series on interest rates, but it suffices to suggest that the cyclical behavior of each kind of interest rate has marked peculiarities which the theorist cannot afford to overlook. The call loan rate is subject to large random fluctuations and to cyclical fluctuations that are rivalled in amplitude only by the most volatile series on the production of industrial equipment. The cycles in the commercial paper rate have less than half the amplitude of the call loan rate, but they have almost four times the amplitude of the wholesale price indexes charted above. However, the rate on customers' loans charged by New York City banks shows cycles of smaller amplitude than that shown by the A. T. & T. index for a comparable period; and the customers' rate in 27 Southern and Western cities exhibits cycles that are even milder than those found in wholesale prices. The differences in timing are almost as marked as the differences in amplitude. The call loan rate leads about as often as it lags at reference revivals and recessions. But the commercial paper rate evidences a tendency to lag at the turns of general business, and so do the two series on customers' rates. The conformity indexes run highest in call money rates and lowest in the customers' rate of Southern and Western banks. Neither of the two long series—the commercial paper rate and the call loan rate—shows a strict one-to-one correspondence of specific to business cycles; but the excess of specific cycles over reference cycles results almost entirely from the intercalation of financial cycles between the reference dates of business cycles.

SOURCES OF DATA

The following notes identify briefly the sources from which the original data of the series discussed in this *Bulletin* are drawn.

Fig. 1. For 1900-33, American Telephone and Telegraph Co., *Index of Industrial Activity in the United States* (Report, Oct. 20, 1932), and monthly issues of *Summary of Business Conditions.* For earlier years, *Harvard Business Review,* January 1923, p. 159.

Fig. 2. Data on bank clearings outside of New York through 1918, compiled by Dr. F. R. Macaulay of the National Bureau of Economic Research. Figures of bank debits outside of New York beginning with 1919, from the *Federal Reserve Bulletin.* Both series deflated by Carl Snyder's index of the general price level.

Fig. 3. For 1914-18, *Monthly Labor Review,* December 1925, p. 121. For 1919-33, *Federal Reserve Bulletin,* June 1934, p. 326.

Fig. 4. Bureau of Labor Statistics, Bulletin No. 610, p. 22.

Fig. 5. Beginning with 1890, bulletins of Bureau of Labor Statistics. For earlier years, G. F. Warren and F. A. Pearson, *Prices* (John Wiley, 1933), pp. 12-13.

Fig. 6. The Statist, Jubilee Section, June 1928, p. 134.

Fig. 7. Great Britain, *Accounts Relating to Trade and Navigation.*

Figs. 8 and 9. Through June 1914, *Monthly Summary of Commerce and Finance,* particularly the issue of December 1910, pp. 1120-6. Since July 1914, *Monthly Summary of Foreign Commerce.*

Figs. 10 and 11. Journal of the American Statistical Association, June 1935, p. 371.

Figs. 12 and 13. Through June 1921, *Survey of Current Business.* Since July 1921, Bureau of the Census, *Automobiles.*

Fig. 14. Through 1926, Department of Agriculture, Statistical Bulletin No. 25. Since 1927, *Yearbook of Agriculture* and *Crops and Markets.*

Fig. 15. Index constructed by National Bureau of Economic Research from data on federally inspected slaughter of cattle, calves, hogs, sheep and lambs; the weights being in proportion to the average value, as shown in the Census of Manufactures from 1909 through 1929, of each class of animals slaughtered.

Fig. 16. Weekly Statistical Sugar Trade Journal. Data relate to four Atlantic ports.

Fig. 17. For 1877-1924, J. E. Partington, *Railroad Purchasing and the Business Cycle* (Brookings Institution, 1929). Since 1924, *Survey of Current Business.*

Fig. 18. For 1918-19, *Federal Reserve Bulletin.* For 1920-34, Bureau of the Census, *Railroad Locomotives.*

Fig. 19. The Coal Trade (F. E. Saward, editor).

Fig. 20. Mineral Resources and *Minerals Yearbook.*

Fig. 21. For 1919, University of Illinois, Bureau of Business Research, Bulletin No. 16, p. 37. For 1920-33, *Survey of Current Business.*

Fig. 22. From 1902 on, *Iron Age.* For earlier years, unpublished figures estimated by Dr. F. R. Macaulay of the National Bureau of Economic Research.

Figs. 23, 24 and 25. Same as Fig. 20.

Fig. 26. Through 1924, W. M. Persons, *Forecasting Business Cycles* (John Wiley, 1931), pp. 170-1. Since 1924, Warren and Pearson, *op. cit.,* p. 45.

Fig. 27. Weltwirtschaftliches Archiv, March 1935, pp. 293-4.

Fig. 28. For 1866-1910, Food Research Institute, *Wheat Studies,* Vol. II, pp. 260-1. From 1911 on, latest revisions of Department of Agriculture.

Fig. 29. Through 1884, *Journal of the Royal Agricultural Society of England,* Third Series, Vol. IV, p. 132. From 1885 on, Food Research Institute, *Wheat Studies,* Vol. IX, p. 268 and Vol. X, p. 278.

Figs. 30 and 31. Review of Economic Statistics, August 1921, pp. 275-6.

Fig. 32. Unpublished series compiled by Dr. F. R. Macaulay of the National Bureau of Economic Research.

Figs. 33 and 34. Annual Report of the Federal Reserve Board, 1931, p. 82.

Fig. 35. Same as Fig. 32.

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A NON-PROFIT MEMBERSHIP CORPORATION FOR IMPARTIAL STUDIES IN ECONOMIC AND SOCIAL SCIENCE

The National Bureau's Measures of Cyclical Behavior

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I. THE PURPOSE FOR WHICH THE MEASURES ARE MADE

BUSINESS cycles consist of interrelated fluctuations in many economic processes—the production of commodities by farmers, miners and manufacturers; the transporting of freight and passengers by land and water; the pricing of commodities at successive stages of their journeys to business enterprises and households; marketing merchandise at home and abroad; carrying stocks of raw materials and finished products; employing men and disbursing wages; borrowing money and paying interest; making profits or losses and declaring dividends; saving and investing capital; paying current expenses and maturing debts with money or bank credit. That the cyclical fluctuations in these diverse processes differ from one another in timing, amplitude and relationship to the expansions and contractions of general business has been known; but the knowledge has been piecemeal and vague for the most part. Thus economists have had to construct their theories of business cycles without adequate knowledge of the phenomena they were trying to explain, and without adequate means of testing the relations between their hypotheses and what actually happens.

The rapid accumulation of statistical data in recent years is making it possible to work in a more satisfactory fashion. Investigators with adequate resources can now find out the manner in which many economic processes behave with reference to business cycles. By combining what they learn about different processes, they can get a far clearer idea than their predecessors had of the facts to be explained. On the basis of the fuller knowledge of what business cycles are, they should be better able to make tests of existing hypotheses, to devise new ones, and so to improve upon earlier theoretical work.

The National Bureau laid the basis for such an effort in *Business Cycles: The Problem and Its Setting.* Since that volume appeared in 1927, a small staff has been developing a technique for measuring cyclical behavior and has been applying it to some eight hundred time series from the United States, Great Britain, France and Germany.[1] The task of rechecking this analysis and bringing it up to the close of the last completed cycles in the four countries should be finished before the end of the year.

This *Bulletin* gives a brief explanation of the leading features of the technique and a few illustrations of the results. The first three chapters of the book in preparation—*Business Cycles,* Volume II, *Analysis of Cyclical Behavior*—will be available in mimeographed form by August or September. They explain the technique in full detail, interpret the meaning of the results and appraise their representative value. It is expected that Volume II will be published before the close of 1936. The final volume, the *Rhythm of Business Activity,* will follow some time later. This volume will present a theoretical account of how business cycles come about, and it is for this ultimate use that the National Bureau's measures of cyclical behavior are made.

II. THE BASIC UNIT OF THE INVESTIGATION

Each business cycle that runs its course in any country offers one opportunity to observe cyclical phenomena in their mixture of similarities and differences. The more of these units we can observe, the better our chance of disen-

[1] Besides the present writers, Dr. Simon Kuznets has taken an active part in developing the technique. The task of applying it to time series has been supervised by Miss Cicely Applebaum. The assistants who have shared in the work are Mr. H. I. Forman, Miss S. Sakowitz, Mr. D. Volkenau, Miss F. Goldberg, Mr. K. Laubenstein, Mr. W. Friedman, Mr. E. Otto, Mr. C. Wittmann, Miss D. Cook, Mr. W. Levin, Mr. G. Miron, Mr. S. Rubin, and Mr. R. Vernon.

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gaging cyclical fluctuations from the random movements with which they are intertwined; the better our chance, also, of finding out how uniform or how variable the cyclical component in economic changes tends to be, and how the cyclical fluctuations that occur in different countries at the same time are related to one another. But the opportunities for close observation are limited to those countries and periods for which continuous statistical series are available. It would be possible and highly desirable to cover more than four countries; it would be possible also to work this restricted field more intensively than we have done. Both the extensive and the intensive margins of cultivation have been set for us by the resources at our disposal.

III. THE MEASURES OF CYCLICAL BEHAVIOR

1. Reference Dates

To learn how different economic processes behave with reference to business cycles we must observe their movements during the revivals, expansions, recessions and contractions in general business activity. Before we can begin observing we must mark off these periods in time. Hence we have made for each of the four countries a table of 'reference dates', showing the months and years of the troughs and peaks of successive business cycles. We based these tables first upon the *Business Annals,* compiled for the National Bureau by Dr. Willard L. Thorp; then we refined, tested and at need amended the dates by studying whatever statistical series are available for the four countries at different periods. 'General business activity' is a concept that can be made more definite as the field covered by economic statistics expands. Hence we have more confidence in the accuracy of our reference dates for the United States than for the three European countries, and more confidence in the later than in the earlier dates.

