

The Economic Significance of Replacement Cycles in Demand

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For many generations, the even flow of trade among peoples has been interrupted by recurring depressions. Abnormally high levels of commerce have always preceded the serious declines. It is neither logical nor sufficient to explain a disastrous decline in business by stating that the levels before the decline were too high and characterized by excessive inflation. What produced these latter conditions?

This study is concerned not only with the periods of enforced retrenchment but also with those eras of high business levels which invariably precede them. The effort has been made to discover and isolate the underlying causes of these recurring fluctuations. By underlying causes is meant the initial influences, invisible and undetermined at the time, which set in motion the multitude of powerful and obvious forces which are almost instantly transformed into potent sources of further change. The only consistent or normal characteristic of business trends is constant change.

It cannot be seriously doubted that the various indexes of business and the paths described by them are but the composite results of many components. Why, therefore, is it not logical to investigate the movements of general business by analyzing the fluctuations of its principal components?

EXCESSIVE fluctuations in a power circuit can only be traced to their source and eliminated by determining the characteristics of each important component of the load. What are the dominating units in the many divisions of trade and production?

The final objective of all productive enterprise of every kind is the satisfaction of individualistic requirements which in integrated form we know as "consumer demand." There is no kind of so-called "producer goods" which is not made solely as part of the process of supplying the wants of individuals. The cost of all such production is normally and eventually borne by the ultimate consumer as part of the cost he pays for goods used by him.

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Contributed by the Management Division and presented at the Semi-Annual Meeting, Chicago, Ill., June 26 to 30, 1933, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

NOTE: Statements and opinions advanced in papers are to be understood as individual expressions of their authors, and not those of the Society.

Depreciation and obsolescence charges bring this about. Even that portion of such costs as may be at times charged off in some form of liquidation losses is borne by the consumer. All taxes direct or indirect are finally paid by this same individual. These elements embrace all costs and are all paid out of individual income. There is no other source. Since the cost of all producer goods is finally paid by the ultimate consumer, such cost is but part of the total he pays. It is difficult to conceive of the part assuming greater importance than the whole.

Inasmuch as the individual pays all costs and since the ultimate objective of all productive and commercial effort is the satisfaction of individual wants, we may gain a good idea of the relative importance of basic activities by determining the purpose for which consumers' major expenditures are made. Analysis of existing data upon this subject indicates that when weighted for the various groups within the different income classes in the United States approximately 70 per cent of all individual income is expended for the three essentials, food, clothing, and shelter. If to this large percentage we add the expenditures for automobiles in this country, the total will be close to 75 per cent of consumer income. The Ministry of Labour estimates that, in Great Britain, 88 per cent of wage earners' income is expended for food, clothing, and shelter. We therefore find that in the United States three-quarters of individual income which pays for everything is expended for these four important requirements. This leaves but 25 per cent for the great variety of other expenditures and savings. It should be obvious at once that the combined influence of these four non-duplicating elements must govern to a great extent the movements of all business.

What do we find when we analyze the trends of these four industries? These facts stand out:

- (1) No two of these industries follow the same path
- (2) No one of them describes with fidelity the trend of aggregate business as pictured by the various accepted indexes
- (3) When the four are combined on a weighted basis, the composite trend reproduces with significant fidelity the trend of aggregate business.

In a sense this latter condition is the pivotal point of this study. Considering the great importance and differing characteristics of these industries, a logical and mathematical conclusion may be drawn. Briefly it is that consumer demand, dominated by these four outstanding requirements, sets the pace for all industry. There are at least two analogous developments of scientific acceptance and use that are well known and afford a basis for this reasoning. One is the analysis of sound waves into their simple components and the other is the similar resolution of electric voltage and current wave forms into their various component waves.

In these two divisions of scientific endeavor it is accepted without question that the shape of a composite wave is due to the shape and relative importance of the individual components. Likewise, it follows that the contour of the aggregate business trend is due to the weighted contours of its components. It may be reasoned directly therefrom that if definite causes can be discovered for the varying and dissimilar performance of the

predominant industries, causes for the variations in the composite trend will have been determined. This study undertakes to develop these explanations.

Business normally pursues a wave-like course with the passage of time. Used in its correct sense, the term "cyclical" may be applied to this progression. This is true of all industries. The use of the term "cyclical" does not imply waves of equal length but merely wave-like fluctuations that may or may not be equal in length or duration. While all industries are subject to cyclical fluctuations, some of them also manifest certain periodic tendencies, that is, they tend to follow a rhythmic variation in which the wave lengths or time intervals are approximately equal. Due to certain fundamental characteristics inherent in them, the maintenance of periodic fluctuation is more constant in some industries than in others. As will be described later in this study, the reason suggested for the periodic characteristic of some industries is what we have termed the "replacement cycle." This is a phenomenon of demand that tends to reassert itself at intervals following some prior distortion in demand of sufficient magnitude to cause an appreciable disturbance.

It is a fact set forth in the statistical history of the industries themselves that all of the four major industries analyzed in this study were simultaneously depressed in the period of 1920 and 1921 and did not again reach this condition of common agreement in downward trend until 1929 and 1930. These years mark the last two major depressions. Intervening, were the milder depression of 1924 and the even milder one of 1927. At these times only part of these four industries were at abnormally low levels. In similar manner we find that the periods of extraordinary prosperity are marked by a general agreement in timing of the higher levels of the component industries. The conclusions suggested in no way minimize the importance of credit and other monetary questions affecting these situations. Increasing volume of business begets increased volume of credit, and declining volume of business forces liquidation commensurate with the severity of decline. We must explain this fluctuation in demand. In the replacement cycle, we have both a cause for, and an explanation of a variation in demand that is not induced by a prior change in income levels but which will actually precede such a change in income, either upward or downward.

It should be clearly stated that in the prosecution of this study the first step was the accumulation of available, pertinent facts and the second was the interpretation of these facts. Out of this sequence were developed the conclusions set forth in this paper. The investigation was begun with no preconceived notions and with no predetermined conclusions to which the evidence was to be fitted.

The question may arise in the minds of many that a study omitting such important industries as iron and steel and the railroads, for example, must be inconclusive. The answer to this does not depreciate the importance of these industries but rather defines their sequence in these economic movements. Important as they are, they still owe their very existence to the requirements of individuals. Of first rank in the sequence of movements are those industries which produce commodities actually used and consumed by individuals. The backbone of the iron and steel industries is the demand from the railroad, automotive, and building industries. The very life-blood of the railroads is the traffic flow engendered by the movement and consumption of goods in other industries. Neither the iron and steel business nor the railroads can show any improvement in their business levels without prior improvement in the industries which they serve. The iron and steel business may be accepted as a barometer of trade conditions, but the fact remains it is an averaging point for changes that precede it.

If it can be ultimately shown that the repeated economic disturbances are largely the result of unobserved changes in individual demand induced by some prior major disturbance and that these initial, causative changes are due to thoroughly natural buying programs on the part of the great mass of the people, some of the bitterness should be eliminated from our consideration of constructive measures. Real remedies may then find expression in cooperative rather than antagonistic views and actions.

METHOD OF APPROACH

The data utilized in this study are largely in index form. For this purpose the indexes of productive activity computed by the Federal Reserve Board for the food, textile, and building industries were used. The actual output of motor cars was used for the automotive industry. The first, second, and fourth are purely quantitative while the third, embracing contracts awarded, involves the element of value. This latter index is more commonly used.

One modification, however, of the existing data was made for significant reasons. The period chosen as unity or 100 per cent for the Federal Reserve Board data embraces the interval from 1923 to 1925, inclusive. Both the Federal Reserve Board and the Department of Commerce use this period as a basis for measuring trends. It is undoubtedly the longest period adopted as standard in this country for such extensive series of data as published by these two organizations. This interval or shorter ones are entirely satisfactory for tracing the paths of individual industries but are not long enough to measure accurately their relative importance with respect to each other. As an example of this, it may be said that the years 1923 to 1925, inclusive, were in an era of abnormally high building activity and to accept this level as normal for building involves an error when the concurrent levels of other industries are to be compared with it. It is also a fact that, if a composite wave length such as that of aggregate business is to be broken up into its components, the more rapidly fluctuating industries should be related in correct proportion to the longer wave taken as standard. For these reasons, the data previously mentioned were converted from the 3-year base of 1923 to 1925 to the 10-year base of 1920 to 1929. This has the technical advantage of setting up as standard a full span of years between major depressions.

This conception of the statistical problem suggests that the various statistical agencies, both private and public as they exist in this country, might do well to agree upon a common standard of sufficient length to provide adequate accuracy for all purposes, rather than to base their data upon such widely varying times and periods. This would greatly facilitate the comparative use of such data.

In the indexes used in this analysis, the 10-year average for each of the twelve months of the year is used as 100 per cent and all points on the trends represent the activity for the corresponding months expressed as a percentage of the 10-year average for that month. Seasonal movements are thus eliminated or thoroughly minimized. Other and more extended methods involving a much greater expenditure of time would result only in refinements that would not affect the conclusions drawn. The various charts computed in this manner, therefore, show both secular trends and non-seasonal deviations therefrom. It is these non-seasonal deviations that become so highly significant in this work.

FACTS DEVELOPED

The outstanding characteristics of the trends shown by this data will be briefly summarized for each industry and will be illustrated in each case by charts.

