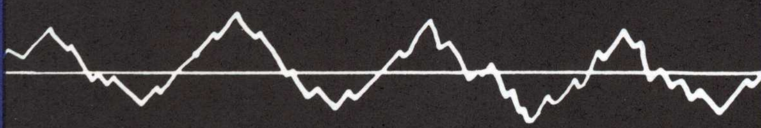
cycles



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The Foundation for the Study of Cycles was founded in 1941 by Edward R. Dewey.

The purpose of *Cycles* is to report on the research done by the Foundation for the Study of Cycles. It also keeps its readers informed on the research done by others in the field of rhythm, and its allied subjects of pattern and interrelationships. In addition, *Cycles* reports regularly to the members, contributors, and the public on the other activities of the Foundation.

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THE DIRECTOR'S LETTER

DEAR MEMBER,

When historians look back at this century they may well conclude its most important discovery, with the greatest consequences for posterity, occurred in 1953 when Dr. James D. Watson, who later won a Nobel Prize for his efforts, first observed the genetic code, or more precisely DNA (deoxyribonucleic acid) which is the carrier of genetic information in the nucleus of every cell. DNA is a chain-like molecule of great length twisted in a double strand, one of which has a plus or positive polarity, the other being minus or negative. On this strand is printed the matrix of each cell's genetic message. Each double strand consists of two chains of alternating units of phosphoric acid residues and deoxyribose, a simple sugar, combined in a simple building block system. Both strands are joined together at regular intervals like rungs on a spiral staircase. Each of these rungs consists of either thymine (T) and adenine (A) in combination or cytosine (C) and guanine (G), again in combination. Each of the two combinations appear on the strand either in the order listed above or in reverse order, that is thymine and adenine may also appear as adenine and thymine thus making possible four different combinations.

Subsequent research shows that every three groupings along the strand produces a code word serving as an instruction for the body to synthesize one of the various amino acids which serve as the body's protein building blocks. The sum total of all the code words on a strand function much like a blueprint or computer program for building a specific plant or animal body. Assuming a single strand which is twisted billions of times could be untwisted, it would be over 50 inches long. Amazingly every cell carries these strands with all the necessary building instructions in its nucleus.

A simple organism like a virus can be constructed from a program using just a few hundred code words whereas the construction of a human requires a program consisting of billions of statements. Yet, regardless of the complexity of an organism or the size of its program, it is derived from an unlimited mixture of instructions based on just 64 code word combinations using just four basic elements.

Gunther S. Stent, a molecular biologist, in his book, *The Coming of the Golden Age,* published in 1969, noted the similarities between the genetic code and the system of change described in the Chinese classic *I Ching* which is also based on the interaction of two antithetical principles in four basic combinations. When these four possibilities are combined three at a time they too produce 64 hexagrams (four cubed to the third power), each of which pictorially represents one of 64 fundamental aspects or qualities of the process of change. These qualities are said to be applicable to everything in the Universe with the exact nature of the change depending on the interaction of the location of the three diagrams in the hexagram.

Dr. Martin Schonberger took Stent's ideas one step further in his new book *I Ching & the Genetic Code - The Hidden Key to Life (ASI Publishers Inc., 127 Madison* Ave., N.Y. 10016, $6.95). Looking to find an exact correlation, he arranged not only the genetic code and the *I Ching* hexagrams on one master table, but he also added the binary number system of Liebnitz (now used as the numerical basis for computer programming), our standard decimal number system and the amino acid table. Unfortunately his first attempt ended in failure in that it did not reveal a mathematical order. In his work, Dr. Schonberger equated Thymine (T) with the *I Ching* symbol for "Old Yin" and the binary number "00"; Cystosine (C) with "Young Yang" and "01"; Guanine (G) with "Young Yin" and "10"; and Adenine (A) with "Old Yang" and "11." Although his first attempt did not reveal a mathematical order, he came very close and the error was readily apparent. The error came as a result of the manner in which the order of the genetic code was set up by the genetic researchers, that is Thymine first, followed by Cystosine, Adenine and Guanine. This produced a sequence numerically equivalent to 1, 2, 4, 3, 5, 6, 8, 7, etc. Simply by reversing the sequence of Guanine and Adenine to (T-C-G-A), he arrived at a precise mathematical ordering in the sense that the new arrangement conformed both to one of the accepted groupings of the *I Ching* codes and to the numerical arrangement of the binary code. Furthermore the catalog of the resulting amino acids appears to be periodically ordered by this change. Examining the consequences of this change from the A - G sequence to G - A, he writes that it does not appear to disturb the arrangement of the amino acids particularly since the A - G sequence itself appears to have been arbitrarily selected. Considering that the *I Ching* sequence is thousands of years old and the binary system of numbers used in modern computer programming is hundreds of years old, if there really is a connection here, Dr. Schonberger suggests geneticists might want to consider revising the genetic table.

Included in this genetic table are several code words functioning as punctuation marks. These represent the beginning or end of genetic "sentences" similar to the computer programming commands START and STOP. Dr. Schonberger discovered that two genetic combinations designed to STOP a genetic code sequence correspond to *I Ching* hexograms titled "Retreat" and "Stand Still." It seems rather obvious that in these cases the meaning of the genetic code words and the *I Ching* hexagrams are synonymous. The genetic code word for START translates to "Youthful Folly" which Schonberger says refers to the youthful nature or start of a situation and its transition to a new, more mature phase.

Commenting on another hexagon, *I Ching* Number 35, he says this translates as "Progress" which could conceivably describe the essential amino acid tryptophane produced by the genetic code word corresponding to this hexagram. Moving on, the hexagram's countersign reads "Darkening of the Light," an accurate description of the state of depression produced by an absence of tryptophane.

Dr. Schonberger also notes a similiarity between the ideogram, or Chinese written symbol, for *I Ching* and the double helix shape of the DNA strand. He claims that the ideogram, if continued in writing has the same shape as the DNA helix photographed by an electron microscope.

Those familiar with the *I Ching* treat it either as an enigma, or claim it has meaning at every level of reality ranging from fortune telling, to holistic medicine, to a description of both the physical and invisible universe at every level, in addition to being a textbook on health and the human psyche. Cycles students might find it of interest as a mathematical model of the cyclic process of change with a description of the qualities to be found at every step of the process. From this latter point of view, two of Dr. Schonberger's observations are especially interesting.

First in answer to the dilemma of how much freedom there is in any given situation, he observes it comes to one quantum out of 64. Only after a person has made a decision does the law of cause and effect take over, forcing us to bear the consequences of our actions. Chance, too, is subject to the code of law. It is characterized in the *I Ching* as the eternal process of creation structured in accordance with law. Both the *I Ching* and the findings of genetic research challenge those of us who believe in cycles literally. Were we to pause a moment, we would realize it would be impossible for a genetic program to develop to the level of a human being or any other form of animal life if the world were constructed in a matrix of pure cycles whereby every cycle troughs at exactly the same level as its predecesor. Were this true, each advance would be followed by a retreat back to the previous bottom. Under these circumstances life could never advance beyond the point of the simplest life form. But we know there has been progress. And, we know that cycles function around the underlying trend. In analysing the 64 states of change, Dr. Schonberger categorizes 43 as tending either toward propulsion or stability while in only 21 is there a tendency toward inhibition and decay. The message here is clearly one of long term growth, expansion and hope. If this in fact is an accurate picture of how events unfold in the universe then, unless an individual, in those quantums of free will available to him or her, insists on making all the wrong decisions, the laws of chance and change place the odds at two to one in his or her favor regardless of how bleak any present situation seems to be.

What we have in this book is either an interesting series of coincidences between a universal code thousands of years old and the newly discovered genetic code, or something that warrents closer examination. The genetic code suggests the vital processes of all living creatures are programmed in precise detail; the other claims all processes in the Universe, be they physical, metaphysical or psychological are subject to the same strictly detailed program.

The basis of both is similar: the plus and minus helix of DNA corresponding to the Yang and Yin polarity of *I Ching.* Both use four letters to label their basic elements; both use three of these letters at a time to form a code word or diagram; both operate with a language of 64 words which are read in a strictly determined sequence. Placed in a common matrix, the elements of both systems correspond mathematically. There tentatively appears to be a similarity in the meaning of corresponding code words in both systems.

Is this similarity fortuitous? Or is science rediscovering an important aspect of a law that a large portion of everyone who has inhabited this world since its inception has believed governs the whole of the Universe?

Cordially,

Michael G. Zahorchak
Executive Director

HOW IT CAME OUT

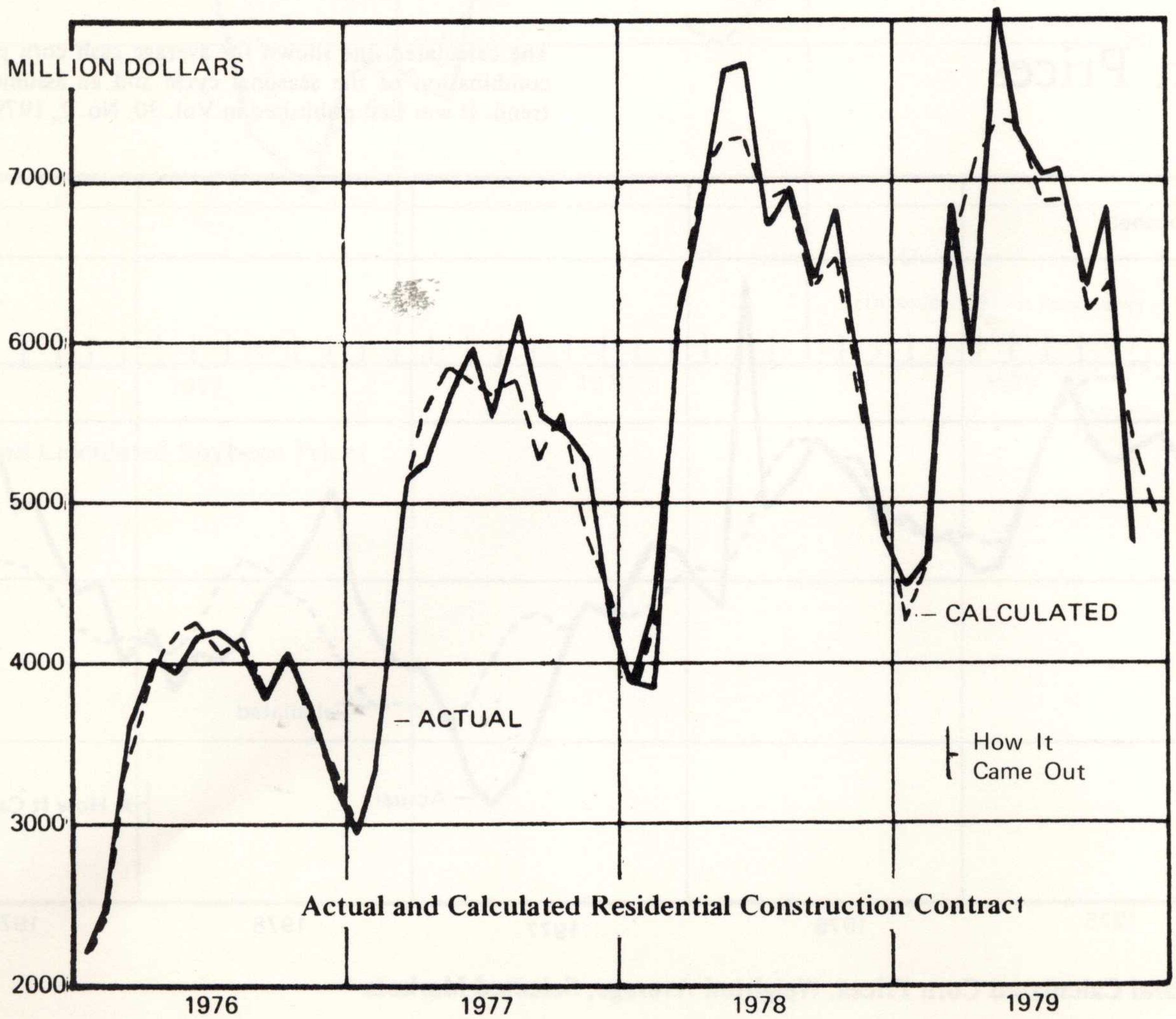
Residential Construction Contracts

From October to November Residential Construction Contracts declined over 30%. These data normally do decline from October to November (and, again, into December), but the average past decline (October to November) has averaged about 15%. This seasonal decline for 1979 was thus about double "normal" behavior.

This chart first appeared in Volume XXX, 1979, No. 5. The solid line is the monthly record of Residential Construction Contracts as compiled by F.W. Dodge Division of McGraw Hill. The broken line is a combination of the recent average seasonal pattern and an assumed trend.

At the time the chart was first published, data for 1979 were available only through March. The portion added to the solid line since the chart was first presented is marked off on the chart.

