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Definitions and Concepts Used in Cycle Study

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I have often been asked to provide authoritative. definitions for words used in cycle study. Only if all of us who are engaged in this work use words to mean the same thing can we understand each other clearly. This article is a first attempt to satisfy this demand.

First, let us turn to the dictionary to get some preliminary meanings for some of the more common words.

ORDER. L. ordo, order. Conformity to law.

PATTERN. OF. patron, from L. pater, father. An arrangement or composition that suggests or reveals a design; a configuration; formal or regular arrangement.

CYCLE. Gr. kyklos, ring, circle, cycle. A complete course of operation returning to the original state.

FLUCTUATION. L. fluctuate, to wave, Fr. fluctum, to flow. Wavelike motion. Fluctuate suggests irregular or alternating movements, especially up and down.

OSCILLATION. L. oscillare, to swing. The act of fluctuating within or between relatively fixed limits. (In physics, a single swing from one extreme to the other of an oscillating body.)

WAVE. A. S. wafian, to wave. One of a series of undulations. Something that swells and has a crest, or rises and falls, like a wave.

RECURRENCE. L. from re currere, to run. The act of occurring again, especially after an interval.

RHYTHM. Gr, rhythmos, measured motion. Movement marked by reasonably regular recurrence, or reasonable regularity of alternation.

PERIODICITY. Gr. periodos, a going around. A perfectly regular idealized motion.
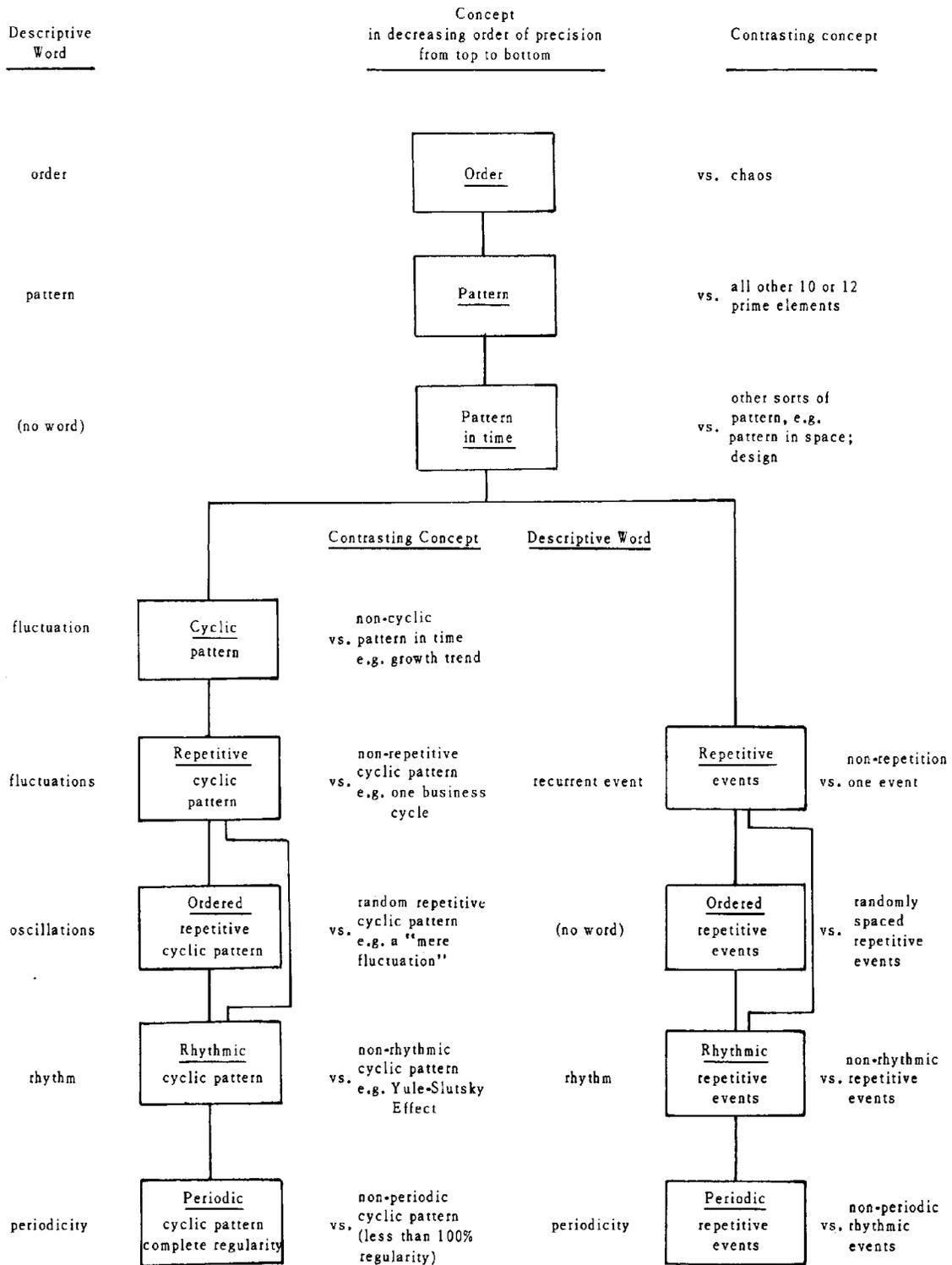Dictionary meanings are good for a starter but they are not precise enough for scientific purposes. Moreover, there are many concepts for which there are no single words -male Manx cats, (or white) for example! If you are to get an adequate idea of the various sorts of cycles it is preferable to start with the concepts and try to find words-where they exist-that will more or less correspond. This is better than starting with the words and trying to pick meaning for them; or, like Humpty Dumpty (and some others) making up meanings of your own!