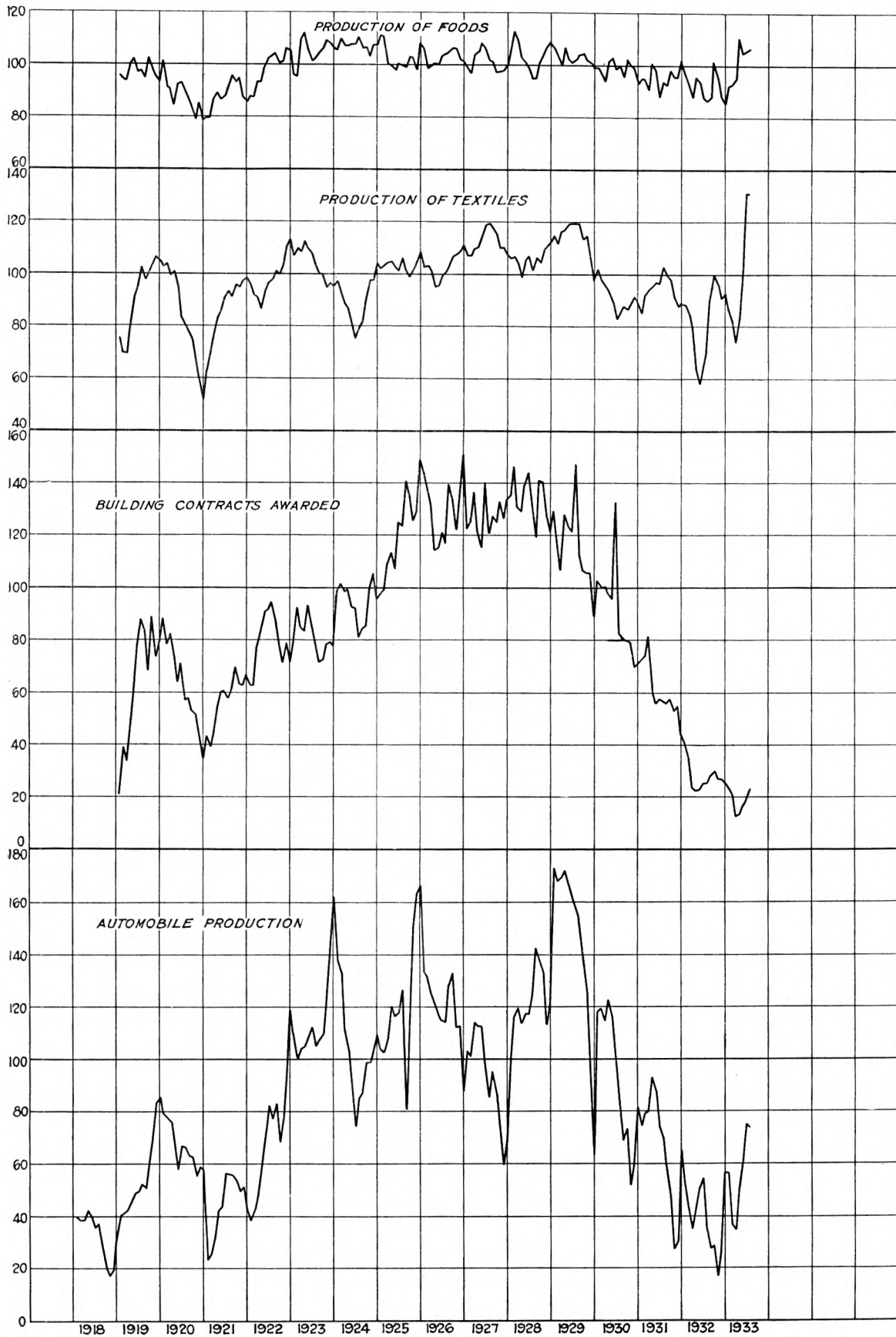


FIG. 1 PRODUCTION INDEXES FOR FOODS, TEXTILES, BUILDING CONSTRUCTION, AND AUTOMOBILES

Food Production. The trends in food production are shown by the first chart in Fig. 1. Food production maintains a sharp reversal in production from time to time but these fluctuations are irregular in timing and deviate but little from an average trend. This is to be expected as man must eat to live and his capacity and requirements are very uniform. The secular trend in this industry should properly show a slight upward inclination to the right. It does not do so chiefly because it has not been adjusted for the gradual decline in recent years in the consumption of meats and grains and coincident increase in the use of fruits and vegetables. During times of economic stress there is always a reduction in the demand for the less essential foods and at the same time a decline in the amount of food thrown away. This naturally results in a slight decline in food production of some types.

Textile Production. By far the predominant class of textiles is clothing. The second chart in Fig. 1 indicates the progress of this industry. This trend is very striking. The secular increase is definitely shown but the graph is chiefly significant for two other reasons. First, deviation from the average trend is much wider than that for foods and second, the variations are sharply periodic. It will be noticed that there are clearly depressed levels of varying intensity every other year. The low areas are in the even- and the high levels in the odd-numbered years. While the effect of the present depression has been to lower the level of operations, the sharp periodicity has continued to the present time. In other words, the peculiar periodicity has not been destroyed by the present economic crisis up to this time. While this index of production levels is based largely on spindle activity, the same oscillating trends are shown in number of people employed and wages paid. These are completely independent data that cover the whole industry.

Building Construction. The third major activity of man is the provision of shelter for his family and his various pursuits. Building construction constitutes by far the greatest single class of man's fixed assets which he himself produces. The third chart in Fig. 1 portrays the activity in this industry. This picture is characterized by an extremely irregular month-to-month movement, a rapid increase in trend up to 1926 followed by an even more rapid decline beginning early in 1928 and by a wide divergence from the average.

The irregular movements from month to month are to be expected from the highly individualistic and widely scattered nature of the business. The rapid increase in trend up to 1926 calls for further explanation which will be given later. The wide divergence from average is also a subject for later discussion but it may be said that conditions of the industry make possible extreme activity at times to be followed by extensive recessions. Due to long structural life and the ability to "double-up" in the use of shelter, deferment of additional construction may continue long after any real surplus of housing has disappeared.

Residences should be considered solely as consumer goods for purpose of this analysis. Residential construction is such an important part of the total building program that the trend of the whole industry normally assumes that of the residential component. The importance of the residential division may be illustrated by the data in Table 1. These data show the importance of each class of construction regularly included in the statistics gathered by the F. W. Dodge Corporation. The proportions shown are based on totals of each class for the five-year period from 1925 to 1929, inclusive.

These figures show that residential construction is virtually as large as the next three largest classes combined but this does not express the full measure of importance. The F. W. Dodge statistics on residential construction do not include the projects valued at less than five thousand dollars each.

TABLE 1 RELATIVE BUILDING CONSTRUCTION VALUES IN 37 STATES

Class	Per cent of total value
Residential.....	40.9
Public works and utilities.....	18.9
Commercial.....	14.6
Industrial.....	9.9
Educational.....	6.3
Social and recreational.....	3.6
Hospital and institutional.....	2.3
Religious and memorial.....	2.2
Public.....	1.3
Total.....	100.0

If these were included the ratio of residential to total construction, conservatively stated, would be at least 55 to 60 per cent. The great importance of individual requirements in this tremendous industry is very significant. Incidentally, the extreme futility of attempting to initiate recovery by an increase in public-building construction should be indicated by the very small value of this class in a period of great activity in such work.

The great irregularity in the trend of building construction during the relatively short period covered makes it difficult to draw definite conclusions regarding any trend toward periodicity. Standard Statistics Company, utilizing available sources of data, has compiled a statement covering probable annual building construction based on contracts awarded in millions of square feet. These data are shown by them in adjusted series from 1900 to 1930, inclusive. From this source the data shown in Table 2 were derived.

There is obviously a strong tendency toward a 3-year periodicity measured in annual terms only. This is apparent in years intervening both between successive peaks and successive valleys. In each case where the interval between peaks was 4 or 6 years instead of 3 years there was an interrupting influence in the form of a business depression. These may be defined as the depressions of 1907, 1914, 1921, and 1924. The present depression is having the same effect and the extension of decline has been carried through the year 1932, making the longest decline in building construction since the turn of the century.

Irrespective of cause, the effect of such depressions would be to retard construction and to interfere with any influences that might otherwise be at work.

TABLE 2 PERIODS OF FLUCTUATION IN BUILDING CONSTRUCTION

High volume	Intervening difference, years	Low volume	Intervening difference, years	Decline, per cent	Years of decline ^a
1905 ^b	4	1908	..	18.6	3
1909	4	1911	3	17.0	2
1912	3	1914	3	14.4	2
1916	4	1917	3	16.8	1
1919	3	1921	4	31.0	2
1925	6	1927	6	9.6	2
1928	3		..		..

^a Annual basis only.

^b Construction volume in 1906 was only 0.8 of one per cent less than that of 1905. If 1906 had chanced to be larger than 1905, the intervening difference first shown between high points would have been three years instead of four, and under "years of decline" the first figure would have been two years instead of three years.

There is another peculiar manifestation in these figures which calls for examination. Reference was made earlier to the rapidly rising trend in construction levels up to 1926 followed by the sharp decline beginning early in 1928 as shown by the third chart in Fig. 1. The data developed by Standard Statistics offer a means for further analysis. This series was smoothed by calculating a 3-year running average and plotting the averages at the middle year. The results of this are displayed in Fig. 2. The normal shown in this chart was calculated by Standard Statistics from the data as compiled by them. This chart shows two very striking and sustained peaks centering, respectively, in 1906 and 1926, that is, just 20 years apart. The peaks are so

evident that no real question as to their existence can be raised. The behavior of this trend and the interpretation to be made later suggest that the computed normal may be somewhat high, especially in the later years. This thought is also supported by the fact that the building normal as calculated is increasing materially faster than population in this 30-year interval. While population was increasing by 65 per cent, the calculated normal for building construction increased 130 per cent. A relative increase in building construction is to be expected but the difference in this case seems too great. This has some significance in view of later interpretation.

The trend of building construction shown in this analysis seems to be composed, since 1900, of two major waves some 20 years apart superimposed on the top of which are ripples of a predominating length of 3 years. The immediate effect of depressions is to cause some deviation from this interval. It should be understood that this three-year period is assumed to be approximate in view of the fact that monthly data throughout this interval are not available.

Automobile Production. With the development of our present mode of living and with the prevailing distribution of population and trade, individual transportation by motor car has become a necessity for many people. The automobile is one of the most widely distributed articles of high unit value and is predominantly utilized in the transportation requirements of the individual. As far as this country is concerned, the automotive industry is one of man's most important economic activities.

Automobile production by years as reported by the National Automobile Chamber of Commerce is recorded in Table 3.

In the foregoing table the combined production of cars and trucks is shown in order to indicate the full activity of the industry. In general, the declines in a number of the years indicated would have been numerically greater if passenger cars only were listed. The passenger car is by a wide margin the predominating factor in the industry.

While annual production is shown in Table 3, the fourth chart in Fig. 1 shows the trend of the industry by months from 1918 to 1932, inclusive. The terrific non-seasonal fluctuations in this important industry are apparent at a glance. Table 3 shows that the first decline in annual output in this industry was encountered in 1918. Since then declines have occurred at intervals of 3 years or in 1921, 1924, 1927, and 1930. The continued decline in 1931 and 1932 is the first time such a decline has exceeded one calendar year. The significance of these three-year fluctuations will be discussed later.

TABLE 3 PASSENGER CAR AND TRUCK PRODUCTION IN THE UNITED STATES

Year	Number	Year	Number	Year	Number
1900	4,192	1911	210,000	1922	2,544,176
1901	7,000	1912	378,000	1923	4,034,012
1902	9,000	1913	485,000	1924	3,602,540 ^a
1903	11,235	1914	569,054	1925	4,265,830
1904	22,830	1915	969,930	1926	4,300,934
1905	25,000	1916	1,617,708	1927	3,401,326 ^a
1906	34,000	1917	1,873,949	1928	4,358,748
1907	44,000	1918	1,170,686 ^a	1929	5,358,414
1908	65,000	1919	1,933,595	1930	3,354,870 ^a
1909	130,986	1920	2,227,349	1931	2,390,000 ^a
1910	187,000	1921	1,616,119 ^a	1932	1,369,000 ^a

^a Years of decline from prior years.