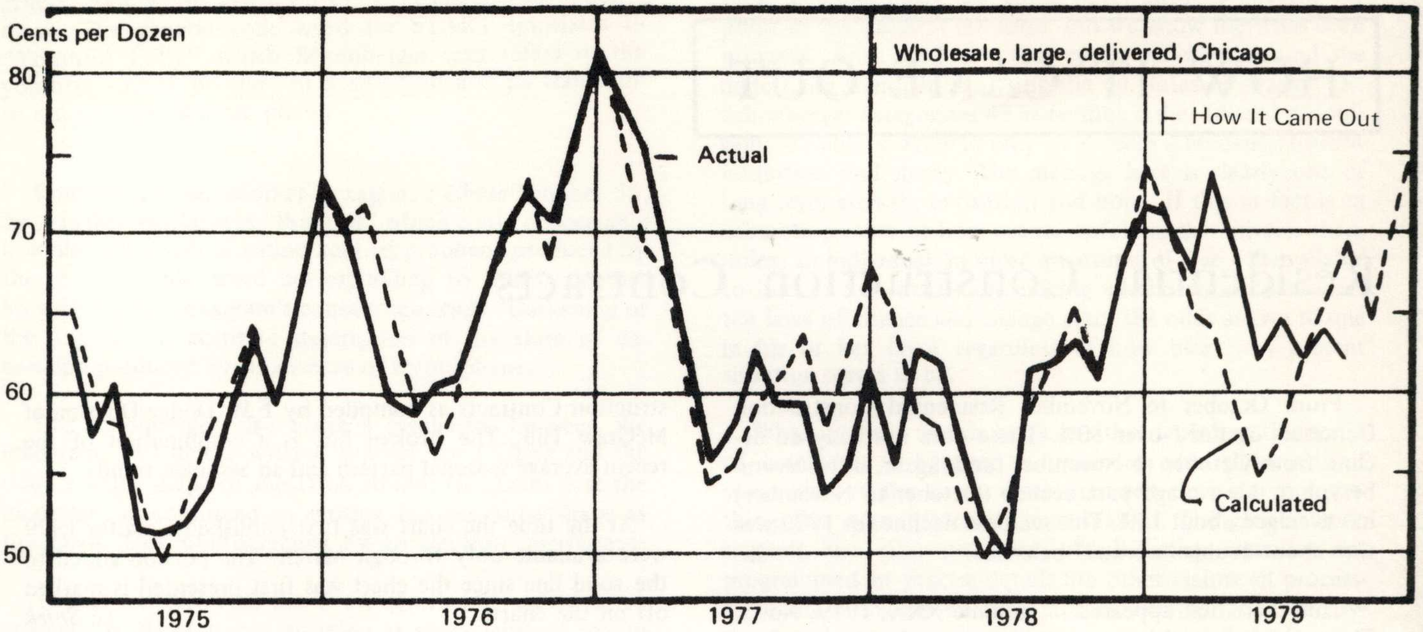
G. Shirk



Actual and Calculated Residential Construction Contract

Egg Prices

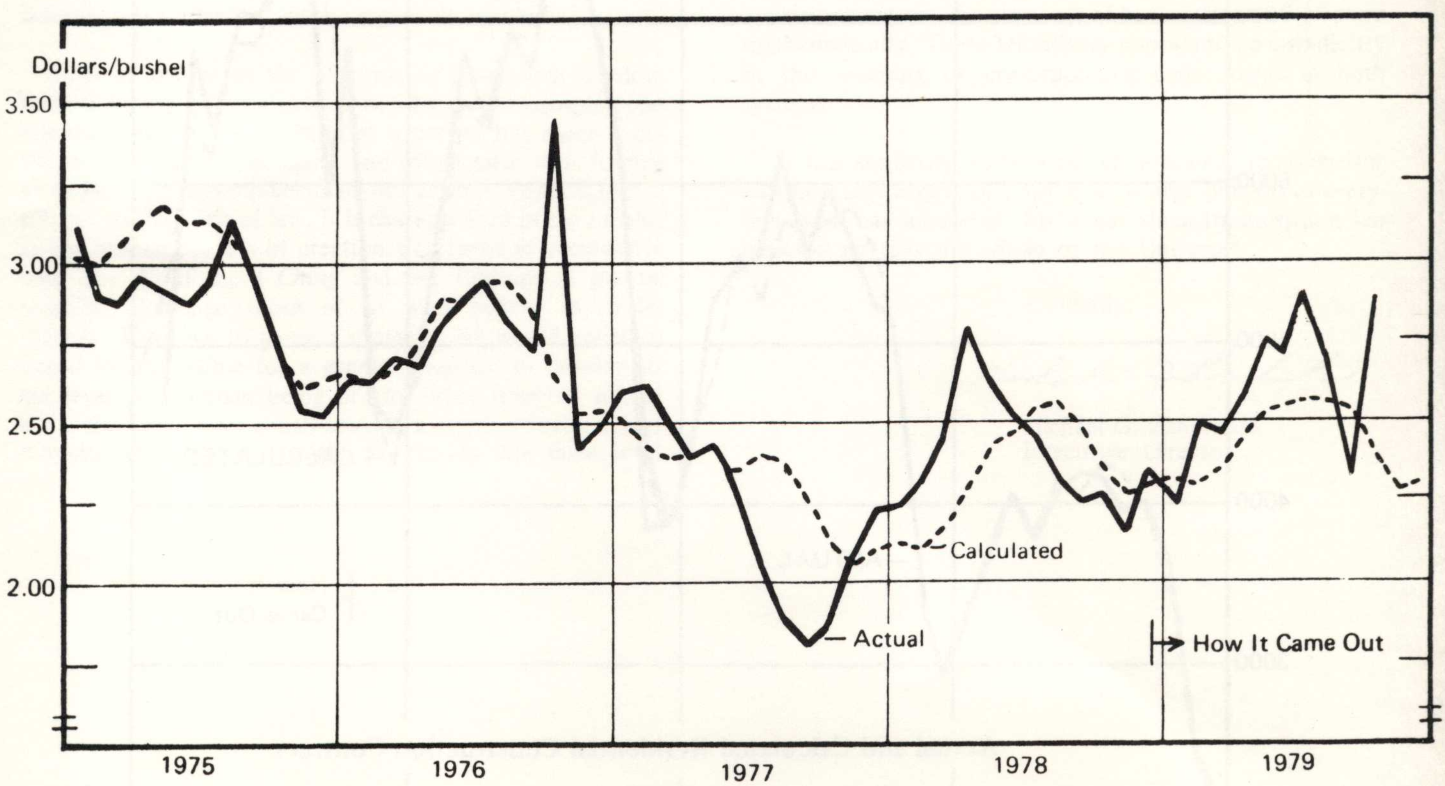
See *Cycles*, Vol. XXX, No. 3, 1979



Actual and Calculated Egg Prices

Corn Prices

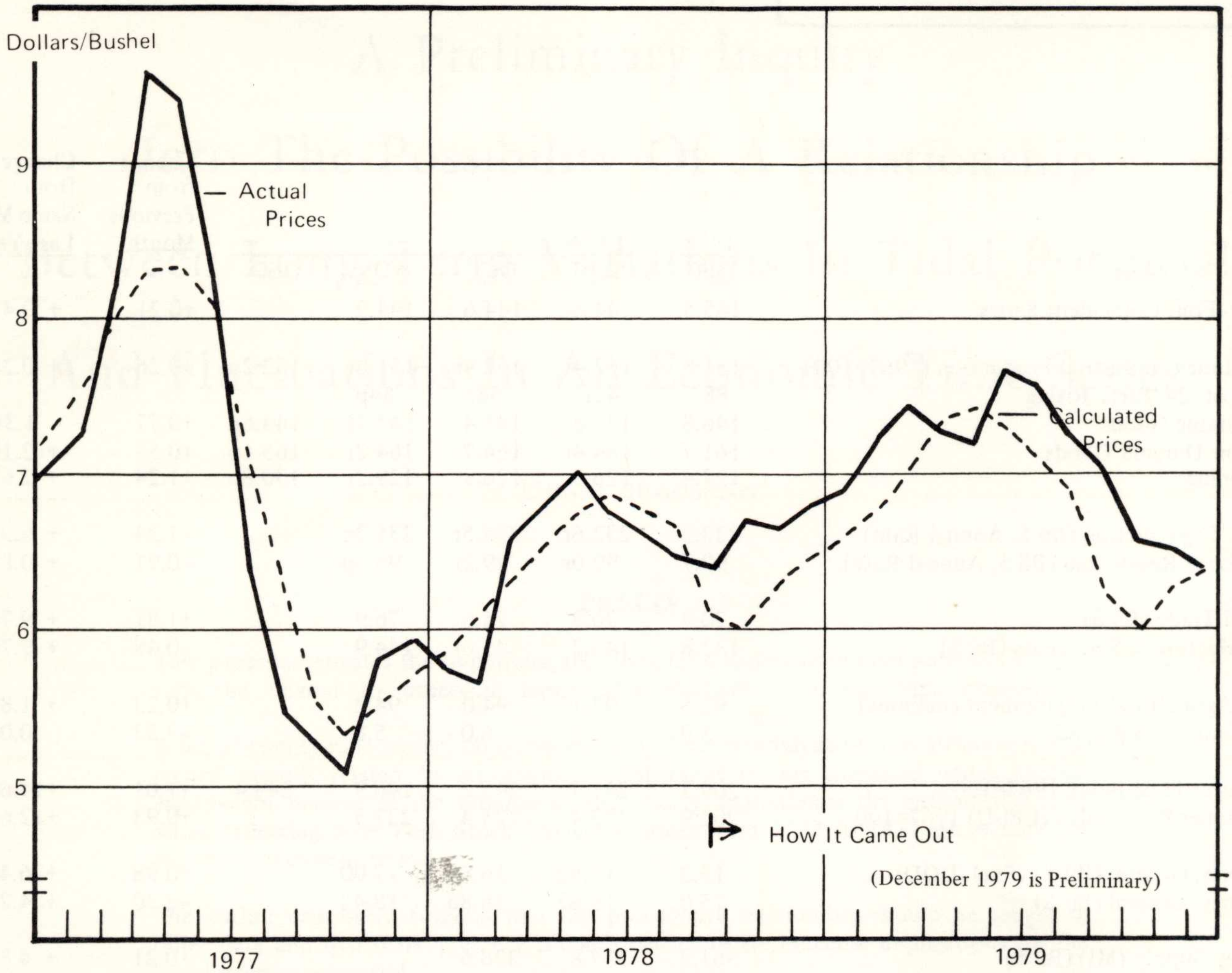
The calculated line shown for average cash corn prices is a combination of the seasonal cycle and an assumed yearly trend. It was first published in Vol. 30, No. 2, 1979.



Actual and Calculated Corn Prices, Weighted Average, Selected Markets

Soybean Prices

The calculated line for soybean prices includes a trend, the the seasonal cycle, the 24.75-month cycle and the 39.29-month cycles. It was first published in Vol. 29, No. 7, 1978.



Actual and Calculated Soybean Prices

DATA UPDATE

Series	1978 DEC	1979 SEPT	OCT	NOV	DEC	Change from Previous Month	Change from Same Month Last Year
Index-Four Coincident Series[1]	145.5	144.8	144.6	144.9		+0.21	+ 0.42
FRB Index, Industrial Production (1967=100)	151.8	152.4r	152.4r	151.8r	152.2p	+0.26	+ 0.26
% of 24 Parts Rising	88	42r	56r	54p			
Durable Goods	146.8	145.8	145.4	143.7r	144.8p	+0.77	- 1.36
Non Durable Goods	161.7	164.4r	164.7	164.2r	165.1p	+0.55	+ 2.10
Mining	127.4	126.3	126.9	129.2r	130.8p	+1.24	+ 2.67
Total Construction (Bil $, Annual Rate)	223.2	232.6r	238.5r	235.3p		-1.34	+ 6.95
Private Residential (Bil $, Annual Rate)	99.7	99.0r	99.2r	98.3p		-0.91	+ 0.82
Retail Trade (Bil $)	70.9	76.9	75.6	76.9		+1.81	+ 9.74
Manufacturer's Shipments (Bil $)	133.8	143.2	145.6r	144.9		-0.48	+ 9.70
Non-Agricultural Employment (millions)	92.5	94.1	94.0	94.2		+0.23	+ 1.89
Per Cent Unemployed	5.9	5.8	6.0	5.8		-3.33	0.00
Producer Price Index 1967=100	209.3	241.7	245.2	246.9	249.4	+1.01	+14.67
Consumer Price Index (CPI-U) 1967=100	202.9	223.4	225.4	227.5		+0.93	+12.62
Exports, General (Bil $) (Excl. DOD)	13.3	15.82	16.84	17.00		+0.98	+26.41
Imports, General (Bil $)	15.0	18.67	18.86	18.42		-2.30	+24.25
Money Supply (MI) (Bil $)	361.2	377.8	378.6			+0.21	+ 4.82
Time Deposits (Bil $)	611.2	642.2	651.1			+1.39	+ 8.93
S & P 500 Index	96.11	108.60	104.47	103.66	107.78	+3.97	+12.14
Dow-Jones Industrials	807.94	878.50	840.39	815.78	836.14	+2.50	+ 3.49
Bond Yields (Moody's, Domestic Corporate)	9.49%	9.93	10.71	11.37	11.35	-0.18	+19.60
SUNSPOT NUMBERS	119.1	188.7	188.2	185.0			

[1]Summarizes: Employees on Non-Agricultural Payrolls, the F.R.B. Index, Personal Income, and Manufacturing and Trade Sales

p - preliminary; r - revised

RESEARCH BY OTHERS

A Preliminary Inquiry Into The Possibility Of A Relationship Between Long Term Variations In Tidal Potential And Fluctuations In An Economic Time Series

by JOHN B. BRADSHAW*

PRECIS

This paper investigates the hypothesis that long term variations in tidal potential may, in turn, be related to otherwise inexplicable fluctuations in economic phenomena.

