National Resources Committee (See National Resources Board.) | |
| Aerial | 160, 170, 177, 501 | National Machine Tool Builders Association | 193B |
| Air route | 156 | National Tube Co. | 406 |
| Base | 154 | Notion's Business | 466A |
| Chart (See also Statistical map) | 503 | Navigation map | 156 |
| Contour | 231-237, 502 | Navigational chart | 156 |
| Crosshatched | 178-186, 270, 502 | New Jersey Department of Institutions and Agencies | 316 |
| Distorted | 238-242, 459, 502 | New Jersey State Planning Board | 179B |
| Dot | 187-193, 502 | New York Building Congress | 141 |
| Flow | 216-230, 502 | New York City Tunnel Authority | 104A, 404B |
| Geographic | — | New York Employing Printers Association, Inc. | 435 |
| Geologic | — | New York Federal Reserve | 106A, 114B, 132A, 132B, 112, |
| Guide | — | 269A, 285A, 285B, 287B, 294A, | |
| Historical | 161-169, 456, 503 | 301A, 301B, 309A, 361B | |
| Hurricane | — | New York Herald Tribune | 11, 13, 183A, 285C, 468, |
| Hydrographic | — | 488A, 499A | |
| Information Office | — | New York Journal & American | 29A |
| Key | — | New York Times | 63A, 479B, 480A |
| Measuring device | — | New York World-Telegram | 469 |
| Mechanical intensity shading | 182B | New York World's Fair, 1939 | 60, 159, 207, 279, 293B, |
| Navigation | — | 330A, 492B, 493A, 495B, 496 | |
| Orange-peel | — | New Yorker | 466B, 467A |
| Pictorial | 167, 168, 169, 180B, 504 | Newton | 423 |
| Pin | 187-193, 497, 499B, 504 | Nolan, T. V. | 356B, 357A |
| Projection (See Projection.) | | Normal, deviation from | 271B |
| Proportional | — | Normal trend | 286 |
| Relief | 170, 177, 192B, 505 | North Jersey Transit Commission | 227 |
| Route | 161-169, 505 | | |
| Statistical | 153-242, 505 | O | |
| Topographic | 156, 155, 233A | Office of Indian Affairs | 156 |
| Traffic | 202B, 219, 222, 223, 221A, 224B, 227, 229, 505 | Offset Gravure Corp. | 32 |
| Weather | 216A, 216B, 217A, 218, 232A, 232B, 233B, 234A, 236 | Offset: | |
| With bar chart | 200-207 | Ink | 453 |
| With circle chart | 194-199 | Printing | 436 |
| With curve chart | 196, 197, 208-210, 263, 274 | Odgen, C. K. | 26 |
| With sector chart | — | Dhive chart | 331, 338, 503 |
| With symbols | 211-215 | 100% band chart | 291, 297B, 503 |
| Marchand Diorama Corp. | 494 | 100% bar chart | 51, 88, 92, 105, 123A, 128A, 132, |
| Market basket | 265A, 265B | 137A, 139A, 144B, 151A, 152, 294, | |
| Marks, Lionel S. | 398 | 297B, 151A, 560A, 501 | |
| Massachusetts Institute of Technology | 152 | Stamp | 92 |
| Maxwell | 423 | 100% block chart | 119, 152, 504 |
| Mead Corp. | 413, 446, 448, 453 | 100% square chart | 119, 152, 504 |
| Mechanical intensity shading map | 182B | Opacity (See also Paper) | 443 |
| Median | 120, 135A | Optical illusion | 313 |
| Mercator, Gerardus | — | | |