Composite Trend of Four Industries. The foregoing summaries of the progress of individual industries are confined to a recital of facts determined in the manner described. Surely there can be no serious question raised regarding these facts. In order to emphasize the dissimilar trends of these industries, the four prior charts have been combined in one. In this combined chart each of the four trends has been slightly smoothed by three-month-running averages. The comparison is shown in Fig. 3.

It is apparent at once that no two of these industries are following the same path and that no one of them agrees with the fluctuating trend of aggregate business as commonly pictured. It is also obvious that in 1920 and 1921 all of them were simultaneously depressed and that this did not again occur until 1929 and 1930. It is apparent also that there have been partial agreements in downward trends as well as complete and partial agreements in upward trends in the interval covered.

It should be beyond logical question that during any period of common agreement in trend, either upward or downward, there will exist an extraordinarily strong stimulus to strengthen and extend the movement due to the increased interaction of the industries upon each other and the consequent influence on purchasing power. In other words, full phase agreement upward tends to create a condition of extraordinary prosperity while the same agreement downward will promote abnormal decline. This interaction which tends to be self-generating when under way and accumulative in its total effects may be compared to the phenomenon of "resonance" in electric circuits and in acoustics.

It seems logical to suggest in view of the picture shown in Fig. 3 that if the prime origin of these economic movements resides in general problems of money and credit, the stimulating and depressing effects on the four industries should be more nearly simultaneous throughout the period. That this is not so is shown by the widely divergent peaks and valleys except at certain intervals. It appears equally logical to suggest under

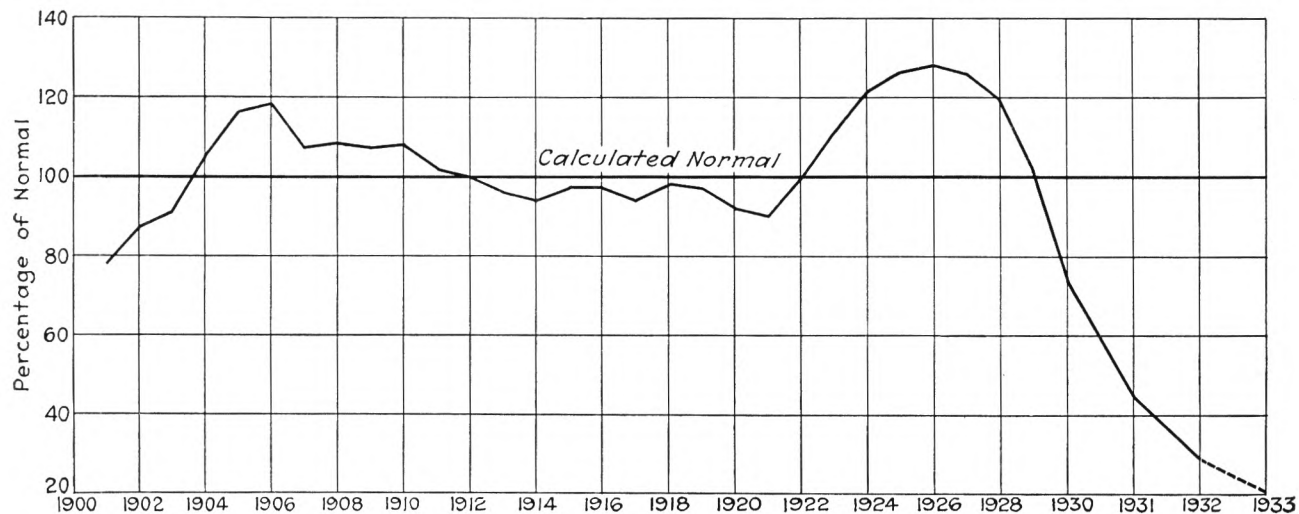


FIG. 2 LONG-TERM TREND OF BUILDING CONSTRUCTION

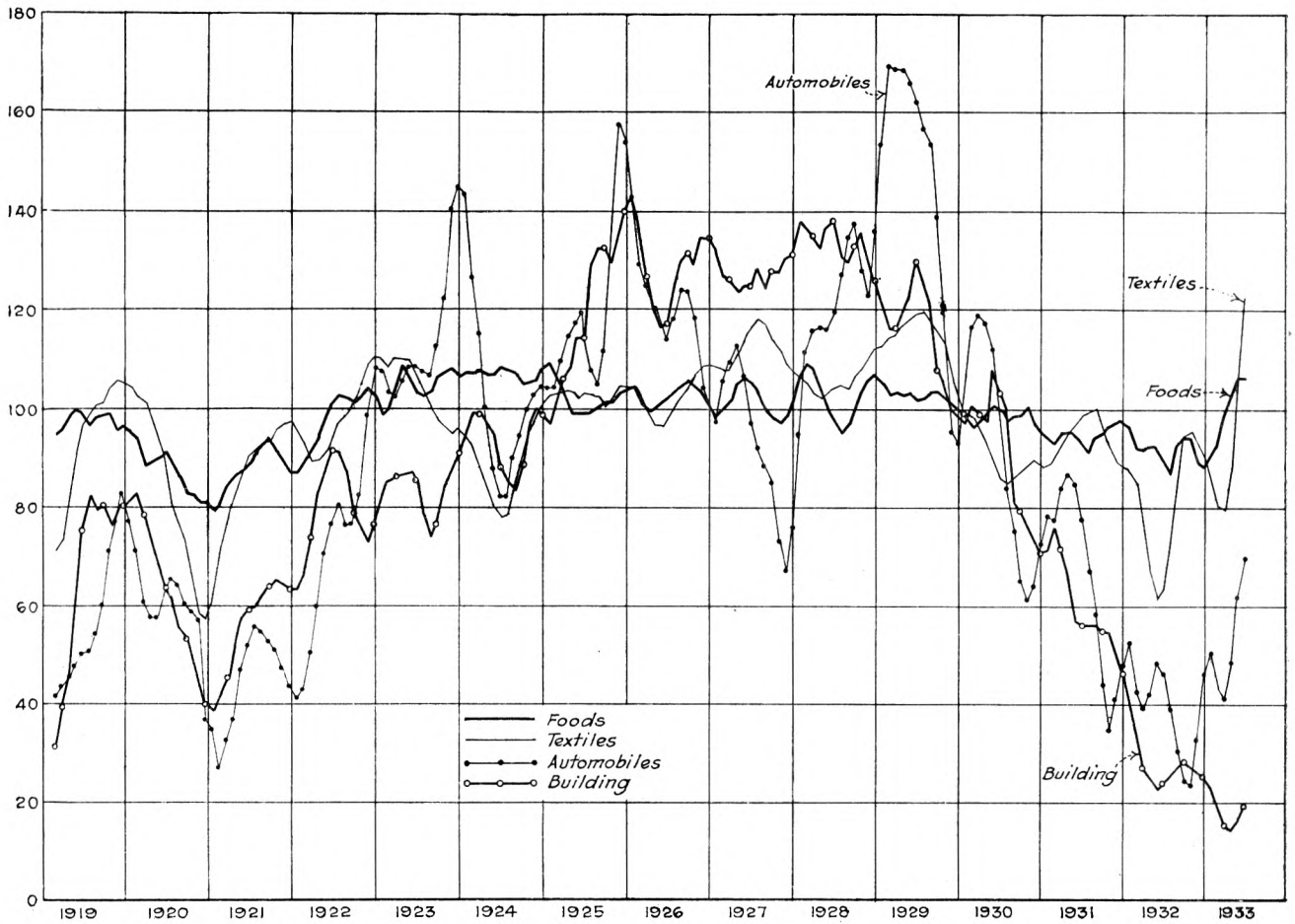


FIG. 3 COMPARATIVE TRENDS OF FOODS, TEXTILES, BUILDING, AUTOMOBILES

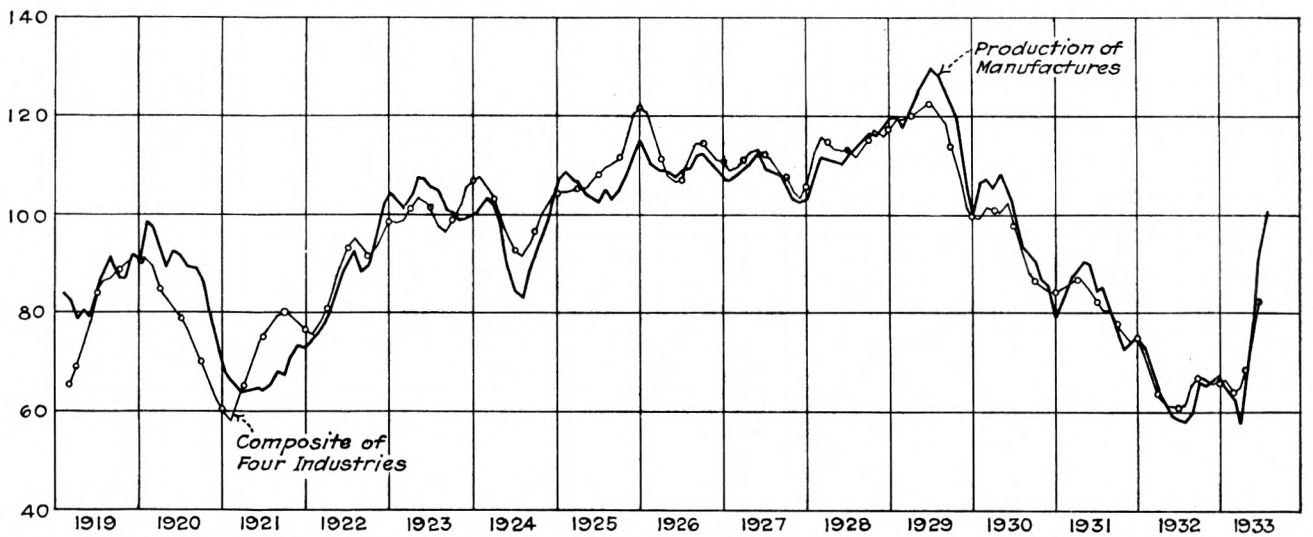


FIG. 4 COMPARISON OF COMPOSITE TREND OF FOUR PRIOR INDUSTRIES AND PRODUCTION OF MANUFACTURES

this conception of trade movements that the individualistic behavior of these industries may be due to other causes and, that the money and credit structure does not suffer and finally fail until a sufficient number of the all-important industries come into phase. Thus the stimulus gained from simultaneous upward trends engenders an extraordinary demand for credit which creates a heavy burden of debt, the orderly liquidation of which demands a continuance of trade at existing levels. The sudden recession in trade which always follows extreme heights begins, of necessity, at a high debt level. The satisfaction of these debts results in a liquidation that becomes for a period increasingly severe and under this strain the credit structure may crack.

