

# Physics and Anticipation in Bio-Systems

Cyril W. Smith

Retired from Salford University

36 Westminster Road, Ellesmere Park, Eccles, Manchester M30 9EA, England.

[cyril.smith@which.net](mailto:cyril.smith@which.net)

## Abstract

This paper looks at contributions from physics to anticipation in biological computing systems. The most important is the physics of coherence in water. This goes back to the contributions by Herbert Fröhlich summarised in his two “Green Books”. The significance of frequency in respect of anticipation is the subject of my paper in Session 10 of CASYS’11. The present paper deals with the physics of water as developed from dielectric and diamagnetic properties and Fröhlich’s ideas of coherence in active biological systems to the subsequent developments. As vicinal water it carries a model of the system’s chemistry. Water memory can be ‘pro-gramed’ in anticipation of future events. The novelty is in further recognition of the significance of coherence.

**Keywords:** Bio-Systems - Physics - Water - Frequencies -Anticipation.

## 1. Introduction

In 1967, Fröhlich presented his ideas on “Theoretical Physics and Biology” at an ‘*Institut de la Vie*’ Conference in Versailles. He covered the topics of: long-range phase correlations, energy pumping to excite organs at some ‘correct’ frequency, the possibility of membrane deformations stimulating cell division with growth ceasing when the increased cell density suppressed coherent modes and absorption defining the range of phase correlations.

He combined high frequencies and cooperative behaviour with long-range phase correlations and applied this to biological systems. This model had been successful in his work on order in superconductors, super-fluids and lasers. His work in this area, only one of his four areas of significant contributions to science, is contained with that of his collaborators in his two “Green Books” (Fröhlich, 1983, 1988).

I was able to provide experimental support dating from his retirement from the Chair of Theoretical Physics at Liverpool University in 1973 until his death in 1991. During this time the work included measurements of the large dielectric constants in moist biological materials and of electric, magnetic and radio-frequency field effects in lysozyme and its enzyme-substrate system. This led to finding an anomalous diamagnetism which can only occur if superconducting current loops are present somewhere in the system. Work on low-frequency magnetic field effects on bacterial growth and the *lac operon* system showed that the onset of the effects occurred when a single quantum of magnetic flux linked the measured cross-section of the cells. Fröhlich pointed out that magnetic flux is always quantised and if the system could respond to a flux quantum it also had the Josephson Effect available. This we found together with another quantum effect that living systems are sensitive to NMR conditions at

geomagnetic field strengths. Coherent radiation emission at yeast cell mitosis was found at the frequency corresponding to the rate constant for ATP hydrolysis. In 1982, I became involved with chemically sensitive patients who had become electrically hypersensitive. One early result was finding that these persons were as sensitive to the A-field produced by a toroidal coil as they were to the B-field of a solenoid implying that the frequency information affecting them was carried on the A-field component. I have given an account of this work in the Fröhlich-Festschrift (Smith, 2008a).

## 2. Coherent Frequencies

While Fröhlich showed the importance of coherence in active biological systems, Preparata and Del Giudice showed theoretically that water consists partly of *incoherent* water molecules oscillating at random as in steam, and partly in *domains of phase coherence* with all water molecules oscillating in-phase but without need for ‘pumping’ as in the laser. Predictions from their theory are in good agreement with experimental values for physical constants of liquid water. The development of coherence theory in water and biological systems is summarized in Figure 1.

