Towards a Unified Theory of Cycles

by Ray Tomes

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Conference Proceedings February 1990

Many thanks to Michael Taler who encouraged me and
assisted in the preparation for presentation of this paper in 1989.

Note by the Author, June 2005. This paper is being made available through Cycles Research Institute more than 15 years after its original preparation and presentation. Considerable developments have happened since then:

* The Foundation for the Study of Cycles has ceased to exist.

* Cycles Research Institute has started in a small way to try and re-establish cycles research.

* Much work has been done on the Harmonics Theory first presented in this paper. Although the correct calculation was derived before publication of this paper, a slightly different calculation was presented here. It incorrectly results in the dominant cycles always being related by ratios of 2.

* This paper presents ideas on understanding irregular cycles in planetary configurations that are very little known, specifically average cycles versus specific occurrences.

* The relativistic gravitational effect of the planets on the Sun outlined here has been presented in a later paper. However the discussion of how this idea came about and problems with both the COM and tidal theories are presented here.

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Dewey and others have shown that cycles in many disciplines are related, from economics and biology to geology, weather and astronomy. Along the way some unexpected relationships have been found, such as cycle synchronies by Dewey (1970) and cycle frequency harmonics by Dewey (1967). There is evidence that earth based cycles are caused by lunar and solar effects on the earth's weather system. The relationship of solar cycles to planetary alignments has been contested. No doubt this debate was partly due to the astrological association, but the problem of finding a credible mechanism remained.

This paper explores cycle relationships. It presents new ideas to explain both the mechanism by which planetary alignments cause solar variations and the reasons for detailed harmonic relationships.

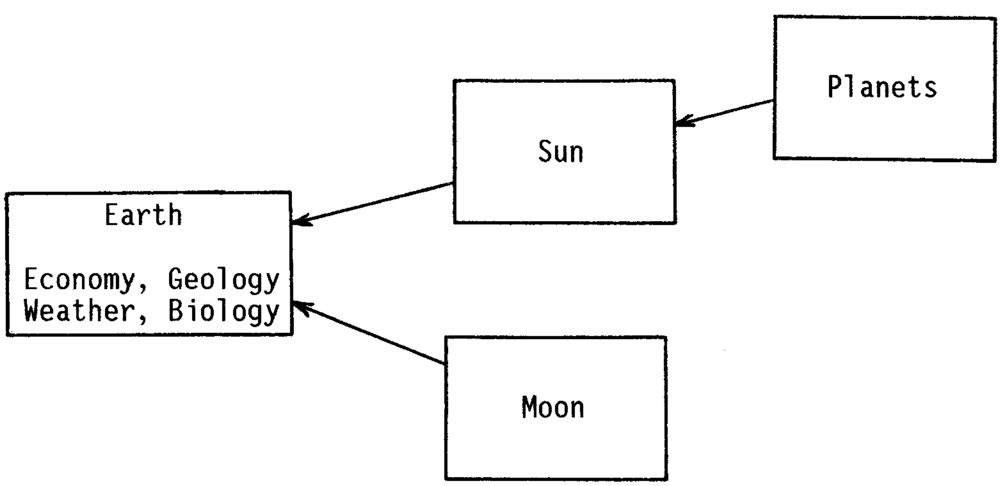

Figure 1. Broad flow of cycle cause and effect.

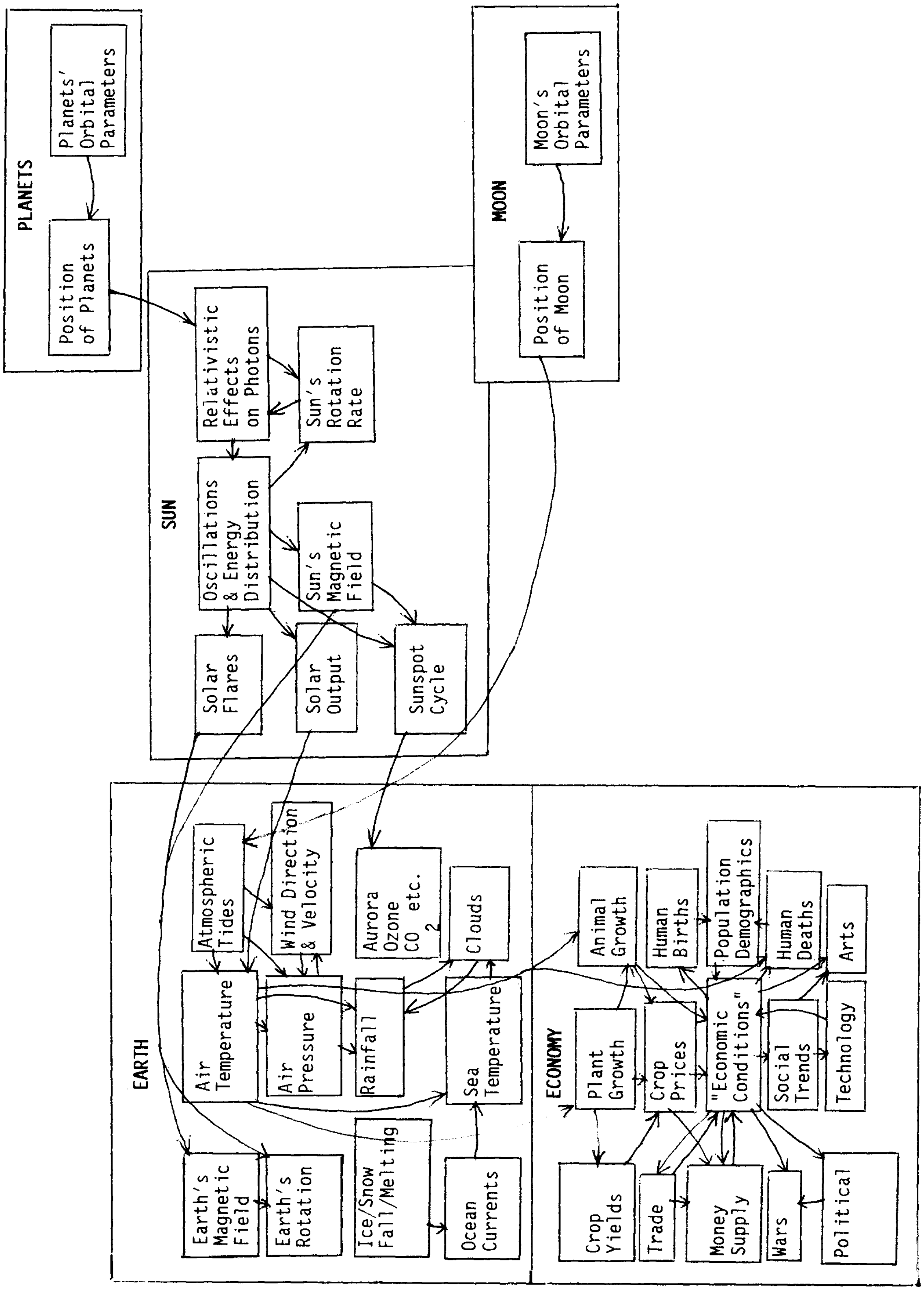

Figure 2. Detailed flow of effects.

This is not intended to be complete, but is indicative of the flow.

In 1977, I performed an analysis of a wide range of economic variables looking for common factors. Several factors had nearly regular cycles. Further investigation, specifically looking for cycles, lead to the discovery of regular cycles with periods of 4.45, 5.9, 7.15 and 9.0 years. These cycles were used to successfully predict a variety of economic trends in the following years

Later, I noticed that the various periods were all integral fractions of a period of a little under 36 years.

4.45	5.9	7.15	9.0
x8	x6	x5	x4
-----	-----	-----	-----
35.6	35.4	35.75	36.0

Subsequently I found periods of 3.0 and 4.0 years which fitted the pattern (as 3.0 x 12 and 4.0 x 9 are 36 years).

Looking at my original graph (figure 3), it shows a hint of a cycle near 5 years which might give 5.1 x 7 = 35.7 years. Research showed that both Hirst and Dewey (1967) had made similar observations, based on quite different data, but arriving at values of 17.7 to 17.9 years, or half of my 35.7 year result.

Omitting the 7.15 year cycle, and using 4.45 x 4, 5.9 x 3 and 9.0 x 2 would have given me the same answer (say 17.8 years). However, Dewey's catalogue of cycles does have a slight concentration of cycles near 7.15 years, so I prefer the 35.7 year figure.

The ultimate "fundamental" is clearly longer than this as both my 36 year and the 54 year Kondratieff cycle are fractions of a larger 108 year period.