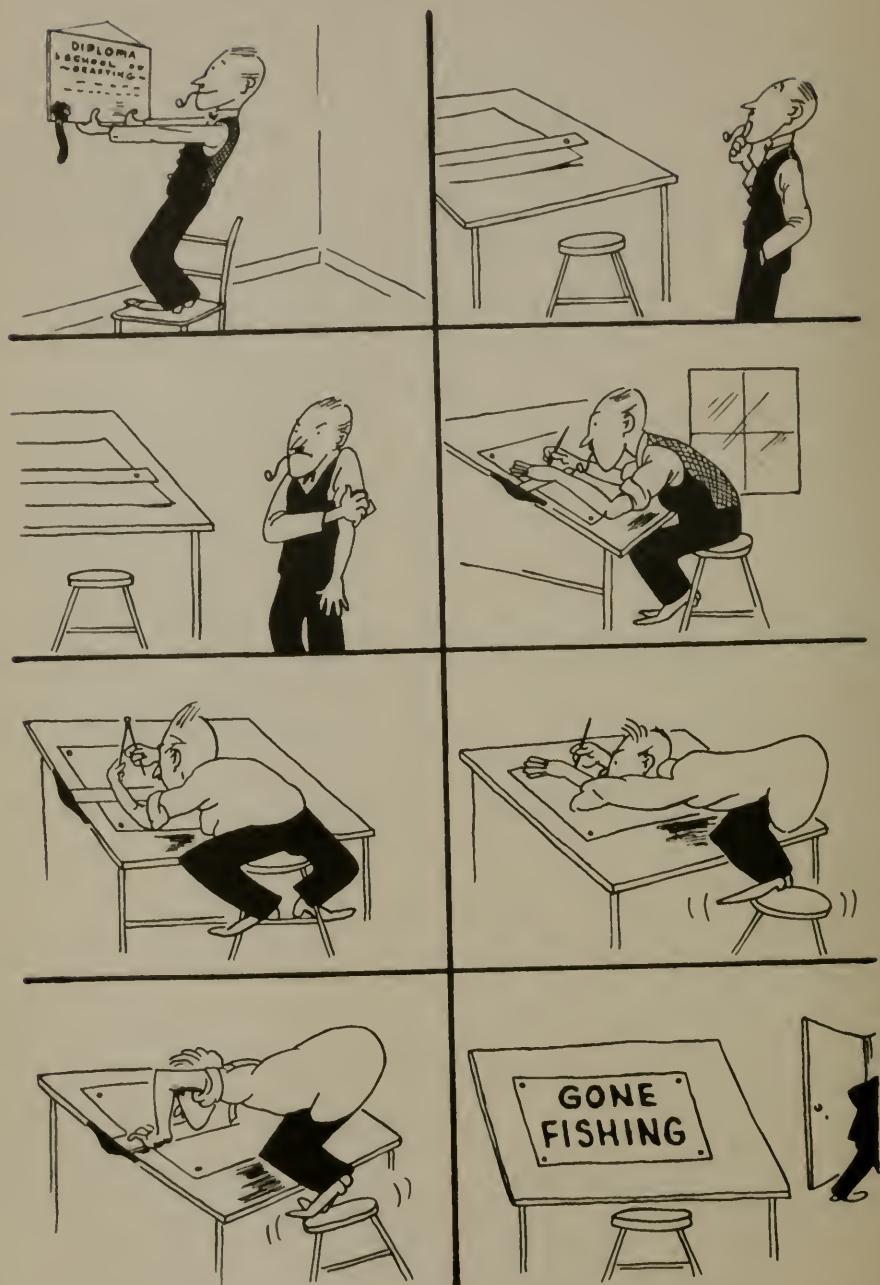
GRAPHIC PRESENTATION

Orange-peel map	158	Projectors (See also Lantern slides)	498, 500B, 500C
Organization chart	59, 67, 105, 504	Proofreader's marks	442
Oring, Guy	454	Proportional map	504
Orthographic projection	154	Protractor	368B
Orthological Institute	27	Isometric	357A
Ostwald	427	Public Service Company of Northern Illinois	460A
P			
Pacific Gas & Electric Co.	355A	Quantitative cartoons	464-474
Paper:		Quantitative posters	475-478
Colored	371		
Cross-section (See also Cross-section paper)	367		
Machine	443		
Pressure bulkier	444		
Selection of	443-448		
Utility	367		
Paragon Revolute Corporation	111		
Pasadena, California, City Manager	66, 268		
Patton, Alison C.	21		
Paullin, Charles O.	153, 204, 205		
Payne Fund	27		
Pease, C. F., Co.	430, 431		
Pedigree chart (See also Genealogy and Genetics charts)	43		
Pencil lengthener	370		
Pen, ruling	374B		
Percentage chart	294, 298A		
Band chart	504		
Bar chart	504		
Curve chart	504		
Perfex camera	397B		
Perkins, R. F., & Sons, Inc.	444		
Perozzo, Luigi	358		
Philadelphia Evening Bulletin	35B		
Photo-Engravers Board of Trade	416, 417		
Photoengraving	421		
Photograph, instructions for handling	412, 413		
Photomontage	401A		
Photomural	498, 490B, 498		
Pica type	376B		
Pictogram	504		
Pictorial chart	114A, 457, 461		
Bar chart	121-131, 211, 365, 504		
Map	167, 168, 169, 480B, 504		
Pie chart	504		
Pike, E. W., & Company	411A		
Pin	192B, 193		
Map	187-193, 497, 499B, 504		
Planographic printing	435, 436, 441B		
Plates (See also Printing)	504		
Playfair, William	81, 266B		
Plotting	504		
Plymouth Motor Corp.	488A		
Pneumatic Scale Corp., Ltd.	490A		
Pogue, Joseph E.	284B, 330H, 332B, 340		
Polyconic projection	155		
Poster Products, Inc.	371, 375		
Posters, quantitative	475-478		
Power	86B		
Printer's Ink	242, 259A		
Printing	435-442		
Gravure	437, 441C		
Intaglio	435, 437, 441C		
Letterpress	435, 441A		
Lithographic	436		
Offset	436		
Planographic	435, 436, 441B		
Press, portable	376A		
Relief	435, 441A		
Rotogravure	437		
Probability paper	333B, 338		
Procedure chart	504		
Process chart	504		
Product Engineering	269B		
Production control chart	504		
