

## NEW BIOMECHANICAL CONSIDERATIONS IN SPORTS

The importance of rhythm in sports is recognized by most athletes and coaches. This paper presents the specific electromagnetic particle frequencies that permeate the Universe and affect the growth, development and performance of all of nature. It is meant to stimulate the thinking of scientists to apply the rhythm of the Universe to specific sports in various ways to enhance performance. The many applications, however, go far beyond the bounds of sports.

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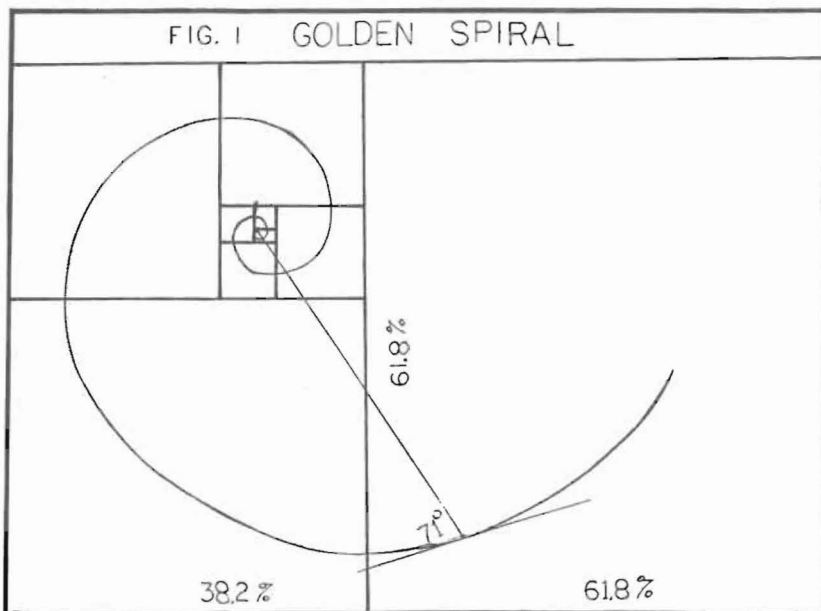
In the recorded history of mankind, the study of the movement of the sun and the planets has fascinated and challenged the scholars. The building of the pyramids, Stonehenge, and the Round Towers of Ireland (Ref. 2) illustrated that mathematics was a part of early life, and the shape of the Parthenon and many art objects brought about the term "Golden Mean", meaning a proportion that was pleasing to the eye. Pythagorus, Plato, DaVinci, Bernoulli, Kepler, and probably many other scholars felt that there was a certain proportion that was compelling and controlled the Universe. It was recognized that a certain rhythm permeated the Universe, and that all mankind was influenced and even driven by some invisible force. The recognition of something rhythmical, something mystical, something of specific proportions, something that brought about good feelings began as early as 4000 B.C., (Ref. 13) and progressed to the measuring of radio waves coming from the Universe. (Ref. 12) The chronology of the continual recognition of some force and the accumulation of knowledge to measure that force is given in Appendix I.

Specific numbers relative to the unknown force began when Leonardo Fibonacci introduced a sequence of numbers in 1202 to predict the multiplication of rabbits. (Ref. 5) His series of numbers resulted from the sum of the two preceding numbers, and continued indefinitely. (1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, etc.). This gives each number a ratio of 0.62 to 1.0 to determine the next higher number. More precisely, multiply a number by  $1 + \sqrt{5} / 2 = 1.6180339$  to obtain the next higher number. Because Fibo-

nacci used only whole numbers, his series of numbers were not as precise as they could have been. The square root of 1.6180339 equals 1.2720196 which produces intermediate numbers in the series, and by multiplying one and each successive number by 1.2720196 a precise series is obtained that varies considerably from the whole number series. The sequence now becomes 1, 1.272, 1.618, 2.058, 2.618, 3.33, 4.236, 5.398, 6.854, 8.718, 11.09, 14.106, 17.944, 22.825, etc. (See Table I) The "Golden Mean" term was now related to the Fibonacci series because the 8 to 5 ratio approximated the base to height ratio of pyramids, the rectangular shape of the Parthenon, and many other shapes and structures of this proportion.