With these thoughts in mind it is in order to determine the result of combining the trends of the four industries. When this is done upon a weighted basis, approximating the proportions which the four components assume in the family budget, the composite trend shown in Fig. 4 results. For the purpose of comparison, the trend in "Production of Manufactures" as determined by the Federal Reserve Board is plotted to the same scale and base. This is a volumetric index and embraces a sampling of all the basic industries of the country included in the census of manufactures. In addition to three of the four industries embraced in this study it covers such industries as iron and steel, non-ferrous metals, chemicals and oils, rubber, leather, paper, ceramics, railroad equipment, and others.

The close agreement between these two graphs, with such radically different components is obvious and of great significance. This accord is not due to preponderant weighting assigned to the four consumer industries in the Federal Reserve Board index. The latter index includes no component from building construction. This was assigned a weighting of 25 in the index of consumer industries, leaving a combined weighting of 75 for the remaining three industries. These same three components in the Federal Reserve Board index have an aggregate weight slightly under 31. It should therefore be clear that the agreement shown is not due to coincidence in weighting. If the Federal Reserve Board index was thus heavily weighted with these consumer industries it would be tacit admission of their outstanding importance.

This agreement between these two widely differing indexes has been previously mentioned as the pivotal point in this study. It is of great scientific significance. The principles involved in the analysis and synthesis of harmonic and inharmonic wave forms have been widely accepted and used in the scientific world for years. As mentioned earlier in this paper, a striking analogy exists in the treatment of composite wave forms of electric voltage and current, and of sound. A sound wave is normally composed of a certain fundamental wave length upon which are superimposed a number of waves of higher frequency or shorter lengths. If this longer wave length is a multiple of all the shorter wave lengths included in the tone, the shorter waves are said to be harmonics of the longer and the result is a musical tone. If these shorter wave lengths are not exactly divisible into the longer, the relationship is inharmonic and the result is noise. The latter condition governs the aggregate business curve, a fact which is not inappropriate as this wave has certainly produced its full quota of noise. If these relationships were strictly harmonic their onset would be predictable with greater accuracy and the disturbance would assuredly be of even greater severity.

Whether these relationships are harmonic or inharmonic, one fact of scientific acceptance stands out and this is that the outline or contour of the composite wave form is definitely due to the shape and relative importance of its components. A corollary of this is that those influences which are responsible

for the differing fluctuations of the components are inherently responsible for the movements or shape of the compound form.

A clearer conception of the result of combining two periodic and symmetrical waves may be gained from Fig. 5. In this case the wave indicated by the heavy line is the resultant of the two waves of 2- and 3-year periodicities which are shown in full and dotted light lines, respectively. If undistorted by external causes this wave would be repeated every six years.

The problem then remains to discover the motivating influences that result in the widely differing paths of the four dominant industries.

Before proceeding further with this analysis, it will be well to develop briefly the relationship between production and demand. There is much misunderstanding and disagreement about these two divisions of economic endeavor. The statistics of the De-

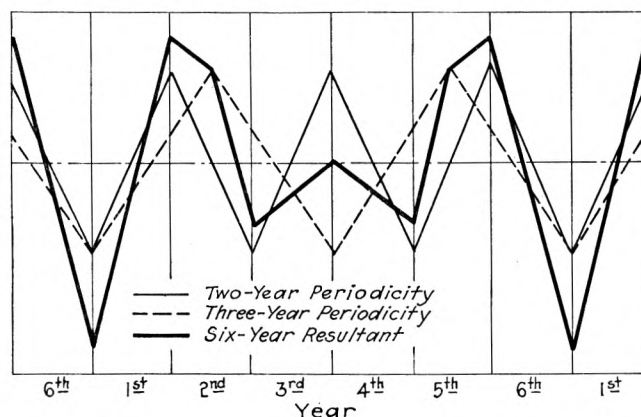


FIG. 5 COMBINATION OF PERIODIC WAVES

partment of Commerce and of the Federal Reserve Board jointly include much valuable data on inventories and production. Unfortunately, there is relatively little information on sales or demand. Reference has just previously been made to the index of production of manufactures computed by the Federal Reserve Board and which is plotted in Fig. 4. The Department of Commerce calculates an index of stocks or inventories of manufactured goods. The industries sampled in this case include the same comprehensive list of basic industries as those used in the production index. These indexes may then, for the moment, be considered as comparable. Notwithstanding the lack of sales data, the existence of these two measures affords a thoroughly convenient means of securing the sales trend.

The accuracy and significance of the following formula are obvious: $\text{Inventory}_1 + \text{Production} - \text{Inventory}_2 = \text{Shipments or Sales}$, where "Inventory₁" and "Inventory₂" are respectively the inventories at the beginning and the end of the month and "Production" is the goods added to inventories during the month. It only remains therefore, to apply these existing indexes to this formula month by month to determine the sales trend during the same interval. This has been done and the results are shown in Fig. 6. The vertical scale on this chart is double that used on the prior charts in order to magnify any existing difference between production and sales. It will be noted at once that production and sales are virtually inseparable in their irregular march over the peaks and through the valleys. This extremely close agreement in two highly fluctuating trends month by month through this interval of years would be utterly impossible if either of the indexes of production and stocks was seriously in error and it may be safely concluded, therefore, that the two are comparable as tentatively assumed. The secular trends of production and inventories are identical, which indi-

cates a uniformity in inventory control measured in terms of annual turnover. It is not the size of a plant which determines its output, but the load that is placed upon it.

In view of this convincing relationship, what becomes of the need for a master planning control to balance production and demand? When all the mists are blown away, does it not come clearly to mind that one of the principal objectives of management these many years has been such a balance attained by planning, scheduling, and inventory control? Stock rooms are not made with rubber shelves and if they were the bankers

search, we wish to inquire more closely into the characteristics of demand.

CHARACTERISTICS OF DEMAND

The term "demand" as used in this discussion is comprised of two components—desire, supplemented by the ability to pay—which together are translated into dynamic action or purchase. Such demand, based on the nature and use of the goods purchased, may be divided into producer and consumer classifications. All demand, both producer and consumer, may be di-



FIG. 6 COMPARISON OF PRODUCTION, INVENTORIES, AND SALES OF MANUFACTURED GOODS

would soon limit their elasticity. To suggest that production and demand in the broad economic sense are in balance in the great world of manufactures is not to say that some individual component never gets out of step. The ever-working laws of chance will usually smooth out such irregularities through compensating variations.

One important interpretation to be made from Fig. 6 is that the agreement between production and demand is so close that the two are almost interchangeable. This means that the production indexes used in describing the trends of the four consumer industries are essentially equivalent to those of demand. This close agreement may also be taken as a measure of ability and practise on the part of an industry in following closely the pace set by its customer industries. This is an important consideration in the classification of industries to be mentioned later. With this picture of agreement between production and demand, we may revert to the problem of determining the causes for the highly individualistic behavior of the four industries. In this

vided into two classes: namely, new or first-time and replacement. It will be advisable to define each.

New or first-time demand emanates from those industries and individuals who come into the market for the first time for the commodities in question.

Replacement demand, for the purpose of this discussion, is composed of those purchases which replace similar commodities which have been worn out, discarded, or transferred to other users.

It will be obvious upon a moment's consideration that these two basic classes of demand may have widely varying importance in different industries. For example, the demand for clothing is overwhelmingly that of replacement; the demand for automobiles is rapidly reaching this condition; while the demand for electric refrigerators is preponderately first-time demand.

We have previously classified commodities into producer and consumer merchandise. Before proceeding further with the study of demand, still another classification of commodities

should be made. All commodities may be divided into two groups, perishable and durable. In the use of these terms in this discussion, perishable commodities are considered to be those whose useful life is less than one year, while durable commodities are those which will last over one year. It is apparent that both producers' and consumers' goods are divisible into these two classes. We therefore find that demand, itself, is composed of producer and consumer requirements both of which embrace perishable and durable goods for which the demand is either first-time or replacement. The significance of this classification is that activity in demand and production follows the same principles in both consumer and producer industries and that these principles may prove to have great economic significance.

The demand for short-lived goods is in some respects the simplest we encounter. This is especially true with regard to perishable staples. Growing style influence and consciousness are transferring more and more goods from the staple to the style class with increasing difficulties in properly balancing supply and demand. This is also having no small part in the increasing flood of small orders. The trend of such demand, plotted against time as a base, instead of showing a relatively stable performance will rise rapidly from zero to some indefinite height and then decline more or less symmetrically to zero and before this time it usually will be supplanted by another style which repeats the cycle.

The demand for durable goods in continuing use presents a totally different picture although such goods are in part subject to style influences.

The natural growth trend for such goods is shown in Fig. 7.

With the passage of time the total sales of a durable commodity in continuing use will normally follow the trend illustrated by graph A. Total sales after replacement begins is made up of two components, first-time sales to new buyers and replacement sales to former buyers. The total sales trend will set the pace for replacement sales at the expiration of the average life of the commodity before replacement. Therefore if the total sales curve be reproduced at a later interval equal to the average life before replacement, the trend of replacement sales will be indicated. This is shown by graph B. Original sales to new buyers are obviously the difference between total sales and replacement sales. This difference is shown by graph C. This graph is particularly interesting because it shows the turning point and maximum value of original sales.

As the life of any business is extended, its replacement sales will normally become of greater importance. The increasing percentage of replacement sales to total sales is shown by graph D.

THE REPLACEMENT CYCLE

It is obvious that with the passage of the years, a tremendous proportion of merchandise has attained a use that is preponderantly replacement. In other words, the replacement market and any outstanding characteristics which it may assume will have great economic significance. There is a characteristic of the replacement market which may prove to be of first importance in our study of economic conditions. It is a phenomenon of demand.

It may be assumed for the moment that the trend of demand for a durable commodity in broad general use for a long period of years will be reasonably uniform from year to year if not influenced by shortage of supply or lack of income at any particular time. Since this discussion applies to a durable commodity in long-continued use, it will follow that the replacement demand is an important share of the total market. Suppose now some transient event takes place of such nature and importance that the supply or demand is seriously impaired; for example, our entrance into the World War. This immediately created

chaos in the automobile industry and reduced the output and demand for passenger cars in 1918 over 45 per cent below that of 1917; the first actual decline in any year within the history of the business. Such an interruption means that a large number of original as well as replacement sales will be deferred until a

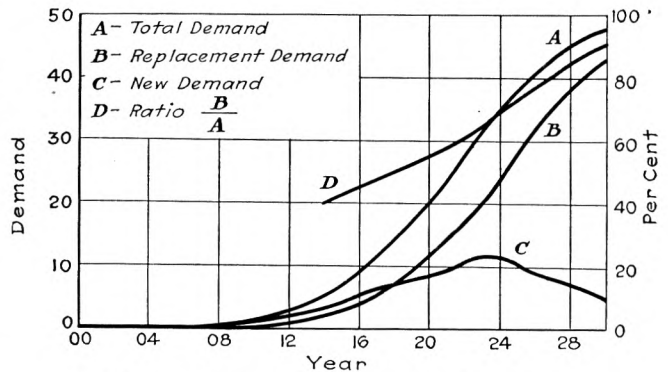


FIG. 7 NATURAL GROWTH TRENDS OF INDUSTRY

later time. However, this commodity under discussion is a durable commodity whose useful life in the hands of its original purchaser will be fairly definite because of wear and tear or obsolescence in style or design.