2. Reference Cycles and Specific Cycles

After eliminating the seasonal variations of a series, we break it into segments marked off by the reference dates for the country from which the series comes. Then we compute the average of the monthly values during each 'reference cycle' and convert the data into percentages of this base; we call these percentages 'reference-cycle relatives'. The application of a uniform set of dates to all series for a given country and the reduction of the original data expressed in diverse units to relatives of their average values during the periods thus marked off put all the materials into comparable form and enable us to see how different processes behave during successive business cycles in our four countries.

While our interest centers in this picture of what happens in the course of a business cycle, it reaches out to other matters. On working with our series we find that almost all of them have cyclical fluctuations, but that these fluctuations bear widely different relationships in time to business cycles. The cyclical movements found in a series, what we call its 'specific cycles', may have turning dates that differ little from our reference dates, or that usually lead or lag behind the reference dates by brief or by considerable intervals, or that have no regular relationship to the reference dates. Now the course of business cycles is influenced by cyclical fluctuations in every economic process, whether or not these fluctuations harmonize with the general tides of activity. Hence, to lay a satisfactory basis for a theory of business cycles, we must supplement our analysis based upon business-cycle periods by studies of the specific cycles peculiar to each series.

To that end, we look in every series for wave-like movements, the duration of which is of the same order of magnitude as that of business cycles. In most series the dates of the troughs and peaks of the specific cycles are clearly defined, but in some series they are obscured by random or secular movements. We mark off the specific cycles by the dates of their turning points as well as we can; compute the average value of the data during each cycle, and make a second set of relatives, corresponding in character to the reference-cycle relatives, except that the new set shows movements during specific cycles.

Table 1 and Chart 1 illustrate these steps. The table shows by months the seasonally adjusted figures of total coke production in the United States from 1914 through 1933—a series chosen because it is short and presents few of the complications that we ordinarily encounter. These figures are plotted on the chart, which shows also the turning points of business cycles and of the specific cycles in coke production. The average monthly production of coke during the first specific cycle (December 1914 to May 1919) was 4,256,000 net tons. With that figure as a base, we convert the monthly values shown by Table 1 for the months covered by this cycle into specific-cycle relatives. The first reference cycle covered by this series runs from January 1915 to April 1919. The average monthly output during that period was 4,316,000 net tons, which is the base upon which the first set of reference-cycle relatives is computed. During the second specific cycle (June 1919 to July 1921) the average monthly output was 3,502,000 net tons; during the second reference cycle (May 1919 to September 1921) it was 3,367,000 net tons. These figures are the bases upon which relatives are computed for the second specific and the second reference cycle. All of the eight tables shown below are made by using the turning points marked on Chart 1.

3. Measures of Timing and Duration

Our tables of reference dates yield measures of the durations of business cycles and of their phases of expansion and contraction. The dates of the cyclical turning points in a given series yield similar measures of the durations of its specific cycles. By comparing the turning points of specific cycles with the reference dates, we determine how regularly the specific cycles of a given series correspond in time to business cycles. When the correspondence is close, we determine the number of months by which the troughs and peaks in the series precede or follow the reference troughs and peaks.

These procedures are illustrated by Table A1. After the specific cycles have been marked off, the dates of the

TABLE 1

PRODUCTION OF COKE, UNITED STATES, 1914-1933[1]

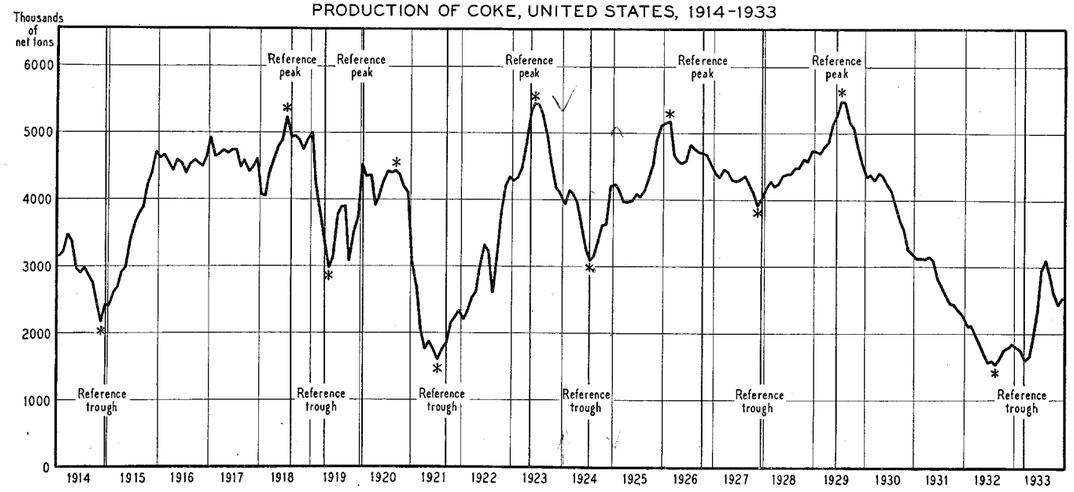
(*In thousands of net tons*)

	Jan.	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
1914	3128	3215	3476	3364	2940	2867	2991	2841	2742	2459	2150	2419
1915	2400	2610	2675	2897	2990	3376	3613	3759	3880	4198	4387	4693
1916	4609	4662	4554	4425	4581	4535	4392	4529	4591	4524	4503	4637
1917	4907	4620	4672	4720	4693	4730	4731	4475	4600	4413	4487	4589
1918	4056	4042	4415	4639	4801	4891	5228	4918	4934	4875	4749	4874
1919	5011	4215	3773	3335	2977	3141	3777	3870	3865	3068	3529	3735
1920	4554	4353	4360	3885	4031	4255	4412	4403	4431	4369	4200	4093
1921	3043	2662	2048	1749	1879	1752	1595	1762	1850	2160	2254	2338
1922	2195	2317	2560	2638	3009	3317	3236	2597	3150	3785	4187	4342
1923	4269	4330	4512	4878	5302	5441	5407	5274	4995	4538	4174	4107
1924	3928	4144	4078	3959	3617	3242	3092	3160	3371	3606	3632	4182
1925	4223	4112	3961	3964	3990	4068	4052	4130	4317	4508	4885	5087
1926	5142	5171	4658	4580	4552	4588	4820	4750	4721	4695	4665	4540
1927	4384	4335	4437	4419	4304	4276	4307	4351	4241	4107	3887	4031
1928	4166	4259	4197	4236	4364	4368	4375	4480	4468	4614	4569	4735
1929	4728	4699	4798	4858	5148	5257	5473	5460	5156	5059	4761	4547
1930	4354	4388	4306	4427	4374	4272	4125	3936	3691	3549	3280	3225
1931	3133	3127	3128	3170	3106	2841	2738	2601	2471	2450	2356	2300
1932	2108	2128	1999	1890	1726	1602	1619	1570	1647	1775	1817	1864
1933	1815	1779	1631	1670	1911	2338	2984	3119	2888	2601	2438	2545

[1] The figures are adjusted for seasonal variations.

CHART 1

PRODUCTION OF COKE, UNITED STATES, 1914-1933



The figures are adjusted for seasonal variations. The cyclical peaks and troughs in general business are indicated by vertical lines; the peaks and troughs in the specific cycles of coke production are indicated by asterisks.

TABLE 2

SAMPLES OF THE TABLES USED IN MEASURING CYCLICAL BEHAVIOR

A1. TIMING AND DURATION OF SPECIFIC CYCLES

PRODUCTION OF COKE IN THE UNITED STATES, 1914 TO DATE

DURATION OF CYCLICAL MOVEMENTS

Dates of specific cycles			Lead (−) or lag (+)		Specific cycles			Excess over reference cycles			Per cent of duratio of specific cycles	
Revival	Peak	Trough	At reference peak	At reference trough	Expansion	Contraction	Full cycle	Expansion	Contraction	Full cycle	Expansion	Contraction
			mos.	*mos.*	*mos.*	*mos.*	*mos.*	*mos.*	*mos.*	*mos.*		
(1)			(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
				−1								
1. Dec. '14	July '18	May '19	−1	+1	44	10	54	0	+ 2	+2	81	19
2. June '19	Sept. '20	July '21	+8	−2	16	10	26	+7	−10	−3	62	38
3. Aug. '21	June '23	July '24	+1	0	23	13	36	+3	− 1	+2	64	36
4. Aug. '24	Feb. '26	Nov. '27	−8	−1	19	21	40	−8	+ 7	−1	48	52
5. Dec. '27	July '29	Aug. '32	+1	−7	20	37	57	+2	− 8	−6	35	65
Average			+0.2	−2	24	18	43	+1	− 2	−1	58	42
Average deviation			4	2	8	9	10	4	6	3	13	13

turning points are entered in column (1) of this table. The differences in months between the turning dates of the specific cycles and the reference dates (shown by Tables B1-B3) are entered in columns (2) and (3). The durations of the specific cycles and their phases are shown in columns (4)-(6). The differences between the durations of specific cycles and corresponding business cycles are given in columns (7)-(9). Finally, columns (10) and (11) express the lengths of the specific-cycle phases as percentages of the durations of the full cycles.

4. Measures of Amplitude

We measure the amplitudes of the cyclical swings by finding the rise of the specific-cycle relatives from the initial trough of a cycle to the peak and the fall from the peak to the terminal trough. In order to diminish the influence of random factors upon the amplitudes, we use three-month averages centered on the troughs and peaks. Of course, the results show rise and fall in percentages of the average value of the series during the specific cycle that is being measured.