In the 17th century, Jacob Bernoulli used the "Golden Mean" ratio to convert straight lines into a spiral. If a Golden Rectangle (sides 1 to 0.618) has a square drawn in one end, another smaller Golden Rectangle remains. By continuing this division, a series of squares results, and by connecting the center points of each square, a spiral results. (Fig. 1) (Ref. 5) This spiral has the same ratio as the rectangles, in that any section is 0.618 as large as the next larger square. Bernoulli also called the spiral an Equiangular spiral, as any line drawn from the center intersects the spiral at the same angle. Bernoulli had discovered the proportions of nature. The shape which enables growth to occur without a change in form, as with most shell fish. The spiral occurs in many forms such as a ram's horn, an elephant's tusk, the curve of a breaking wave, or anything where strength and beauty are combined. The spiral is seen in something as small as the track of a proton in an atom (Ref. 1) and in something as large as the shape of the galaxies, or the distance of the planets from the sun. (Ref. 9) Only three colors are within the visible light frequencies, if the corrected Fibonacci numbers are calculated to those high frequencies. These are also the only colors that show during the flash of the spectrum of the chromosphere at the beginning and end of a total eclipse - violet, green, and red. The relationship between the Fibonacci series and astrology, architecture, art, nature, and harmonic rhythms gave the name "Golden Mean" a number base to be used for all things on earth. The numbers are in harmony with that mystical force permeating the Universe that affects everything.

The 17th century established the fact that the planets revolved around the sun, and many basic laws were introduced, but it was not until the 19th century that great gains were made in the areas of magnetism and electricity. The 20th century brought about gigantic changes in all areas unparalleled in the history of the earth. Atomic structure, quantum and nuclear physics, Einstein's theory of relativity, Freud's theory of the unconscious mind, Kirlian's measurements of electrical and magnetic fields in the human body, (Ref. 8) the measurement of wave lengths from the cosmos, and the awareness that the human body is effected by the force of the Universe.



It was not until after World War II that Gauquelin showed that planetary alignment affects personality, and several researches (Halberg, Knocke, Axelrod, Wurtman, Moore, Ott) showed that light affected the endocrine system (Retinal-Hypothalamic-Endocrine System). (Ref. 6) The mysterious force recognized by scholars for centuries is the frequency of vibration emitted from the Universe and permeating everything affecting growth and behavior of all plants and animals.

All five senses occur through vibrations with varying frequencies, coming from a central source, but passing through different media. (Ref. 7) Visible light has variable frequencies passing through the air, between  $4 \times 10^{10}$  and  $7 \times 10^{10}$  cycles/second resulting in different colors. Sound results from air vibrations with frequencies between 20 and 20,000 cycles/second producing different levels of sound. Nerve endings extract vibrations from solids or liquids stimulating the brain to differentiate tastes. The olfactory nerves transmit vibrations to the brain through a gaseous medium to differentiate smells. Touch transmits vibrations to the brain to differentiate shapes and textures. Bennett invented a grip shape that produced optimum vibrations tactily, which has a  $19^\circ$  bend within the hand and an elliptical proportion of 1 to 1.272. (Ref. 3) Vibrations are common to everything in the Universe, and vibrations emitted from the Universe are responsible for all the senses.

Human stress can be explained by comparing the corrected Fibonacci numbers to the frequency of the senses.

TABLE I

Fibonacci Numbers	Corrected Fibonacci Numbers
1	1
2	1.27201965
3	1.618
5	2.058
8	3.33
13	4.236
21	5.388
34	6.854
55	8.718
89	11.09
144	14.106
	17.944
	22.825
	29.034
	36.932
	46.978
	59.757
	76.013
	96.69
	122.991
	156.448

TABLE II

Work	Rest	Measures/Minute *		
		18	23	29
Repetitions per work time				
18 sec.	80 sec.	5	7	9
23	75	7	9	11
29	68	9	11	14
37	60	11	14	18
47	51	14	18	23
60	37	18	23	29
76	22	23	29	37

\*one measure of four beats=3.33 sec. equals 18 measures/min.

one measure of four beats=2.26 sec. equals 23 measures/min.

one measure of four beats=2.06 sec. equals 29 measures/min.