The serious decline in sales during the period of interruption, no matter what the cause, means that at a later time equal to

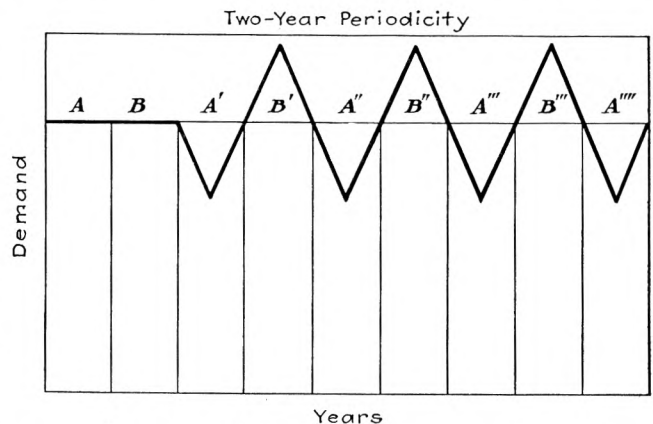


FIG. 8 ORIGIN OF REPLACEMENT CYCLE

the prevailing life of the commodity before replacement, another decline will be induced. This follows because the number of units of the commodity to be replaced during the subsequent period will be less than normal by the amount of the enforced decline in the prior period, but this decline is only a deferment, not an elimination. When normal conditions return, the usual replacement for that period will occur on schedule but to that quantity will be added the deferred buying from the prior period which will carry the total demand above the prior uniform trend. Thus a decline in demand is followed by a resurgence which carries the total above any prior levels and a period of depressed demand is followed by one of super-normal magnitude. The commodity, however, still possesses the same useful life which means that replacement which is an important share of the total demand will in subsequent years tend to follow the same surging pattern. This is illustrated diagrammatically in Fig. 8 in which the life of the commodity before replacement is assumed to be two years. In this illustration sales made in the year A are normally due for replacement in the year A' and sales made in

the year B are likewise due for replacement in the year B' . This progression of demand will carry forward into the years A'' , B'' , A''' , B''' , etc. as shown.

Thus the decline in total sales in any one period becomes in effect a decline in replacement sales in a subsequent period. But no material decline in replacement, when replacement is a large share of the total, can occur without inducing a simultaneous decrease of some magnitude in first-time sales for that period. This is true because a disturbance of this nature will result in declining demand for the commodity itself as well as for raw materials thereby causing unemployment in contributory industries as well as in the one directly affected. The effect thus begins to spread in all directions. The total decline in demand will then be the sum of the two. The translation of these declines

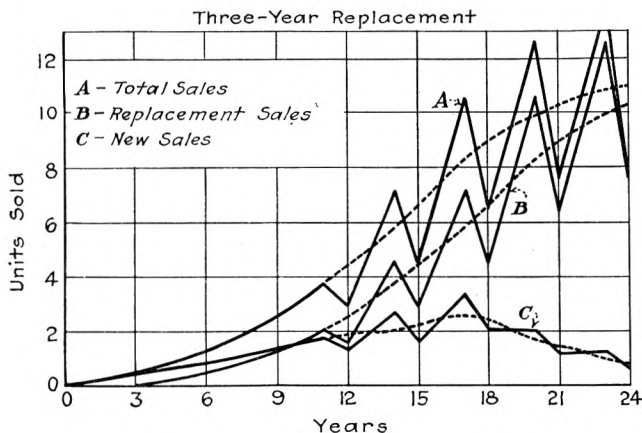


FIG. 9 PROGRESSION OF REPLACEMENT CYCLE

from period to period in both types of demand is illustrated, diagrammatically only, in Fig. 9.

This phenomenon or characteristic of demand for durable goods may be termed the "Replacement Cycle."

Conditions Necessary for Formation of the Replacement Cycle. From the foregoing considerations it may be said that the conditions necessary to produce recurring declines in demand for any durable commodity are:

- (1) Any external or internal event that will cause a serious break in the continuity of demand
- (2) The commodity and its use must be of such nature that purchase may be deferred for a reasonable length of time
- (3) The existence of any factors such as wear and tear, style changes, or similar conditions which result in an average life before replacement that is fairly definite and greater, for example, than one year when the year is the unit used for the measurement of time
- (4) The absence of an unusual new or original demand that would counterbalance the loss in replacement sales resulting from the prior period of decline.

In the third condition just previously outlined, the existence of a "fairly definite" life of the commodity before replacement is imposed. This term needs further explanation. It means that the replacement buying habits of purchasers must be sufficiently uniform to produce a certain degree of concentration in the life of the commodity before replacement. Thus if ten men each bought a suit of clothes at the same time and if the first one replaced at the end of one year, the second at the end of two years, and so on uniformly until the tenth man replaced at the end of the tenth year, the replacement cycle would not exist. However, if five or six of the ten replaced at the end

of the second year or if three replaced during each of the second and third years, there would be a concentration of buying that would satisfy this condition for the replacement cycle. These latter figures are illustrative only. It is necessary only that there be some predominant or typical time at which a higher proportion of replacements is made.

Replacement of commodities bought at any particular time will usually conform to this requirement because they tend to follow the general trend of the normal "frequency distribution" or "probability curve" with the area of highest concentration around the average life before replacement. This will be illustrated later when the replacement cycle in the automobile industry is discussed.

A thought that will naturally arise is that, by an averaging process, such oscillations should soon die out through a series of constantly diminishing fluctuations. This attenuation most assuredly would occur if no other influences were at work. The operation of the cycle would also ultimately cease with the disappearance from the market of those whose buying was first affected by the external event that produced the distortion. As previously mentioned, however, no real disturbance of the replacement market, when this demand is an important part of the total, can occur without disturbing the buying program of original buyers about to come into the market. Thus some additional purchasers are affected at each recurrence. Furthermore, each time there is a major coincidence of these trends, as in the present depression, a new impetus of wide amplitude is provided and the train of surges is renewed with additional vigor. In addition, war as a disturbing factor comes into the picture with sufficient frequency to leave a new heritage of such trouble in its wake. War has this unique effect in participating countries: It unduly stimulates certain industries while greatly depressing others. No other random event possesses the power to do this on a large scale. Thus, the very onset of war gives birth to the major fluctuations which result in the ensuing replacement cycle.

What is the real significance of this replacement cycle in its operations? It provides both a cause for and an explanation of a variation in demand that is not induced by a variation in income or loss in buying power. It is inherent in demand, itself, and initially independent of buying power. When such a decline in replacement demand is due, *it will begin without any prior change in income levels for the reason that the existing replacement market is satisfied for the time.* During a period of market disturbance, the only replacement demand that is subject to deferment is that which is due for replacement during that period. Other replacement demand is not affected at the time and will reassert itself on schedule after normal conditions return. To this will be added the deferred demand as it gradually comes into the market. From this time forward, as far as the individual is concerned, replacement goes on normally until the next disturbance. The subsequent decline induced by the operation of the replacement cycle does not arise through the conscious act of any group of individuals. Rather is each one pursuing his normal replacement schedule. What does happen is that integrated replacement demand is no longer uniform from time to time because *more of us are now making some important purchase at one time than at another.* These surges due to the replacement cycle are similar to those caused by seasonal changes but occur at longer intervals and last for longer periods.

We are then brought face to face with the conclusion that those industries producing durable goods in sustained demand may sooner or later be subjected to the influence of an oscillating or surging demand induced primarily by the operation of the replacement cycle following some prior major disturbance. Furthermore, the time interval between these surges will vary

among different industries according to the prevailing life of their commodities before replacement.

It is not suggested that the full amplitude of variation above and below normal is directly measured by the volume involved in the replacement cycle. On the contrary, a relatively small proportion of the whole change may be traced directly to this cycle. Business is in such a state of sensitive balance that relatively minor changes will put in motion the involved forces that will cause the movement to feed upon itself and grow with accumulative effect. In other words, changes induced by the operation of the replacement cycle may be compared with the loosening of the first stone that causes the avalanche.

To the scientist and the engineer this latter thought may again suggest the similarity between the generation of the replacement cycle with its accumulative spread in all directions and the origin of resonance in a power circuit. In this latter case, the source of what ultimately becomes of serious consequence may reside in some minute, periodic change in voltage that builds up with astonishing rapidity and effect when conditions are favorable to it. Likewise, destructive vibration may be progressively set up in a mechanical structure or prime mover by sources originally so minute as to avoid detection providing physical conditions are favorable to the propagation of this influence.

Because of the sensitive balance in industry and commerce, a deviation of ten per cent above or below usual levels means the difference between prosperity and depression. A fractional amount of this disturbance may then be sufficient to start the self-propagating movements on their way. The terms "vicious circle" and "destructive spiral" have been frequently used to describe the business condition wherein a relatively small change induces further change of accumulative intensity. In truth, it seems that the instruments we have set up to detect these disastrous changes lack the sensitivity to catch the early movements which later become so obvious. When once released, the expansive power of these small self-generative movements is enormous.

INFLUENCE OF THE REPLACEMENT CYCLE ON VARIOUS INDUSTRIES

How do the characteristics of the four industries conform to the conditions necessary for the formation of the replacement cycle? If the periodic tendencies, where they do exist, coincide in duration with the usual life of the commodity before replacement, the indication is very strong that this phenomenon may furnish the origin of such fluctuations at repeated intervals. In discussing this question as it applies to the several industries, it will be well to consider the automobile industry first as the records are simpler and more complete.

The Automobile Industry. From the beginning of this industry to 1918, the output did not show a decline from one year to the next. In the depression years during this interval there was a retardation in the rate of increase but never a reduction in output. This retardation should be considered as an effect, not a cause. In 1918 there was a decline in output and sale of over 800,000 passenger cars or about 45 per cent of the 1917 output. This was unquestionably due to war conditions which reacted on the passenger-car industry with peculiar force. Following this first and large reduction, a major decline reappeared every third year—namely, in 1921, 1924, 1927, and 1930—and in no intervening years. This seemed too often and too regular to be a coincidence and the question arose as to what induced it. From a consideration of this question it seemed obvious that, if the output of passenger cars in 1918 was 800,000 less than that of 1917, the replacement of 1918 sales should be 800,000 cars fewer than replacement of 1917 sales, and this decline would occur in the normal replacement period for 1918 sales. If the successive

reductions were the result of enforced fluctuations in replacement, it seemed logical to conclude that the average new-car buyer kept his car about three years before trading for a new one. The conclusion seemed logical, the three-year period seemed to be in accord with common practise, but there were no available records to answer the question.