("When I use a word," Humpty Dumpty said, as you will remember, "'it means just what I choose it to mean - neither more nor less.'")

"Cycle" - to use a catch-all or omnibus word - is a subdivision of the basic concept of "order", but to see how we get from the one to the other it will be helpful to refer to the diagram on the next page. The various boxes contain words describing concepts. The boxes are under each other in ever-increasing order of limitation of meaning. To the right of the boxes I have placed the contrasting concept. To the left of the boxes I have placed the popular word - where there is one - that more or less expresses the concept described within the box.

In the topmost box I have placed the word order. Order, of course, is fundamental. Order is the antithesis of chaos. Order is law. For me, order comes closer than any other single word to the meaning of the universe. (If you will permit me to use all of four words, I would express the meaning of the universe as "fulfillment of the law.")

OUTLINE OF CYCLE CONCEPTS

Descriptive Word	Concept in decreasing order of precision from top to bottom	Contrasting concept

order   **Order**   vs. chaos

pattern   **Pattern**   vs. all other 10 or 12 prime elements

(no word)   **Pattern in time**   vs. other sorts of pattern, e.g. pattern in space; design

Contrasting Concept   Descriptive Word

fluctuation   **Cyclic pattern**   vs. non-cyclic pattern in time e.g. growth trend

fluctuations   **Repetitive cyclic pattern**   vs. non-repetitive cyclic pattern e.g. one business cycle   recurrent event   **Repetitive events**   vs. non-repetition one event

oscillations   **Ordered repetitive cyclic pattern**   vs. random repetitive cyclic pattern e.g. a "mere fluctuation"   (no word)   **Ordered repetitive events**   vs. randomly spaced repetitive events

rhythm   **Rhythmic cyclic pattern**   vs. non-rhythmic cyclic pattern e.g. Yule-Slutsky Effect   rhythm   **Rhythmic repetitive events**   vs. non-rhythmic repetitive events

periodicity   **Periodic cyclic pattern complete regularity**   vs. non-periodic cyclic pattern (less than 100% regularity)   periodicity   **Periodic repetitive events**   vs. non-periodic rhythmic events

Pattern is the broadest of the words we use in cycle study. It is any arrangement that suggests or reveals design or order. It is the antithesis of unpattern - for example, the surface of a mirror, or sheets of polished steel, as they appear to the naked eye. Pattern is one of the eight or ten prime constituents of the universe. It is as fundamental as time, space, energy, matter, life, change, motion, emotion, thought, consciousness.