Production Yearbook (See Colton Press.)			
Profit graph	328B		
Progress chart	256-262, 462, 504		
Progressive average	286, 288A, 504		
Projection:			
Azimuthal	176		
Map	171		
Mercator	155		
Orthographic	154		
Polyconic	155		
Stereographic	154		
Projectors (See also Lantern slides)			
Proofreader's marks			
Proportional map			
Protractor			
Isometric			
Public Service Company of Northern Illinois			
Q			
Quantitative cartoons			
Quantitative posters			
R			
Raisz, Erwin			
Rand McNally & Co.			
Range bar chart		285A, 285B, 361B, 504	
Rank chart			
Rate-of-change chart			
Rating chart		243-246, 504	
Ratio chart		339-353, 504	
Paper			
Reading, England, County Borough of			
Redcent Letter Co.			
Reducing glass			
Reference symbol		382, 395	
Hegensteiner Corp.		441A, 441B, 441C	
Regional Plan Association		184, 202B	
Reinforcements (See also Binding)			
Relationship chart		68-72, 505	
Relative bar chart			
Relief Map		170-177, 492B, 505	
Relief printing		441A, 435	
Reproduction, methods		429-431	
Review of Review		312B	
Rhodes, Henry J.			
Hice, John L.			
Richardson, Arthur H.			
Richmond, Leonard			
Riggelman, John H.			
Rint, Charles			
Roberts, Welden, Rubber Co.			
Holleiflex camera			
Hoot-two			
Ross, Charles J., Co.			
Rotogravure printing		420A	
Route map		413, 437	
Royal Statistical Society of London		161-169, 505	
Rubber cement			
Ruling:			
Horizontal		382, 383	
Pen			
Vertical		382, 383, 389, 391	
S			
Sales Management		127A, 135A, 173	
Sampling		178, 187	
Sargent, Walter			
Saseo Photo Products			
Saturday Evening Post			
Seacheri, Mario and Mabel			
Scale			
Broken			
For area of circle			
Time			
Scallop copy			
Scatter chart		320, 321A, 321B, 505	
Schraier, J. F.			
Schedule chart			
Science Service, Inc.			
Screen			
Seattle Star			
Sector chart		183B	
Cumulative		81-91, 363, 505	
Made on typewriter			
On map			
Semi-logarithmic chart			
Shading (See also Halftone and Crosshatching)			
Halftone			
Crosshatching			
98, 100, 116, 180, 186, 278A, 278B,			
350, 380, 420B, 421, 422			
Shading film			
Shaw Blue Print Machine Co.			
Shewhart, W. A.			
Shot-gun chart			
Signature (See also Printing)			
Simonds, Frank			
Sinclair, Prior			
Slide rule			
		328B	
		411B	