Finally, one of the large motor-car companies after a check of its records furnished the following information regarding the length of time new-car buyers retain their cars: For one, two, three, four, and five years the percentages are, respectively, 9.9, 38.6, 29.8, 13.6, and 7.7.

This accounts for 99.6 per cent of the new-car buyers and the weighted average time is approximately 2.75 years. The actual average computed in months might vary slightly from this figure and a more extensive search might modify the results to some extent. The data, supplemented by common experience, are sufficiently representative to support the conclusion previously reached, that the typical new-car buyer replaces his car about every third year. It should be realized that the new-car replacement demand does not come from those who drive old ones to the scrap heap but from those who trade used cars on new purchases. The Ford Motor Company was out of production several months in 1927 and this naturally increased the severity of decline in that year. It will be noted, however, that the depth reached in the latter part of 1927 merely marked the end of a drastic decline that began at a high level early in 1926. This downward surge was far greater and started much earlier than that induced by the closing of the Ford plant in 1927.

It must be clearly stated that the operation of the replacement cycle does not account for the full depth of the decline. On the contrary it may directly produce a relatively small part of it. The calculated reduction in replacement sales in 1921 due to the original decline in 1918 was 62 per cent of the actual total decline; very much more than necessary to start the downward trend. The corresponding ratio for 1924 was 18 per cent and for 1927 and 1930, 16 per cent. These percentages are still sufficiently large to start the self-generating surges which develop accumulative energy as they progress. As suggested previously, this action is closely analogous to that of resonance in an electric circuit where enormous surges may be initially started by very minute oscillations when conditions are favorable.

While the new-car buyer exchanges his car on the average every third year, the average useful life of the car according to the National Automobile Chamber of Commerce is seven years. There is, then, an average life of four years in a car after it has left its original owner. This margin provides a relatively long period during which the original purchaser may defer replacement if the incentive to do so is sufficiently strong. This is exactly what is happening during the current depression and is responsible for the long-continued decline in the industry. When replacement is actively resumed, the period during which such deferred demand will be satisfied will undoubtedly make the recovery period longer than those in the recent past. Thus, there is in these conditions the opportunity to force the automobile cycle out of its prior periodicity, but unless buying habits are definitely changed the former surge will be resumed after renewed demand is satisfied. The present decline will induce a later one. The greater the possibility of deferment of replacement demand, the greater is the possibility of such demand temporarily departing from its natural fluctuations. Thus the automobile and building industries are now forced out of their strides while the clothing industry which is much closer to the level of necessity and the product of which is subject to much shorter life, is maintaining its rhythm although at definitely lower levels.

It seems apparent from the foregoing discussion that logical

causes for the recurring three-year cycle in automobile output have been determined. We therefore have in this case, a serious recurring condition in our economic life that for the most part is the direct result of the interruption of the natural flow of trade by the great war. It is a fact, however, that surges similar to this but of much smaller magnitude would ultimately have been introduced into the automotive industry as an effect of the recurring depressions such as have visited us long before the origin of the automobile. What originally were merely periods of retarded growth would have become net declines as the demand stabilized in accordance with the trends shown in Fig. 7. Effect and cause then become hopelessly intermingled. Certainly it seems reasonable to suppose that similar movements having their origin in the replacement cycle in other important industries may induce serious distortions in all trade when they occur simultaneously.

Food. It is evident that food and its use will not conform to the conditions outlined for the formation of the replacement cycle. The existence of this phenomenon should therefore not be expected and it is not found. The trend is the most stable of the four examined and such minor fluctuations as do occur are quite irregular. Strictly speaking, there is a distinct periodicity in replenishment of food supplies. This is manifested in any locality by the well-defined "rush hours" in retail grocery stores. This is of technical interest only inasmuch as we are measuring such frequency of replacement in terms of months or years. In this sense, reflection will suggest that characteristic or predominant frequency of buying may apply to most commodities.

Textiles. In this industry we find wider divergence from the average and a very definite two-year periodicity. What characteristic of this industry should result in such pronounced two-year variations? The industry is divided into three main groups, namely, cotton, wool, and silk. Each of these, as measured by textile fiber consumption, is found to display in varying degree the same two-year fluctuations. The industry as a whole produces a countless variety of products and yet as is usual in such cases a few lines predominate. Wearing apparel is of overwhelming importance and of this class, durable garments are of greatest value. It is to be expected therefore that they may impress their characteristics on the industry.

How often on the average do most people replace their durable garments? Unfortunately, there is a serious lack of data upon this important question. The following facts, however, are known:

(a) A critical study of the levels of production and inventory shows that the sales of textiles as a whole decline every other year. While data are not available for evidence, it is known that the sales of certain large textile companies show decided reductions every other year in agreement with the timing shown by the second curve in Fig. 1.

(b) One statistical organization specializing in the textile industry announced that for a period of years between 1920 and 1930, examination had disclosed that on the average each man bought one-half a suit of clothes per year. This obviously is equal to a suit every two years. According to this same agency the foregoing average was reduced to 0.38 of a suit per year in the current depression.

(c) A large manufacturer of women's coats has stated that the records over an extended period positively show that women's coats are replaced on the average every two years.

(d) One commercial survey in a small city showed an average purchase of one suit approximately every two years by the men of the family.

(e) Detailed investigations on cost of living in workmen's families, made by the National Industrial Conference Board,

have resulted in the provision for replacement of women's coats and dresses every two years while two-thirds of a suit per year for the men is provided in the budget. This average would tend to be lower in rural areas and higher among the greater incomes in the urban areas.

These fragmentary bits of information taken in connection with the characteristics of the replacement cycle and the unmistakable trend of the textile industry warrant the conclusion that the replacement cycle is probably the source of the repeated oscillations in this industry. Final proof of the truth or falsity of this position can be secured by a comprehensive survey of buying habits and of sales in the industry.

Building Construction. It has been shown that the trend in building construction is featured by short-term fluctuations, approximating three years in length, superimposed on longer variations indicated in one 30-year span to be about 20 years apart. Are these fluctuations manifestations of the replacement cycle? It is obvious that any short period of three years can have no direct relationship with the life of buildings before replacement. It is not so certain that this can be said of the 20-year span. Studies by various real-estate and building agencies and decisions of the Treasury Department for tax purposes seem to fix upon a typical structural life of 40 to 50 years. Any building, however, is obsolete long before it has reached this age. This is caused by changes in design and equipment and by migration of commercial, industrial, and residential centers.

The National Building Owners' and Managers' Association, in a comprehensive study of operating income and expenses on a large list of identical buildings in a number of cities, found that income from rentals takes a sharp drop after twenty or twenty-one years of life. This is undoubtedly significant. There can be no doubt that after twenty years of life a building is no longer of first rank. Early tenants of commercial buildings have in most cases moved to more modern quarters and have been replaced by others yielding lower rentals. Residential property for the most part will have been replaced with more modern quarters long before its structural life has ended. It seems entirely possible that the 40- to 45-year life of the building corresponds to the seven-year life of the automobile and the 20-year period in the life of the structure to the three-year period in the life of the automobile.

A most interesting confirmation of the long- and short-term movements in real estate activity is described by Lewis A. Maverick in the *Journal of Land and Public Utility Economics* for May, 1932, in an article entitled "Cycles in Real Estate Activity." Mr. Maverick studied three measures of real-estate activity for the period from 1853 to 1929. Official county records were utilized in this analysis which included the number of lots added by subdivisions, the number of deeds recorded, and the value of property transferred. When these long series were statistically smoothed, he found throughout the interval a series of long fluctuations of fifteen to twenty years between centers and, superimposed on the top of this trend, a series of short-term movements predominantly three years in length. These movements had no relation whatever to increases in population and have absolutely nothing in common with building construction data. The last two peaks were coincident with those shown in Fig. 2. Similar long-term movements in residential construction have occurred in Greater London where, between 1871 and 1916, such construction progressed in two great waves just twenty years apart.

The short-term surges in construction are of much interest. They not only appear definitely in building construction but are also typical of many of the fluctuations in general business throughout the life of the nation. Prior to the advent of the

automobile, building construction was certainly the most highly variable industry of large magnitude. From the standpoint of economic value and extent of fluctuation combined, it is probably of the greatest importance today. Is the three-year period in construction activity the cause or the effect of similar movements in other branches of business? If a logical reason can be found for these oscillations in construction, it may indicate their causative influence.

This industry is widely scattered and highly individualistic. It is not subject to the control afforded in manufacturing by proper scheduling of production to meet the requirements of inventory and sales. There can be no reasonable doubt but what there are recurring times when we are overbuilt, but why should the three-year periods appear with such consistency? An immense amount of credit is needed to finance this industry. The unit value of the transactions is large and the percentage of credit required is high. These credit requirements are undoubtedly larger than those needed for any other single industry.

While the long-term investor ultimately supplies much of this credit, a large part of the actual construction is usually carried on by loans subject to relatively rapid turnover. Time will not permit an extended discussion of these conditions but it may be said that much residential construction money may at intervals be turned over two or three times a year by those who make a business of supplying such funds. Mortgage loans are commonly extended for periods of one, three, five, and ten years. Examination of data pertaining to such credit indicates that the weighted average duration of all such loans may fall between three and four years and probably nearer the former. Data have not yet been found from which such an average can be accurately computed. The fact remains, however, that except for those mortgages going into the hands of permanent investors and remaining there, the turnover of such loans would no doubt be somewhat less than once every four years. There is undoubtedly a definite typical length of such loans.

Under these conditions, it seems entirely possible that the principle of the replacement cycle applies to the extension and release of credit in construction. Capital available for financing construction is not unlimited. As the volume of construction increases in an era of prosperous times, more and more capital is involved until credit so extended reaches abnormal heights. This naturally means that during such a rise less and less capital is available for this purpose. The end of such an upward movement is usually featured by a surplus of available facilities and a greater inability to dispose of the mortgages created through this activity. This naturally results in a retardation of building and construction then begins to recede from its high levels. The capital tied up in these enterprises, however, will be released only as mortgages are sold or payments are due under existing contracts. It follows directly, therefore, that after a building peak, the maximum funds released from prior contracts will be attained at that time representing the maturity of the greatest amount of funds loaned. Such a time would be determined by the weighted average of maturity dates on the credit extended. Thus it will be seen that if there is no other influence to distort the flow of funds, such flow will tend to follow a surging path with the interval between waves represented by the average duration of loans. It seems entirely probable that the three-year fluctuation in construction is induced by this behavior. It is not to be supposed that this periodicity would remain fixed under all circumstances. The conditions imposed by the credit instruments themselves will usually prevent a quicker repayment of the loans than that specified, but there is nothing to compel the reloaning of such funds as soon as they are repaid. This means that if three years be assumed as the average duration of a loan, this interval between surges will not be materially

decreased but it may be increased if conditions are not favorable for reinvestment of construction funds in the industry.