(If you were God, sitting down to create the universe, as we know it, what other basic building blocks would you first need to create? What else is there in the universe?)

Examples of pattern are infinite. They run from a straight line to an oriental rug, from a circle to an ocean liner. Pattern can be one, two or three dimensional. It can represent, either in one, two, or three dimension, the passage of time. Time is not a necessary condition of pattern. You can have pattern in space - for example, a colonade; or a maple leaf; or the capital of a Corinthian column. However, the only kind of pattern with which we are concerned in cycle study is pattern in time (or its two-dimensional representation on a chart).

Unfortunately I can think of no single word to express the concept of pattern in time in contrast to the concept of pattern in space (design).

Pattern in time can be cyclic or non-cyclic. Cyclic, as you know, means a complete course of operation returning to the original state. It is a series of changes regarded as leading back to its starting point. It involves sequence in contrast to separate (discrete) events. Many examples of cyclic pattern in time could be given. A business cycle, for instance, or a four-cycle engine, or a seasonal weather cycle (summer, fall, winter, spring, and summer again), or the life cycle of an insect (egg, larva, pupa, adult, and egg again). In all instances, what we have is a succession of events from a starting point through a variety of changes back, more or less, to the starting point.

Non-cyclic patterns in time are time patterns that do not return to the place of beginning - populations growth is a good example, or the daily weight of a growing baby. Both of these sequences are definitely patterns in time, but because they do not return to the original state they are not cyclic. The popular word that most nearly describes cyclic patterns in time, as the phrase is being used here, is fluctuation.

(This is not to say that the words "cycle" or "cyclic" do not have other perfectly valid meanings. Most words have other meanings. For example, my dictionary gives 23 different meanings for the word "order"!)

Cyclic pattern in time can be repetitive or nonrepetitive - many cycles, or just one cycle. Business exhibits repetitive cyclic patterns in time. Starting, let us say, with a depression, business rises and falls and comes around to another depression, time after time. Also, one can speak of a single business cycle: the sequence from one depression to the next. The best popular word for repetitive cyclic pattern might be fluctuations (plural). A nonrepetitive cycle could perhaps best be called a wave, but the words cycle, fluctuation, oscillation, undulation are also used.

Note that we have not yet introduced the idea of regularity of time. Two consecutive business depressions could be 3 years or 20 years apart. We are talking merely of repetition.

At this point a new concept must be introduced-the concept of recurring events. Recurring events are similar to recurring cycles in that they are both recurring in time, both (at this point in our outline) may be any interval apart. The point of difference is that the recurring cycle is a sequence, a coming around again, whereas the recurrent events are discrete. Art forms that repeat again and again over the ages are good examples of recurrent events. So are certain religious symbols. So are volcanic eruptions or earthquakes. So are the deaths of presidents in office. (In any given year, or month, week, or day, the president dies or he doesn't.) All these examples are "yes" or "no" matters.

Do not overlook the importance of recurrent events. First, they require different statistical treatment than do repetitive cycles. Second, sequences that we observe as repetitive cycles may sometimes be triggered by recurrent events.

From now on these two concepts occupy parallel positions on our diagram.