Certain rhythms and chords in music sound good, and a certain intensity of sound produces satisfaction. (Ref. 4) The eye is more pleased by certain wave lengths that differentiate colors, as does light intensity and proportion of light to darkness. The stimulation of the endocrine system by full spectrum light, and certain frequencies subjected to the body for the brain to interpret results in good health. (Ref. 11) The proper frequencies influence growth, how people feel, and keeps one disease free and functionally efficient.

Experimental research has shown that the body responds to certain frequencies. Lazy eye has been corrected with a strobe flashing at 9 cycles/second. The hypnotist uses the same frequency. The proportion of 1.0 to 0.618 is present in many body proportions, and the heart beat rests for 61.8% of a cycle and works for 38.2% of the cycle. The ratio of the unconscious wave lengths to the conscious is also 0.618 to 0.382 (Delta 1/2 to 4,

Theta 4-7, Alpha 7-14, and the conscious Beta 14-22).

If the frequencies transmitted to the brain are stressful, one can feel irritated, depressed, sleep poorly, have indigestion, and have work production reduced. Prolonged stress can affect metabolism, glandular function, blood count, blood sugar, and water balance. Poor lighting has produced lethargy, lack of concentration, and disciplinary problems in school children, and poor lighting has affected the health and egg laying capabilities of chickens. (Ref. 10, 11) The rhythm of the Universe relates to the rhythm of the brain, which influences health and performance.

#### The Golden Mean Applied to Sports

Because an athlete is influenced by specific rhythms and proportions, the proper rhythms and proportions can be used to improve performance. A world class kayaker filmed during a 10,000 meter race, paddled at a stroke rate of 1.62 seconds in the middle of the race, and paddled at 1.38 seconds per cycle during the final sprint. The corrected Fibonacci numbers should be applied to all sports or exercises to help the athlete determine proper rhythms. Foot fall patterns of walkers, runners, speed skaters, and foot rotation speeds for cyclers should match one of the numbers. The jump frequency for jumping rope, the length of a stride relative to leg length in track and field events. The speed of movement in tennis and golf swings can be measured and matched to a corrected Fibonacci number. The list could be magnified greatly, but it is up to the imagination of the biomechanist to take any sport or movement pattern and apply the Golden proportions and corrected Fibonacci frequencies. This should aid in determining the best or most efficient way to perform a movement.

#### The Plagenhoef Exercise Method

One application of the Golden Mean is to relate all numbers and rhythms in devising an exercise method that should bring growth and development, muscular balance, and efficiency of function of the neurological, vascular, and muscular systems.

The human body was developed and designed to function best at certain tempos with periodic work-rest intervals. The devised system has a very specific tempo to the movement pattern, a very specific exercise to rest ratio, and very specific limitations to repetitions and sets of repetitions to control the heart rate and blood pressure at desired levels. The system based on the corrected Fibonacci numbers is as follows:  
(See Table II)

1. All exercises are performed at specific tempos. The body movements are done slowly for safety and to control the force levels throughout the total range of motion. The speed of movement is between 35° and 65° per second depending on the body part moving. The trunk

is kept at the slowest speeds and the forearms and lower legs can safely move at the slightly higher speeds. The corrected Fibonacci numbers that best fit the body motions are 2.618 seconds and 3.3 seconds per range of motion. If an exercise is done to music with each four beat measure equal to 3.33 seconds, one would get 17.944 measures per 59.757 seconds (three Fibonacci numbers). If the range of motion of  $100^{\circ}$  took 2.618 seconds, one would get 22.8 measures per 59.757 seconds, and the speed of motion would be  $38^{\circ}$ /second. It is necessary to use a metronome or music to the exact tempo for best results.

2. The work to rest ratio is also based on the corrected Fibonacci numbers. The Golden Mean ratio of 38% to 62% is the basis for Table II, which gives steadily increasing work to rest ratios to accommodate the low work levels needed for a hospitalized person, to the high demands needed by a world class athlete. Table II also lists the number of repetitions required for each work time if the rhythm selected were 18, 23, or 29 measures per minute.

3. The weight being moved, as well as the speed of motion and work to rest ratio, will affect the heart rate. The weight may be a body part, or it may be a body part plus resistance. The weight should be kept very low at first, so many repetitions are possible without raising the heart rate much above your normal.