A continuous production and consumption of food is essential to life itself and therefore is not subject to serious interruptions. The long life of buildings is supplemented by the ability of people to "double-up" under stress and this means an enormous and sustained capacity to retard normal construction. These are the fundamental reasons why building construction is subject to much wider fluctuations than food production. The fact that the nominal three-year cycle does not maintain itself during times of economic storms is therefore to be expected. Conditions at such times are not favorable to extension of credit. It will be recalled that mention was previously made of the fact that the only deviation from the three-year oscillation between 1900 and 1930 was when depression periods intervened.

If this conception of the ebb and flow of credit is correct, it is of tremendous importance and is worthy of much study. The conclusions and the questions arising in this analysis in no way minimize the importance assigned to credit control by many investigators. Rather do they supplement these convictions by breaking the problem up into its component parts and suggesting their real sequence. The reasoning behind these conclusions is sound. The proof of the average duration of loans has yet to be derived.

CLASSIFICATION OF INDUSTRIES

From the consideration of the differing characteristics exhibited by the various industries is derived a basic classification of all industries:

First, there is that class that displays the greatest stability of all yielding only slightly to the influence of major depressions. It is typified by staple foods and tobacco.

Second, comes that group which yields sharply to general business conditions and whose path follows that of aggregate business. The duration of depressions in these industries will be shorter or longer than that of general business depending on the ability to defer purchase. Examples of such products are shoes and food luxuries.

Third, there is that group which, due to conditions inherent in them and their use, yield to the influence of the replacement cycle and develop characteristic periodicities of their own. Examples of this class are automobiles and textiles.

Fourth, comes a group which, subject to their own inherent conditions only, might fall into any of three prior groups but which are so thoroughly dominated by the industries they serve that they follow the production levels of those industries. Examples of this class are the production of cans as strongly influenced by the food-canning industries, and machine tools whose activity is predominantly controlled by the automotive industry. It is in this class that most of the so-called producer industries will be found.

With this conception of the nature of fluctuating demand upon business, it becomes clear that the so-called producer industries take their tempo in last analysis from the demands placed upon them by the production of consumer goods. It may then be suggested that all industries fall into one or more of four basic groups with a pilot industry or pacemaker leading each group. This intricate interlacing of industries, with each group following its own path, ultimately weaves the pattern of aggregate business. This pattern is only relatively fixed and may be distorted by the extraordinary reaction of industries upon each other when their trends are simultaneously upward or downward or when they are all confronted by some major random event such as a declaration of war between major countries.

This ability to "follow-the-leader" may be definitely inferred from the extreme fidelity with which production follows demand as previously described and shown in Fig. 6.

This idea of the ebb and flow of industrial and commercial activity in various channels defined by a few dominant industries should be of value to any organization in charting its own course. Its position on its normal growth curve as illustrated in Fig. 7 should be determined. The relative importance of its principal customers by industries can be evaluated from the sales records. The probability and degree of fluctuation in demand from each customer can be approximated by working from the foregoing classification of industries. Such a picture should be of great aid in facilitating proper control of production schedules, inventories, advertising, sales effort, and capital investment.

INCREASING DEPTHS OF MAJOR ECONOMIC DEPRESSIONS

It is almost axiomatic to say that those industries which have carried us down into these depressions are the ones which must finally lift us out of them. The discussion of industry trends and of the replacement cycle has conveyed a picture of widely differing characteristics in these dominant industries. The capacity of any industry to carry us into the depths of decline and to bring us out of them is dependent on two things: first, the economic weight or importance of the industry in meeting human requirements, and second, the degree of fluctuation characteristic of it between good and bad times. Thus if this capacity be considered as a product of these two factors, it becomes in reality an energy component in these movements and may be termed economic momentum. The great food industry with the heaviest weighting of all is of little importance in recurring economic surges because its amplitude of fluctuation is so small. Building construction, on the other hand, is of lesser weight but vastly more important in promoting economic surges because of its extremely wide fluctuations. The conception should then be held of a vast array of industries, each of its own proportionate importance in our budgets, but each subject to a varying degree of oscillation through the years. This variation in amplitude will be in proportion to our ability to eliminate, defer, and expand purchases with the needs and desires of the day.

The replacement cycle is set forth in this analysis as the continuing cause of these recurring surges in certain industries. If this be true, the initial distortion that first gave impetus to the replacement cycle must still be isolated. It is quite characteristic to assign the reason for each recurring economic storm to some special condition predominating at the time. But a succession of these surging movements of trade has run through organized society for many generations. Why is it not logical to suppose that there may be some factors common to all these generations that have produced these serious results?

The replacement cycle is a phenomenon of demand, and demand has existed through all generations since barter began. Food, clothing, and shelter have been the dominating requirements of man through all this time and will continue to be as long as he exists. The combination of these three basic necessities in a weighted total matches the timing of the business fluctuations very closely but with generally diminished amplitude. This latter point is of economic interest and importance. Observation of the long-time trends of business shows clearly that the major depressions are growing deeper. As the standard of living rises, a larger and larger percentage of the family budget is expended for more articles that are farther removed from the levels of bare subsistence and minimum demand. More and more people are employed in the industries that make these products, and more of the profits of all business are derived from them. With this increase in the standard of living the per capita

purchases of durable goods are increasing. The longer the useful life of a durable commodity, the longer can deferment of replacement occur. The replacement of a rug can be postponed longer than replacement of a suit of clothes. We find statistically what judgment tells us should be so, namely, that those industries producing luxuries and the longer-lived durable goods are the ones which suffer the greatest decline in times of economic stress. Since these industries are gradually comprising an increasing share of our activities, it follows directly that our retrenchment capacity is increasing. This means that as the standard of living rises we are naturally subject to greater hazards of unemployment and deeper depressions. As the standard of living rises, the elasticity of demand increases. A wider distribution of income would tend to raise the standard of living but by the same token to increase the depths of major depressions when they do come. It is not the amount of money spent but the rate of spending which governs uniformity in trend.

INITIAL DISTURBANCES IN ECONOMIC TRENDS

The question still remains as to what was the first disturbing influence that destroyed the even flow of goods between producer and consumer and what events have happened to renew these impulses.

Among the transient events of both natural and human origin that may exert seriously disturbing effects on industry and trade are famine, pestilence, flood, drought, earthquake, tornado, revolution, war, an occasional excess or short yield of crops, and various other happenings. Most of them are usually quite localized and would be incapable of producing wide-spread unfavorable effects. Of all the isolated and random events of importance, war seems to predominate. It has accompanied man through history and is probably the most potent force for producing the original impact of which the replacement cycle is but the continuing echo. This thought does not exclude the possible effect of important random events. The behavior of the business graph rather suggests the existence of quite regular or periodic forces of varying frequency and amplitude upon which are occasionally superimposed certain irregular and transient forces of varying importance.

The conjunction of downward trends in a number of important industries may precipitate a general depression of such severity that it will break up for a time the natural periodicity of some industries. The onset of a major war might have the same effect, the result of which would be to start a new succession of surges of increased amplitude. Thus each new disturbance is the progenitor of more to follow.

CORRECTIVE MEASURES

Granting the validity of these thoughts regarding the replacement cycle, what can be done about it? It is not within the scope of this paper to present a treatise on all phases of these economic oscillations. Nevertheless, some reference to corrective treatment is impelled by the nature of the suggestions regarding causation. Corrective measures may be considered as of two types—preventive and remedial. It seems logical to say that neither of these can attain maximum effectiveness until substantial knowledge of the actual causes can be acquired.

When Elmer Sperry studied the application of the gyroscope to the stabilization of ships, he realized the difficulties in the way of counteracting the roll of a ship when it was once fully developed. The energy required is too great. He noticed that the roll of the ship was essentially periodic but was not directly in unison with the pounding of the individual waves. He reasoned that it was the accumulative resultant of a series of wave impacts modified by the design of the ship. From this conception, he concluded that if he could make the apparatus sufficiently

sensitive to detect and counteract the individual wave components before their energy accumulated, the idea might be feasible. The application was developed in this manner.

In the same way, under this conception of economic surges, preventive measures applied to a massive roll of the whole business structure must lack the compensating energy required. On the other hand, the application of counteracting forces properly timed to neutralize the oscillations in the individual industries before they attain real momentum might prove effective. It should be remembered that these surges are initially due to the fact that more of us are buying certain important goods at one time than at another and that this numerical and economic inequality should be adjusted by shifting the buying periods of part of the people. Thus demand should be stabilized by damping the surges of the replacement cycle in their incipient stages. The same type of consideration should be applied to the short-term fluctuations in building construction. This would possibly involve elements of control similar to those applied to production and inventories in manufacturing.

Those industries whose operation and control are more highly centralized may offer a more favorable opportunity for coordinated action than those which are highly individualistic. The way might have to be cleared legally for joint action on price and supply so timed as to retard buying at the peaks and accelerate it in the valleys. Such methods, if effective at all, might have to be applied in degree through several cycles before sufficient leveling resulted. It may be suggested that our luxury taxes are usually imposed and removed at just the time to accentuate the surges in the industries to which they apply and that these same industries are among the ones which naturally are subjected to the greatest fluctuations. Stability of tax receipts requires stability in source.

Centralized control of a highly individualized and widely scattered enterprise like building construction is scarcely feasible. Even the smallest of manufacturing plants cannot operate successfully without balancing of inventories, production, and sales. In the tremendous building industry there is nothing to compare with the records and methods so necessary in manufacturing. Decentralized control through a running record of available facilities modified by building permits, completion, occupancy, vacancy, and demolition notices might prove to be of advantage providing necessary control of credit can be maintained. Speaking generally, the more speculative classes of building construction are subject to the widest fluctuation.

Timely control of this speculative credit would be essential.