A set of twenty-nine cosine, sin curves based on Fourier Analysis of four different fundamental periods related to astronomical tidal variations are suggested which explain eighty-eight percent of the variance in and closely approximate the outline of a time series reflecting New York Stock Exchange prices from 1792 to 1977 when they are expressed in current terms.

The author cautiously suggests that this provocative relationship should be sought in other data and that if its presence is confirmed there are immense implications for the social sciences in general.

BACKGROUND

A basic assumption of social science has been that phenomena observed occur in a constant physical environment, or that random changes in the environment are short lived and offsetting with no aggregate long term effect. Explication is therefore sought in the endogenous interaction of events.

A few authors have questioned this stability assumption and suggested that the curious rythmicity of fluctuations in statistical time series observed historically and world wide should be taken into account and studied further towards developing an entirely different basis for explication and prediction. A very few have proposed physical causal relationships, sunspots, planetary cycles, etc.

Mr. Bradshaw is a graduate student of Economics at the University of Texas. He holds a BS degree from Indiana University and an MA degree from St. Mary's University.

A collection and biblography of this literature in economics lists over 1,400 allegations of "cycles" in 151 different economic phenomena by more than 370 different authors (Wilson 1964).

Further and more numerous allegations in a great number of other disciplines, biology, meterology, geology, etc., are collected and indexed in (Dewey 1968).

The "cycle" approach has not gained general acceptance. Economists and statisticians have demonstrated that the sort of complex rythmicity observed can be duplicated by random processes or that extensive use of moving averages can produce spurious periodicity. (Bailey 1962)

However, Dewey has presented demonstrations of a synchrony between peaks and troughs of "cycles" in unrelated phenomena and suggests a need for seeking an exogenous cause which he speculates might even be extraterrestrial. In conjuction with Wing, he has also alleged a latitudinal passage of peaks and troughs for cycles in the same sort of phenomena when collected at different latitudes.

Since conventional economic theories of causation seem deficient in identifying first causes, it seems that inquiry into possible exogenous causation is not precluded. (See any text on business cycles or industrial fluctuations.)

The period allegations collected in cycle literature seem to have a suggestive congruence with periods and aliases of periods which can be discovered in long term variations in tidal potential.

This paper is a preliminary investigation of the cautiously advanced hypothesis that variations in gravity associated with long term fluctuations in tidal potential may have a massaging effect on the biosphere with resultant effects of currently unspecifiable nature whose influences are in turn, detectable in an aggregated economic time series.

THE DATA

Annual price index data of the New York stock exchange from 1792 to 1977 were used as a proxy for economic fluctuations in general. This is a time series of general interest, readily available and generally understood. The stock exchange prices have also been characterized as reflecting the general state of confidence, energy, expectations, productivity and optimism. The data are collected and preserved with great care, it is generated on a timely basis with a minimum lag from any external influence until its results would be recorded; as opposed to investment or construction figures which might represent an extended decision and implementation period. Stock market prices also represent aggregated actions and the series has the advantage of relative geographic stability. Other series for the United States as a whole such as productivity, national imcome and wholesale prices can be expected to have an underlying south and westward shifting of the geo-economic center over the period addressed. The geographic center of stock market participation has also shifted but if the role of the specialists at the market itself is taken to be paramount then geographic shift is less in stock market data than in most other available economic series for the United States.

Stock market price data are accompanied by a long term growth trend making the series non-stationary and complicating attempts to analyse it as fluctuations. For this inquiry, the conventional method of fitting a least squares line and then measuring variations from this trend was modified by multiplying an annual percent growth trend with the number of years back from 1978 as the exponent, a compound interest calculation in reverse. (The percent change method of putting the data on a stationary basis seemed to be too abstract and difficult to relate intuitively to history and to the general concept which was to be demonstrated so its' use was postponed for later studies).

DETRENDING THE DATA

For this preliminary inquiry a trend in stock prices from Shirk (1978) was employed. This rate of increase; .0285% per year was applied by working backward through the 186 years of data to put each year on a current footing.

The stock market value for 1792 was multiplied by $(1.0285)^{186}$; 1793 was multiplied by $(1.0285)^{185}$. . . . . 1977 multiplied by $(1.0285)^{1}$ which left the 1978 value the first with no adjustment.

As can be seen from the plot of this detrended time series (Chart 1), it gives an impression of stationarity with the sort of amplitude that might be expected in the generally hazardous procedure of detrending a non-stationary series. The result also seems to agree visually with Shirk's results in which she used differences between stock prices and trend.

ASTRONOMICAL PERIODS IN THE LONG TERM VARIATION IN TIDAL POTENTIAL

The average astronomical periods present in fluctuations in tidal potential are known with great precision and used to predict ocean tides. (Schureman 1958, Wood 1976). However, predicting short range tides in oceans requires approximately forty constituents and long term variation in ocean tide is still an area in which, due to inadequate data, there is considerable uncertainty. (Rossiter).

In order to simplify the problem, it seems helpful to see the variations in tidal potential as members of families with related periodicities. The families are related internally by harmonic multiples in tandem. But they are largely incommensurable between families except at periods of hundreds of years.

THE FAMILIES OF PERIODICITIES

The families of periods identified for this inquiry are:

NODAL (1) The regression of the lunar node 18.613-403 years, multiples of that period and its sub-harmonics 9.305 and 4.65 years and their multiples which will put them approximately in conjunction with perihelion or equinoxes and solstices. i.e. 46.5, 93.05 years and 186 years.

PERIGEE SYZYGE (2) The perigee syzyge phenomena or evectional period in the lunar perigee, 411.784 days and its half period 205.892318 days. Particular attention is attached to multiples of that period which approximate integral numbers of years so that they are in conjunction with either the seasonal cycle, equinoxes and solstices, perihelion.

Table 1: STOCK PRICE RECORD, 1789 TO DATE, BY YEARS

SOURCES: Prior to July 1831: Confidential Source
July 1831 to February 1854: Cleveland Trust Company Index
March 1854 to July 1871: Clement-Burgess Index
August 1871 to July 1897: Cowles Index of Industrial Stocks
August 1897 to Date: Dow-Jones Industrials

CURRENT FIGURES ARE DOW-JONES INDUSTRIALS

YEAR	AVERAGE	YEAR	AVERAGE	YEAR	AVERAGE	YEAR	AVERAGE	YEAR	AVERAGE
1789	2.87	1827	11.75	1865	23.85	1903	40.60	1941	121.82
1790	3.08	1828	11.04	1866	25.35	1904	39.40	1942	107.20
1791	3.51	1829	11.28	1867	25.34	1905	57.80	1943	134.81
1792	3.28	1830	13.54	1868	28.73	1906	68.59	1944	143.32
1793	3.45	1831	12.51	1869	29.40	1907	55.27	1945	169.82
1794	4.09	1832	13.11	1870	26.23	1908	54.36	1946	191.65
1795	4.36	1833	17.15	1871	28.72	1909	67.12	1947	177.57
1796	3.83	1834	15.67	1872	33.60	1910	62.07	1948	180.07
1797	3.44	1835	21.11	1873	32.72	1911	59.84	1949	179.14
1798	3.68	1836	18.22	1874	33.97	1912	64.21	1950	216.30
1799	4.24	1837	13.67	1875	32.03	1913	57.72	1951	257.63
1800	5.44	1838	12.07	1876	32.08	1914	57.70	1952	270.76
1801	4.36	1839	11.09	1877	25.44	1915	74.04	1953	275.96
1802	3.59	1840	9.56	1878	25.21	1916	95.39	1954	333.94
1803	4.08	1841	8.89	1879	26.87	1917	87.76	1955	442.72
1804	5.69	1842	6.58	1880	29.60	1918	80.98	1956	493.01
1805	6.31	1843	8.17	1881	34.57	1919	99.75	1957	475.75
1806	7.15	1844	13.05	1882	34.08	1920	90.07	1958	491.66
1807	4.62	1845	12.67	1883	31.83	1921	73.35	1959	632.12
1808	4.55	1846	13.39	1884	29.07	1922	93.14	1960	618.04
1809	6.33	1847	14.52	1885	30.99	1923	94.93	1961	691.55
1810	6.32	1848	13.11	1886	35.06	1924	99.68	1962	639.76
1811	5.93	1849	13.81	1887	36.72	1925	134.51	1963	714.81
1812	4.77	1850	15.22	1888	38.07	1926	153.08	1964	834.05
1813	4.77	1851	16.87	1889	45.83	1927	175.94	1965	910.88
1814	7.59	1852	18.96	1890	42.27	1928	226.22	1966	873.6
1815	8.84	1853	19.31	1891	40.62	1929	311.24	1967	879.12
1816	8.86	1854	15.70	1892	45.11	1930	236.36	1968	906.
1817	9.10	1855	14.34	1893	37.63	1931	138.58	1969	876.72
1818	10.69	1856	14.63	1894	33.96	1932	64.57	1970	753.19
1819	10.46	1857	12.76	1895	34.62	1933	83.72	1971	884.76
1820	10.47	1858	10.29	1896	31.39	1934	98.29	1972	950.71
1821	11.79	1859	9.05	1897	33.42	1935	120.00	1973	923.88
1822	11.56	1860	11.12	1898	38.04	1936	162.26	1974	795.37
1823	11.81	1861	11.64	1899	51.50	1937	166.37	1975	802.49
1824	12.94	1862	15.40	1900	44.44	1938	131.62	1976	974.92
1825	12.47	1863	23.81	1901	50.23	1939	141.83	1977	894.63
1826	11.49	1864	25.35	1902	47.30	1940	134.74		

Table 2: DETRENDED DATA

1792	611.0	1819	912.0	1846	547.0	1873	626.0	1900	398.0	1927	738.0	1954	655.0
	625.0	1820	887.0		576.0		631.0		437.0		922.0		845.0
	720.0		972.0		506.0		579.0		400.0		1233.0		915.0
	746.0		926.0		518.0		564.0		334.0	1930	911.0		858.0
	637.0		920.0	1850	555.0		435.0		315.0		519.0		862.0
	557.0		980.0		598.0		419.0		450.0		235.0		1078.0
	579.0		918.0		654.0		434.0		519.0		296.0	1960	1025.0
	648.0		823.0		648.0	1880	465.0		406.0		338.0		1115.0
1800	809.0		818.0		512.0		543.0		389.0		402.0		1003.0
	630.0		747.0		455.0		506.0		467.0		528.0		1089.0
	505.0		742.0		451.0		459.0	1910	420.0		527.0		1236.0
	558.0	1830	867.0		382.0		408.0		393.0		405.0		1312.0
	756.0		778.0		300.0		423.0		410.0		424.0		1224.0
	815.0		793.0		256.0		465.0		359.0	1940	392.0		1197.0
	898.0		1009.0	1860	306.0		474.0		349.0		345.0		1200.0
	564.0		896.0		312.0		477.0		435.0		295.0		1129.0
	540.0		1174.0		401.0		559.0		545.0		360.0	1970	943.0
	731.0		985.0		603.0	1890	501.0		487.0		373.0		1077.0
1810	709.0		719.0		624.0		468.0		437.0		429.0		1125.0
	647.0		617.0		571.0		506.0		524.0		471.0		1062.0
	506.0		551.0		590.0		410.0	1920	460.0		424.0		890.0
	492.0	1940	462.0		573.0		360.0		364.0		418.0		873.0
	762.0		418.0		632.0		357.0		449.0		405.0		1031.0
	862.0		301.0		629.0		314.0		445.0	1950	475.0		920.0
	823.0		363.0	1870	546.0		325.0		455.0		550.0		
	839.0		564.0		581.0		360.0		596.0		562.0		
	959.0		532.0		661.0		474.0		660.0		557.0		

i.e. .56371448 years

x 8 = .45097159
x 9 = 5.0734303
x 11 = 6.2008592 (Link to 31, 62,
x 16 = 9.0194316 186, etc.)
x 32 = 18.038863
x 39 = 21.984864
x 48 = 27.058295
x 55 = 31.004296
x 64 = 36.077727
x 71 = 40.023728
x 87 = 49.043159
x 94 = 52.989161
x 96 = 54.11659
x 110 = 62.008592
x 126 = 71.028025
x 142 = 80.047457
x 165 = 93.012889
x 330 = 186.02578

Wood (1976) identifies this period of 205.892318 days or .56371448 years as the principal period in the repetition of tides of similar phase and origin. He notes particularly the thirty-one year period of close perigee-syzygy alignment. Wolfe (1976) has commented on the unusual phenomena of its relative at sixty-two years.

SARITOS (3) The eclipse phenomena when centers of the three bodies are aligned i.e. the Saros cycles 18.03, 54.09, 27, 6.01, 9.01r, 4.5 years.