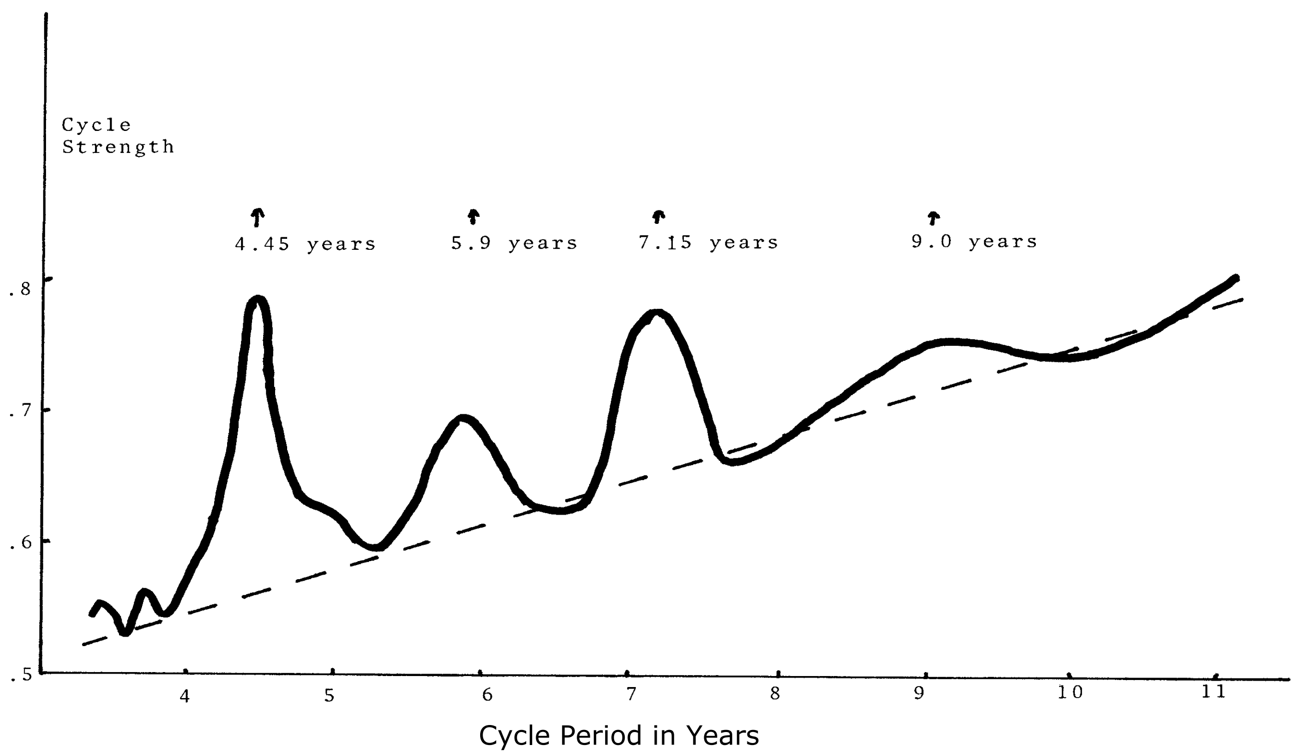

Figure 3. Analysis of 22 Economic Variables for Cycles.