While any remedial treatment to be undertaken is intimately involved with preventive measures, separate consideration must nevertheless be given to the former. These recurring declines in trade are always featured by serious contraction in prices, volume of trade, employment, and, finally, in enforced liquidation throughout the business structure. If there is a break in demand when demand and output are at abnormally high levels, the increase in inventories will tend to be very rapid. This will very quickly force a break in prices which in turn will accelerate the decline and the vicious movement is under way. Stability of demand is a prerequisite of stability in prices. When prices are at abnormal heights they are increasingly sensitive to changes in demand. Up to a certain point increases in demand at such times are extremely likely to induce further extraordinary growth because such times are eras of high wages and profits. Earnings at high price levels are ordinarily greater than at low levels. This most naturally drives the security markets in the same direction. Thus, the ability supplemented by the desire to buy before another price increase tends to elevate all factors of trade with the resulting periods of inflation so common to these movements. In due time the turn will come, invisible at first but rapidly approaching the stage where all the upward momentum is reversed with disastrous effect.

No real perspective of the price trend and its importance can be gained without reference to the long-term movement of prices which is shown in Fig. 10.

Mechanical analogies will suggest the extreme instability of the towering price structures existing in the three peaks. The cause of the three enormous peaks is obvious from the chart. As against the level in 1926 which is taken as 100 per cent, the average for the 135-year period is 76.9. The long-term trends following the three high peaks are certainly significant. The facts that only 18 years out of 135 were featured by prices at or above 1926 levels and that these were solely induced by war should point to the futility of price stabilization at 1926 levels as a sound means of recovery. Due to the effect of the extraordinary price levels on the average, only 52 years in the period shown were above the average while 83 were below. In 38 years prices have been lower than the average of 1932.

The source of recovery is an increase in demand. An increase in prices would be a powerful stimulus to this end but it seems dangerous to build recovery on a foundation of 1926 prices. How can a sound increase in demand be stimulated? To be

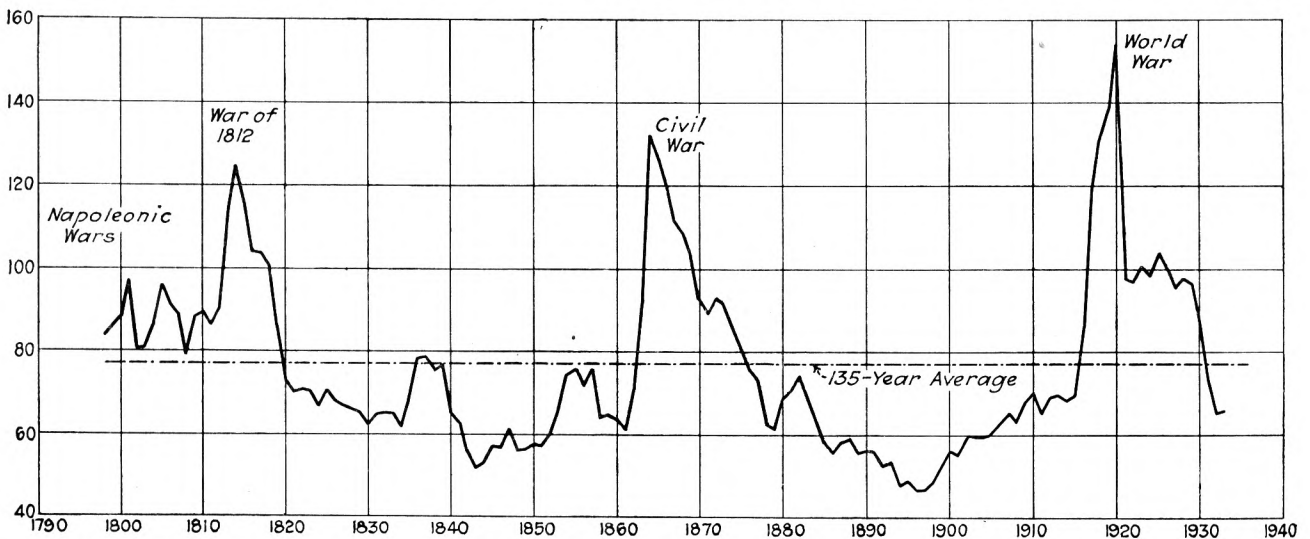


FIG. 10 LONG-TERM PRICE TREND

effective, such effort should be directed toward a revival of those basic industries whose economic momentum has dragged us down. As an engineering conception this thought is sound.

The two pacemaking industries which have had the maximum depressing effect are residential building and automobile activities. The reconstruction energy latent in the deferred demand for automobile replacement is enormous. A similar need in residential building is not so obvious and yet it exists if we grant the validity of our living standards for a generation past. The present period of depressed activity in residential building has been longer and deeper than that which resulted from the World War when a large shortage of housing developed. Nevertheless, the actual net increase in population is greater than it was during this war period. The acute shortage in housing during the former period and the apparent surplus at the present time were influenced by the totally different income conditions in the two periods.

Wages were high during the war period. For nearly two years after the close of the war there was a great revival in trade due to the satisfaction of demand deferred so seriously during the war. These conditions magnified the demand for housing during and immediately following the period of curtailment. During the present contraction of residential construction, income conditions are reversed from those of the war period. The result is that the real need based on families to be housed is obscured by the necessity of "doubling-up" in existing facilities. When the regenerative forces break loose in this industry, activity will develop with rapidity and certainty.

Many conceive the reduction in demand to be due to loss of buying power on the part of the unemployed and that as a corollary, there can be no recovery until the unemployed are put to work. This thought is hopeless from the viewpoint of recovery. The unemployed will not go back to work until the dollar begins to work. In other words, a revival of demand must arise before payrolls will be increased. A critical study of the concurrent inventory, production, and sales trends shown in Fig. 6, especially during the period 1920 to 1922, will illustrate the significance of this statement.

What is the source of increasing demand? The country possesses the buying power necessary for recovery. If this were not true, there would have been no recovery from prior major crises. The difficulty is that this buying power is dormant. The initial source of recovery lies not with the unemployed but with the vast majority who are still at work but who are spending nothing except for bare necessities. In this course they are impelled by fear of the future and of the mysterious nature of these tempests that sweep over us in the midst of plenty. The enormous flow of money from bank deposits into hoarding should convince the most sceptical of the existence of a large amount of latent buying power which is very wide spread. When it is considered that these hoarded funds are but a fraction of such static buying power, the evidence seems overwhelming.

When desire overcomes fear and when necessity of replacement outweighs further deferment, demand will increase and the idle will begin to work. Each increase in healthy demand will beget its own share of increased credit and regenerative reconstruction will be under way. Stimulants applied to this process should be designed to move the idle funds of those who have them (their number and economic power are enormous) and this movement must start the wheels in those industries of maximum effectiveness in promoting recovery.

To increase the public debt, already at dangerous levels, by inducing an increase in spending for public buildings and public works is not to provide a real leverage for recovery. As shown in Table 1, the value of these two classes of construction in a period of abnormally high levels for each is less

than half that of residential construction and would be less than a third if the latter figures could be properly adjusted. One of the keystones of recovery will be the extension of credit for residential building to those who are waiting to build and who can supply their own reasonable share of funds. Such credit is dynamic in results as compared with purely static effect afforded by credit relief. Any retardation of this credit is a block to recovery. There may be a real shortage of homes when there are still visible vacancies.

It must be realized that economic momentum is derived ultimately from demand and that the motivating force behind this demand is supplied by the great mass of the people. The predominant characteristics of this demand will be imparted not by the rich nor yet by the poor but by the great median group representing the common or average man. After all the business graph may be considered as measuring the ebb and flow of human energy. The driving power behind this movement comes from the great intermediate group. The vicious circle must be broken at this point.

Remedial measures, to be effective, must reach this class of people and stimulation must be applied to those predominant industries which serve it and have contributed principally to the decline. Fear that has grown to panic proportions is retarding recovery. There is no more insidious fear than that of the unknown. One of the greatest needs of the times is the determination of real causation. Let the veil of mystery be torn from these crises and much of the unreasoning fear will vanish with it. And yet how little interest is really displayed in actual causation is indicated by the relatively small amount of intensive work upon the subject.

CONCLUSION

This conception of the formation of economic trends explains why we enter periods of recurring expansion and inflation and why the ensuing periods of depression creep upon us almost without accepted warning. Each of the important industries is moving along in what may be described as its natural path when merely by the passage of time, their concurrent movements may come into phase with the result that their mutual interaction stimulates or reduces volume at a rapid rate. The greater the number of industries in phase, the greater is the regenerative influence prevailing among them. The higher the abnormal price level the lower is the stability of the structure.

The higher the amount of credit outstanding, the more sensitive is the situation to any decline in demand. High demand at high price levels multiplies debt. Orderly satisfaction of this debt demands a continuance of trade at levels not materially lower than those at which the debt was contracted. Any decline in demand accelerates the liquidation of this debt with disastrous consequences in a falling market. It is the initial decline in demand which precipitates the downward trend. The high debt level and strained credit conditions lower the resistance of the business system to the inroads of the germ in the disguise of the replacement cycle. This same cycle in its upward trend induces the stimulation that leads to the inflated condition. Thus the changes in credit are initially effects which are almost instantly transformed into causes far more potent than those of primary origin.

The origin of demand preceded that of credit. Credit originated as the result of demand and is the device used to bridge the gap between purchase and payment which are out of phase. This sequence in relationship has not changed. The replacement cycle is possible under conditions of pure barter, but its potential power is drastically increased as the volume of outstanding credit is enlarged.

Whether or not the theory of the replacement cycle as set.

forth in this study is ultimately proved or disproved, the facts covering the importance of the industries analyzed can scarcely be refuted and the differing fluctuations described are written into the very history of these industries. The close fidelity with which the weighted total of these components matches the trend of aggregate business cannot be seriously denied. The point, that explanation of the individualistic behavior of these industries will provide the reason for the ultimate trend of composite industry, is scientifically sound. This question then comes to mind: *If the replacement cycle does not furnish the proper explanation of the differing oscillations of these industries, what is the explanation?* The answer to this question is of tremendous economic importance. Some one should go to work upon it. This conception of underlying causes should carry an appeal to those whose training and experience have made them familiar with the real significance of harmonic and inharmonic forces.

The composite trend manifested by the four consumer industries bears very significant relationship to the movement of interest rates which is a barometer of credit conditions. It accords closely with the fluctuations in rate of deposit in savings

banks. It bears a striking similarity to the changing trends in individual bank debits when allowance is made for the growth of speculative activity beginning about 1925. Its variations are in close timing with those of car-loadings throughout the period.

These thoughts are not offered as the result of finished work. On the contrary, the field to be surveyed has scarcely been entered. The possibilities of further exploration are enormous. It does seem that the work done and conclusions derived are sufficiently logical to warrant earnest thought upon the points raised. If and when it can be found that these economic catastrophies are not the effect of mismanagement by any one group of society, but are rather the integrated results of the thoroughly natural actions of the great mass of consumers, a forward step toward solution will have been taken. With due consideration of all the technical factors involved in this study, one seems to be drawn to the conclusion again and again that the devastating peace-time catastrophies which we call economic depressions may be, after all, the repercussions of the deadly conflicts of the past.