METONIC (4) The Metonic alias cycle of conjunction of lunar mean longitude with seasons or perihelion i.e. when a cycle of 2.7154803 years comes into conjunction at an integral length i.e. 7x = 19.008362 years. And sub cycles generated at one half that length 1.3577402 x 3 =4.0732205 years 7x = 9.5041811.

COMBINATION (5) Combinations of the above where they come into approximate synchronization.
46.5 years = 3 x 15.5 or 5 x 9.05
93 years = 5 x 18.61 or 3 x 31
186 years = 10 x 18.61 or 6 x 31

NODE PERIGEE (6) Node and Perigee Conjunctions which occur each 5.996907 and its half period for conjunctions of perigee with either node i.e. at 2.9984804 years (Lane 1957)

PERIGEE (7) AND PERIGEE PERIHELION	Mean Longitude of Lunar Perigee 8.84 years and its half period 4.42 years and alias cycle of 6x = 53.085053.

It may be helpful to conceive of the phenomena as short cycles of; tropical, anomalistic, and synodic months as carrier frequencies with long term complex amplitude modulations as the short frequencies beat against each other or come in conjunction with perihelion or particular configurations of the lunar or earth orbit nodes.

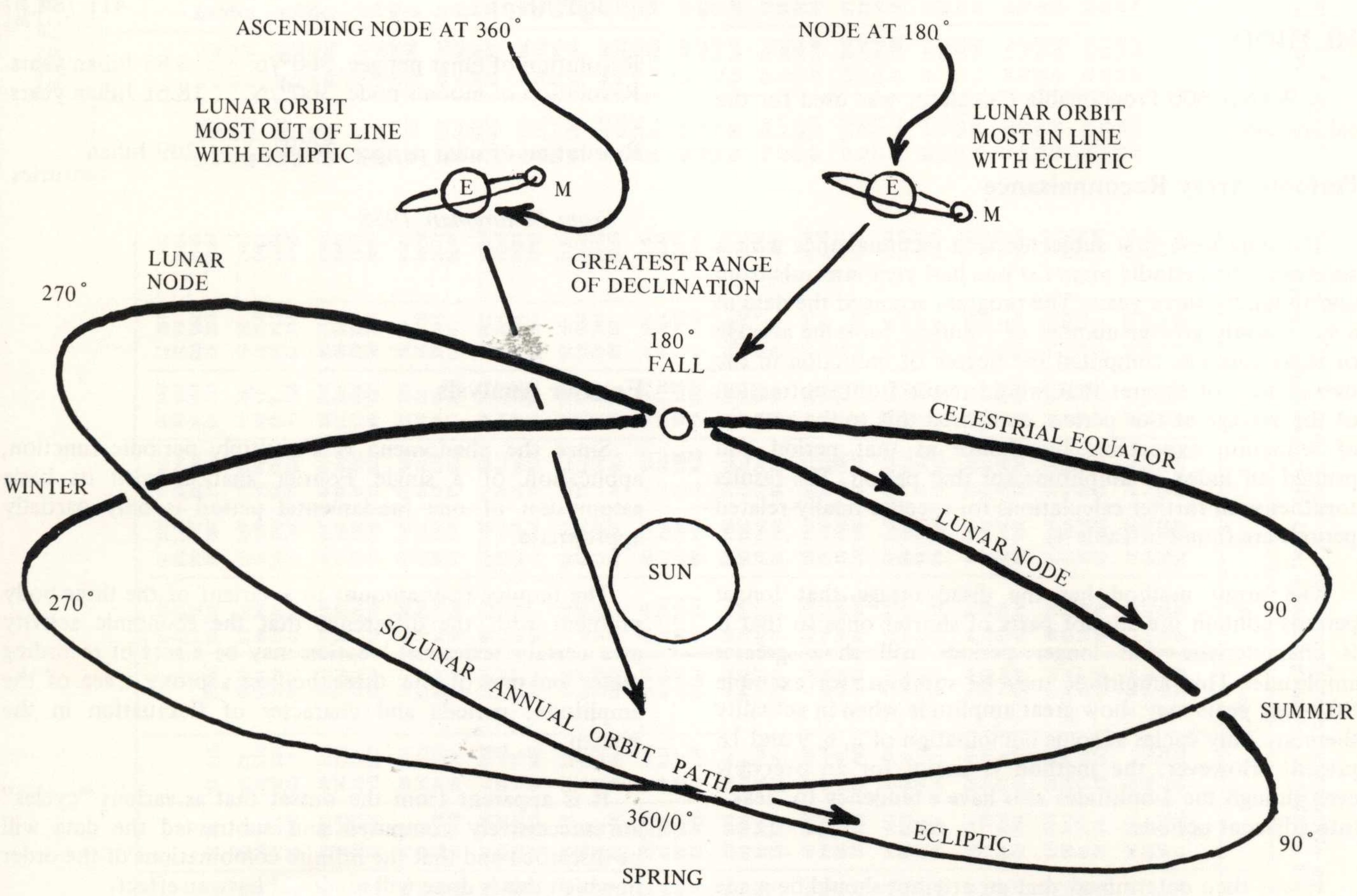
It might be commented in passing that the incommensurable periods with varying remainders played against each other or perihelion produce effects similar to some techniques employed for generating pseudo random numbers.

It is to be expected also that there may be a unique signature of influences and effects at any given terrestrial longitude and latitude. (While it is apparent that the entire world turns under a lunar perigee or node it is also true that there is some particular geographic location most potentially effected even as it would be from an eclipse. Therefore the phenomena produces potential general world-wide effects together with those which are specifically or uniquely local or regional.)

Maximum perigee spring tides have been estimated to occur approximately every 1,600 years with the sun in perhelion and the axis of the moon's and earth's orbits in coincidence with the line of nodes, i.e. that is with both sun and moon at zero declination. These phenomenal conditions give rise to the greatest possible astronomical tide raising forces. The last occurance has been calculated as AD 1433 (Russell and MacMillan) (Wood 1976) cites similar condition giving last previous occurance as AD 1340.

At any rate the problem becomes one of attempting to analyze and isolate the constituents of a relatively short segment of a much longer and intricately complex vibration with a heavy risk that incorrect results may be obtained, even if the influence is real and present in the data.

Fig. 1: Regression of Lunar Nodes



Because the plane of the moon's orbit pivots on the ecliptic, the moon's maximum declination will occur alternately in and out of phase with the direction of the earth's inclination to the ecliptic. This pivoting, known as the regression of the moon's nodes, is westward and takes 18.61 years to complete. The consequence is that the semi-monthly declination of the moon will vary from $28\frac{1}{2}^0$ to $18.\frac{1}{2}^0$ and back again over the 18.61 year period. Reckoning convention is such that when the longitude of the moon's ascending node is zero (at the vernal equinox) maximum declinations occur.

—Approximate Dates on Which Maximum Lunar Declinations Occurred, According to the 6,798.4-Day Nodical Cycle

(Based on Epoch 1932 January 12.1)

1634 Mar. 19.7	1820 May 7.7
1652 Oct. 29.1	1838 Dec. 18.1
1671 June 10.5	1857 July 29.5
1690 Jan. 19.9	1876 Mar. 9.9
1708 Sept. 1.3	1894 Oct. 20.3
1727 Apr. 13.7	1913 June 1.7
1745 Nov. 23.1	1932 Jan. 12.1
1764 July 4.5	1950 Aug. 23.0
1783 Feb. 13.9	1969 Apr. 3.4
1808 Sept. 26.3	(1987) Nov. 13.8

From Wood 1976

METHOD

A WANG 600 Programable Calculator was used for the calculations.

Periodic Array Reconnaisance

The data were first subjected to a reconnaisance with a succession of periodic arrays at one half year intervals from one to ninety-three years. The program arranged the data in a successively greater number of columns, took the average of these columns computed the degree of reduction in the overall sum of squares that would result from subtraction of the average at this period, compared this to the amount of reduction expectable by chance at that period and printed an index of amplitude for that period. The results together with further calculations for specific tidally related periods are found in Table 4.

The array method has the disadvantage that longer periods contain the aliquot parts of shorter ones so that it is characteristic that longer periods will show greater amplitude. This amplitude may be suprious, for example fifty-four years may show great amplitude when in actuality there are only cycles at some combination of 3, 6, 9 and 18 present. However, the method is useful for an overview even though the amplitudes also have a tendency to "leak" into adjacent periods.

It was then determined that an attempt should be made to find twenty to thirty principal constituent periods related to tidal potential which when subtracted algebraically would reduce the data to a minimum variance (hopefully a straight line at the average value) and when synthesized would produce as close as possible a reproduction of the original data.

MEAN ASTRONOMICAL PERIODS
(Symbols refer to rate of change in mean longitude)

	Solar days
Sidereal day, $360^0/(360^0+h)$	0.997,270
Lunar day, $360^0/(360^0+h-s)$	1.035,050
Nodical month, $360^0/(s-N)$	27.212,220
Tropical month, $360^0/s$	27.321,582
Anomalistic month, $360^0/(s-p)$	27.554,550
Synodical month, $360^0/(s-h)$	29.530,588
Moon's evectional period, $360^0/(s-2h+p)$	31,811,939
Eclipse year, $360^0/(h-N)$	346.620,0
Tropical year, $360^0/h$	365.242,2
Anomalistic year, $360^0/(h-p_1)$	365.259,6
Common Year	365.000,0
Mean Gregorian year	365.242,5
Mean Julian Year	365.250,0
Leap Year	366.000,0
Evectional period in moon's parallax, $360^0/(h-p)$	411.784,7
Revolution of lunar perigee, $360^0/p$	8.85 Julian years
Revolution of moon's node, $360^0/N$	18.61 Julian years
Revolution of solar perigee, $360^0/p_1$	209 Julian centuries

From Schureman 1958

Fourier Analysis

Since the phenomena is a multiply periodic function, application of a single Fourier analysis with its basic assumption of one fundamental period is only partially appropriate.

The inquiry may amount to a variant of the three body problem with the difference that the economic activity at a certain terrestrial location may be a sort of recording meter on one of the three bodies; a proxy trace of the amplitude, periods and character of fluctuation in the system.

It is apparent from the outset that as various "cycles" are successively computed and subtracted the data will be disturbed and that the infinite combinations of the order in which this is done will no doubt have an effect.

It also seems likely, from the initial reconnaissance and from knowledge of astronomical periodic repetition, that a period of 186 years subsumes a great many of the important periods in tidal potential and the stock market data within its harmonics.

Table 3

Table 4.—*Mean longitude of lunar and solar elements at Jan. 1, 0 hour, Greenwich mean civil time, of each year from 1800 to 2000*

[*s*=*mean longitude of moon; p*=*mean longitude lunar perigee; h*=*mean longitude of sun;* p_1=*mean longitude solar perigee; N*=*longitude of moon's node*]