INDEX

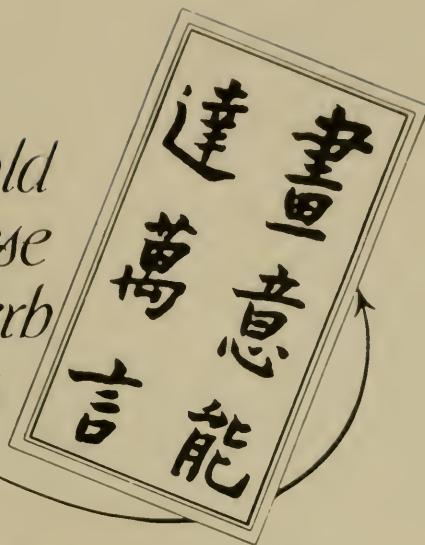
- Smith, L. C., Typewriter Co. 376B
 Smith, W. H. 262
 Smith-sewed binding 150
 Soderstrom, Walter 137
 Soil Conservation Service 160
 South Manchuria Railway Co. 90B
 Spacing divider 174B
 Speed Graphic camera 397D
 Speedway Manufacturing Co. 491B
 Speidel, Charles W., Co. 372
 Spencer Lens Co. 105D
 Spindler & Sauppe, Inc. 106A
 Spiral Binding Co. 151
 Stahl, Gustav R. 361A
 Stair chart 135B, 261A, 287B, 505
 Stamping (See also Binding) 151
 Standard Mailing Machine Co. 432B
 Standard Statistics, Inc. 50H, 264A, 281A, 282A, 292, 306B
 Standards for Graphic Presentation, Committee (See Time Series Charts.)
 Stanford University 322
 Statistical map 153, 242, 505
 Statistician's scale 353
 Steiner Paper Co. 422
 Stereographic projection 154
 Stereotype 421
 Stevens Hotel 356
 Strobilite Co. 489
 Sunray Scratch board 122
 Surface chart 294, 505
 Symbol 121
 On map 211-215
 Reference 382, 395
- T**
- Tablet & Ticket Co. 375
 Tabulation 33-42, 39n, 505
 Mechanical 40
 Tack 193
 Tales, B. B. 170
 Tailoring 33, 34
 Tebbutt, Arthur R. 24
 Temmoneroff, V. A. 24, 309B, 333B, 334, 335, 370
 Textile Economics Bureau, Inc. 347B, 352
 Textile World 27
 This Week 473B
 Thorndike, Clark 461
 Three-dimensional method 354-359, 505
 Time scale 392
 Time Series Charts 113, 116, 264, 272, 280, 298, 299, 318, 349, 381-396, 410, 441
 Topical index 1, 247
 Topographic map 155, 156, 233A
 Toronto Industrial Commission 162B, 190B
 Tracy, M. E. 125B
 Traffic chart (See also Traffic map) 74A
 Traffic map 202B, 219, 222, 223, 224A, 224B, 227, 229, 505
 Transcontinental and Western Air, Inc. 462
 Transit Journal 365
 Transograph Corporation 419, 153
 Transograph shading film 419, 453
 Transparent material 32, 368
 Travelers Insurance Company 32, 42, 319A, 478
 Trend 131B, 275, 284B, 285C, 286, 292, 385, 463
 Trenholm, J. T., & Company 361A
 Triangles 369A
 Triangular.
 Coordinate paper 359A
 Scale 353
 Tricolor camera 398A
 Tricolor Kevin camera 398A
 Trilinear chart 359A, 359B
 T-square 369A
 Turntable 491B, 492A
 Two-directional bar chart 505
 Two-way bar chart 505
 Type:
 Face 453
 Size 438, 453
 Style 439
 Typewriter 377
 Electric 379
 Styles 376B
- Ultra-violet paint 189
 Underwood Elliot Fisher Company 476
 Union Railroad Station, Los Angeles 102A, 402B
 University of Chicago Press 449
 United States Government:
 Army, Corps of Engineers 156
 Bureau of Agricultural Economics 160
 Bureau of Chemistry and Soils 160
 Bureau of Public Roads 160, 495A
 Bureau of Reclamation 156
 Civilian Conservation Corps 61A
 Coast and Geodetic Survey 156, 158
 Department of Agriculture 84, 88A, 89B, 101, 115B, 181, 191, 195, 202A, 271, 277, 278B, 280B, 289, 295, 302B, 313, 314, 321B, 324, 362, 422, 495A
 Department of Commerce 76, 129B, 139A, 139B, 271A, 297A, 404A, 328A, 416, 338
 Department of Interior 41, 46, 69
 Department of Justice 499B
 Department of Labor 37A, 67, 86L, 106B, 130, 308A
 Employment Service 290
 Farm Credit Administration 281A
 Federal Bureau of Investigation 199B
 Federal Power Commission 15A, 97, 173B
 Federal Reserve Board 500A
 Forest Service 156
 General Land Office 156
 Geological Survey 155
 United States Government—Continued
 Maps 155, 156, 160
 National Resources Board (See National Resources Board) 156
 Office of Indian Affairs 156
 Soil Conservation Service 160
 Works Progress Administration 61B, 82A, 96, 99, 102A, 103A, 103B, 104, 105, 107A, 108A, 110, 112, 115B, 120, 133A, 134A, 136, 137A, 137B, 141B, 149, 149, 177A, 178, 180, 182B, 187, 188A, 188B, 189, 211, 230, 234B, 278, 296A, 300, 304B, 306A, 310, 311, 312, 315, 317, 341, 342A, 343, 345, 346
 United States Gypsum Company 477
 United States News 28A
 United States Steel Company 491, 495B
 Utility paper 367
- V**
- Value (See also Color) 425B, 427B
 Van Cleef Bros. 371
 Variable 320
 Dependent 263, 502
 Independent 263, 503
 Vari-Typer 379
 Visual captions 38A, 38B, 39, 42, 129, 131A, 249, 263, 265A, 265B, 266A, 267, 365
- W**
- Walker Engraving Corporation 25
 Walker, Helen M. 24, 35
 Ward, Robert 231
 Warren, F. D., Company 448
 Weather map 216A, 216B, 217A, 218, 232A, 232B, 233B, 234A, 236
 Weber, Martin J. 380, 401B
 Welch, W. M., Manufacturing Company 52A, 52B
 Welp, George 427B
 Wenzel, J. 313
 Westinghouse Electric Manufacturing Company 64
 Wheelwright, William Bond 443
 Whiting-Plover Paper Company 426
 Wirestitched binding 450
 Wood block 415
 Wood-Began Instrument Company 374A
 World's Work 342B
 Wotman Illustration board 421
 Wire-lettering pen 374A
 Wyer, S. S. 100
- Y**
- Young, Charles M. 332A, 423
- Z**
- Zee chart 505
 Zeiss, Carl, Inc. 397C
 Zero line 382, 386, 387, 458
 Zip-a-Tone Company 419