These amplitude measures are given by Table A2 in three forms. Columns (2)-(4) show the three-month averages of the specific-cycle relatives centered at the initial trough, peak, and terminal trough. The second set of measures, given in columns (5)-(7), shows the rise from trough to peak, the fall from peak to trough, and the total rise and fall; these figures are obtained directly from the entries in columns (2)-(4). The third set of measures, given in columns (8)-(10), shows the amplitudes per month; they are obtained by dividing the figures in columns (5)-(7) of Table A2 by the corresponding duration figures in columns (4)-(6) of Table A1.

5. Measures of Secular Movements

Our method of computing cycle relatives as percentages of the average value during a reference or a specific cycle eliminates from the original data what we call the 'inter-cycle' portion of the secular trend. The 'intra-cycle' portion of the trend we make no effort to eliminate. While we should be glad to have two sets of cyclical measures, one showing cyclical movements as deviations from properly fitted trends, and the present set showing cyclical fluctuations and intra-cycle trends in combination, we cannot meet the expense of the double analysis without severely restricting the number of series we cover. Of the two sets of measurements, the one that is easier to make shows more faithfully the 'cyclical' units of economic experience in a business economy, which commonly appear as expansions followed by sharper but briefer and less considerable contractions; it therefore offers better clues to business behavior, and promises to be more useful in framing a theory of business cycles.

While we exclude the inter-cycle portions of the secular trend from the original data, we take account of them by computing the percentage rise or fall in the average value of a series from one specific cycle to the next; also from one phase of expansion to the next and from one phase of

TABLE 2

SAMPLES OF THE TABLES USED IN MEASURING CYCLICAL BEHAVIOR

A2. AMPLITUDE OF SPECIFIC CYCLES

PRODUCTION OF COKE IN THE UNITED STATES, 1914 TO DATE

Amplitude of cyclical movements shown by specific-cycle relatives

Dates of specific cycles			Standing			Total movement			Movement per month		
Revival	Peak	Trough	At initial trough	At peak	At terminal trough	Rise	Fall	Rise and fall	Rise	Fall	Rise and fall
	(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. Dec. '14	July '18	May '19	55	118	74	63	44	107	1.4	4.4	2.0
2. June '19	Sept. '20	July '21	90	126	49	36	77	113	2.2	7.7	4.3
3. Aug. '21	June '23	July '24	47	148	87	101	61	162	4.4	4.7	4.5
4. Aug. '24	Feb. '26	Nov. '27	73	115	93	42	22	64	2.2	1.0	1.6
5. Dec. '27	July '29	Aug. '32	107	145	43	38	102	140	1.9	2.8	2.5
Average			74	130	69	56	61	117	2.4	4.1	3.0
Average deviation			19	13	19	21	23	27	0.8	1.8	1.1

contraction to the next. The average change from one specific cycle to the next indicates the size of the net intra-cycle trend. We take detailed account of the intra-cycle portion of the trends by computing the percentage rise or fall from the average value of a series during one phase of a specific cycle to the succeeding phase of the cycle.

In our sample of Table A3, columns (2) and (3) show the average value of the seasonally adjusted data during the phases of specific cycles, and column (4) shows the average value during full specific cycles—these being the bases on which specific-cycle relatives are computed. Columns (5) and (6) display the intra-cycle trends. Column (5) states the percentage change from the average value during a contraction to the average value during the following expansion, and column (6) states the percentage change from the average value during an expansion to the average value during the following contraction. Columns (7)-(9) display the inter-cycle trends. They show successively the percentage change from the average value during one expansion to the average value during the next expansion,

TABLE 2

SAMPLES OF THE TABLES USED IN MEASURING CYCLICAL BEHAVIOR

A3. MEASURES OF SECULAR MOVEMENTS

PRODUCTION OF COKE IN THE UNITED STATES, 1914 TO DATE

Dates of specific cycles			Average monthly standing (*in thousands of net tons*)			Per cent change from average of preceding phase of specific cycles		Per cent change from average of same phase of preceding cycle			Per cent change per month from average of same phase of preceding cycle		
Revival	Peak	Trough	Expansion	Contraction	Full cycle	Expansion	Contraction	Expansion	Contraction	Full cycle	Expansion	Contraction	Full cycle
	(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1. Dec. '14	July '18	May '19	4231	4366	4256		+ 3						
2. June '19	Sept. '20	July '21	3979	2739	3502	− 9	−31	− 6	−37	−18	−0.2	−1.4	−0.4
Aug. '21	June '23	July '24	3323	4197	3638	+21	+26	−16	+53	+ 4	−0.5	+1.5	+0.1
4. Aug. '24	Feb. '26	Nov. '27	4187	4458	4329	0	+ 6	+26	+ 6	+19	+0.8	+0.2	+0.5
5. Dec. '27	July '29	Aug. '32	4591	3270	3733	+ 3	−29	+10	−27	−14	+0.2	−0.6	−0.3
Average						+ 4	− 5	+ 4	− 1	− 2	+0.1	−0.1	−0.03
Average deviation						9	20	14	31	14	0.4	0.9	0.3

TABLE 2

SAMPLES OF THE TABLES USED IN MEASURING CYCLICAL BEHAVIOR

A4. SPECIFIC-CYCLE PATTERNS

PRODUCTION OF COKE IN THE UNITED STATES, 1914 TO DATE

Averages of specific-cycle relatives at nine stages of the cycles

Dates of specific cycles: Revival	Peak	Trough	I Three months centered on initial revival	II First third	III Middle third	IV Last third	V Three months centered on recession	VI First third	VII Middle third	VIII Last third	IX Three months centered on terminal revival
	(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
				EXPANSION				CONTRACTION			
1. Dec. '14	July '18	May '19	55	85	108	108	118	114	110	79	77
2. June '19	Sept. '20	July '21	94	103	119	123	124	108	61	50	50
3. Aug. '21	June '23	July '24	48	62	85	128	148	130	112	96	88
4. Aug. '24	Feb. '26	Nov. '27	74	89	93	112	111	108	104	97	93
5. Dec. '27	July '29	Aug. '32	108	114	122	134	144	120	84	54	45
Average			✓76	91	105	121	129	116	94	75	71
Average deviation			✓20	14	13	9	14	7	17	19	18

from the average value during one contraction to that during the next, and from the average value during a full specific cycle to that during the next. Finally, columns (10)-(12) reduce the inter-cycle trends shown in columns (7)-(9) to a per-month basis, the divisors being successively the number of months from the midpoint of one expansion to the midpoint of the next expansion, the midpoint of one contraction to the next, and the midpoint of a full cycle to the next.

6. Cyclical Patterns

To show the behavior of a series during the course of its specific cycles in greater detail than in Table A2, we break each specific cycle into nine stages. Stage I covers the three months centered on the initial 'revival', which is the month following the initial trough of the specific cycle; stage V covers the three months centered on the 'recession', which is the month following the peak; stage IX covers the three months centered on the terminal 'revival'. Stages II to IV cover successive thirds of the phase of expansion, and stages VI to VIII cover successive thirds of the phase of contraction. By averaging the specific-cycle relatives for the months included in each of these stages, we get 'specific-cycle patterns'.

We make 'reference-cycle patterns' on a similar plan; but here the nine stages are marked off by the cyclical turning dates, together with the intervening periods of expansion and contraction, of general business. By breaking each reference cycle into nine stages, we show the behavior of different economic processes from stage to stage of business cycles and put both our concept of business cycles and our schedule of reference dates to a critical test. When charted the reference-cycle pattern of a series gives a vivid picture of its behavior with respect to business cycles.

Table A4 illustrates how the specific-cycle patterns are made and Table B1 how the reference-cycle patterns are made. The captions of each table indicate the manner in which the cycles are divided into stages. Table B1 is like Table A4, except that the dates of revival and recession are taken from the standard list of reference dates instead of being taken from the turning points of specific cycles, and that the entries are expressed in units of reference-cycle relatives instead of specific-cycle relatives.

Tables A5 and B2 are closely related to Tables A4 and B1. The entries in Table A5 are obtained by dividing the differences between successive figures in Table A4 by the number of months from the middle of one stage to the middle of the next stage. Table B2 is made from Table B1 just as Table A5 is made from Table A4; that is, the differences between successive entries in Table B1 are divided by the number of months between the middle of one stage and the middle of the next.

7. Rates of Change per Month

In making the cyclical patterns we pay no heed to differences in duration. A very brief business cycle like that which followed the World War (May 1919 to September 1921 in the United States) is broken into nine stages in the same fashion as is a very long cycle like that which lasted from January 1871 to March 1879. Similarly, we disregard differences of duration in measuring amplitudes

TABLE 2

SAMPLES OF THE TABLES USED IN MEASURING CYCLICAL BEHAVIOR

A5. AVERAGE RATES OF CHANGE PER MONTH FROM STAGE TO STAGE OF SPECIFIC CYCLES

PRODUCTION OF COKE IN THE UNITED STATES, 1914 TO DATE

Rate of change per month in specific-cycle relatives from stage to stage of the cycles

Dates of specific cycles: Revival	Peak	Trough	I-II Revival to first third	II-III First to middle third	III-IV Middle to last third	IV-V Last third to recession	V-VI Recession to first third	VI-VII First to middle third	VII-VIII Middle to last third	VIII-IX Last third to revival
	(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			EXPANSION				CONTRACTION			
1. Dec. '14	July '18	May '19	+4.0	+1.6	0	+1.2	−2.0	− 1.3	−10.3	−1.0
2. June '19	Sept. '20	July '21	+3.0	+3.2	+0.8	+0.3	−8.0	−15.7	− 3.7	0
3. Aug. '21	June '23	July '24	+3.5	+3.3	+5.7	+4.4	−7.2	− 4.5	− 4.0	−3.2
4. Aug. '24	Feb. '26	Nov. '27	+4.3	+0.7	+3.2	−0.3	−0.9	− 0.6	− 1.0	−1.0
5. Dec. '27	July '29	Aug. '32	+1.7	+1.3	+1.8	+2.5	−3.7	− 3.0	− 2.5	−1.4
Average			+3.3	+2.0	+2.3	+1.6	−4.4	− 5.0	− 4.3	−1.3
Average deviation			0.8	1.0	1.7	1.5	2.6	4.3	2.4	0.8
Average interval in months			✓ 4.3	7.6	7.9	4.6	3.3	5.7	5.8	3.4

of cyclical rise and fall, and in measuring inter-cycle secular movements.