Year.	s	p	h	p_1	N	Year.	s	p	h	p_1	N
	°	°	°	°	°		°	°	°	°	°
1800	342.31	225.45	280.41	279.50	33.25	1852	28.44	181.24	279.82	280.40	107.55
1801	111.70	266.12	280.17	279.52	13.92	1853	171.00	222.02	280.57	280.41	88.16
1802	241.08	306.78	279.93	279.54	354.59	1854	330.38	262.68	280.33	280.43	68.84
1803	10.47	347.44	279.69	279.55	335.26	1855	69.77	303.34	280.09	280.45	49.51
1804	139.85	28.10	279.45	279.57	315.93	1856	199.15	344.00	279.85	280.46	30.18
1805	282.41	68.88	280.20	279.59	296.55	1857	341.72	24.78	280.60	280.48	10.80
1806	51.80	109.54	279.96	279.61	277.23	1858	111.10	65.44	280.36	280.50	351.47
1807	181.18	150.20	279.72	279.62	257.90	1859	240.49	106.10	280.12	280.52	332.14
1808	310.57	190.86	279.48	279.64	238.57	1860	9.87	146.77	279.88	280.53	312.81
1809	93.13	231.64	280.23	279.66	219.19	1861	152.43	187.54	280.63	280.55	293.43
1810	222.51	272.30	279.99	279.67	199.86	1862	281.82	228.20	280.39	280.57	274.10
1811	351.90	312.96	279.75	279.69	180.53	1863	51.20	268.87	280.15	280.58	254.78
1812	121.28	353.63	279.51	279.71	161.20	1864	180.59	309.53	279.91	280.60	235.45
1813	263.84	34.40	280.26	279.73	141.82	1865	323.15	350.30	280.66	280.62	216.07
1814	33.23	75.06	280.02	279.74	122.49	1866	92.53	30.96	280.42	280.64	196.74
1815	162.61	115.73	279.78	279.76	103.17	1867	221.92	71.63	280.18	280.65	177.41
1816	292.00	156.39	279.54	279.78	83.84	1868	351.30	112.29	279.94	280.67	158.08
1817	74.56	197.16	280.29	279.79	64.46	1869	133.86	153.06	280.69	280.69	138.70
1818	203.94	237.82	280.05	279.81	45.13	1870	263.25	193.73	280.45	280.71	119.37
1819	333.33	278.49	279.81	279.83	25.80	1871	32.63	234.39	280.21	280.72	100.04
1820	102.71	319.15	279.57	279.85	6.47	1872	162.02	275.05	279.97	280.74	80.72
1821	245.28	359.92	280.32	279.86	347.09	1873	304.58	315.83	280.72	280.76	61.34
1822	14.66	40.59	280.08	279.88	327.76	1874	73.96	356.49	280.48	280.77	42.01
1823	144.04	81.25	279.84	279.90	308.43	1875	203.35	37.15	280.24	280.79	22.68
1824	273.43	121.91	279.61	279.91	289.11	1876	332.73	77.81	280.01	280.81	3.35
1825	55.99	162.69	280.35	279.93	269.72	1877	115.29	118.59	280.75	280.83	343.97
1826	185.38	203.35	280.11	279.95	250.40	1878	244.68	159.25	280.51	280.84	324.64
1827	314.76	244.01	279.87	279.97	231.07	1879	14.06	199.91	280.27	280.86	305.31
1828	84.15	284.67	279.64	279.98	211.74	1880	143.45	240.58	280.04	280.88	285.98
1829	226.71	325.45	280.38	280.00	192.36	1881	286.01	281.35	280.78	280.89	266.60
1830	356.09	6.11	280.14	280.02	173.03	1882	55.39	322.01	280.54	280.91	247.28
1831	125.48	46.77	279.91	280.03	153.70	1883	184.78	2.67	280.31	280.93	227.95
1832	254.86	87.43	279.67	280.05	134.37	1884	314.16	43.34	280.07	280.95	208.62
1833	37.42	128.21	280.41	280.07	114.99	1885	96.72	84.11	280.81	280.96	189.24
1834	166.81	168.87	280.18	280.09	95.66	1886	226.11	124.77	280.57	280.98	169.91
1835	296.19	209.53	279.94	280.10	76.34	1887	355.49	165.44	280.34	281.00	150.58
1836	65.58	250.20	279.70	280.12	57.01	1888	124.88	206.10	280.10	281.01	131.25
1837	208.14	290.97	280.44	280.14	37.63	1889	267.44	246.87	280.84	281.03	111.87
1838	337.52	331.63	280.21	280.16	18.30	1890	36.82	287.54	280.61	281.05	92.54
1839	106.91	12.30	279.97	280.17	358.97	1891	166.21	328.20	280.37	281.07	73.22
1840	236.29	52.96	279.73	280.19	339.64	1892	295.59	8.86	280.13	281.08	53.89
1841	18.85	93.73	280.48	280.21	320.26	1893	78.16	49.63	280.87	281.10	34.51
1842	148.24	134.39	280.24	280.22	300.93	1894	207.54	90.30	280.64	281.12	15.18
1843	277.62	175.06	280.00	280.24	281.61	1895	336.93	130.96	280.40	281.13	355.85
1844	47.01	215.72	279.76	280.26	262.28	1896	106.31	171.62	280.16	281.15	336.52
1845	189.57	256.49	280.51	280.28	242.90	1897	248.87	212.40	280.91	281.17	317.14
1846	318.95	297.16	280.27	280.29	223.57	1898	18.26	253.06	280.67	281.19	297.81
1847	88.34	337.82	280.03	280.31	204.24	1899	147.64	293.72	280.43	281.20	278.48
1848	217.72	18.48	279.79	280.33	184.91						
1849	0.28	59.26	280.54	280.34	165.53						
1850	129.67	99.92	280.30	280.36	146.20						
1851	259.05	140.58	280.06	280.38	126.87						

Reproduced from: Manual of Harmonic Analysis and Prediction of Tides
Paul Schureman 1958 USGPO Wash, D.C.

Table 4.—*Mean longitude of lunar and solar elements at Jan. 1, 0 hour, Greenwich mean civil time, of each year from 1800 to 2000*—**Continued**

Year	s	p	h	p_1	N	Year	s	p	h	p_1	N
	°	°	°	°	°		°	°	°	°	°
1900	277.03	334.38	280.19	281.22	259.16	1952	323.15	290.16	279.60	282.12	333.45
1901	46.41	15.05	279.95	281.24	239.83	1953	105.72	330.94	280.35	282.13	314.07
1902	175.80	55.71	279.71	281.26	220.50	1954	235.10	11.60	280.11	282.15	294.75
1903	305.18	96.37	279.47	281.27	201.17	1955	4.49	52.26	279.87	282.17	275.42
1904	74.57	137.03	279.23	281.29	181.84	1956	133.87	92.92	279.63	282.18	256.09
1905	217.13	177.81	279.98	281.31	162.46	1957	276.43	133.70	280.38	282.20	236.71
1906	346.51	218.47	279.74	281.32	143.13	1958	45.82	174.36	280.14	282.22	217.38
1907	115.90	259.13	279.50	281.34	123.81	1959	175.20	215.02	279.90	282.24	198.05
1908	245.28	299.79	279.27	281.36	104.48	1960	304.59	255.69	279.67	282.25	178.72
1909	27.84	340.57	280.01	281.38	85.10	1961	87.15	296.46	280.41	282.27	159.34
1910	157.23	21.23	279.77	281.39	65.77	1962	216.53	337.12	280.17	282.29	140.01
1911	286.61	61.89	279.53	281.41	46.44	1963	345.92	17.78	279.93	282.30	120.69
1912	56.00	102.55	279.30	281.43	27.11	1964	115.30	58.45	279.70	282.32	101.36
1913	198.56	143.33	280.04	281.44	7.73	1965	257.86	99.22	280.44	282.34	81.98
1914	327.94	183.99	279.80	281.46	348.40	1966	27.25	139.88	280.20	282.36	62.65
1915	97.33	224.65	279.57	281.48	329.07	1967	156.63	180.54	279.97	282.37	43.32
1916	226.71	265.32	279.33	281.50	309.75	1968	286.02	221.21	279.73	282.39	23.99
1917	9.27	306.09	280.07	281.51	290.36	1969	68.58	261.98	280.47	282.41	4.61
1918	138.66	346.75	279.84	281.53	271.04	1970	197.96	302.64	280.24	282.42	345.28
1919	268.04	27.41	279.60	281.55	251.71	1971	327.35	343.31	280.00	282.44	325.95
1920	37.43	68.08	279.36	281.56	232.38	1972	96.73	23.97	279.76	282.46	306.63
1921	179.99	108.85	280.10	281.58	213.00	1973	239.29	64.74	280.50	282.48	287.24
1922	309.37	149.51	279.87	281.60	193.67	1974	8.68	105.40	280.27	282.49	267.92
1923	78.76	190.18	279.63	281.62	174.34	1975	138.06	146.07	280.03	282.51	248.59
1924	208.14	230.84	279.39	281.63	155.01	1976	267.45	186.73	279.79	282.53	229.26
1925	350.71	271.61	280.14	281.65	135.63	1977	50.01	227.50	280.54	282.54	209.88
1926	120.09	312.27	279.90	281.67	116.31	1978	179.40	268.17	280.30	282.56	190.55
1927	249.47	352.94	279.66	281.69	96.98	1979	308.78	308.83	280.06	282.58	171.22
1928	18.86	33.60	279.42	281.70	77.65	1980	78.16	349.49	279.82	282.60	151.89
1929	161.42	74.37	280.17	281.72	58.27	1981	220.73	30.26	280.57	282.61	132.51
1930	290.81	115.03	279.93	281.74	38.94	1982	350.11	70.93	280.33	282.63	113.19
1931	60.19	155.70	279.69	281.75	19.61	1983	119.50	111.59	280.09	282.65	93.86
1932	189.58	196.36	279.45	281.77	0.28	1984	248.88	152.25	279.85	282.67	74.53
1933	332.14	237.13	280.20	281.79	340.90	1985	31.44	193.02	280.60	282.68	55.15
1934	101.52	277.80	279.96	281.81	321.57	1986	160.83	233.69	280.36	282.70	35.82
1935	230.91	318.46	279.72	281.82	302.25	1987	290.21	274.35	280.12	282.72	16.49
1936	0.29	359.12	279.48	281.84	282.92	1988	59.60	315.01	279.88	282.73	357.16
1937	142.85	39.89	280.23	281.86	263.54	1989	202.16	355.79	280.63	282.75	337.78
1938	272.24	80.56	279.99	281.87	244.21	1990	331.54	36.45	280.39	282.77	318.45
1939	41.62	121.22	279.75	281.89	224.88	1991	100.93	77.11	280.15	282.79	299.13
1940	171.01	161.88	279.51	281.91	205.55	1992	230.31	117.77	279.91	282.80	279.80
1941	313.57	202.65	280.26	281.93	186.17	1993	12.87	158.55	280.66	282.82	260.42
1942	82.95	243.32	280.02	281.94	166.84	1994	142.26	199.21	280.42	282.84	241.09
1943	212.34	283.98	279.78	281.96	147.51	1995	271.64	239.87	280.18	282.85	221.76
1944	341.72	324.64	279.54	281.98	128.19	1996	41.03	280.53	279.94	282.87	202.43
1945	124.28	5.42	280.29	281.99	108.80	1997	183.59	321.31	280.69	282.89	183.05
1946	253.67	46.08	280.05	282.01	89.48	1998	312.97	1.97	280.45	282.91	163.72
1947	23.05	86.74	279.81	282.03	70.15	1999	82.36	42.63	280.21	282.92	144.39
1948	152.44	127.40	279.57	282.05	50.82	2000	211.74	83.29	279.97	282.94	125.07
1949	295.00	168.18	280.32	282.06	31.44						
1950	64.38	208.04	280.08	282.08	12.11						
1951	193.77	249.50	279.84	282.10	352.78						

Table 4: Results of Periodic Arrays of the Data

PERIOD	INDEX	PERIOD	INDEX	PERIOD	INDEX	PERIOD	INDEX	PERIOD	INDEX
1.00	.000	20.0	.353	39.0	.367	58.0	.243	77.0	.763
1.50	.000	20.5	.304	39.5	.387	58.5	.253	77.5	.738
2.00	.022	21.0	.206	40.0	.482	59.0	.271	78.0	.709
2.50	.051	21.5	.158	40.5	.504	59.5	.365	78.5	.679
3.00	.127	22.0	.072	41.0	.536	60.0	.369	79.0	.668
3.50	.209	22.5	.117	41.5	.582	60.5	.391	79.5	.666
4.00	.072	23.0	.128	42.0	.630	61.0	.376	80.0	.659
4.50	.052	23.5	.265	42.5	.689	61.5	.421	80.5	.674
5.00	.322	24.0	.241	43.0	.742	62.0	.460	81.0	.669
5.50	.035	24.5	.164	43.5	.819	62.5	.464	81.5	.670
6.00	.236	25.0	.147	44.0	.854	63.0	.468	82.0	.659
6.50	.047	25.5	.143	44.5	.954	63.5	.484	82.5	.705
7.00	.099	26.0	.185	45.0	1.064	64.0	.552	83.0	.705
7.50	.177	26.5	.246	45.5	1.215	64.5	.633	83.5	.703
8.00	.110	27.0	.328	46.0	1.266	65.0	.686	84.0	.695
8.50	.124	27.5	.509	46.5	1.413	65.5	.702	84.5	.566
9.00	.198	28.0	.488	47.0	1.358	66.0	.727	85.0	.672
9.50	.821	28.5	.410	47.5	1.337	66.5	.723	85.5	.653
10.0	.377	29.0	.221	48.0	1.154	67.0	.752	86.0	.647
10.5	.253	29.5	.262	48.5	1.039	67.5	.777	86.5	.636
11.0	.044	30.0	.461	49.0	.941	68.0	.789	87.0	.627
11.5	.159	30.5	.420	49.5	.941	68.5	.799	87.5	.654
12.0	.264	31.0	.528	50.0	.879	69.0	.800	88.0	.661
12.5	.117	31.5	.542	50.5	.882	69.5	.826	88.5	.717
13.0	.159	32.0	.413	51.0	.763	70.0	.856	89.0	.708
13.5	.428	32.5	.478	51.5	.314	70.5	.905	89.5	.768
14.0	.200	33.0	.463	52.0	.710	71.0	.888	90.0	.767
14.5	.135	33.5	.584	52.5	.763	71.5	.895	90.5	.829
15.0	.434	34.0	.593	53.0	.655	72.0	.880	91.0	.829
15.5	.621	34.5	.601	53.5	.680	72.5	.902	91.5	.869
16.0	.282	35.0	.710	54.0	.590	73.0	.885	92.0	.862
16.5	.176	35.5	.761	54.5	.568	73.5	.872	92.5	.891
17.0	.169	36.0	.678	55.0	.529	74.0	.851	93.0	.887
17.5	.300	36.5	.692	55.5	.558	74.5	.861	93.5	.945
18.0	.386	37.0	.632	56.0	.465	75.0	.863	94.0	.889
18.5	.662	37.5	.615	56.5	.434	75.5	.850		
19.0	.519	38.0	.517	57.0	.378	76.0	.816		
19.5	.223	38.5	.446	57.5	.295	76.5	.783		

Following the array reconnaissance, a Fourier analysis was done of the 186 year fundamental period. With strikingly powerful results in the long periods (Table 5).