GRAPHIC PRESENTATION



Redrawn. Courtesy of Dave Gerard, Crawfordsville, Indiana

*An old
Chinese
Proverb
says*



**"ONE PICTURE IS WORTH
TEN THOUSAND WORDS"**

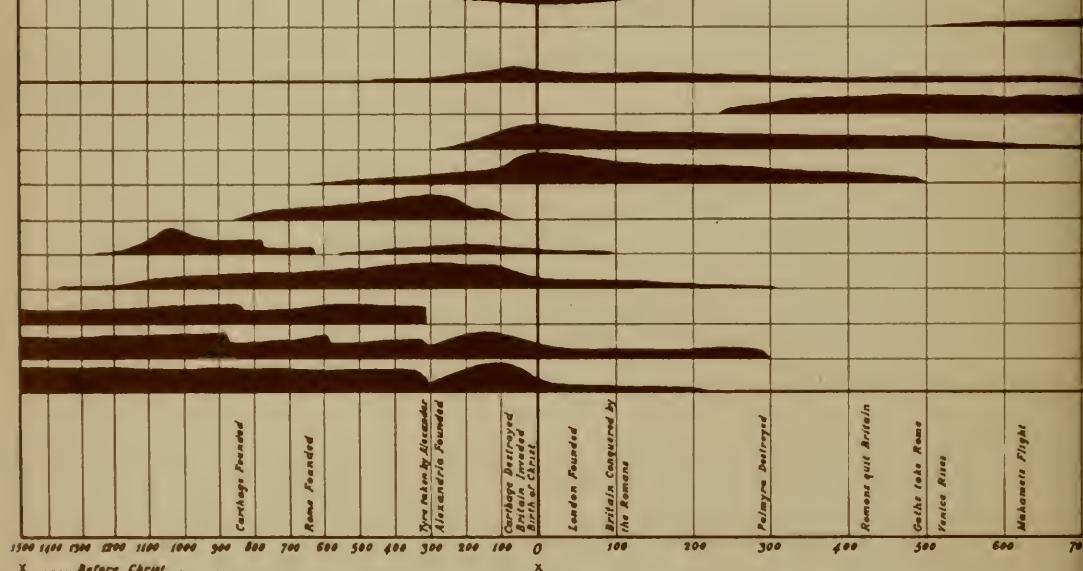
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of
UNIVERSAL COMMERCIAL HISTORY,