Dewey (1967) also noted that repeatedly multiplying and dividing by 2 and 3 from the base figure of 17.75 years gave many periods which were common cycles.

```
   142.0      213.9      319.5      479.3
   -----
        71.0       106.5      159.8
                   -----
             35.5       53.3
             ----       ----
                  17.75
                  -----
              5.92       8.88
              ----       ----
         1.97       2.96       4.44
         ----       ----       ----
    .66       .99       1.48       2.22
    ---       ---       ----
.22      .33       .49        .74       1.11
         ---       ---        ---       ----
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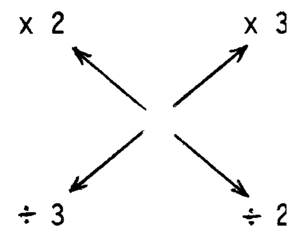


Figure 4. Dewey's Harmonics of 17.75 years by repeated multiplication and division by 2 and 3. Known cycles underlined.

It is true that harmonics of ratios 2 and 3 and their combinations give most of the significant cycles. The factors 2 and 3 can give 2, 3, 4, 6, 8, 9, 12, 16, 18, 24 and so on. However there are some occasional ratios of 5 and 7.

Curious about even shorter period cycles, I obtained 44 years of daily corn prices. Analysis showed many cycles from weeks and months to years. Again there were many cycles in exact ratios involving 2 and 3 and their multiples. Eventually I realised that the pattern of frequencies present in the corn prices was the same as the arrangement of frequencies of the white notes on a piano, and that the ratios again lead back to a value near 18 or 36 years as the fundamental period. This was peculiar, and going back to my early common economic cycles study I realised that the ratios 4:5:6:8 were exactly those of a major chord in music! Why are economic series playing major chords and scales in *very* slow motion?

Research showed that such patterns had been observed and reported before by several contributors to Cycles magazine. One of these was D.S. Castle (1956) who found that stock market cycles fit the musical scale. The pattern found ranged over three octaves, and all seven white notes plus one black note were present in at least one octave. The fundamental period was consistent with either 36.5 years or 54.7 years, and so fitted into the Dewey classification.

Dewey (1970) studied groups of cycles with the same period, and found that the phases were generally clustered. Almost invariably the cycles were closely synchronised, and Dewey referred to this as "Cycle Synchrony". It was a major factor in dispelling his remaining doubts about the reality of cycles. Although at times these groups of cycles were in related fields, at other times synchrony was observed for diverse time-series.

Response Functions

In the real world, many things have an effect on many others. Sometimes the effect has a simple straight line relationship with the cause, but more often the relationship when graphed has a shape that is curved, possibly even in a complex manner.

An example might be the response of the earth's temperature to changing levels of solar radiation reaching the earth. Initially, supplying more heat may raise the temperature at a uniform rate, but then cloud formation may reflect much of the heat, reducing the effect of adding more heat. Eventually the clouds might be dissolved by greater heat allowing a more rapid heating again. This is a hypothetical example to explain why relationships may be non-linear.

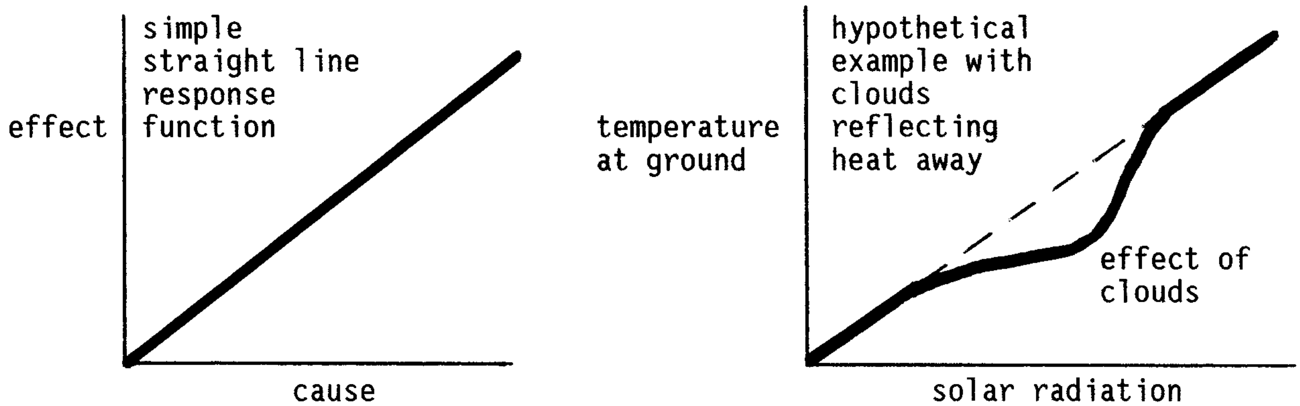


Figure 5. Response Functions

It is possible to imagine other more complex response functions, including ones with sharp kinks or even discontinuities, but even relatively simple functions such as an exponential response will later prove to have very interesting properties.

The above assumes an instantaneous response, which of course may not be the case. In our temperature example, a sudden change in solar output would take some time to heat the earth, which was ignored above. We will consider this now as a separate topic.

Lagged Functions

When a cause takes some time to have an effect, which may be gradual and die out after a while, then we can construct a lagged function showing the effect over time. In this case, a very short pulse will be assumed to be the cause, and the variation in the effect is graphed.

Take our hypothetical solar radiation example, and let the sun shine suddenly brighter for a short time as shown.

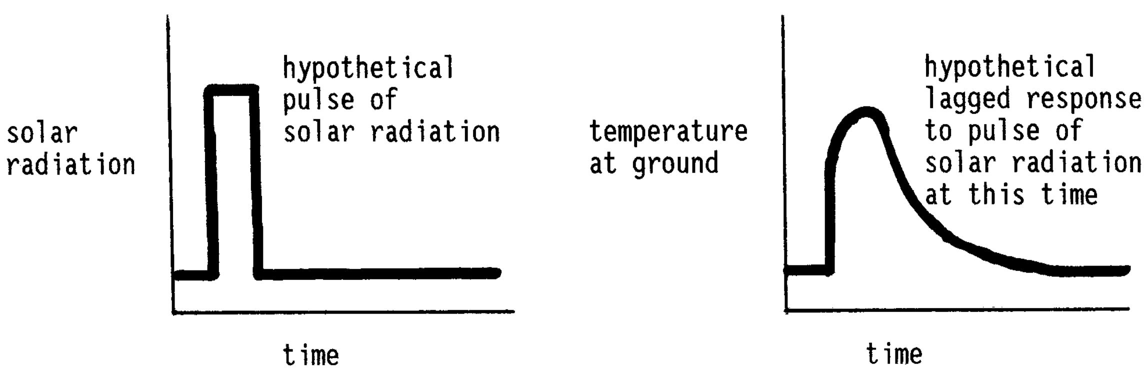


Figure 6. Lagged Functions

The hypothetical lagged effect of a pulse of solar radiation is shown, with a rapid warming at first at ground level, and then a gradual return to the original temperature as the heat slowly dissipates.