This procedure is dictated by our basic assumption that one business cycle in one country may be taken as a unit in a study of cyclical behavior. But these units, like most of those used in the biological and the social sciences, are variable, and part of our task is to study the character of the variations that occur. Having measured variations in duration, we should find whether they are associated with variations in amplitude, inter-cycle movements and cyclical patterns. Partly to facilitate such studies, we supplement our first measurements of these behavior traits by computing in Table A2 the rates of change per month from the troughs of specific cycles to the peaks and from the

TABLE 2

SAMPLES OF THE TABLES USED IN MEASURING CYCLICAL BEHAVIOR

B1. REFERENCE-CYCLE PATTERNS

PRODUCTION OF COKE IN THE UNITED STATES, 1914 TO DATE

Averages of reference-cycle relatives at nine stages of the cycles

Dates of reference cycles: Revival	Peak	Trough	I Three months centered on initial revival	II First third	III Middle third	IV Last third	V Three months centered on recession	VI First third	VII Middle third	VIII Last third	IX Three months centered on terminal revival
	(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
				EXPANSION				CONTRACTION			
1. Jan. '15	Aug. '18	April '19	57	88	106	107	114	111	115	87	73
2. May '19	Jan. '20	Sept. '21	94	103	107	117	131	125	113	54	62
3. Oct. '21	May '23	July '24	56	64	85	121	144	135	109	96	86
4. Aug. '24	Oct. '26	Dec. '27	74	90	103	109	107	102	100	95	96
5. Jan. '28	June '29	March '33	118	122	129	140	154	128	83	51	50
Average			✓80	93	106	119	130	120	104	77	73
Average deviation			✓21	15	10	9	16	11	10	19	14

TABLE 2

SAMPLES OF THE TABLES USED IN MEASURING CYCLICAL BEHAVIOR

B2. AVERAGE RATES OF CHANGE PER MONTH FROM STAGE TO STAGE OF REFERENCE CYCLES

PRODUCTION OF COKE IN THE UNITED STATES, 1914 TO DATE

Rate of change per month in reference-cycle relatives from stage to stage of the cycles

	Dates of reference cycles			I-II Revival to first third	II-III First to middle third	III-IV Middle to last third	IV-V Last third to recession	V-VI Recession to first third	VI-VII First to middle third	VII-VIII Middle to last third	VIII-IX Last third to revival
	Revival	Peak	Trough	EXPANSION				CONTRACTION			
		(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1.	Jan. '15	Aug. '18	April '19	+4.1	+1.3	+0.1	+0.9	—2.0	+2.0	—11.2	—7.0
2.	May '19	Jan. '20	Sept. '21	+6.0	+1.6	+3.3	+7.0	—1.7	—2.0	— 9.1	+2.0
3.	Oct. '21	May '23	July '24	+2.3	+3.5	+5.5	+5.8	—3.6	—6.5	— 2.9	—3.3
4.	Aug. '24	Oct. '26	Dec. '27	+3.6	+1.5	+0.7	—0.4	—2.0	—0.5	— 1.1	+0.3
5.	Jan. '28	June '29	March '33	+1.3	+1.3	+1.8	+4.0	—3.5	—3.1	— 2.1	—0.1
Average				+3.5	+1.8	+2.3	+3.5	—2.6	—2.0	— 5.3	—1.6
Average deviation				1.3	0.6	1.7	2.6	0.8	2.2	3.9	2.8
Average interval in months				4.0	7.3	7.8	4.5	3.5	6.1	6.6	4.0

peaks to the troughs; by computing in Table A3 the rates of change per month from the average value of a series in one specific cycle to the average value in the next; and by computing in Tables A5 and B2 the rates of change from stage to stage in each specific and each reference cycle.

δ. Measures of Conformity to Business Cycles

The comparisons between the timing and duration of specific and reference cycles show roughly whether the wave-like movements in a given series do or do not conform regularly to the waves in general business activity. Further light is shed upon this problem by the similarity or the difference between the specific-cycle and the reference-cycle patterns of a series. But it is desirable to measure explicitly the varying degrees of conformity.

For this purpose we study the movements of a series from stage to stage of successive reference cycles, endeavoring to find during what reference stages the series commonly expands and during what stages it commonly contracts. The typical period of rise may be, let us say, from stages I to V, from VIII to IV, or from VIII to V. In any of these cases we say that the stages during which the series typically rises are 'associated with reference expansion', implying that the remaining stages are 'associated with reference contraction'. Whatever division of the stages is chosen is applied uniformly in the later operations to all the reference cycles covered by a series.

We make two sets of measures of conformity. The first set shows the average rate of change per month during the reference-cycle stages associated with reference expansion, during those associated with reference contraction, and the difference between these two rates of change. This third result is needed because some series with rapidly rising trends at times continue to advance even during the stages associated with reference contraction, and we wish to show how much, if at all, the rate of rise is accelerated during expansions in general business and retarded during contractions.

While the average rates of rise or fall shown by the first set of conformity measures are useful, they do not indicate the *regularity* with which a series responds to the stimuli of general business expansion and contraction. To bring out this feature of cyclical behavior as well as may be, we make 'indexes of conformity'. These show uniformity or lack of uniformity in the direction of movement, but take no account of magnitude of change. When a series rises during the stages associated with reference expansion in one cycle, we mark it +100; when the series remains unchanged, we mark it 0; when it falls, we mark it —100. We cast up the algebraic sum of these entries and divide by their number. The result varies between +100 (positive conformity in all the reference cycles covered) and —100 (inverse conformity in all the cycles). An equal number of positive and inverse movements produces an index of 0. An 'expansion index' of +50 means positive conformity in 3 and inverse conformity in 1 case out of 4; one of +33 means positive conformity in 2 and inverse conformity in 1 case out of 3. For conformity during the stages associated with reference contraction we make a 'contraction index' in a similar way, but now a decline is marked +100 and a rise —100; for a decline means positive conformity to reference contractions and a rise means inverse conformity. Finally, we make indexes of conformity to business cycles as wholes. In doing this we allow for the fact that some series rise or decline throughout business cycles, but at a different rate during reference expansions and contractions. We attain a preliminary 'business-cycle index' by crediting each difference between the rates of change per month during the stages associated with reference expansion and contraction with +100 when the difference is minus, with —100 when it is plus, and then striking an arithmetic mean of these entries. Since this index shows merely the conformity to business cycles considered as running from trough to trough, we supplement it by another index showing conformity to business cycles considered as running from peak to peak. A weighted average of the two preliminary indexes gives us the final 'business-cycle index'. An index of +100 means that the rate of change per month during the stages associated with reference contraction is without exception algebraically lower than the rate of change during the next preceding and following reference expansions.

Table B3 presents these measures for coke production. We read in the captions that 'expansion covers stages I-V' and that 'expansions are related to reference expansions'. This means that the typical period of expansion of coke production is from stage I to stage V of the reference cycles, that the movements of the series during these reference stages are associated with reference expansion, and that the movements from stages V to IX are associated with reference contraction. Column (2) states for each reference cycle the interval from the middle of stage I to the middle of stage V, and column (4) states the interval from the middle of stage V to the middle of stage IX. Column (3) shows the average change per month from the middle of stage I to the middle of stage V, and column (5) shows the average change per month from the middle of stage V to the middle of stage IX; the first is obtained by dividing the entries of column (2) into the differences between the standings in stages I and V as shown in Table B1, and the second is obtained by dividing the entries of column (4) into the differences between the standings in stages V and IX. Column (6) shows the excess of the entries in column (5) over those in column (3). The average rates of change per month, which constitute our first set of conformity measures, are recorded below the entries for individual cycles in columns (3), (5) and (6).

The conformity indexes shown at the bottom of Table B3 constitute our second set of conformity measures. The

TABLE 2

SAMPLES OF THE TABLES USED IN MEASURING CYCLICAL BEHAVIOR

B3. MEASURES OF CONFORMITY TO BUSINESS CYCLES

PRODUCTION OF COKE IN THE UNITED STATES, 1914 TO DATE

(Expansion covers stages I-V. Expansions are related to reference expansions.)

	Dates of reference cycles			Average change of reference-cycle relatives during stages associated with Reference expansion: Interval in months	Reference expansion: Average change per month	Reference contraction: Interval in months	Reference contraction: Average change per month	Average change for reference expansion subtracted from average change for reference contraction
	Revival	Peak	Trough					
		(1)		(2)	(3)	(4)	(5)	(6)
1.	Jan. '15	Aug. '18	April '19	44.0	+1.3	8.0	—5.1	—6.4
2.	May '19	Jan. '20	Sept. '21	9.0	+4.1	20.0	—3.4	—7.5
3.	Oct. '21	May '23	July '24	20.0	+4.4	14.0	—4.1	—8.5
4.	Aug. '24	Oct. '26	Dec. '27	27.0	+1.2	14.0	—0.8	—2.0
5.	Jan. '28	June '29	March '33	18.0	+2.0	45.0	—2.3	—4.3
Average					+2.6		—3.1	—5.7
Average deviation					1.3		1.3	2.1
Index of conformity to								
Reference expansions					+100			
Reference contractions							+100	
Business cycles (low to low)								+100
Business cycles (high to high)								+100
All business cycles								+100

expansion index is based on the signs of the entries in column (3), the contraction index is based on the signs in column (5), and the index of conformity to business cycles considered as running from trough to trough is based on the signs in column (6). The index of conformity to business cycles considered as running from peak to peak requires in most series some special computations, but in our sample series it is obvious from the distribution of signs in columns (3) and (5) that this index is +100. The index of conformity to all business cycles, or the final business-cycle index, is a weighted average of the two preliminary indexes, the weights being proportionate to the number of cycles covered by each.