Although the 186 year Fourier was encouraging it was realized that the method inherently distributes all variance among only the harmonics represented in that fundamental and that if Fourier analysis were the end of the problem the answer was that the next 186 years would be like the last 186. It may be that that is the situation, but because of the presence of the multiply periodic tidal potential variations and a desire to experiment with interweaving the effects of other periods, the initial 186 Fourier was set aside and it was determined to discover first any influence from the Saros and Metonic families and subtract them before returning to an analysis of the Nodal and Combination period. Therefore a 162 year Fourier analysis was computed and the 54 year and 27 year results were subtracted from the entire 186 years. Then a 152 year Fourier was computed and the 19 and 9.5 year Metonic periods were likewise subtracted. A return to a 186 Fourier computation of the resulting data was a third step. And the 186, 93, 62, 46.5, 37.2, 31, 15.5, 13.28, 10.33, 8.84, 7.75, 6.2, 6, 5.166, 4.42, and 3 year periods were in turn subtracted. Following this an 180 year Fourier was computed and the 18, 9, 5, 10, 15, 3.333 and 2 were subtracted for a total of 29 periods detailed in Table 6. The order of subtraction within fundamental periods makes no difference but the order of fundamental periods and the individual periods selected as significant is of course critical.

There is room for considerable improvement, including better selection of periods for inclusion and more frequent computation of the Fourier periods; perhaps after each period removal, moving from one to the other alternately as one might tighten nuts on a tire. The failure to get beyond 90% in the reduction of variance and a diminishing ability of additional periods to effectively reduce it could partially stem from the use of the Fourier Harmonic period length rather than the astronomical length when both subtracting and synthesizing. Fifty-four years is for example actually 54.09 years and all the periods have similar remainders over integral length which lead to cumulative error over a number of periods. The quicksilver nature of the problem is which each action effects all subsequent ones requires a number of experiments with the technique in order to rationalize a standard approach which must await future study. It might, for example, be preferable to start with the short period end of the spectrum leaving the longer cycles to the last.

Notes On Table 4

In addition to the annual and semi-annual periods in the program some specific periods related to suspected astronomical periods or their interaction or harmonics were also computed.

Period	Index	Period	Index
23.25	.176	4.42	.075
20.66	.359	4.152	.305
18.61	.705	3.91	.063
11.625	.313	3.875	.301
10.33	.405	3.444	.220
9.305	.671	2.906	.120
8.84	.071	2.72	.088
6.88	.085	2.583	.119
5.81	.302	2.2962	.195
5.1666	.268	1.9373	.121

The very strong index at around 46.5 is in agreement with results obtained by Shirk (1978).

SUMMARY

The objective was to demonstrate support for the hypothesis that periods of long term variation in tidal potential may in some fashion entrain similar periods of fluctuation in an economic time series. The demonstration involved attempting to decompose and resynthesize such a series using tidal periods. The resulting synthesis of twenty-nine periods is at the bottom of Chart III and should be compared with the chart of the original data at the top of Chart I.

It is apparent from Table 6 that only six periodic functions derived from the data and related to the perigee syzygy phenomena or a combination of it with the nodal cycle are sufficient to reduce the variance in the data by .7456%. Those periods are: 186, 93, 62, 46.5 31 and 15.5 years.

The addition of two functions from the Metonic family, 19 and 9.5 years reduces the overall variance by .839319%. Beyond this the reduction begins to encounter rapidly diminishing returns.

It cannot be said that the case for existance of a series of tidally entrained macroseasons has been proven. However, there does seem to be a very provocative relationship.

Alternate and improved formulations can undoubtedly be found and it appears that the hypothesis merits further serious consideration, using other periods, other geographic locations, and data from other socio-economic phenomena.

The exercise raises more questions than it answers and speculation about a possible causal nexus must also await further investigation. If and when this study is replicated and confirmed in other phenomena the implications for the social and physiological sciences seem enormous.

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Table 5: Results of 186 – Year Fourier Analysis of Original Data

MEAN 622.7526881

COS	207.6420435	186 Years	-11.48822048	7.44	.7286211299	3.795	1.315315588	2.5
SIN	61.44562907		10.03619328		-1.890712609		1.570035615	
	47.01124919	93	5.026702249	7.1538	.780122196	3.72	-7.985212077	2.5135
	-17.65712158		18.80488019		-2.706229053		4.364122790	
	-8.873631685	62	11.03857222	6.8888	-3.328867057	3.647	-.902888358	2.48
	-67.64773445		-6.851195034		-3.328867057		4.842513414	
	11.75477941	46.5	-5.207156882	6.6428	-8.669993064	3.576	2.148448004	2.4473
	-166.9412300		-8.279324395		4.933324752		-2.486103721	
	-25.58954540	37.2	-1.563852210	6.4137	-6.999256481	3.509	3.422391102	2.4155
	-74.61825587		4.016963844		12.54850289		-2.482891976	
	-51.73723468	31	9.570639608	6.2	6.331184452	3.444	4.425460563	2.3846
	2.798190663		12.81427177		-2.247725405		3.056558447	
	-16.03174581	26.5714	23.87634405	6	-11.13344841	3.3818	1.371050650	2.3544
	-3.595069520		-8.0735911648		-6.456796817		6.922071649	
	-16.03174581	23.35	-13.55924755	5.8125	-3.562180803	3.3214	1.040650437	2.325
	-3.595069520		10.39132470		13.92791028		1.282970755	
	-14.06769013	20.66	-12.25054880	5.636	6.326701191	3.263	-3.958436187	2.296
	-27.94169089		8.235057529		-4.185179205		-6.441326784	
	-3.937628381	18.6	7.762232152	5.4705	2.334195412	3.206	.802863096	2.268
	51.54013544		-.093195423		.991040873		1.971584515	
	-24.34402904	16.9	-7.250175903	5.31428	-4.217957359	3.1525	-3.614364134	2.2409
	-16.61308542		-2.911890610		.212312198		3.164851308	
	14.60529503	15.5	-26.54060533	5.1666	-2.980578647	3.1	-3.884773323	2.214
	-59.53001897		-10.32740533		-1.632091234		2.249972602	
	15.71402908	14.307	-31.75409092	5.027	-7.485519883	3.049	-4.505147726	2.1882
	-6.57866576		-8.582336423		.113736120		-2.727840091	
	.801267402	13.2857	-8.974985830	4.8947	-14.22043035	3	1.683970101	2.1627
	42.66886647		-10.58646137		-6.509158285		1.145580771	
	18.75470350	12.4	7.156323873	4.769	.993156051	2.952	4.506039729	2.1379
	-2.508641036		-24.13839157		-10.36433341		1.179243564	
	-8.885801379	11.625	-2.863682294	4.65	6.315327397	2.9062	-1.003535474	2.113
	-21.71555878		-7.285359268		-6.065209540		-5.973743624	
	-12.18277534	10.94	6.474472263	4.536	5.062942692	2.861	-4.471957218	2.08988
	-1.192790167		-7.795670214		3.688080794		-4.439118099	
	24.21852115	10.333	16.20127559	4.4285	-6.883082298	2.818	1.508740146	2.0666
	28.04577537		-16.72368061		6.821020724		-7.687811146	
	3.047506623	9.789	3.089006675	4.325	3.620128823	2.776	4.312399800	2.0439
	-6.260373476		-15.60019877		-4.974984373		-2.595444299	
	-43.45197686	9.3	-4.322018429	4.227	8.089641493	2.735	-.927530754	2.0217
	-49.73402235		-.508227869		-2.282666265		-4.243057533	
	-5.020527876	8.85714	-16.98699231	4.1333	3.255314113	2.687	-3.795698924	2
	9.090314538		.332013789		8.339757519		.000000058	
	3.301868822	8.4545	-5.371865855	4.0434	-6.505718513	2.616	93.00000	
	8.674521094		-10.18542474		2.083558777		93.00000	
	12.52690982	8.8695	-11.94988581	3.957	-6.505718513	2.619		
	-5.356053478		-2.552810094		2.083558777			
	-12.52690982	7.75	-15.91261878	3.875	-6.648003323	2.583		
	-19.10781854		2.162127678		-1.090349463			

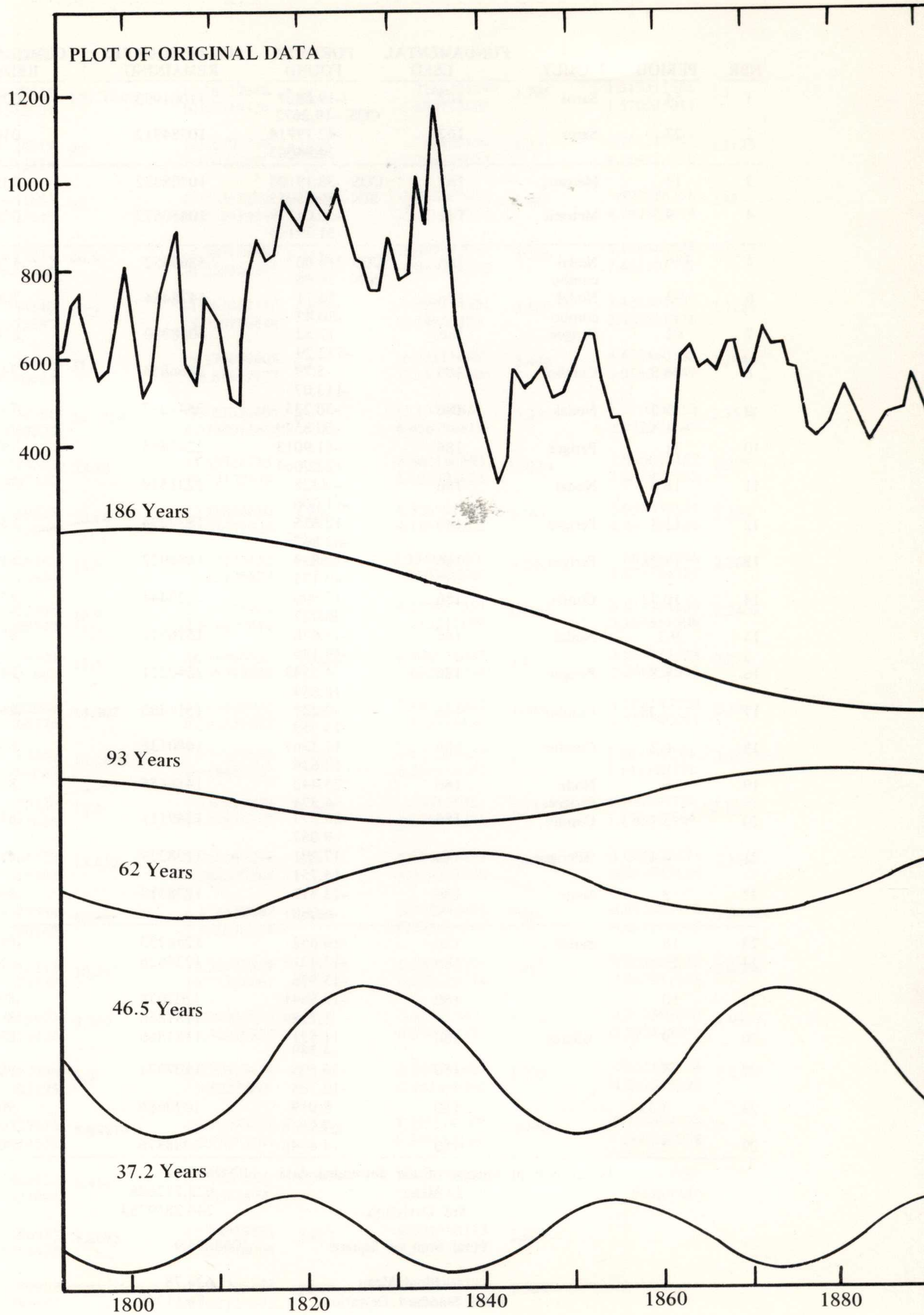
Table 6: Formulas From Fourier Computations Used To Reduce And Synthesize Example

NBR	PERIOD	FAMILY	FUNDAMENTAL USED	FORMULA FOUND	SUM OF SQUARES REMAINING	CUMULATIVE % REDUCED
1	54	Saros	162	-19.0327 COS -19.2672	11001993	.00879
2	27	Saros	162	-42.19714 24.84003	10984912	.01033
3	19	Metonic	162	COS 38.19105 SIN 59.55083	10708332	.03525
4	9.5	Metonic	152	-50.04179 31.79128	10450672	.058469
5	186	Nodal combo	186	COS 214.66 SIN 56.96	5863652	.4717
6	93	Nodal combo	186	56.71 -30.42	5478454	.50643
7	62	Perigee	186	17.52 -122.29	4058980	.63431
8	46.5	Combo	186	-5.79 -113.07	2866854	.7417
9	37.2	Nodal	186	-30.235 -50.8529	2541337	.7710
10	31	Perigee	186	-51.9013 22.7064	2242865	.7979
11	18.6	Nodal	186	-.8328 -11.006	2231534	.7989
12	15.5	Perigee	186	12.655 -63.867	1837294	.8344
13	13.28	Perigee	186	-1.6889 40.175	1686923	.84802
14	10.33	Combo	186	15.906 20.727	1623444	.85373
15	9.3	Nodal	186	-11.678 -19.189	1576513	.85796
16	8.85	Perigee	186	4.5549 18.654	1542221	.86105
17	7.75	Combo	186	-9.227 -15.553	1511805	.86379
18	6.2	Combo	186	11.2367 14.636	1480138	.8666
19	6	Node Perigee	186	25.442 -6.374	1416155	.87241
20	5.166	Combo	186	-25.277 -9.052	1349111	.87845
21	4.42	½Perigee	186	17.291 -15.751	1298229	.883
22	3	Node	186	-13.319 -6.0605	1278313	.88483
23	18	Saros	180	-16.662	1256233	.8868
24	15		180	-13.4313 -15.956	1224626	.8896
25	10		180	-19.5641 1.7389	1202078 1181866	.8917 .8935
26	9	½Saros	180	11.531 -4.549	1181866	.8935
27	5		180	-26.608 -16.788	1107971	.900
28	3.333		180	8.019 7.0668	1090686	.9017
29	2		180	-4.4746	1088876	.9019