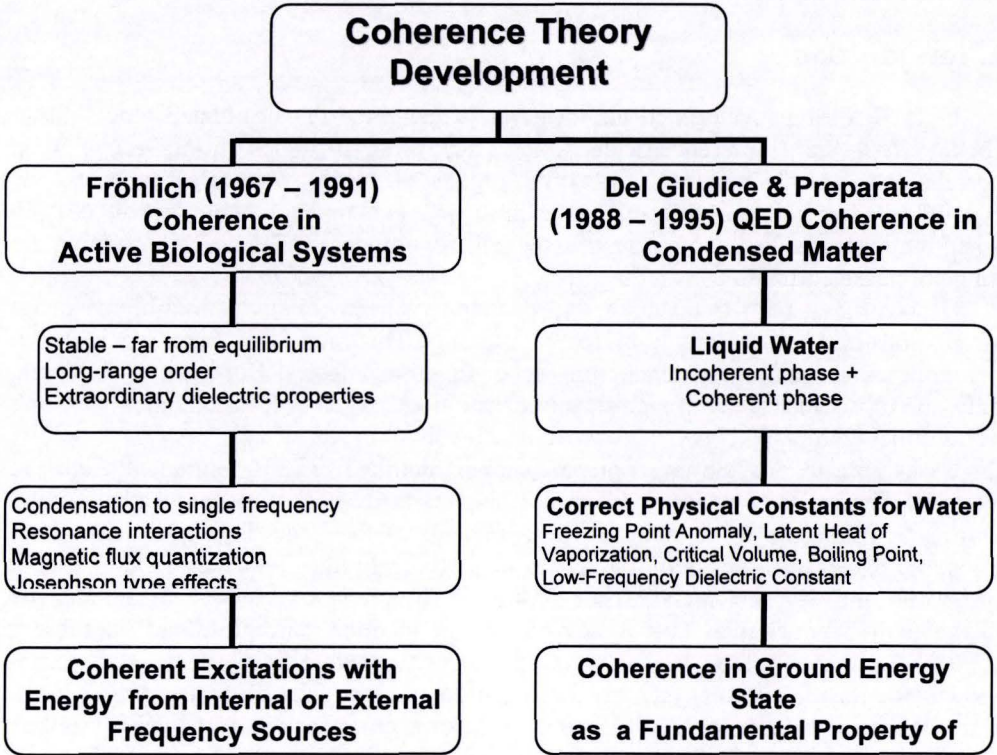


Figure 1: The Development of Coherence Theory in Water and Biological Systems

## 2.1 Fields for Coherent Frequencies

The “Classical Electromagnetic Field” is the basis of electronics and radio; it describes oscillations whose phase is well defined (coherent) but for which the number of particles (quanta, photons) carrying the energy is undefined. The “Quantum Field” has uncertainty in both its phase and the number of particles involved and this uncertainty is determined by the Heisenberg Relation. The more the uncertainty is taken up by fluctuation in the number of particles, the more perfect the phase coherence becomes.

## 2.2. Frequency in a Coherent System has Fractal-Like Properties

Within a coherent system such as water and living systems, the range of the coherence (*coherence length*) becomes the constant parameter replacing the velocity of propagation. This makes frequency proportional to the velocity of propagation of the coherence. There can be many such frequencies. These occur in the ratios of velocities supported by the system such as velocity of light ( $3 \times 10^8$  m/s) or the velocity of coherence diffusion ( $\sim$  m/s). Consequently, the same effects can be produced in, and observed in widely different parts of the electromagnetic frequency spectrum. This inter-links effects involving frequencies characteristic of chemical, technical and biological systems. It is why environmental frequencies can mimic the effects of toxic chemical exposure and chemically hypersensitive patients can become hypersensitive to patterns of environmental frequencies. For the frequencies of the optical mercury spectrum imprinted into water from a quartz discharge lamp, the optical/microwave frequency ratio is  $1.734 \times 10^6 \pm 0.34$  % and the microwave/low frequency ratio is  $4.770 \times 10^7 \pm 0.75$  %. The overall Optical/Low-Frequency Ratio becomes  $8.271 \times 10^{13}$ . These ratios make the yellow mercury lines also interact at 298 MHz and 6.26 Hz.

## 2.3. Chemical Frequency Signatures

In 1995, by courtesy of Dr. John Laseter of Accu-Chem, Richardson, TX, I was able to measure the frequency signatures of their reference collection of toxic environmental chemicals. The only ones which did not give a frequency signature were halogen saturated molecules such as octachloro-naphthalene. For n-hexane, these resonances disappeared when it was thoroughly dried with silica gel and only reappeared at a trace water content of 14 ppm.

If there are interactions involving water spectra and the characteristic molecular spectra of n-alkanes, these must be in the far-infra-red (FIR) rotational spectrum because this is the only place that n-hexane has any spectrum. This is the reason n-hexane is widely used as a solvent in spectroscopy.