9. Averages and Average Deviations

All the measures described above are made for every reference and for every specific cycle covered by a series. These figures for individual cycles show net changes produced by the interaction of cyclical fluctuations, intra-cycle trends and random perturbations. So long as the cycles are considered one at a time, there is no way of telling what part of the net changes is due to each of these three components. But when averages are struck for all the cycles covered by a series, features peculiar to single cycles tend to fade away, while features common to all the cycles tend to stand out clearly.

Averaging of this sort is our preliminary device for dealing with that most difficult problem of time-series analysis: how to segregate cyclical fluctuations from random perturbations. In general, the larger the number of cycles covered by an average, the more probable it is that the random perturbations of individual cycles will cancel one another. Hence we feel more confidence in our measures of cyclical behavior made from long series than in those made from short ones. But in analyzing price and value series, we exclude from our averages the cycles affected by the monetary changes that occurred during and soon after the Civil War and the World War. We make exclusions in a few other cases when some exceptionally powerful random factor, such as a great coal strike, has warped an individual cycle out of resemblance to the other cycles of its array.

Intra-cycle trends, like random perturbations, tend to disappear in the averages when their direction changes within the period covered by our analysis. These cases, however, are few. Except when we use series from which the compilers have eliminated secular trends, we commonly get averages that show cyclical fluctuations and intra-cycle trends in combination. The trend factor stands out clearly in the upward or downward tilt of most of the cyclical patterns shown by Charts 2-6.

Our attempt to find what cyclical behavior is characteristic of different economic processes does not end in contemplation of average measures; for one of the leading characteristics of actual business cycles is that they vary in duration, intensity and other features. To keep this characteristic prominently before our minds and to provide materials for studying it at a later stage of the investigation, we compute the average deviations from our averages. These deviations are simple measures of the degree in which the figures for individual cycles in a series are clustered about the arithmetic means that we use to represent 'central tendencies'. Random perturbations enter prominently into the average deviations; any changes that occur in the cyclical component proper do likewise, also whatever changes occur in intra-cycle trends, and so too whatever seasonal variations escape our efforts to eliminate them.

IV. CONSTRUCTION OF THE CHARTS

We have devised standard charts of cyclical patterns that show most, though not all, of our measures of cyclical behavior. Since in this *Bulletin* we base our illustrations of results mainly upon the charts, it is necessary to describe their construction in detail. The reader will do well to check this description against any of the charts that follow —preferably Figure 23 showing coke production.

The Captions

We state on the charts the number of specific and reference cycles included in the cyclical patterns, the periods covered, and the conformity indexes. In the chart showing the cyclical patterns of coke production we find the legend 'Conformity: +100, +100, +100'. The first figure is always the index of conformity to reference expansions; the second is the index of conformity to reference contractions; the third is the final index of conformity to whole business cycles.

The Time Scales

The average durations of the specific and reference cycles are represented by the long horizontal lines above and below the cyclical patterns.

The short horizontal lines above and below these time scales show the average deviations from the average durations.

The time scales showing the average duration of specific and reference cycles are broken by nine vertical lines dropped from or erected at the midpoints of the stages into which we divide both sets of cycles. The distances between the vertical lines correspond to the average time intervals between the midpoints of successive cycle-stages. The verticals at recession are extended through the time scales in order that the eye may quickly find this stage.

Cyclical Patterns and Amplitude Scales

The vertical scale at the left of the chart runs in units of cycle relatives; that is, percentages of the average value of the series during a specific or a reference cycle. With the aid of this scale, the amplitude of the cycles can be read.

The two curves show the specific-cycle and reference-cycle patterns derived by averaging the standings at the nine successive stages into which individual cycles are divided.

The lengths of the vertical lines show the average deviations of the individual cycles from their average standings at the nine stages plotted.

In dealing with series that run by years instead of months or quarters, it is not feasible to break the reference and specific cycles into nine stages. We make five-stage instead of nine-stage patterns in these cases. The first stage represents the initial trough of a cycle, the second represents mid-expansion, the third the peak of the cycle, the fourth mid-contraction, and the fifth the terminal trough.

Leads and Lags

When the specific and reference cycles correspond to one another, the two time scales are so placed with reference to one another that they show the average lead or lag of the turning dates of specific cycles in relation to the turning dates of business cycles.

An arrow drawn from the revival (or the recession) of the specific-cycle pattern to the revival (or the recession) of the reference-cycle pattern means that we consider the average lead or lag of the specific cycles at that point a representative average. When the arrays of leads or lags at a cyclical point seem to have no clear central tendency, no arrow appears. A vertical arrow signifies a significant coincidence in average timing.

When the specific and reference cycles do not correspond to one another, the two time scales are arbitrarily placed so that the recession of the specific-cycle pattern and that of the reference-cycle pattern fall on the same vertical line. In these cases, the charts do not show leads or lags.

Uniformity of Scales

In the charts strict uniformity is maintained in both the time and the amplitude scales. Hence the features of one chart can be compared directly with the similar features of any other chart.

However, in making comparisons, it must be remembered that charts drawn from annual data show coarser time scales and lower amplitudes than charts from monthly data.

V. ILLUSTRATIONS OF RESULTS

All that a time series can reveal directly is the cyclical movement in a particular process—mining coal, clearing checks, pricing of securities, and so on. Even index numbers—whether of prices, production, or 'general business'—represent merely average changes within limited ranges of activities. Yet it is only through time series of restricted significance that business cycles manifest themselves definitely enough to be measured. To obtain quantitative knowledge of the wholes we must first gain quantitative knowledge of the parts. Charts 2-6 represent a small sample of the 'parts' that the National Bureau has been investigating in an endeavor to determine what sort of 'wholes' business cycles are.

1. A Few Aids in Reading the Charts

The charts will at first seem puzzling even to a person who has taken the trouble to study the manner in which they are constructed. But the reader will soon learn how to use them if he bears in mind the following points. (1) The specific-cycle and reference-cycle patterns cover periods that are as nearly the same as the varying turning dates of specific and business cycles permit. (2) The representative value of the patterns is indicated by the vertical lines showing average deviations and by the captions stating the number of cycles covered. (3) Even when the number of cycles is large and the average deviations are small the full significance of the patterns cannot be known without close study of the quality of the original data, the arrays from which the patterns are made, and the many measures we compute but do not record on the charts. (4) In the main the differences among the charts reflect typical differences in cyclical behavior, but to some extent they are connected with the varying periods covered by the series. (5) As already stated the time scales show average leads or lags at reference turns only when there is a one-to-one correspondence of specific and reference cycles. Identity of number of cycles is a necessary but not a sufficient condition for correspondence; thus two short specific cycles may correspond to one reference cycle and one long specific cycle to two reference cycles. (6) Most important of all, the amplitude of the reference-cycle pattern relatively to that of the specific-cycle pattern provides a quick clue to the relationship in time of a given series to business cycles. If the turning dates of the specific cycles are virtually coincident with the reference dates, the two patterns will be nearly the same. If the turning dates of the specific cycles differ from the reference dates by tolerably regular intervals, the two patterns will be much alike when allowance is made for the difference in timing. But if the timing of the specific cycles is relatively independent of that of business cycles, then what may have been a large amplitude in the specific-cycle pattern will be obscured or disappear entirely in the reference-cycle pattern.

2. Indicators of General Business

Chart 2 shows the cyclical patterns of several series that are often regarded as 'indicators of business conditions'. They are introduced by the familiar index of industrial activity in the United States, constructed by the American Telephone and Telegraph Company. This series is one of the few that we treat in a form adjusted for secular trend and it is the only such series in the present list. The

slight downward tilt of its cyclical patterns is accounted for entirely by the severity of the recent depression. The contraction phase of the specific cycles is briefer, but marked by a more rapid rate of movement, than the expansion phase. The average amplitude of the specific cycles is moderate in relation to most series showing output of individual commodities. However, the amplitude is larger than what would be found in a comprehensive index of production or employment. Though the A. T. & T. index tends to lead slightly at business revivals, its movements conform closely to fluctuations in general business activity. This is shown graphically by the resemblance which the reference-cycle pattern bears to the specific-cycle pattern, and is confirmed by the conformity indexes and by the one-to-one correspondence of specific to business cycles.

The series covered in the next eight figures derive their claims as 'indicators of business conditions' from the importance of the single processes which they represent, not from a combination of measures of several basic processes, as is the case with the A. T. & T. index. Thus Figure 2 presents the cyclical behavior of deflated bank clearings outside of New York City prior to 1919 and of bank debits outside of New York City after that date. The most striking difference between this series and the A. T. & T. index is the upward tilt of its cyclical patterns. As may be expected of a process with a rapidly rising secular trend, deflated clearings tend to lead fairly consistently at reference revivals and to lag at reference recessions, so that the contraction phase of the specific cycles is exceptionally brief. The high level of the conformity indexes and the similarity of the reference-cycle and specific-cycle patterns indicate that the series has conformed well to the cyclical fluctuations in general business. But the specific cycles have not borne throughout a one-to-one correspondence to business cycles. Even the business-cycle index falls short of +100, for the reason that the series rose more rapidly during the contraction phase than during the expansion phase of the business cycle of 1924-27.