Initial sum of squares of the detrended data 11099668.62
Mean 622.752688
Std Deviation 244.2859753

Final Sum of Squares 1088876.9

Final Mean 626.78
Final Standard Deviation, 76.51259


PLOT OF ORIGINAL DATA
1200
1000
800
600
400
186 Years
93 Years
62 Years
46.5 Years
37.2 Years
1800
1820
1840
1860
1880

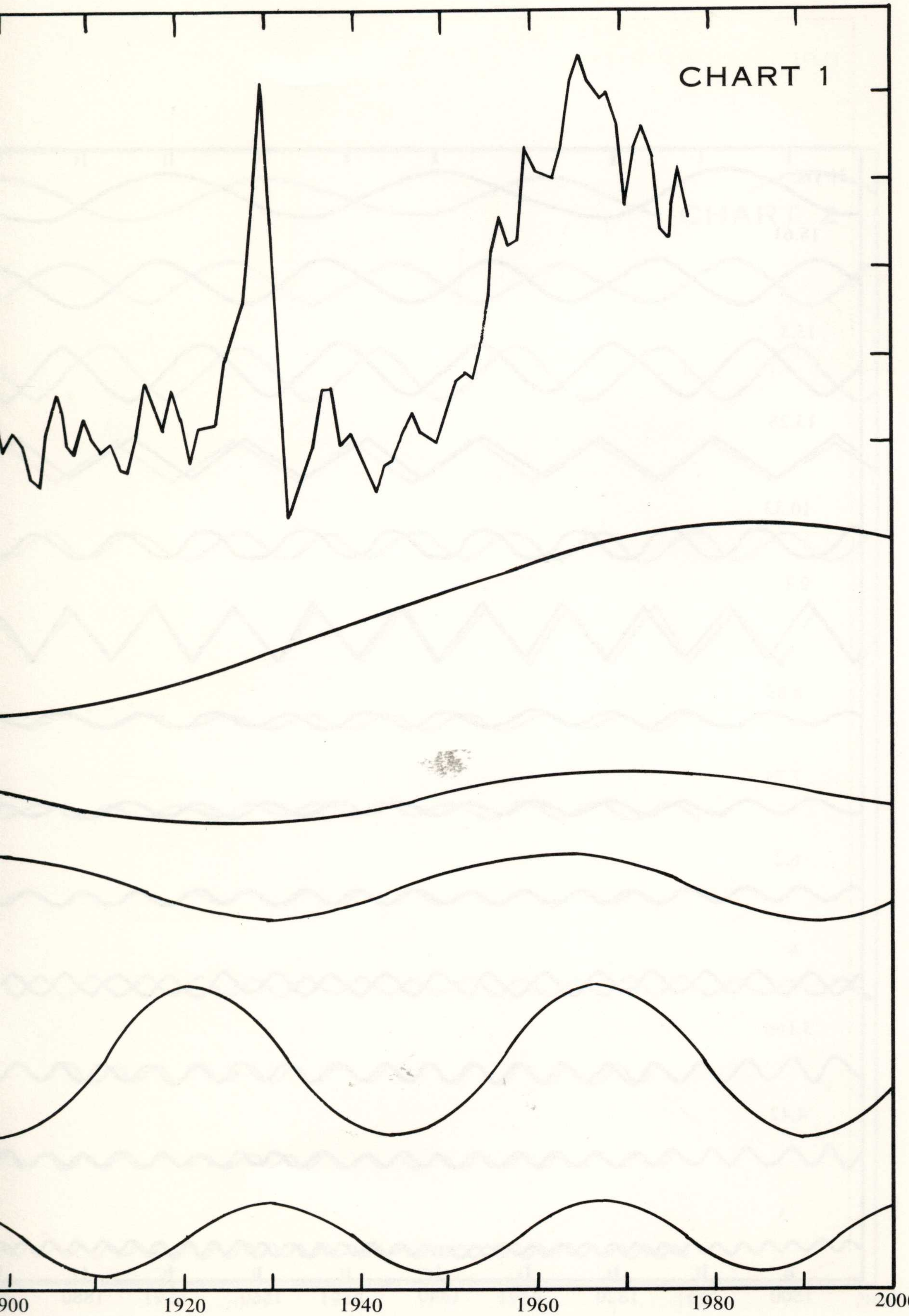
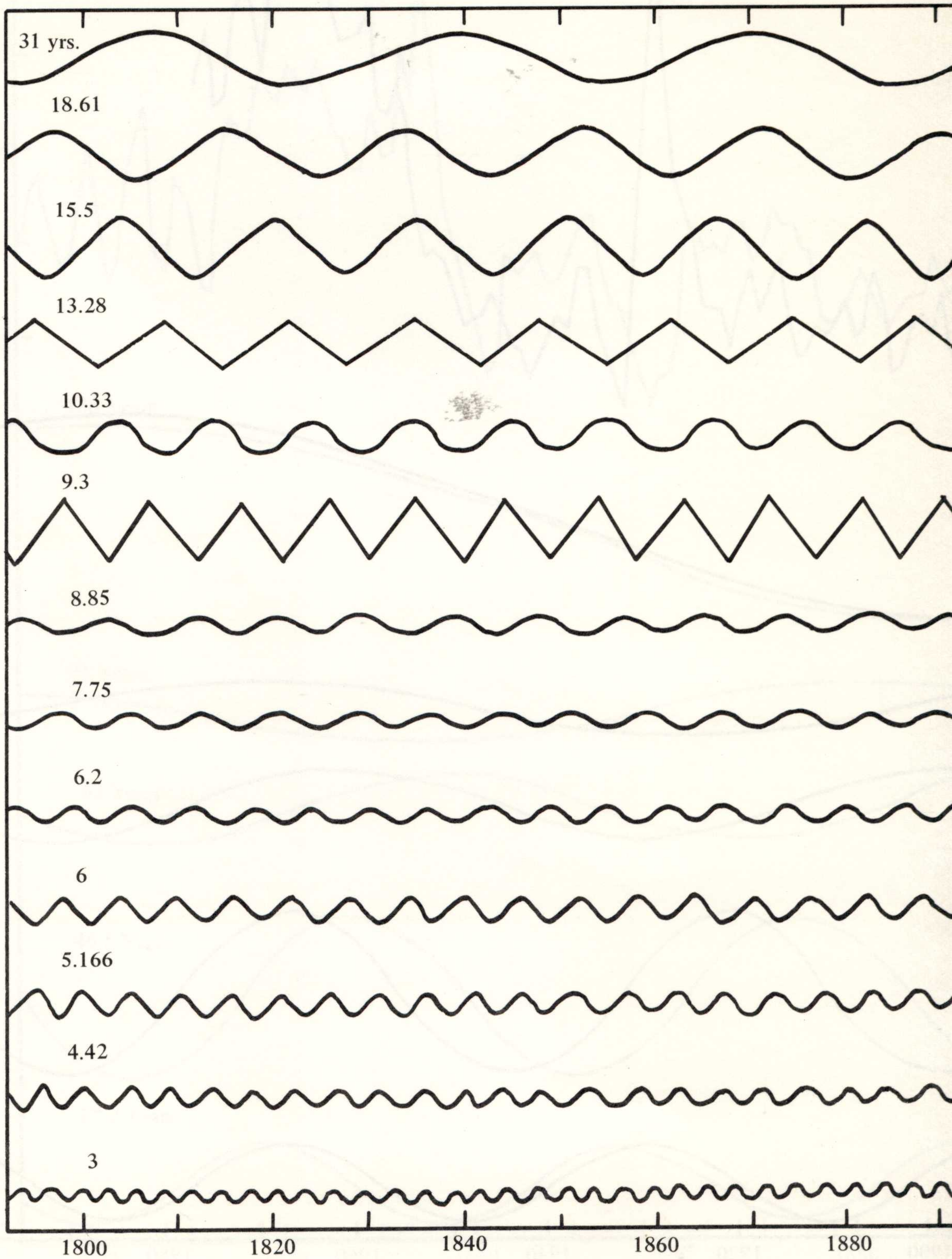


CHART 1
900
1920
1940
1960
1980
2000


31 yrs.
18.61
15.5
13.28
10.33
9.3
8.85
7.75
6.2
6
5.166
4.42
3
1800
1820
1840
1860
1880

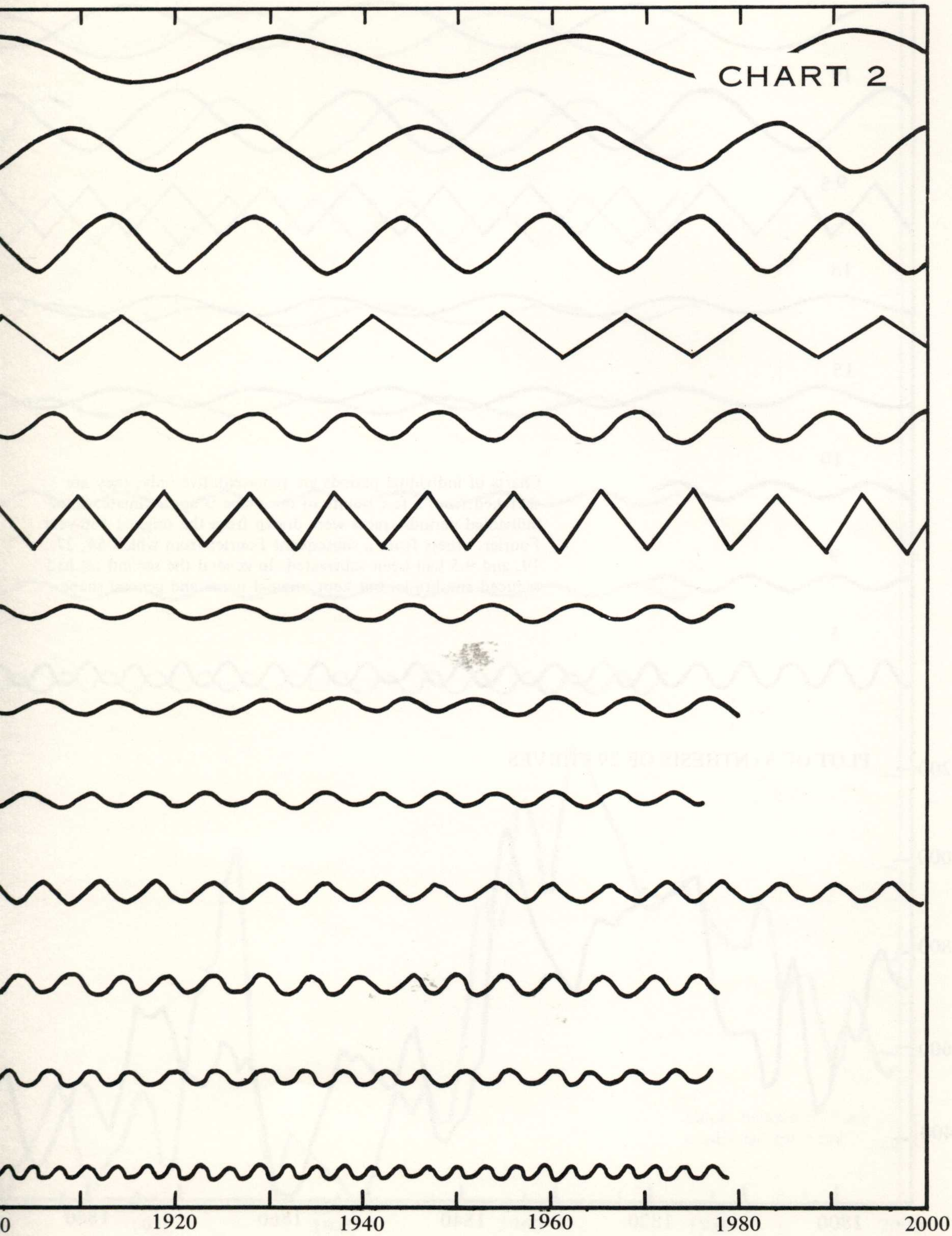
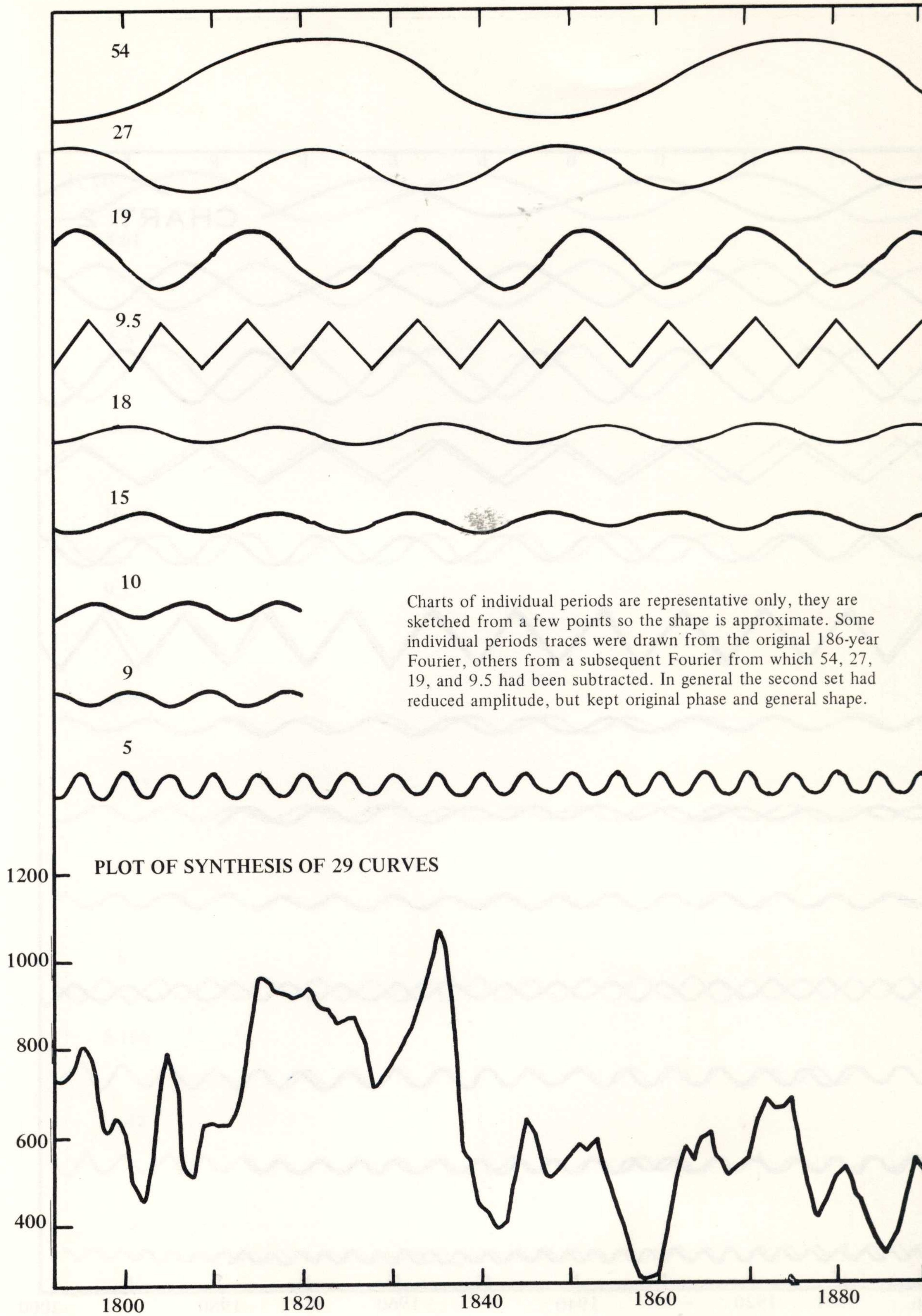