**Table 1:** Relation between Far-Infra-Red Spectra and ELF Resonances for Trace Water in n-Hexane

n-Hexane from tables $\text{cm}^{-1}$	Water-Laser lines $\text{cm}^{-1}$	Differences $\text{cm}^{-1}$	n-Hexane - ELF measurement ( fractal ratio $6.57 \text{ cm}^{-1} \text{ Hz}_{\text{ELF}}$ )
385	357	28	$28 \text{ cm}^{-1}$ (4.141 Hz)
403	357	46	$46 \text{ cm}^{-1}$ (6.793 Hz)
450	357	93	$93 \text{ cm}^{-1}$ (13.11 Hz)
485	357	128	$12 \text{ cm}^{-1}$ (19.16 Hz)
403	213	190	$192 \text{ cm}^{-1}$ (26.51 Hz)
485	213	272	$263 \text{ cm}^{-1}$ (42.52 Hz)

However, it was necessary to place some arbitrary restriction on the hundreds of rotational water lines which might otherwise have had to be considered. The rotational water lines at  $28 \mu\text{m}$  ( $357 \text{ cm}^{-1}$ ),  $47 \mu\text{m}$  ( $211 \text{ cm}^{-1}$ )  $67 \mu\text{m}$  ( $149 \text{ cm}^{-1}$ ) and  $78 \mu\text{m}$  ( $127 \text{ cm}^{-1}$ ) can be coherent enough for use in a water vapour laser. The wave number differences between the tabulated FIR spectra for the n-alkanes and two of these spectral lines for water and were compared. to the measured ELF resonances. The results for n-hexane are given in Table 1. The mean FIR/ELF ratio is remarkably constant at  $6.57 \text{ cm}^{-1}$  per  $\text{Hz}_{\text{ELF}}$  or  $1.97 \times 10^{11} \pm 0.16 \text{ Hz}_{\text{FIR}}/\text{Hz}_{\text{ELF}}$ .

The fractal-like effect also works upwards in frequency. A plastic molecular model of n-hexane was immersed in saline at a salt concentration giving a coherence velocity for the correct fractal ratio. The ELF frequency pattern for the chemical n-hexane matched that of the frequencies measured from a model in saline of  $\text{C}_6\text{H}_{14}$  with 4  $\text{H}_2\text{O}$  molecules bridging  $\text{C}_1$  and  $\text{C}_6$  as shown in Table 2 rather than the straight chain alone. This suggests that the chemical frequency signature depends on the molecular spatial configuration rather than the chemistry.

**Table 2:** ELF Frequencies Measured from n-Hexane Model in Saline

Frequencies measured from chemical n-Hexane	Frequencies measured from a model of $\text{C}_6\text{H}_{14}$ in saline	Frequencies measured from a model of $\text{C}_6\text{H}_{14}$ in saline with 4 $\text{H}_2\text{O}$ molecules bridging $\text{C}_1 - \text{C}_6$
Hz	Hz	Hz
4.141	4.113	4.204
6.793	7.132	6.824
13.11	20.31	13.10
19.16	38.11	19.32
26.51	80.32	25.32
42.52		41.63

## 2.4 Fractal-Like Coherent Frequency Effects in Water

The above relates to effects of trace water in n-alkanes. The crucial question then was whether the same argument could be applied to water laser lines interacting with water laser lines in the absence of any n-hexane and whether there were any measurable frequencies corresponding to differences between the FIR water lines.

This conjecture led to the results listed in Table 3 where the fractal ratios are: THz/GHz =  $1742 \pm 59$  (3.4%) and GHz/Hz =  $108 \pm 4.7 \times 10^6$  (4.4%). Note also that 1.42 GHz is the 21 cm resonance of molecular hydrogen.

**Table 3:** Water Laser Line Transitions Compared to Measured Microwave and ELF Resonances.

Transition cm <sup>-1</sup>	357-127 =230	357-149 =208	357-211 =146	211-127 =84	211-149 =62	149-127 =22
THz	6.90	6.24	4.38	2.52	1.86	0.66
Measured GHz	4.03	3.56	2.65	1.42	1.01	0.384
Measured ELF Hz	36.8	34.8	22.6	13.3	9.50	3.53

Water will not potentise in a cylinder 21 cm in length and 1.42 GHz has erasing properties for frequency imprints in water. Coherence diffusion at this frequency does not refract at an air/water interface. Lower frequencies have a critical angle in water, higher frequencies have a critical angle in air implying a superluminal velocity for the coherence.

Dividing the velocity of light by the fractal ratio gives the velocity of the coherence:  $3 \times 10^8 / 10^8 \times 10^6 = 2.8$  m/s.

The measured velocity for coherence propagation in water using a Fizeau Method was 2.6 m/s.