Figures 3 and 4 picture the cyclical behavior in recent years of factory employment and payrolls in the United States. The fluctuations of both series conform very closely to business cycles. The amplitude of the cycles in payrolls is larger than in employment; in each of the three comparable cycles the former is half again as large as the latter. The explanation is that business enterprises adjust themselves to the changing markets for their wares by varying cyclically the amount of work offered to individual employees and the rate of pay as well as the number of workers carried on the payrolls. Restricting comparisons to 1921-33, we find that the amplitude of the A. T. & T. index is about the same as that of factory payrolls. The vertical lines representing average deviations indicate by their conspicuous lengths that the three cycles covered by payrolls have widely dissimilar patterns. The downward tilts of the patterns of both payrolls and employment are due mainly to the severity of the latest depression.

After excluding the cycles affected by grave monetary disturbances, we contrast in Figures 5 and 6 the cyclical behavior of wholesale prices in the United States and the United Kingdom. For the United Kingdom we use the Sauerbeck index of wholesale prices; for the United States we use the Bureau of Labor Statistics index for the period since 1890 and the index recently constructed by Professors Warren and Pearson for the earlier years. According to these indexes, the average amplitude of cyclical fluctuations in wholesale prices has been about the same in the two countries. But the charts show plainly that both specific and business cycles are longer in the United Kingdom; and when allowance is made for the difference in duration, it becomes clear that American commodity prices have fluctuated more widely than British prices. However, a glance at the other charts in this *Bulletin* will show that, in the absence of sharply abnormal monetary changes, the general level of commodity prices at wholesale is a relatively stable factor. Both here and in Great Britain commodity prices have conformed fairly well to the cycles in general business, although in each country the wholesale price index has occasionally risen during the downward swing of a business cycle and declined or failed to rise during the upward swing.

Figures 7 to 9 enable us to contrast the cyclical behavior of American exports with both British exports and American imports. As in the case of the wholesale price indexes, the cycles most affected by monetary disturbances are excluded from the averages. The charts show that the absolute amplitude of American exports has been about the same as that of British exports but that the cyclical rise and fall per month of American exports has been notably larger. They show also that, while there have been fewer cycles in American imports than in American exports, the former have on the average attained larger amplitudes. But the outstanding differences among the several series consist in their behavior in regard to business cycles. While the exports of the United Kingdom have conformed closely to British business cycles and the imports of the United States to American business cycles, the exports of the United States show only faint traces of conformity to American business cycles. The cyclical variations in American imports have reflected the power of this country to purchase foreign goods and have therefore conformed with considerable regularity to the cyclical alternations in general business. On the other hand exports have been governed mainly by business conditions in America's foreign markets, which in considerable measure have been independent of business conditions in this country. In Great Britain exports form a much larger proportion of domestic produc-

CHART 2

CYCLICAL PATTERNS OF INDICATORS OF GENERAL BUSINESS

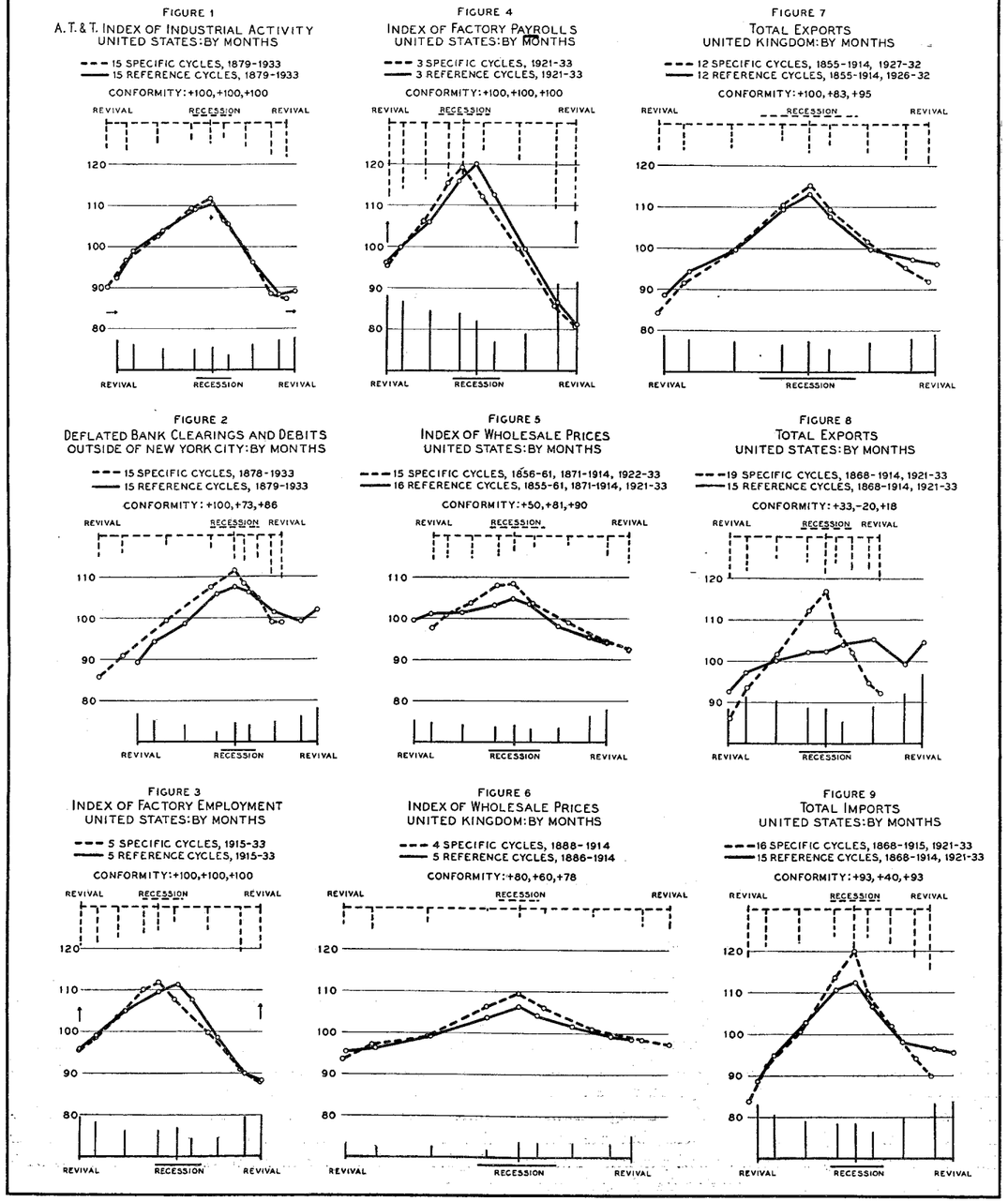


CHART 3
CYCLICAL PATTERNS OF PRODUCTION OF PRODUCERS' AND CONSUMERS' GOODS

FIGURE 10
LEONG'S INDEX OF PRODUCTION OF PRODUCERS' GOODS
UNITED STATES: BY MONTHS

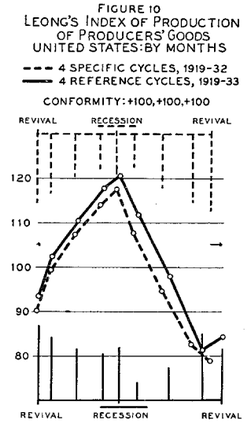


FIGURE 11
LEONG'S INDEX OF PRODUCTION OF CONSUMERS' GOODS
UNITED STATES: BY MONTHS

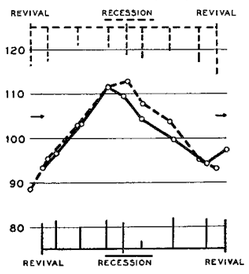


FIGURE 12
PRODUCTION OF AUTOMOBILE TRUCKS
UNITED STATES: BY MONTHS

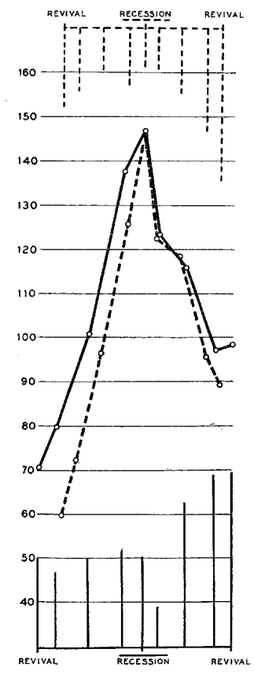
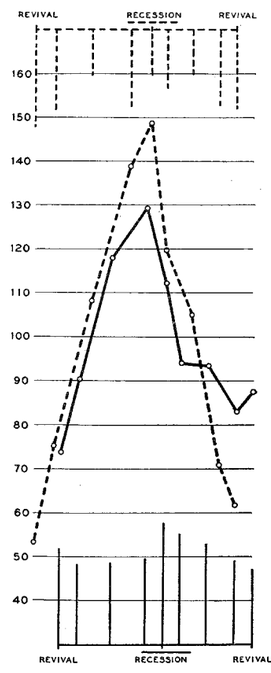


FIGURE 13
PRODUCTION OF AUTOMOBILE PASSENGER CARS
UNITED STATES: BY MONTHS



tion than in the United States; they are also dominated by finished manufactures rather than by raw materials or semi-manufactures; hence the state of British exports, unlike that of American exports, is a sensitive barometer of domestic business conditions.