CHART 2
0
1920
1940
1960
1980
2000



54
27
19
9.5
18
15
10
9
5
Charts of individual periods are representative only, they are sketched from a few points so the shape is approximate. Some individual periods traces were drawn from the original 186-year Fourier, others from a subsequent Fourier from which 54, 27, 19, and 9.5 had been subtracted. In general the second set had reduced amplitude, but kept original phase and general shape.
PLOT OF SYNTHESIS OF 29 CURVES
1200
1000
800
600
400
1800
1820
1840
1860
1880

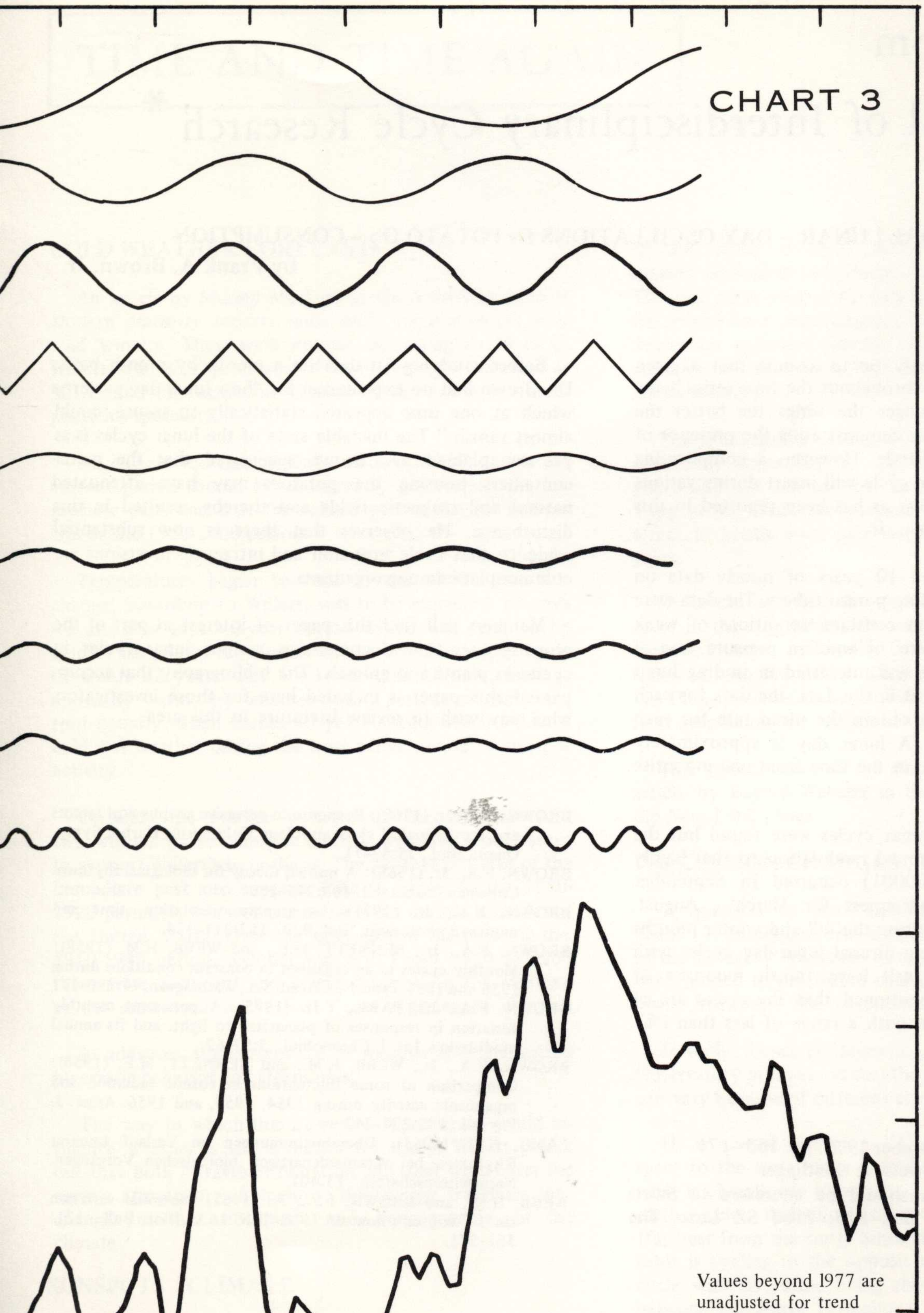


CHART 3
Values beyond 1977 are
unadjusted for trend
1920
1940
1960
1980
2000

Reports from
The Journal of Interdisciplinary Cycle Research *

SEASONAL, UNIMODAL LUNAR - DAY OSCILLATIONS IN POTATO O_2 - CONSUMPTION . . . . .

by Frank A. Brown, Jr.

A common practice may be to assume that a given cycle will repeat regularly throughout the time series being investigated. Thus, the longer the series the better the chances are for statistically demonstrating the presence of cycles of very low amplitude. However, a complicating factor may be that a given cycle will invert during various intervals of the time series, as has been reported in this paper by Dr. Frank A. Brown, Jr.

Dr. Brown re-examined 10 years of hourly data on O_2-consumption of sprouting potato tubers. The data were obtained from potatoes in constant conditions of weak illumination, of temperature, of ambient pressure; and of O_2 and CO_2. Because he was interested in finding lunar cycles that might be present in the data, the data for each month were organized to obtain the mean rate for each hour of the lunar day. (A lunar day is approximately 24 hours and 50 minutes, or the time from one moonrise to the next moonrise.)

Significantly, diurnal lunar cycles were found but the cycles demonstrated an annual modulation so that highly significant cycles ($P< .000001$) occurred in September -February and only randomness for March - August. Furthermore, the result during the fall and winter months revealed group of inverting dirunal lunar-day cycles with maxima at either upper transit, lower transit, moonrise, or moonset. It should be mentioned that the cycles are of very low amplitude (often with a range of less than 1%).

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Before studying his data on a month by month basis, Dr. Brown had no explanation for "how lunar-day patterns which at one time appeared statistically so secure, could almost vanish." The unstable state of the lunar cycles is as yet unexplained. Dr. Brown speculated that the metal containers housing the potatoes may have attenuated natural and magnetic fields and thereby resulted in this disturbance. He observes that there is now substantial evidence that cycle inversion and intracycle inversions are commonplace among organisms.

Members will find this paper of interest at part of the growing literature documenting various lunar cycles in cycles in plants and animals. The bibliography that accompanied this paper is included here for those investigators who may wish to review literature in this area.

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TIME AND TIME AGAIN

COLD WEATHER FORECAST

An article by Shirley Moskow in the April-May issue of *Modern Maturity* reports once again on our recent very cold winters. They were normal, according to Hurd C. Willett. He is a professor of meterorology, emeritus at M.I.T. and has made the climate of the northern hemisphere his speciality.

His current forecast (actually made in 1974) is that the current period should be consistently colder than the immediate past, and that the coldest part of the current era will be the 1980-2000 period.

Temperatures began to cool in the 1960's and this change, according to Willett, was to be expected. He says we are now in a 40-year period which will tend to be colder. He relates the climate to the double sunspot cycle of about 22 years. For a 40-year span of time, there is unusually warm, dry weather during periods of rising sunspot activity. Then comes 40 years during which we have cold wet weather during the least active period of sunspot activity.

Certainly the weather patterns of the immediate past two winters (when sunspot activity was low) would seem to support Willett's hypothesis. The weather patterns of the immediate past also support Willett's cycle. In the 1880-1920 period, it was wet across the lower middle latitudes of the United States. Over the next part of the cycle, in the 1910-1940 period, weather was dry. From 1920 to 1960 there were recurrent and severe droughts in the Midwest at the same time as the East Coast experienced wetness.

In addition, the current colder weather is characterized by erratic behavior and storminess.

The way in which this 22-year sunspot cycle would influence weather is still a matter for study. Willett points out that both ultraviolet radiation and solar wind enter the earth's atmosphere. Somehow, this energy translates into changes in the atmosphere and, consequently, in the climate.

SUNSPOTS / CLIMATE

Another scientist has concluded that the magnetic changes on the sun, identified by the double sunspot cycle (rather that the sunspots themselves), are related to climatic shifts on earth. Robert H. Dicke of Princeton studied deuterium-to-hydrogen ratios in tree-ring cellulose. The tree rings were from two bristle cone pine trees, and the record from them spanned 1000 years. The amount of deuterium indicates warmer or colder weather. Larger amounts of deuterium vis-a-vis hydrogen are related to colder weather.

The comparative amounts of the two components are apparently controlled by the temperature of the atmosphere and the sea surface. Samuel Epstein and Crayton Yapp of the California Institute of Technology studied this effect in bristle cone pine rings going back some 22,000 years.

Dicke did not find the manifest 8 to 17 year sunspot cycle in the ring ratios. He thinks that the source of the climatic changes, as revealed by the ratios, may be the variation in solar luminosity. Changes in the brightness of the sun Dicke believes to be caused by changes in the magnetic field deep below the surface of the sun.

This contribution to the discussion was carried in an article by Bayard Webster in the July 17, 1979, issue of the *New York Times.*

PRECESSION CHANGES / ICE AGES

A question on the "Letters" page of *Science News* (Feb. 17, 1979) concerns a discrepancy in the figures used in the ice-ages / Precession-changes discussion. Ice ages have been related to precession changes with a period of 23,000 years. However, the astronomical value is 25,725 years.

In reply, James D. Hayes of Lamont-Doherty Geological Observatory pointed out that the measurement of precession can vary because of different astronomical reference points.

He is quoted as saying, "The precession cycle with respect to the stars has a period of 26,000 years. However, what is climatically important is the season of the year the earth reaches Perihelion [closest to the sun] or Aphelion [farthest from the sun]. Since the major axis of the earth's orbit is cycling in the opposit direction to the precession cycle with its period being about 96,000 years, the time between successive Perihelions or Aphelions at the same time of the year is less than 26,000 years. Over the time period we studied [the last 500,000 years] it averaged 23,000 years."

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