To confirm this fractal effect, water was imprinted at frequencies between 0.001 Hz and 0.01 Hz (chosen for reasons of available frequency coverage). This water also showed corresponding resonances between 200 MHz and 2GHz giving a mean frequency ratio =  $1.98 \pm 0.07 \times 10^{11}$  Hz<sub>FIR</sub>/Hz<sub>ELF</sub>. For the converse experiment, water was imprinted at frequencies between 200 MHz and 2 GHz and showed resonances between 0.001 Hz and 0.01 Hz with a mean frequency ratio =  $2.09 \pm 0.43 \times 10^{11}$  Hz<sub>FIR</sub>/Hz<sub>ELF</sub>.

The endogenous frequency of the acupuncture Heart meridian is 7.8 Hz. The measured coherence velocity along a leg = 6 m/s. The ratio 0.384GHz / 7.8 Hz gives 6.1 m/s. This implies that the Heart meridian frequency is fractally stabilised by the 0.384 GHz and 0.66 THz water resonances as shown in Table 3. For 50 "healthy" persons, the standard deviation on the Heart meridian was 260 ppm.

## 2.5 Frequency Memory in Water

In 1983, we showed that living systems can respond to nuclear magnetic resonance (NMR) conditions at geomagnetic field strengths (Jafary-Asl et.al 1983). This allowed speculation that a frequency might be retained in water if the magnetic resonance precession of protons could be synchronised to any applied frequency. This could happen if the precession generates a local internal magnetic field which exactly satisfies the proton NMR conditions within the coherence domain. Such an imprint should be stable unless the domain is thermally broken up by removing the stabilising geomagnetic field so that the domain contained a magnetic energy less than thermal energy  $kT$  (Smith, 2008a).

The proton NMR condition gives the precession frequency:  $\nu = \gamma B / 2\pi$  where  $\gamma$  is the gyro-magnetic ratio ( $2.675 \times 10^8 \text{ rad. T}^{-1} \text{ s}^{-1}$ ),  $B$  is the magnetic field in Tesla and the frequency  $\nu$  is in Hz.

The magnetic field  $B$  at the centre of a magnetic dipole from a rotating charge is:  $B = \mu_0 n e v / 2a$  where  $\mu_0$  is the permeability of free space,  $n$  is the number of charges of  $e$  (Coulombs),  $v$  is frequency (Hz) and  $a$  is the radius (m) of the orbit. Hence, the number of charges  $n$  is independent of frequency:  $n = 4\pi a / \mu_0 e \gamma$ .

If the magnetic energy in domain is erased at less than  $kT$  and water erases at 380 nT the coherence domain is  $53 \mu\text{m}$  diam. and  $a = 26.5 \mu\text{m}$  (humid air erases at 47 nT giving a coherence domain  $162 \mu\text{m}$  diam.).

Whence, number of proton charges  $n$  required to become coherent and generate a magnetic field to satisfy NMR conditions  $n = 6.29 \times 10^{12}$ . The fractional proton fluctuation should be  $1.2 \times 10^{-7}$  and imprint bandwidth measured with an Agilent 33250A waveform generator was  $\sim 1.5 \times 10^{-7}$ .

The number of imprints possible depends on the volume of water and the proton availability. An increase in pH corresponds to the removal of  $\text{H}^+$  ions and the generation of an equal number of  $\text{OH}^-$  ions. A  $53 \mu\text{m}$  domain contains  $2.76 \times 10^{15}$  water molecules so, there should be enough protons for 982 frequency imprints. In an experiment, water at pH 7 accepted 965 imprints but, at pH 9 only 77.

A solution of NaOH at pH 8.01 increased to pH 8.05 at imprint saturation with 377 different frequency imprints. This pH change involves  $3.2 \times 10^{12}$  hydrogen and hydroxyl ions. Thus, a total of  $6.4 \times 10^{12}$  protons is involved per imprint and is consistent with the memory condition that  $6.3 \times 10^{12}$  coherent protons are required to satisfy NMR conditions (Smith, 2007).

## 2.6 Chirality

In general, the first and last frequencies in the signatures of chemicals are stimulatory they then alternate between being stimulatory and depressive of biological activity. Frequency imprints made using the field near a toroidal coil connected to a waveform generator are stimulatory of biological activity if succeeded on the North side of the toroid and depressive if succeeded on the South side.