3. Producers' Goods and Consumers' Goods

Writers on business cycles make much of the differences in cyclical behavior between producers' and consumers' goods. A few of the characteristics of the production of these two classes of goods are illustrated in Chart 3. In Figures 10 and 11 we compare the cyclical patterns of the output of producers' and consumers' goods, made from the index numbers constructed by Dr. Y. S. Leong. Both indexes conform closely to business cycles, but the former shows slightly more symmetrical cyclical patterns. The two indexes confirm expectations in showing that the cycles in the output of producers' goods have larger amplitudes than the cycles in the output of consumers' goods. However, this valuable generalization must not be used indiscriminately. Figures 12 and 13 indicate that the average amplitude of the production of passenger cars, a consumers' good, is larger than that of trucks, a producers' good; and this difference between the averages is on the whole borne out by the arrays of individual cycles. Nor can the close conformity of the index of production of consumers' goods be accepted as representative of the output of the generality of consumers' goods. The production of durable consumers' goods such as passenger cars (Figure 13) and of ephemeral pleasant goods such as ice cream (Figure 14) conforms rather closely to business cycles, but the production of staples such as meats (Figure 15) or refined sugar (Figure 16) bears a rather irregular relationship to business cycles.

CHART 3 (CONT.)
CYCLICAL PATTERNS OF PRODUCTION OF PRODUCERS' AND CONSUMERS' GOODS

FIGURE 14
PRODUCTION OF ICE CREAM
UNITED STATES: BY MONTHS

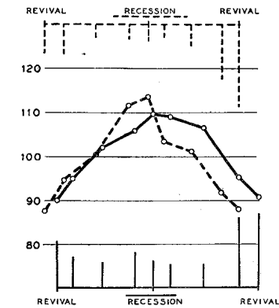


FIGURE 15
INDEX OF ANIMALS SLAUGHTERED
UNITED STATES: BY MONTHS

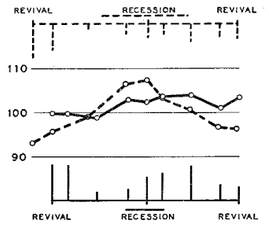


FIGURE 16
SUGAR MELTINGS
UNITED STATES: BY MONTHS

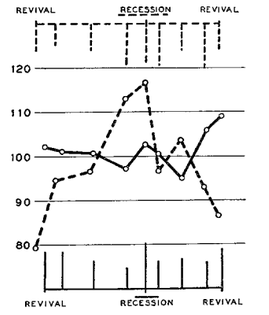


FIGURE 17
ORDERS OF RAILROAD LOCOMOTIVES
UNITED STATES: BY QUARTERS

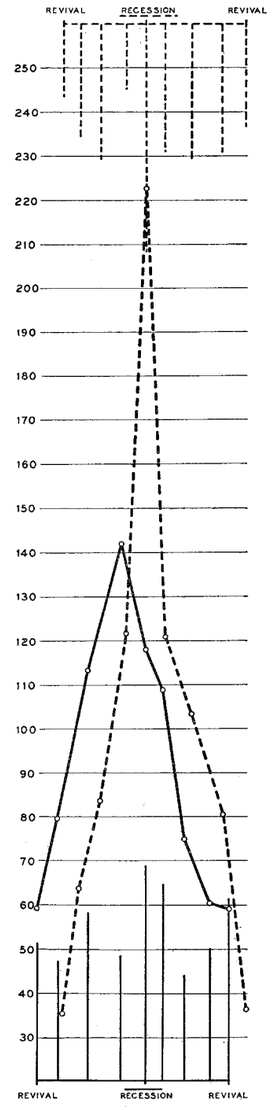
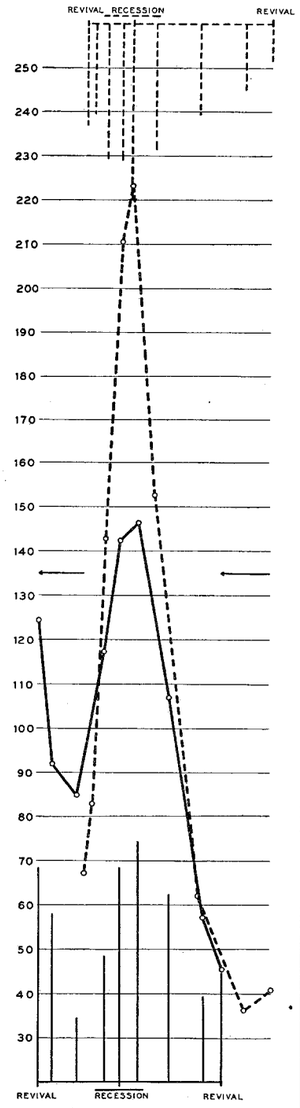


FIGURE 18
SHIPMENTS OF RAILROAD LOCOMOTIVES
UNITED STATES: BY MONTHS



The fluctuations in the output of producers' goods find their most violent expression in the railway equipment industry. Here a business depression always means a sharp curtailment of output, and at times a complete cessation of output. Figures 17 and 18 show the cyclical behavior at two stages in the production of locomotives; the first chart represents the initial stage—the placing of orders, and the second represents the terminal stage—the shipment of completed locomotives. The enormous range of the fluctuations overshadows every other feature of the patterns. But the charts show also that orders respond more quickly to cyclical changes in general business than do shipments, that orders are slightly more volatile than shipments, and that orders conform somewhat more closely to business cycles than do shipments. These differences persist when the cyclical patterns of orders are made to cover the same brief interval as shipments. The brief specific-cycle expansion and the downward tilt of the patterns of locomotive shipments attest the declining trend in the number of locomotives produced.

4. Coal, Electricity, Coke and Iron

In Chart 4 we show the cyclical patterns of a closely related group of basic industrial processes in the United States—the production of power and iron. Anthracite coal (Figure 19) has become more and more a consumers' good with the passage of time. Vastly more important as a business factor is the production of bituminous coal (Figure 20). Though burned by millions of families, it is primarily a producers' good—perhaps the producers' good which has the most widely distributed demand. Largely for this reason the amplitude of bituminous coal production is smaller than is usual among raw producers' goods in the United States; but it is about the same as the amplitude of Leong's index of the output of producers' goods and larger than the amplitude of anthracite coal shipments. If the cycles in the anthracite coal industry seriously affected by strikes are included in the averages, the amplitudes of anthracite shipments and bituminous production become virtually identical. Even when the cycles affected by strikes are excluded, random factors continue to mar the specific-cycle pattern of anthracite coal, as Figure 19 shows. But the specific-cycle pattern of bituminous coal is severely continuous, as is also the reference-cycle pattern. The conformity of the anthracite coal industry to business cycles is moderate at best, while the conformity of the bituminous coal industry is remarkably high.

Electricity is the latest type of energy to be utilized on an extensive scale by industry and households. The greater portion of electric power is produced from coal and enters into industrial uses. Our statistical records catch the electric power industry in the stage of rapid growth, as the sharp upward tilt of the patterns of Figure 21 indicates. As befits a youthful industry, the contractions of specific cycles are brief and mild, with production tending to lag at recessions in general business and to lead at revivals. Our series of electric power production shows positive conformity to each business cycle, but it does so at times through a retardation of growth during reference contractions rather than through actual declines.

More than any other industry the production of iron and steel has long enjoyed the distinction of being regarded as an excellent barometer of trade; so diversified are the uses of iron and steel, particularly for industrial equipment and construction work. The cyclical behavior of pig iron production in the United States is pictured in Figure 22, and of coke—a good complementary to pig iron—in Figure 23. The cyclical patterns of the two series are much alike when compared for the full periods of their statistical histories and are nearly replicas of one another when compared for identical periods. Iron production conforms with exemplary regularity to business cycles, as does coke production. The cyclical patterns of coke production may be compared profitably with the patterns of bituminous coal production; partly because coke is a fuel of more restricted industrial use and partly because it constitutes one of the main outlets for the bituminous coal trade.

A striking shift in the cyclical behavior of the coke industry, consequent upon a change in industrial technique, is illustrated in Figures 24 and 25. In this country coke was long made in 'beehive' ovens from which the by-products ran to waste. But by the end of the World War, the output from the more efficient 'by-product' ovens exceeded that from the older ovens. Hence we break the record of the production of beehive coke in 1919, and show separately the cyclical patterns during the period of secular growth when beehive coke was the main portion of the coke output and during the period of secular decline when beehive ovens were relied upon mainly to supplement the chief supply. The cyclical patterns of beehive coke output prior to 1919 resemble closely the patterns of total coke output, even though the two series have only one cycle in common. But comparing the cyclical behavior of beehive coke production before and after 1919, we find that the average amplitude of the cycles in the later period is more than twice that in the former, that expansions have become shorter and contractions longer, and that a tendency to lead at revivals and lag at recessions has given way to a tendency to lag at revivals and lead at recessions. The average lead at reference recessions shown by Figure 24 is a distortion produced by a lead of 32 months at the reference recession of the War cycle.