4. The number of repetitions are determined from the heart rate. By following Table II, one can exercise at a certain speed, with a low force level, for a certain number of repetitions, with an exact rest period as given, and maintain a heart rate at a specific pre-selected level. It is important to design an exercise program that maintains a low level heart rate that can be gradually increased month by month, giving the body time to adapt to the new work level. One should not start out exercising trying to reach a high target heart rate, maintaining it for a certain length of time to obtain that magical aerobic fitness, any more than you would start lifting heavy weights when starting a weight program. Progressive heart training is more important than progressive weight training.

5. The number of sets of repetitions done determines the length of the workout. The same exercise movement can be repeated, or a number of different exercises can be done, or a combination can be chosen. The five variables are used to control the heart rate and blood pressure at a certain level. The corrected Fibonacci numbers are used to determine a maximum or target heart rate and blood pressure to establish an exercise progression with small intervals of increase. As an example: a person in poor physical condition (taken from line one of Table II), starts out with five repetitions and rests for 80 seconds using a tempo of 18 measures per minute. The heart rate should stabilize at a very low rate of no

more than 89 beats/minute if the resting heart rate is 70/minute (heart rate x 1.272 = target). Continue doing sets of five repetitions until the heart rate remains the same for four sets. If the rate exceeds 89/minute, the exercise is terminated at that point. However, if the target heart rate was not reached, slightly more weight can be used, more repetitions done, or the work to rest ratio changed. If the heart rate did not get up to the calculated maximum, the next exercise sequence could be: seven repetitions, rest 75 seconds, and stop the sets when the first target is reached (89).

A fit person would find that they could work at a higher level on the chart (Table II). Line 5 would require 14 repetitions and a rest of 51 seconds between sets, and if this did not get the heart rate up to 89, the repetitions could be increased to 18 with a rest of 37 seconds. The target heart rates are changed over a period of months as a person's body adapts to the training. The adaptation is measured by taking the blood pressure, which also has a target maximum based on the corrected Fibonacci numbers. For a normal heart rate of 70, the maximum target should change from 89 to 97 to 113 to 125 to 140 to 159 and to 183. The blood pressure of 120/70 should not exceed 152/89 (resting blood pressure x 1.272) and the high for a fit person would be: (resting x 1.382 which = 166/96). If the diastolic pressure increases out of proportion to the systolic, the exercises should be terminated.

This proper mixture of tempo, weight used, repetitions done, number of sets done, and the work to rest ratio will allow control of the heart rate and blood pressure. Everyone should progress gradually from a low heart rate level to the next higher level regardless of the starting fitness level. This graduated exercise program based on the corrected Fibonacci numbers can be used by heart and stroke patients as well as the fittest athlete to balance all bodily systems and correct partially functioning systems for better health.

#### APPENDIX I

##### Chronology of Contributors to Rhythm of the Universe

1. 3000-4000 BC Babylonian, Egyptian, Chinese, Indian - knowledge of astrology.
2. 2600 BC Great Pyramid of Giza - Dimensions approximate "The Golden Mean."
3. 2000 BC Stonehenge - The alignment of stones showed precise knowledge of astronomy.

4. 500 BC Pythagoras - Recognized the order of the Universe expressed by numbers.
5. 400 BC Greek knowledge of astronomy Parthenon (Greek art using the Golden Rectangle.) Plato - (Certain proportions were the Secret of the Universe. Phidias - Greek sculptor who applied the "Golden Mean" to the body.
6. 150 AD Ptolemy - All planets and sun revolve around the earth. His theory accepted for about 1400 years. He recognized retrogradation.
7. 700 AD The Celts built the Round Towers of Ireland showing special electro magnetic conducting powers.
8. 1202 AD Leonardo Fibonacci - Introduced Arabic numbers to the world. Discovered the proportions of the "Golden Mean," a term used by early Greeks meaning a ratio pleasing to the eye.
9. 1509 AD Leonardo DaVinci - Scientific insight into proportions and wrote De Divina Proportione.
10. 1550 AD Copernicus - The first to show the world that everything revolved around the sun, not the earth.
11. 1602 AD Galileo - Wrote law of falling bodies and was the first to use the telescope in astronomy.
12. 1602 AD Gilbert - Wrote law of magnetism.
13. 1609 AD Kepler - Established the three great laws of planetary motion to prove the theories of Copernicus.
14. 1650 AD Descartes - Introduced analytical geometry.
15. 1687 AD Newton - Introduced several mathematical principles and explained Kepler's laws.
16. 1690 AD Bernouli - Derived the Golden Spiral (Equiangular Spiral) from the Golden Mean.
17. 1808 AD Dalton - Introduced atomic theory.
18. 1810 AD Volta and Galvani - Produced many experiments in electricity.