Repetitive cyclic patterns and recurrent events (which, by definition, must also be repetitive) can be ordered or random. In cycle and pattern study we are of course interested in the ordered patterns and in separating the ordered from the nonordered. The fact that the behavior is ordered has two aspects to it. These need to be clearly distinguished. Almost any cyclic behavior is ordered in that the consecutive states are related, one to the other. It has what the statisticians call "serial correlation". Stock prices tomorrow are related to stock prices today. They may be a little higher or a little lower, but never drastically up or down. They do not go from 900 to 200 in one day and back to 600 the day after as they would do if they were completely random. When we talk about ordered cycles we are not talking about this kind of randomness, but rather about the randomness or lack of it of the period or length of the cycle (or, in the case of recurrent events, of the intervals between the events). We ask, are these spacings ordered or random?

The word oscillation, which implies a little more regularity than the word fluctuation, could perhaps be used for ordered, repetitive, cyclic pattern in time, but it is not entirely satisfactory. M. G. Kendall uses the word oscillation to denote fluctuations that are "subject to law, and therefore predictable". The trouble here is that you can have ordered repetitive cyclic patterns in time that are not predictable, at least in any practical sense of the word. And of course the word oscillation does not apply to recurrent events at all.

Ordered repetitive cyclic patterns in time can be rhythmic or nonrhythmic (and ordered recurrent events can be, too). A complication here is that rhythm, or reasonably regular repetition, can be found in random repetitive cyclic patterns and in random recurrent events, too. This fact is indicated by the run-around lines on the diagram.

Rhythm means that the length of the successive waves -or the intervals between successive recurring events - are "reasonably" regular, so that the behavior repeats with a beat. Your heart beats are rhythmic. Old Faithful geyser is rhythmic (or at least it was until the earthquake).

Rhythm, of course, is a relative, not an absolute, concept. One time series is more rhythmic than another. Therefore, although you can say that "nonrhythmic" is the contrasting concept, it is not really a question of black or white but of progressive shades of grey. "Reasonable" regularity is, of course, a subjective measure, but it can be made mathematically exact such as "80% on the regularity index scale".

The importance of rhythm is that rhythm involves regularity (of timing), and where you have regularity (regularity not the result of chance) you have predictability. Predictability is what w e are all after.

When rhythmic cyclic patterns or rhythmic recurrent events evidence complete regularity they are called periodic and the pattern is called a periodicity. It is, of course, much harder, by mere chance, to get true periodicity than to get mere rhythm, but, even so, it can be done. Toss a coin, for example. Nothing could be more random. Yet you might easily get a head, a tail, a head, a tail, a true periodicity if there ever was one. You might even get three repetitions: a head, a tail, a head, a tail, a head, a tail. And yet it would mean nothing!

On the other hand, if your cycle were longer, a true periodicity would be much harder to get. Suppose you had five heads followed by five tails, you would hardly expect the pattern to repeat even once.

And now for a recapitulation:

1. Order includes pattern and everything else in the universe except chaos.

2. Pattern includes pattern in time and all other sorts of pattern, but does not include other basic concepts.

3. Pattern in time includes cyclic pattern in time and non-cyclic pattern in time, but excludes pattern in space.

4. Cyclic pattern in time includes repetitive cyclic patterns in time and non-repetitive or single cyclic patterns in time, but excludes non-cyclic pattern in time.

(There is no corresponding "recurrent" event, because, unless repetitive, there is no recurrence. You could, of course, put "event" as a concept, but from our point of view here the pattern consists of the intervals between the events, and there are no intervals until you have at least two occurrences.)

5. Repetitive cyclic patterns in time (or in recurrent events) can be ordered or random, rhythmic or non-rhythmic, but do not include one single cyclic sequence (wave) or one single event.

6. Ordered repetitive cyclic patterns in time (or ordered recurrent events) can be rhythmic or not.

7. Rhythmic cyclic patterns in time or rhythmic repetitive events, both of which, by definition, must be repetitive, (but which may be either ordered or random), may or may not be truly periodic.

8. Truly periodic cyclic patterns in time and truly periodic recurrent events-are both patterns developed to the nth degree and are therefore necessarily special cases of recurrent cyclic patterns in time or recurrent events.

I trust that these distinctions will prove helpful.