It is possible to have lagged functions that swing first one way and then the other before returning to zero. Many economic responses are of this type, carrying the seeds of their own destruction. It is also possible that the lagged function will not ultimately return to zero, but a permanent change will result.

As with response functions, it is possible to imagine some very complex lagged functions, but again, some quite simple examples will be found to be of interest. It is not uncommon to have discontinuities in lagged functions.

Systems Built from Response and Lagged Functions

In our real world, as mentioned earlier, the interconnectedness of all things is exceedingly complex. The objective here is not to perfectly explain all things, but to show some of the possibly interesting results that might occur based on assumptions which will at least be approximations to the truth.

It is possible to imagine various parts of our world being affected in an interconnected way:-

Notice that the temperature affects evaporation which affects the cloud cover which in turn further affects evaporation. There are many such examples of feedback in the above very simplified picture. Feedback itself is an interesting topic and can lead to many diverse forms of behaviour including stable, cyclic and chaotic behaviour, depending on the nature of the relationships.

Figure 7 needs to be interpreted by applying our earlier examples of response functions and lagged functions:-

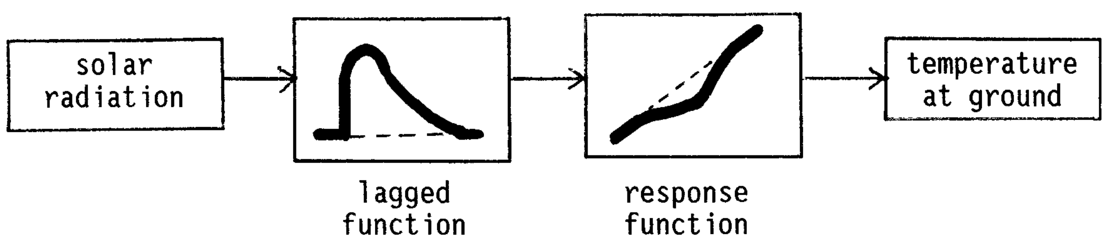


Figure 8. Lagged and Response Functions Combined

In practice, it may be difficult to fully separate the lagged and response functions, or their order may be reversed.

Time Series seen as Cycles

Any time series (that is measurement of anything throughout time) may be expressed as the sum of a number of perfect sine waves. We do not need to consider that the series was actually produced this way, it is simply another way of expressing the same information.

The purpose of expressing time series as sums of sine waves is that some processes can be better understood when the data are in this form.

As an example, our lagged functions will enhance or diminish cycles depending on the period or frequency of the input. The lagged function will not create any new frequencies, but just change the amplitude and phase of existing frequencies.

We may show this graphically:-

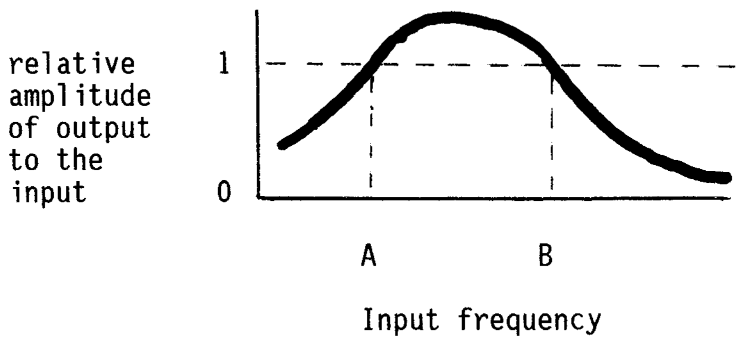
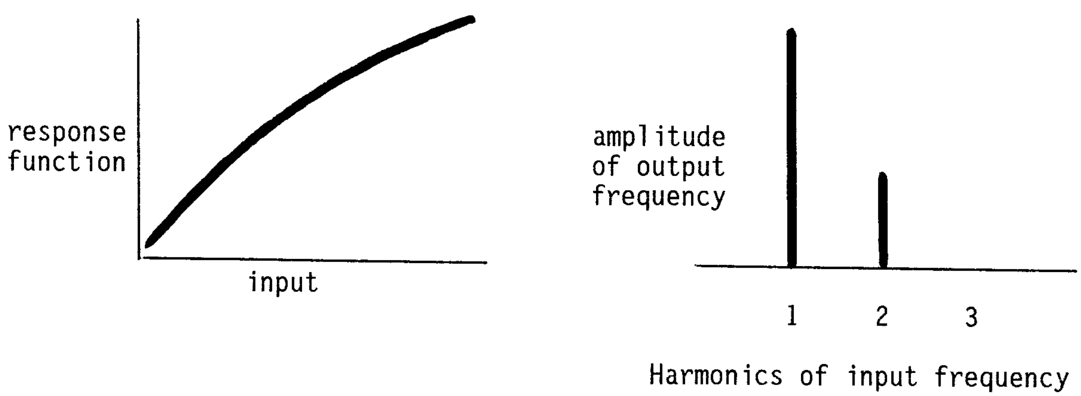


Figure 9. Response Function effect of frequency on amplitude

In this example, frequencies in the range A to B are enhanced, while all others are diminished. Very high frequencies are not responded to at all. This might be the frequency response of our solar radiation - temperature example.

Harmonics are created by non-linear Response Functions

If we feed sine waves into different response functions, the result is quite surprising. The output is always a time series which is the sum of various sine waves that are all harmonics of the original wave. By harmonics we mean frequencies that are integer multiples of the original frequency.



This means that in this case the input and output would look like:-

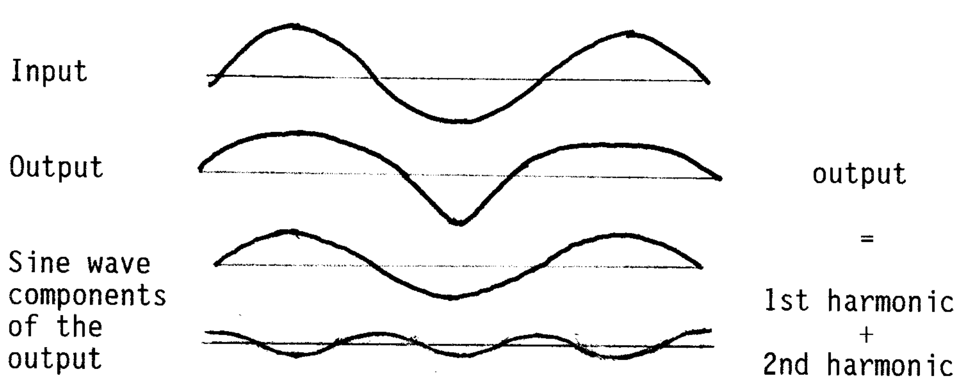


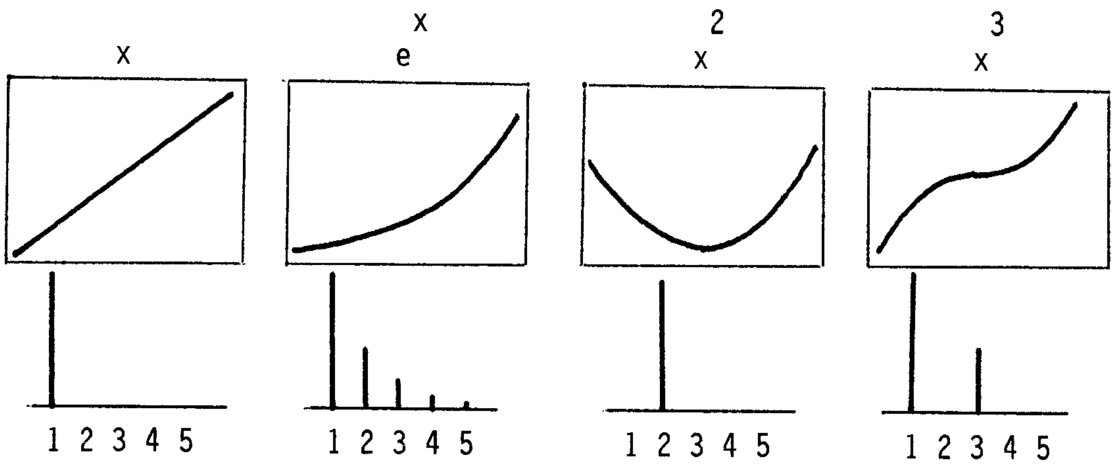
Figure 10. Development of Harmonics by Response Function

Notice that the first harmonic output is in phase (or 180 degrees out of phase) with the input in all cases. This results in cycle synchronies even after multiple steps in a cause and effect chain and helps explain Dewey's observations.

Some other examples of response functions and their makeup from harmonics are shown below. In no case can any frequency be created which is not an exact multiple of the input frequency.

Note - not true for multiple input frequencies when sums and differences of frequencies may result.

Figure 11. Examples of Harmonics for various Response Functions



All Harmonics are not equal in complex systems

We have seen that a single response function can create harmonics. Generally the first few harmonics are the strongest, with a gradual fading away of higher order harmonics. The exact manner of fading out depends on the particular function, but often we will find that harmonics fade away approximately in proportion to 1/frequency.

In complex systems in the real world, we have already seen that there may be many interconnections between different variables:-

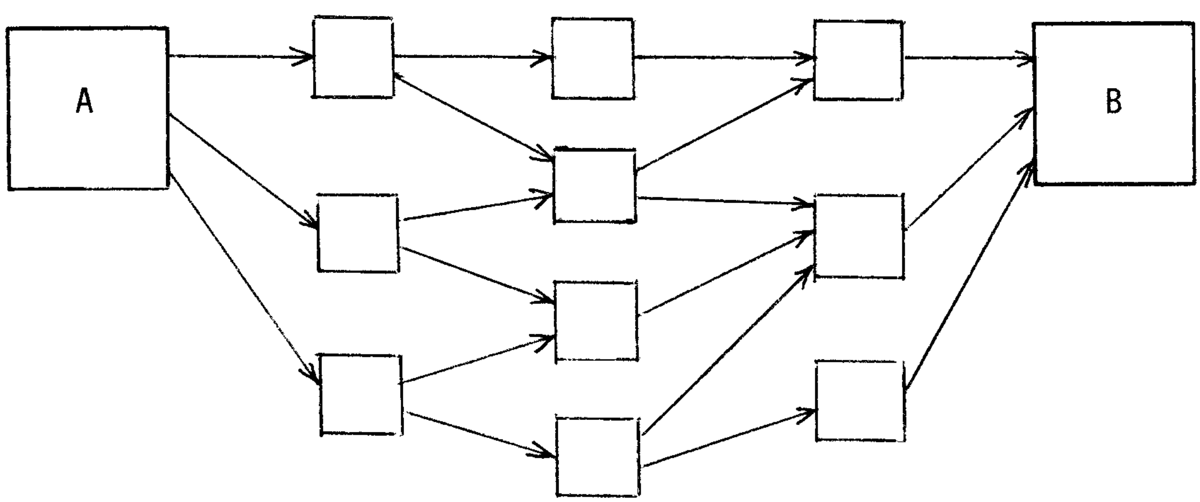


Figure 12. Complex System with many interconnections.

We shall consider a collection of response functions, with many paths from A to B, but without any feedback. In practice, feedback nearly always exists, but it can complicate things by creating new cycles, and for the moment we only wish to investigate the creation of harmonics.