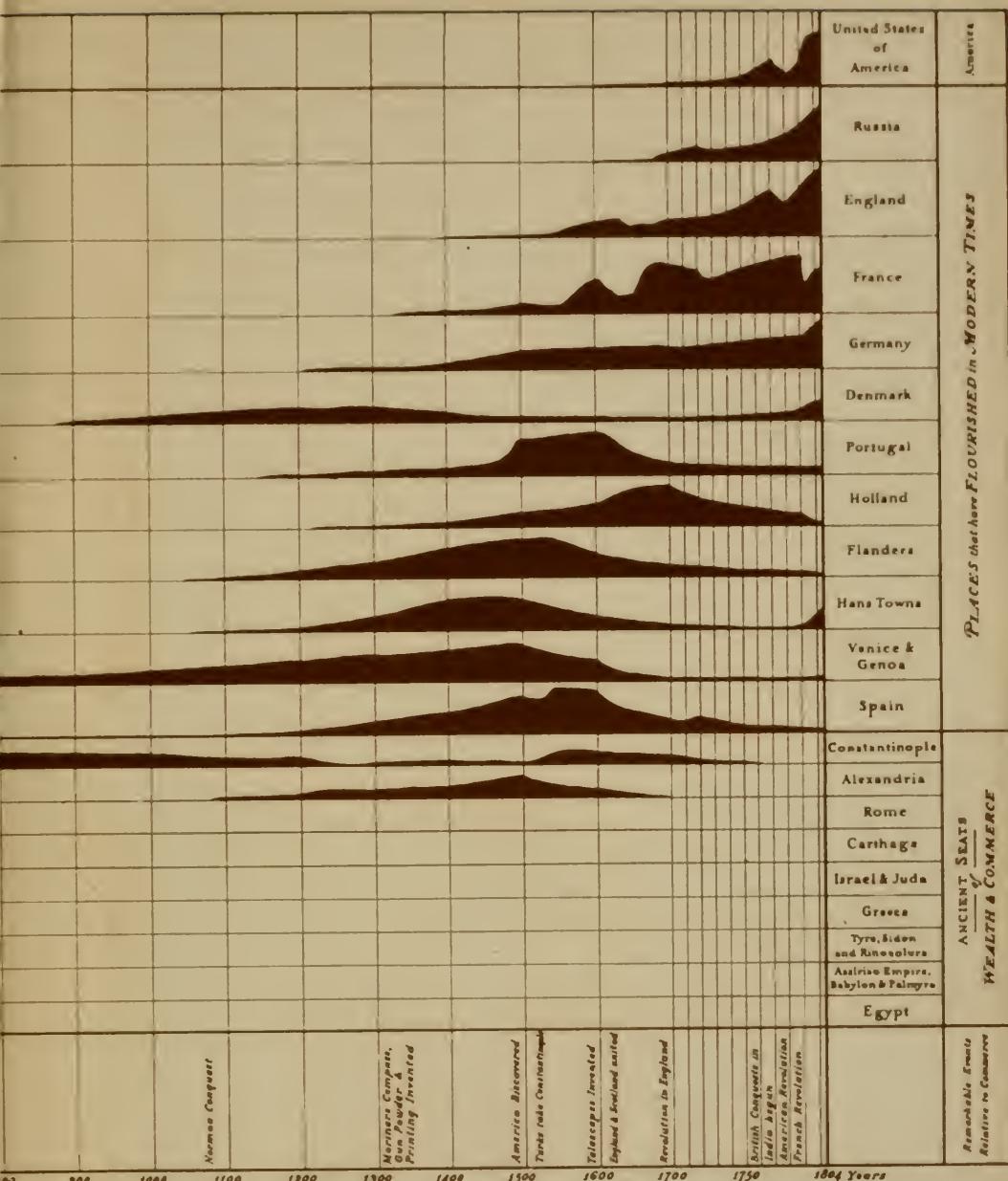
*From the Year 1500 before the Christian Era
to the present Year 1805.*

being a space of Three Thousand three hundred & four Years.

By
WILLIAM PLAYFAIR.

Inventor of Linear Arithmetic.





From Frontispiece of Book by WILLIAM PLAYFAIR, An Inquiry Into the Permanent Causes of the Decline and Fall of Powerful and Wealthy Nations, London, 1805.