19. 1850 AD Voule and Mayor - Wrote law of conservation of energy.
20. 1859 AD Darwin - Proposed theory of origin of species.
21. 1860 AD Faraday - Experiments in electricity.
22. 1873 AD Maxwell - Work on magnetism and electricity.
23. 1879 AD Edison - Invention of the incandescent lamp.
24. 1884 AD Tesla, N. - Father of the electrical industrial revolution with many inventions.
25. 1895 AD Roentgen - Introduced X Rays.
26. 1903 AD Planck - Introduced Quantum Theory.
27. 1905 AD Einstein, A. - Introduced Theory of Relativity.
28. 1913 AD Bohr - Showed atomic structure.
29. 1920 AD Urey, Gamow, Hoyle - Leaders in the New Astronomy.
30. 1920 AD Freud - Presented Theory of the Unconscious Mind.
31. 1927 AD Lange - Showed that early blindness retards growth and produces skeletal problems.
32. 1927 AD Volker - Showed that body based rhythms affect body temperature changes, basal metabolism, pulse, and blood pressure.
33. 1932 AD Jansky, K. - Discovered radio waves from the cosmos.
34. 1945 AD Southworth, G. - Discovered centimeter wavelengths from the sun.
35. 1946 AD Nelson, J. - Predicted interference from sunspots due to the sun-planetary relationships.
36. 1950 AD Gauquelin, M. - Through statistical work on thousands, he showed that planetary alignment affects personality.
37. 1953 AD Halberg - Did experimental work on the Circadian rhythm showing daily bodily changes.

38. 1956 AD Knoche - Showed light effect on pituitary gland through Retino-Hypothalamic path.
39. 1967 AD Sleeper, H.P. - Measured an 8 Hertz resonance between the earth and its ionosphere.
40. 1969 AD Wurtman, A.P. - Won the Nobel prize in 1970 showing that light through the eyes affected the pineal gland, and that there are biological consequences of living under artificial light, rather than sun light.
41. 1969 AD Moore - Showed the neural connection of light to the pineal gland.
42. 1973 AD Ott, J. - Wrote "Health and Light" as a culmination of 40 years of work showing the effect of full spectrum light and less than full spectrum on plants and animals.
43. 1974 AD Selye, H. - Wrote "Stress" to show that stress of any kind can lead to abnormalities and pathological changes in organisms.
44. 1977 AD Dean, G. - His advances in astrology showed how planets effect the earth.
45. 1977 AD Bennett, J. - Patented a handle that fit the hand proportions and was based on 1 to 1.272 with a 19° bend.
46. 1979 AD Callahan, P. - Recorded monopoles and tachyons using a fig tree.
47. 1979 AD Hollwich - Light entering the eye regulates and stimulates numerous autonomic and hormonal processes.
48. 1981 AD Cole, F. - Postulated that man dwells in a field of North-South magnets - electric dipoles capable of disassociation into pairs of monopoles that are attracted to organic and nonorganic things on earth. Some particles are called tachyons because they move at speeds greater than the speed of light.
49. 1981 AD Dewey, E. - Studied mysterious forces that trigger nine year cycles in nature.
50. 1983 AD Montgomery, P. - Evidence that the stock market fluctuated with the planetary forces effecting humans.

51. 1984 AD Plagenhoef S. and Bennett, J. - Bennett Ergonomic Labs, corrected the Fibonacci sequence, and discovered the relationship between this mathematical sequence and the force and frequencies of the Universe.
52. 1985 AD Plagenhoef S. - Bennett Ergonomic Labs, developed the Plagenhoef Exercise System from the rhythm of the Universe.
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