Some harmonics can be created in more ways than others. For example, the fifth harmonic can only be created in one way, as 5 is a prime number. The sixth harmonic however can be created in three ways, either directly as 6 or indirectly as 2 x 3 or 3 x 2. Some harmonics can be created in very many ways for example 24 has twenty different ways of being created and 576 has 1,376 ways!

In B we would therefore expect the 6th, 24th and 576th harmonics of a frequency in A to be much stronger than the 5th, 23rd and 577th which each have only one way of being created.

When a very complex interconnected system is assumed, all the possible ways of arriving at a harmonic are counted, and 1/frequency fading of harmonic amplitudes is assumed, we obtain a chart of power in the harmonics from 1 to 2048 (figure 13).

It is not difficult to see the wide variation of power in the different harmonics and the nearly regular pattern for each doubling in harmonic number.

Relative Power (Log. Scale) of Harmonics from 2 to 2048.

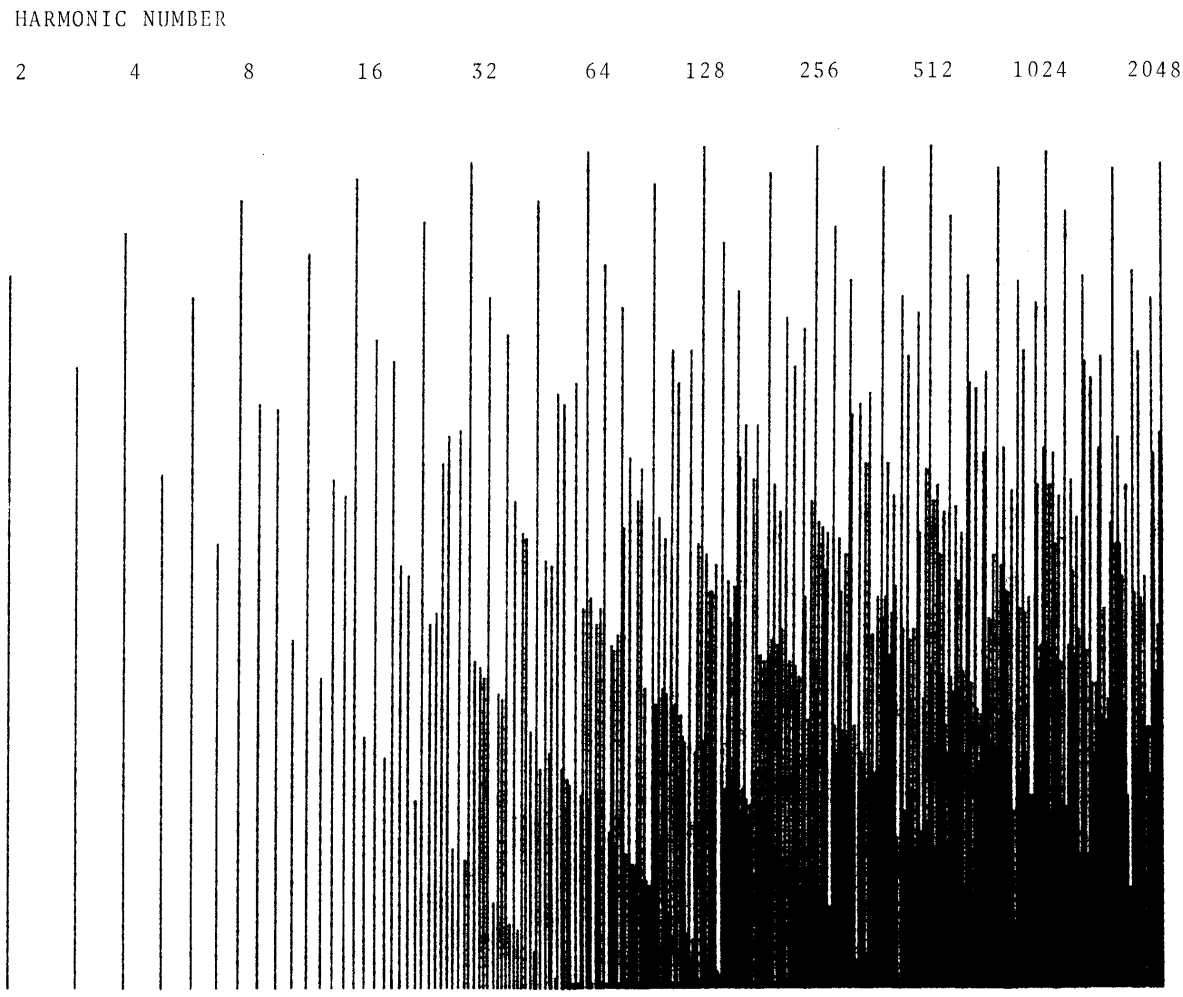


Figure 13. Relative Power of Harmonics.

Let there be Music

If we look at one part of the structure, for example the "octave" from 48 through to 96, we find that the harmonics with most power are:-

Table 1. Most Powerful Harmonics related to musical scale.

Harmonic	48	54	60	64	72	80	84	90	96
Note	C	D	E	F	G	A	Bb	B	C

Amazingly, the nine most powerful harmonics turn out to have frequencies in the same ratios as the eight white notes in one octave on the piano plus one black note. Also, the one black note Bb is required to make the chord of C7 along with C-E-G-C. The strongest notes are in the two chords C-F-A-C (F major) and C-E-G-C (C major).

The assignment of C to harmonic 48 is quite arbitrary, but this choice was made because the major scale of C is all white notes. The choice of the "octave" from harmonic 48 to 96 was also somewhat arbitrary. Different octaves have different power distributions of the individual "notes". As we go up the harmonics scale, the relative power of the notes in each octave changes gradually, but at a diminishing rate.

Well that is rather interesting, we started out trying to find out which harmonics are expected to be generated in time series after going through complex systems of response functions, and ended up explaining how the notes used in music are exactly as they are, and what the main chords should be!

Background to Planets' Influence on the Sun

Past attempts to explain aspect of solar variability and cycles in terms of planetary motion have generally been based on either tidal forces or the motion of the sun about the Centre Of Mass (COM) of the solar system.

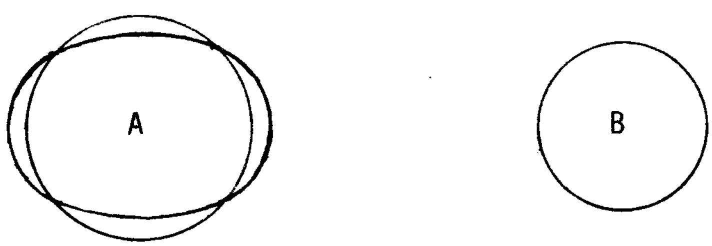


Figure 14. The tides on body A raised by body B are high in the direction of B and opposite it, and low at right angles to these directions.

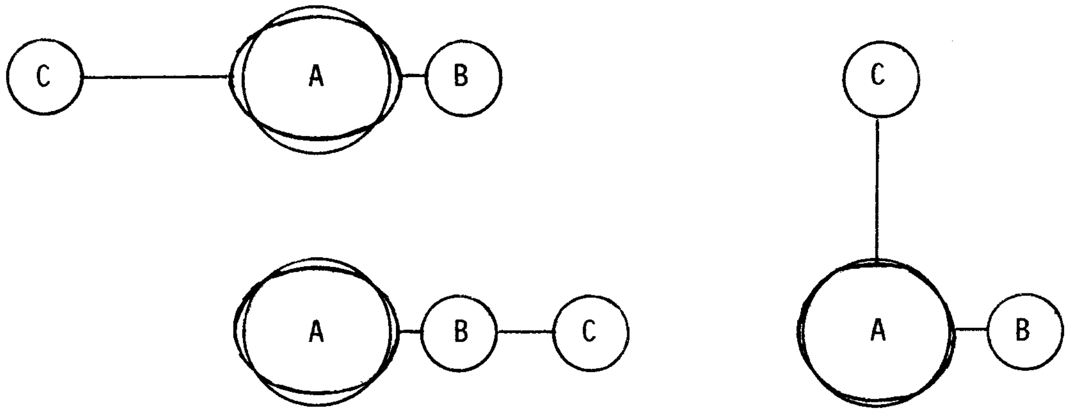


Figure 15. The tides on body A raised by two other bodies, B and C are added when B and C are in a straight line with A on the same or opposite sides. When B and C make a right angle at A their tidal effects are subtracted.

Tidal Hypothesis

The tidal forces hypothesis for solar cycles has been proposed by Wood (1972) and others. Table 2 below shows the relative tidal forces of the planets on the sun. Jupiter, Venus, Earth and Mercury are called the "tidal planets" because they are the most significant. According to Wood, the especially good alignments of J-V-E with the sun which occur about every 11 years are the cause of the sunspot cycle. He has shown that the sunspot cycle is synchronous with the alignments, and J. Schove's data for 1500 year of sunspot maxima supports the 11.07 year J-V-E period average.

Although the average period of J-V-E alignments is 11.07 years, individual periods are clustered near 10.38 and 12.00 years. The sunspot cycle period has been reported as being bi-modal.

In addition, the proportion of occurrences of 10.38 and 12.00 years are very near 4:3, so that the pattern repeats after about 78 years. Gleissberg (1958) observed that there is a cycle of about 80 years in sunspot maximum amplitudes (AM) and Schove confirmed that the phase of sunspot maxima have a 78 year cycle (FM).

Both the 11.86 year Jupiter tropical period (time between perihelion's or closest approaches to the sun and the 9.93 year J-S alignment periods are found in sunspot spectral analysis.
Unfortunately direct calculations of the tidal forces of all planets does not support the occurrence of the dominant 11.07 year cycle. Instead, the 11.86 year period of Jupiter's perihelion dominates the results. This has caused problems for several researchers in this field.

It occurred to me that while the actual tidal force does not have a strong 11.07 period (compared to the 11.86 year period) it might be the case that there are oscillations in the tidal force which are modulated by the 11.07 year period. In that case J-V-E alignments would build up the oscillations over some years and then allow them to die down.