5. Crop Production

The last of the production series that we present are shown in Chart 5. These relate to production on farms, whereas the preceding charts picture the cyclical behavior of production in factories and mines. The specific-cycle patterns in

CHART 4

CYCLICAL PATTERNS OF PRODUCTION OF COAL, ELECTRICITY, COKE AND IRON

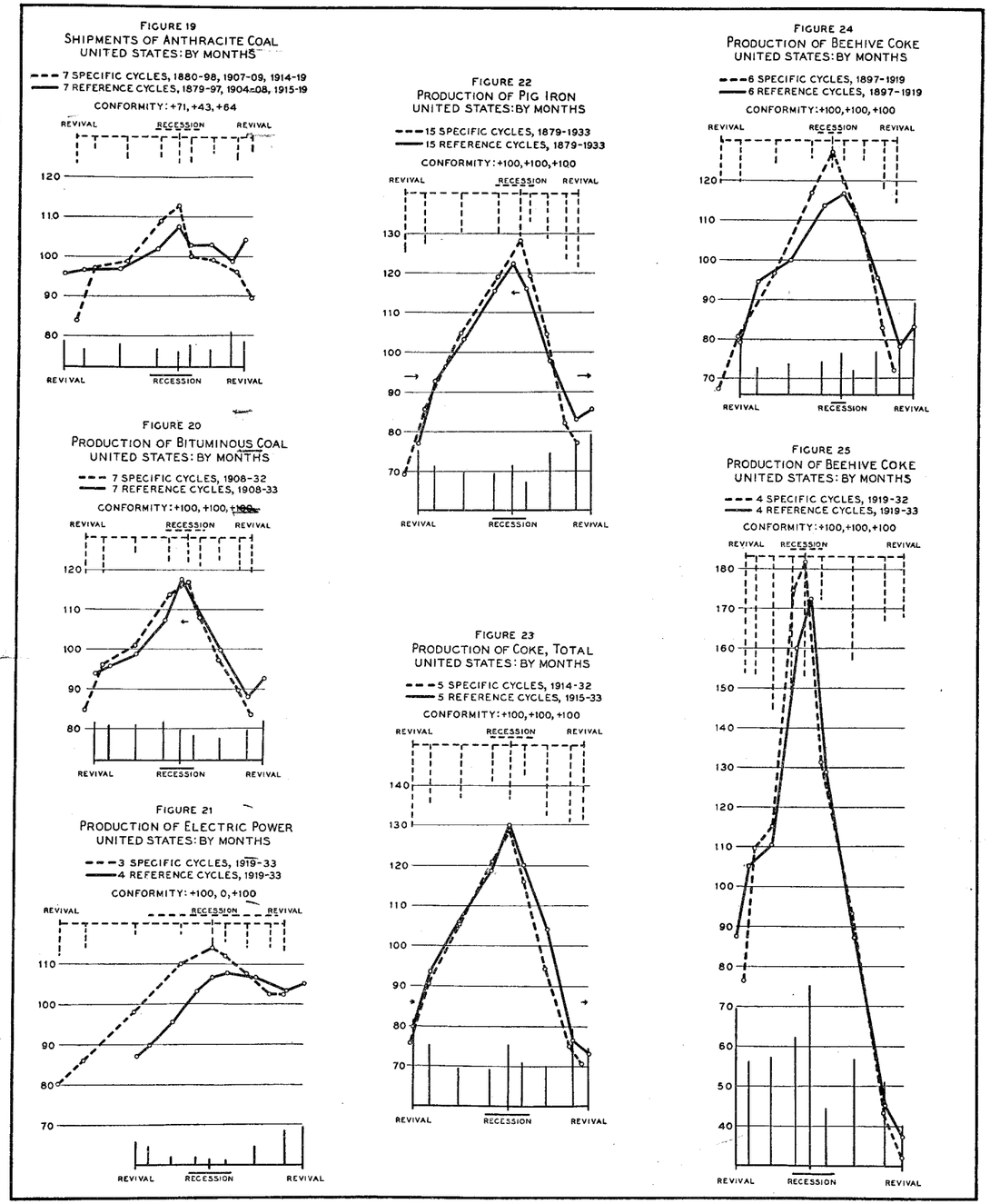


CHART 5
CYCLICAL PATTERNS OF CROP PRODUCTION

FIGURE 26
INDEX OF CROP PRODUCTION
UNITED STATES: BY YEARS

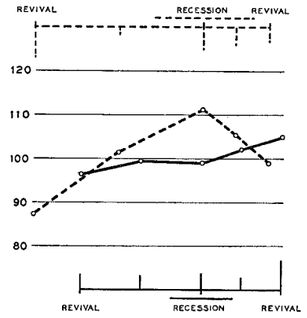


FIGURE 27
INDEX OF CROP PRODUCTION
GREAT BRITAIN: BY YEARS

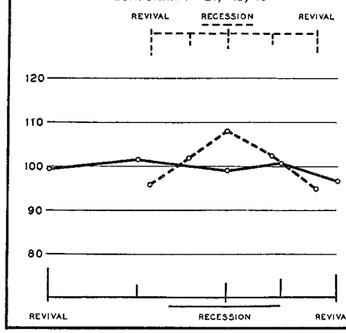


FIGURE 28
PRODUCTION OF WHEAT
UNITED STATES: BY YEARS

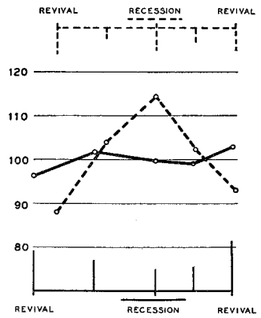
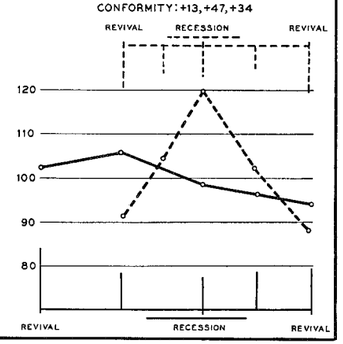


FIGURE 29
PRODUCTION OF WHEAT
UNITED KINGDOM: BY YEARS



each of the crop charts are as clear-cut as in any of the industrial charts. They are rather mild in amplitude; but they are based on annual harvests and allowance must be made for the fact that annual data yield smaller amplitudes than monthly data. What distinguishes the crop charts from all preceding charts—except, perhaps, American exports and animal slaughter—is the flatness of their reference-cycle patterns. The behavior of crop production during the period of one business cycle has so little relation to the behavior during another, that when the reference-cycle relatives for a number of business cycles are averaged they reveal mainly the secular trends—rising in the United States and declining in Great Britain. The lack of any semblance of relationship to the timing of business cycles is reflected also in the durations of the cycles in total crop production, which are on the average shorter in Great Britain than in this country though British business cycles are on the average considerably longer than business cycles in the United States. The lack of relationship in time between crop production and business cycles does not mean that harvests have no effect upon business cycles; but it does mean that this influence is a random factor.

6. Stock Prices and Interest Rates

A few series illustrating the cyclical behavior of the security and money markets are assembled in Chart 6. In Figures 30 and 31 we contrast the cyclical patterns of indexes of prices of common and preferred stocks traded on the New York Stock Exchange during three pre-War cycles. These indexes were constructed by Professor Edwin Frickey from quotations for identical lists of 20 manu-

CHART 6
CYCLICAL PATTERNS OF STOCK PRICES AND INTEREST RATES

FIGURE 30
FRICKEY'S INDEX OF COMMON STOCK PRICES
UNITED STATES: BY MONTHS

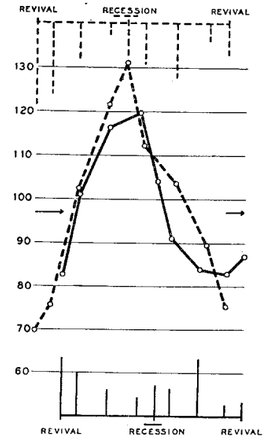


FIGURE 31
FRICKEY'S INDEX OF PREFERRED STOCK PRICES
UNITED STATES: BY MONTHS

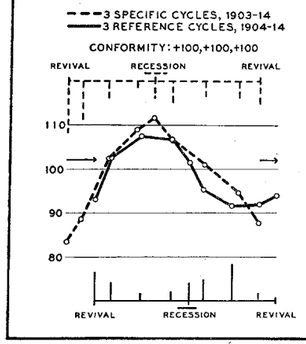


FIGURE 32
INTEREST RATE ON PRIME COMMERCIAL PAPER
NEW YORK CITY: BY MONTHS

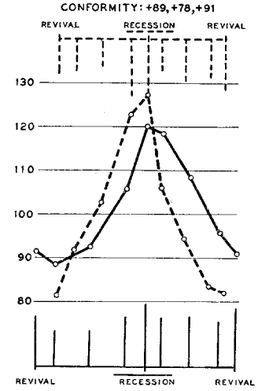


FIGURE 33
INTEREST RATE ON CUSTOMERS' LOANS
NEW YORK CITY BANKS: BY MONTHS

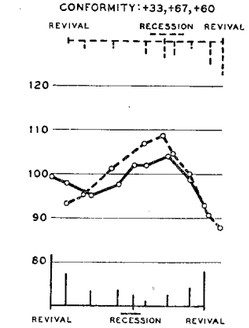


FIGURE 34
INTEREST RATE ON CUSTOMERS' LOANS
SOUTHERN AND WESTERN BANKS, U.S. BY MONTHS

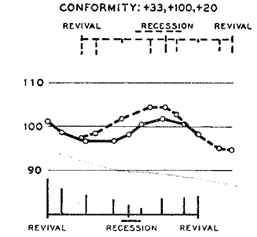
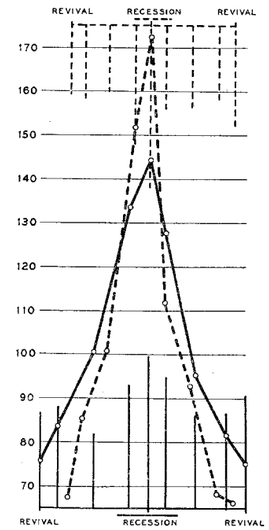


FIGURE 35
INTEREST RATE ON CALL LOANS
NEW YORK CITY: BY MONTHS



facturing corporations. The two indexes consistently show leads at reference revivals and recessions, but the leads of preferred stock prices tend to be slightly longer. Both indexes conform closely in their fluctuations to the general waves in business activity. The amplitude of the cycles in preferred stock prices is less than half the amplitude of common stock prices, but it is larger than that of the A. T. & T. index and well over twice that of the Bureau of Labor Statistics index of wholesale prices during comparable periods. The amplitude of the index of common stock prices exceeds the amplitude even of pig iron production. But it must be noted that Frickey's indexes are designed to serve primarily as measures of speculative activity and that they are heavily weighted with iron and steel shares; also, that the index of common stock prices shows somewhat larger fluctuations than do the Dow-Jones averages during the same period.

Various writers assign to the fluctuations of interest rates—more often, of *the* interest rate—a key position in their explanations of how business cycles come about. Chart 6 includes only four samples from our collection of