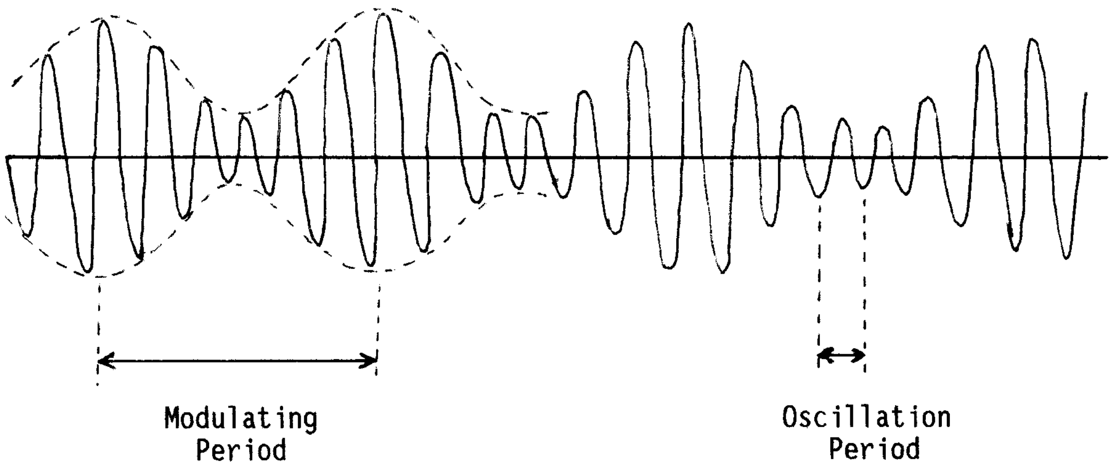
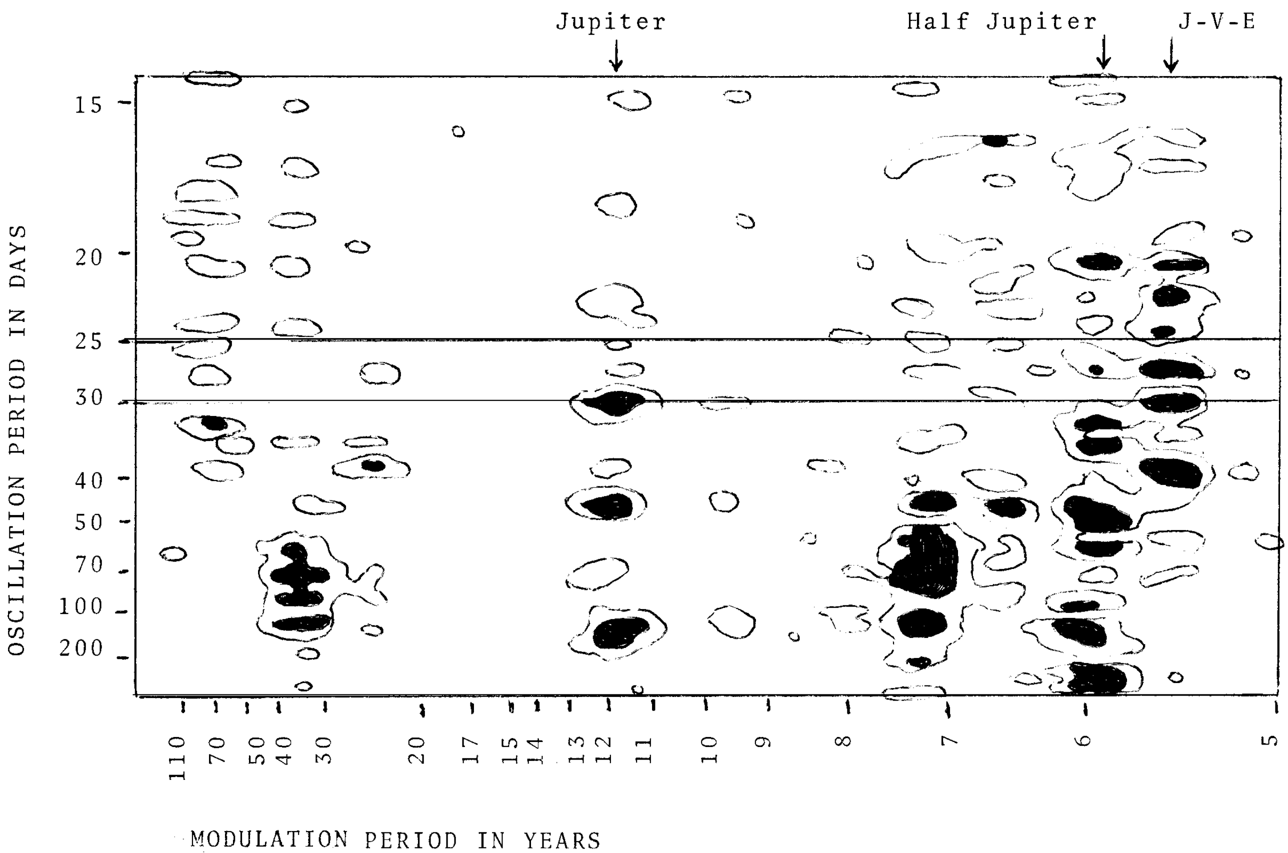


Figure 16. Amplitude Modulation.



The band from 25 to 30 days in oscillation period covers the sun's rotation period.

Figure 17. Tidal Force of the Planets on the Sun. Amplitude of Modulations of Oscillations.

To produce Figure 17 the following steps were performed:

1. Calculate the total tidal force of the planets acting on the sun at weekly intervals from 1890 to 2000 AD.

2. A spectral analysis was performed on the weekly tidal forces for nine months to find the amplitudes of oscillations of various periods. This was repeated but always using nine months' data to produce a "voice print" from 1890 to 2000 commencing at six monthly intervals.

3. For each oscillation period, the amplitudes shown in this "voice print" were then used in a spectral analysis to determine to what extent modulations of that period were present. The amplitude of the modulations are presented as a contour map.

Table 2. Relative Effects of the Planets on the Sun for Various Forces

Note that these are average values because the planets have eccentric orbits.

	Mass (E=1)	Distance (E=1)	Tidal Force (M/D^3)	COM Displ (MD)	Gravity (Relativity) (M/D^2)	Siderial Period (Trop. Years)
Mercury	.056	.387	.97	0	.37	.2408518
Venus	.826	.723	2.19	1	1.58	.6152105
Earth (+ Moon)	1.012	1.000	1.01	1	1.01	1.0000388
Mars	.108	1.524	.03	0	.05	1.880888
Jupiter	318.4	5.203	2.26	1657	11.76	11.86226
Saturn	95.2	9.538	.11	908	1.05	29.45748
Uranus	14.6	19.182	.00	280	.04	84.013
Neptune	17.3	30.06	.00	520	.02	164.795

Tidal Force is proportional to Mass divided by Distance cubed. It is a measure of the distortion of an object due to the variation in the gravitational field surrounding the object. The tidal force is at a maximum in both the direction of a body and the opposite direction, and at minimum at right angles. The main tidal planets are J, V, E, M.

COM displacement is proportional to Mass times Distance. It is useful for describing the motion of the sun, but does not cause any forces to act on any part of the sun. The main COM planets are J, S, U, N.

Gravitational Force is proportional to Mass divided by Distance squared.
It acts in the direction of a body only. The main gravitational planets are J, V, E, S.

The tidal force "voice print" shows clear bands at certain oscillation periods namely at 22, 30, 44, (60-75) and 120 days. The bands show both amplitude and frequency modulation. For example, the oscillation of period 30 days is modulated by a nearly 12 year cycle.

The modulation of oscillations plot (part of which is shown in figure 17) shows many sharp peaks for various combinations of oscillation and modulation periods. Modulation periods shown include 1.72, (2.98), (3.12), (3.26), 5.53, 5.9, 6.0, (6.6), 7.2, 11.8, 24, 36, 72 years. Oscillation periods shown include 22, 24, 26.5, 30, 39, 44, ... 120 days.

Of particular note are the modulation of period 5.53 years to oscillations of periods 22 to 39 days. Most of these oscillations are within the variable range of the sun's rotation period.
Although no modulations of 11.07 years were found, the 5.53 year modulations, which are half

the 11.07 period gave a pointer to the fact that the correct force was not tidal, but direct gravitational as tidal forces have double the frequencies.

COM Hypothesis

The motion of the sun about the COM of the solar system does not give any reasonable explanation for the 11 year sunspot cycle. It does have some success at explaining the longer term modulations, of 80-90 years and 170-180 years. Jupiter, Saturn, Uranus and Neptune are the planets which affect the sun's motion about the COM the most. The dominant period is the Jupiter-Saturn Synodic period of 19.86 years. The 9.93 year component in the sunspot spectrum could be related to this (being half of 19.86 years).

If the COM hypothesis were true, then the most distant stars in the universe would have an enormous effect on the sun due to their distance. This seems absurd.

A Planetary Solar Influence Mechanism

My research showed that the 11 year solar cycle must be the result of modulations of shorter (of the order of the sun's rotation) period oscillations.

The tidal hypothesis predicted cycles with double the required frequency, which leads to the conclusion that the correct force is gravitational not tidal.

I believe that the correct mechanism is a relativistic effect of gravity.

Einstein showed that light travelling past the sun would be bent twice as much as expected by classical physics. This was shown to be correct by observations of stars during eclipses. Until now it seems that no-one has applied these equations to the planets' gravitational effect on photons inside the sun. As well as an effect on photons in the sun, there will be lesser effects on matter in the solar interior, which because of its high temperature will have slightly relativistic velocities.

The planets accelerate the sun by an amount that causes the sun to move about (relative to the COM of the solar system) by several times its own radius over a period of years. Therefore photons contained in the sun have forces acting on them sufficiently different to those acting on the matter to displace the photons by several solar radii were they free to do so. Photons in the sun are contained for long periods due to frequent deflections by matter.

As the planets' gravity displaces the photons, the sun's rotation carries the photons around. Therefore the planetary force does not accumulate in one direction. Instead, only OSCILLATIONS in the planetary forces that closely match the sun's rotation period are able to build up over time. Such oscillations do exist because of the changing alignments of the planets and the non-linear relationship of gravity. Harmonics of the planets' orbital and synodic period have frequencies within the range of the solar rotation.

The sun rotates at significantly different rates at different latitudes, depths and times. This complicates the calculations required to model the relativistic effects, which in turn are probably the cause of the variable rotation.

Sunspots appear at latitudes at which the period of planetary force oscillations exactly match the local rotation period. This should explain the butterfly diagram (figure 18) of sunspot distribution throughout the solar cycle.

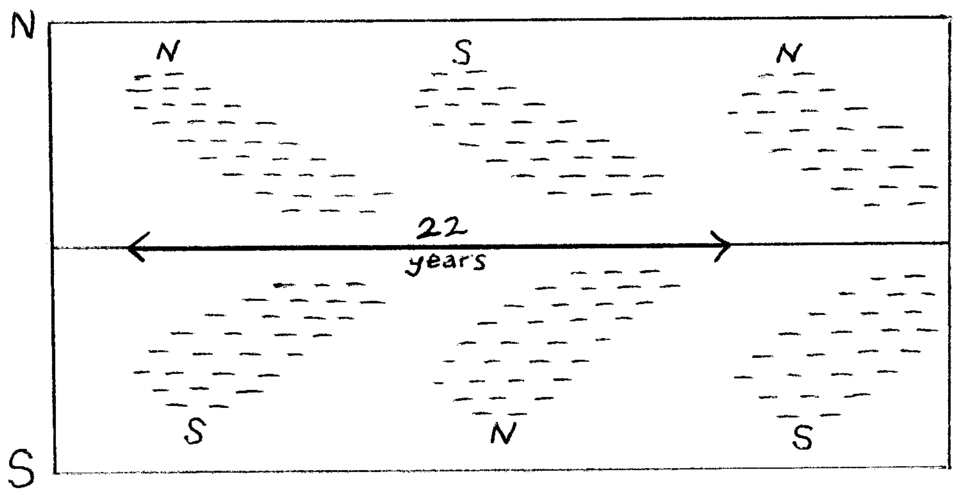


Figure 18. Butterfly diagram of Sunspot Distribution.

The timing and direction of flares are also surely related to these effects.

Calculating Modulations of Solar Gravitational Oscillations

Figure 19 was prepared in a similar way to Figure 17 (except that gravitational forces were used instead of tidal forces) and is based on 100 years of weekly gravitational force data.

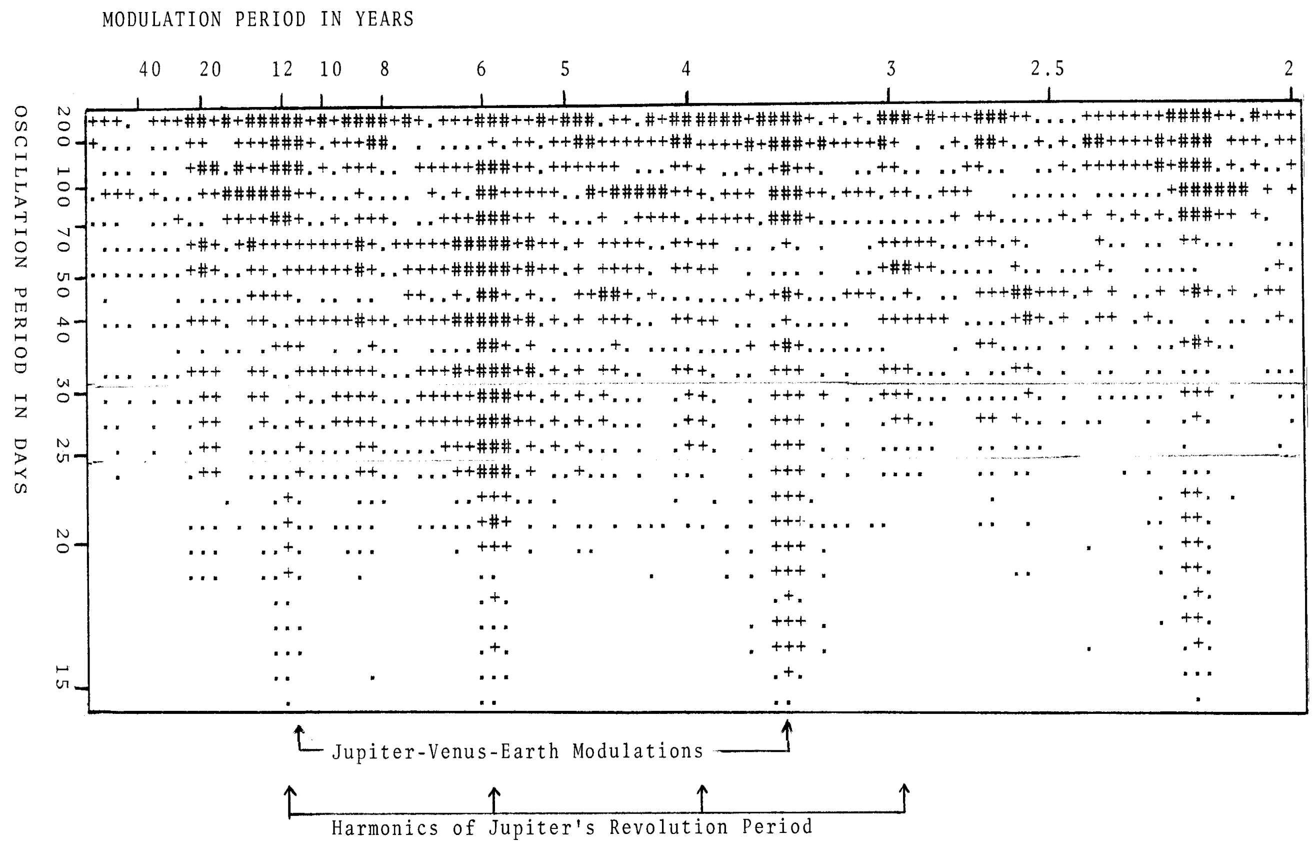
Oscillation periods within the solar rotation range (25 to 30 days) are modulated by periods of near 3.45, 3.95, 5.9, 8.6, 11.1 and 19 years. Many of these periods correspond to known cycles.

Of particular note are the presence of J-V-E modulations of period 3.446 years and 11.07 years which will be explained in detail in the next section.

GRAVITATIONAL FORCE OF THE PLANETS ON THE SUN.

Figure 19.

GRAVITATIONAL FORCE OF THE PLANETS, AMPLITUDE OF MODULATIONS OF OSCILLATIONS.



AMPLITUDE OF MODULATIONS OF OSCILLATIONS SHOWN BY DARKNESS SCALE.

The horizontal band from 25 to 30 days shows the range of the Sun's Rotation Period.

<u>Planetary Alignments</u>

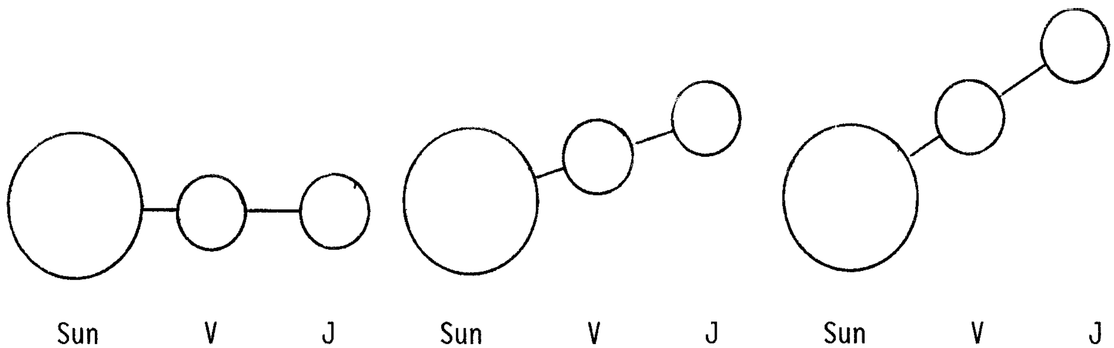
Because the planets' orbits are ellipses, their motions are not uniform. This results in the planetary alignments occurring after slightly varying intervals. Ignoring the variations due to non-uniform motion, any two planets will have regular (superior) conjunctions. The frequency of these conjunctions is the difference between the two planets' orbital frequencies. An orbital frequency is the inverse of the planet's period.

For example, if Jupiter's frequency is 8 orbits per century and Venus' frequency is 162 orbits per century, then Venus overtakes (and therefore conjuncts with) Jupiter 154 times per century. More accurately:-

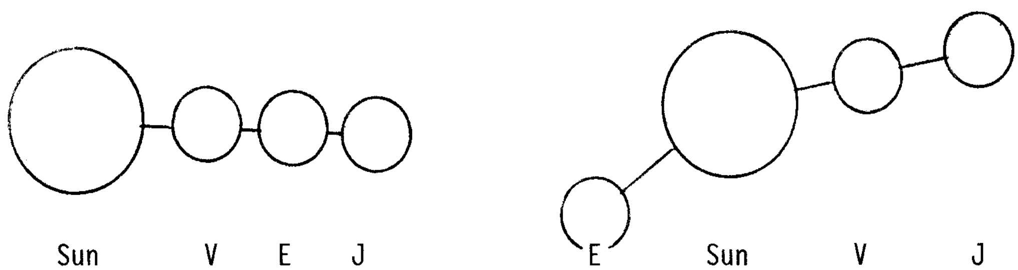
	Sidereal Revolutions per tropical year	Inverse = period in years
Venus	1.6254599	.6152105
Jupiter	.0843009	11.86226
V-J conjunction	1.5411590	.6488623

For two planet alignments, this period can be used to accurately calculate conjunctions forwards or backwards for thousands of years.

Figure 19. For two planets, perfect realignments occur at regular intervals (ignoring eccentricity), while for three planets, perfect realignments never occur.



Two Planets



Three Planets

For three or more planet alignments, the situation becomes much more complex. Adding Earth to the previous J-V example gives:-

	Sidereal Revolutions per tropical year	Siderial Revolutions in .6488623 tropical years
Venus	1.6254599	1.0546997
Earth	.9999612	.6488371
Jupiter	.0843009	.0546997

Note that Venus and Jupiter align exactly after .6488623 years and that Earth is advanced by 0.5941374 revolutions relative to Jupiter (and Venus). Clearly Earth is badly aligned with J-V at this time. If we consider successive J-V alignments, it is possible to plot the amount by which E is misaligned with J-V.

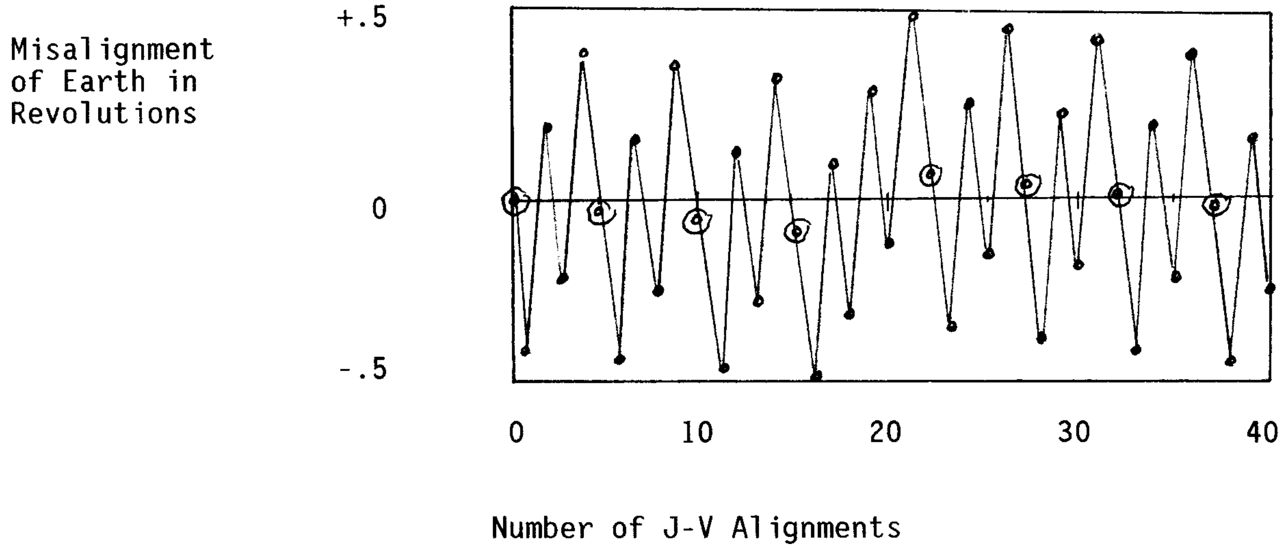


Figure 20. Alignment of three planets J-V-E (Good alignments are circled)

In Figure 20, a good alignment is one where the Earth has a near zero misalignment with J-V. Starting from an assumed perfect alignment, the second J-V period gives a moderate alignment, but the fifth gives a good alignment after an interval of 3.244 years. Multiples of 5 J-V periods thereafter get progressively worse until it becomes necessary to add an extra 2 J-V periods (between 15 and 22) and the alignments then get better every 5 periods until 32 and 37 are very good. These correspond to periods of 20.76 and 24.00 years.

For some unknown reason, the gravitational oscillations reach maxima at intervals of 10.38 and 12.00 years, whereas best alignments take twice as long.

When a different interval is needed to correct for a gradually accumulating misalignment, then any resulting cycles will show a phase shift. In this case, a 4.542 year cycle will occur instead of the more common 3.244 year cycle.

I call the 3.244, 4.542, 10.38 and 12.00 year intervals "specific occurrences" because they are the intervals after which similar conditions occur. They are NOT however the average intervals. The long term average cycle lengths associated with the good and very good repetitions of J-V-E are 3.446 years and 11.07 years. Even better alignments recur after average intervals of 144 years and 570 years.

Jupiter **is** the dominant planet, and has a moderately elliptical orbit, and **its** 11.86 year period between successive perihelions **is** near to the 11.07 year J-V-E cycle. The slight difference between 11.07 and 11.86 years mean that over a cycle of 165.3 years, J-V-E cycles occur with Jupiter at various distances from the sun, and this period therefore modulates the sunspot cycle amplitude.

Table 3. J-V-E average alignment periods derived from frequencies.

	Frequency	Period
VE conjunctions	.6254987	1.5987243
EJ conjunctions	.9156603	1.0921080
EJ – VE	.2901616	3.446355
3VE - 2EJ	.0451755	22.1359
13EJ - 19VE	.019109	(52.33)
41VE - 28EJ	.00696	143.7
142VE - 97EJ	.00177	570
527VE - 360EJ	.0001+	9000

G T Lane in Cycles (1950) reported that the 41 month cycle (3.4+ years) **in** Stock prices was phase modulated by a 22 year cycle. These two periods are expected from the gravitational planetary effect model, due to J-V-E.

Good M-V-J alignments occur on average every 9.94 years with specific occurrences of 7.91 and 11.96 years.

The realignment of the outer planets J-S-U-N is even more complex, involving four planets. U-N align only once every 171.4 years. J-S alignments occur at intervals of 19.86 years. Good alignments of J-S with U occur on average every 159.6 years and with N on average every 185.0 years. Therefore, starting from a perfect J-S-U-N alignment, clusters of good alignments occur at intervals of about 171.4 years, although the specific occurrences are 158.9 and 178.7 years. Many researchers have found the 178.7 year interval and assumed that is periodic. It is not. The average period **is** 171.4 years, with 178.7 years being only the most common specific occurrence. Fairbridge and Saunders (1987) missed this point in their comprehensive review of solar system dynamics and the sun's orbit. Because of the differences between the intervals 159.6, 171.4 and 185.0, the four planet alignments progressively worsen until after 1150 years they reach their worst point and then begin to improve, finally becoming very good again after 2300 years.

Interestingly, the 165.3 year J-V-E/Jupiter at perihelion cycle synchronizes exactly with the J-S-U-N cycle every 4600 years. Every 1150 years it synchronizes with J-S only.

Table 4. Dewey's times two multiples extended to 4600 years

1.12	}	
2.25	}	
4.5	}	Various cycles observed 1.12, 2.25, 4.5, 9 years
9	}	
18		Dewey/Hirst "Fundamental"
36		Tomes "Fundamental"
72		
144		J-V-E very good alignment
288		
575		J-V-E extremely good alignment
1150		J-V-E Sunspot cycle and J-S alignment with J at perihelion
2300		J-S-U-N alignments
4600		J-V-E Sunspot cycle and J-S-U-N alignment with J at perihelion

Major climatic cycles of 2300 and 4600 years have been extensively reported, and they seem to be related to the long term cycles of the solar system. Weather cycles of 145 and 290 years have also been reported. There is also some evidence for a 9200 year astronomical cycle.

The theory of harmonics put forward in this paper predicts that long period cycles will produce many harmonics especially at octaves (frequency doublings or period halvings) from the "fundamental". The above indicates that "somewhere out there" is a very long cycle working its way down from millennia to years, months, weeks, days and even shorter periods. Remember the daily corn prices have short periods consistent with this structure. Other researchers have reported hourly and minute cycles.

The family of cycles in table 4, although not the only one, is certainly the dominant one. In the solar system, other families include 22.5 and 10.0 year cycles.

How long is the "fundamental" period?

I don't know, it could be the cycle of the universe; the time between big bangs.

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