This implies that the **A**-field component of the (East-West) geomagnetic field vector is a chirality reference for biological systems. The fractal-like effect of frequency in a coherent system links this to optical activity. A tube of water is imprinted with a frequency signature and placed in a jar containing optically active solution, a solution of L-fructose blocks the depressive frequencies from the South-side imprint but transmits the stimulatory signal from the North-side imprint. A solution of D-sucrose passes the South-side imprint but blocks the North-side imprint.

## 2.7 Nil-Potency

Rowlands (2007) in “Zero-to-Infinity” has described a form for the Dirac Equation which contains purely physical information so that mathematics becomes an intrinsic part of physical structure. The Dirac Equation contains three terms which separately express “energy”, “momentum” and “mass” in the physical system. These can be written in terms of three frequencies.

Recent work on computer ‘re-write’ systems looks towards a universal system with only a ‘create’ and a ‘conserve’ function which must be iterative and recursive from a ‘start-object’ to a ‘stop-criterion’ with a ‘nil-potency’ rule. The following may be evidence of ‘nilpotency’ situations.

In Classical Chinese Acupuncture: 12 meridians form 3 sets of closed paths along which a vital energy Qi is supposed to flow. When a pair of tubes of water imprinted with 2-Yin and 2-Yang frequencies respectively are placed close together – all frequencies disappear. If one attempts to imprint all four frequencies into a single tube of water and with three frequencies already present, on succession to imprint the fourth frequency there is complete erasure of all frequencies. This gives living systems an *anticipatory* error detection mechanism for control of homeostasis. So long as the four meridians are in a healthy condition, the frequencies around each course will be nilpotent. If a D-chirality imprint of this frequency is imprinted, the current set of imprints is erased. However, the memory is non-Abelian and this process exposes an earlier set of frequency imprints if one exists. It enables one to examine the development of a disease condition. It also implies that the body retains the template of itself under health conditions even though in the disease state it is not being read and implemented.

## 3. Anticipation

Various physical phenomena relevant to ‘Computing Anticipatory Bio-Systems’ have been set out in Section 2. The system needs to have a high degree of phase coherence and to be a quantum system for which the theoretical minimum bandwidth is set by the Poisson Distribution of the number of particles involved in coherence is of the order of  $10^{-7}$ . Thus, a frequency can behave as a specific entity or computing ‘bit’. The measurement of frequency imprints is discussed in Smith, 2009. Water has all the attributes needed to develop frequency signatures representing chemical constituents. These are a permanent memory for frequency which can only be changed through

chemical reaction. Frequency can effect isomeric change in a molecule and so change its frequency signature.

Water also provides a dynamic frequency memory which can be written to, and erased by several different processes. The dynamic memory for frequency is non-Abelian and each layer of imprinting can be accessed successively. There is a geomagnetic field referenced chirality effect which can be stimulatory or depressive of biological activity. Finally, frequencies can give the nil-potency effect of erasure. They can also access various layers of memory and predict likely frequency patterns for the future provided there is no external intervention. This Section discusses the forms that a bio-computing system might take and the ways in which it could be anticipatory.

### **3.1 Computing Operations**

With frequency imprinted water, the basic arithmetic operations can be carried out on frequencies (Smith, 2005). The basic reversible logic gates and their operations on frequency can be demonstrated whence, any reversible Boolean function can be computed. This requires specific spatial arrangements of biological cells which might occur at dendrites or innervated tissues. The sensitivity is sufficient to be clocked by nerve impulses. A biological system is driven by a program written into the frequency signatures of its chemistry in its vicinal water and the dynamic memory of its imprinted water. It is a computing anticipatory system.

### **3.2 Anticipation in the DNA to Amino Acid Sequence**

In CASYS'07 the writer (Smith 2008b) showed that the imprinted frequency signatures of nucleotides could be taken through an anticipatory cycle from the DNA to the amino acid. Nucleotides are the monomers from which DNA and RNA are constructed. The molecules consist of a nitrogenous base, a pentose sugar and a phosphate residue. They form the 'letters' of the genetic alphabet. Each has its own chemical frequency signature.

The frequency pattern resulting from three nucleotides can be sequentially imprinted into 'erased-water'; the water acquires the frequency pattern of the corresponding DNA-codon according to the order of imprinting. Although nucleotide sequences are encoded in the chemistry and structured into the vicinal water, it is possible to operate on the frequency signatures without any chemicals being present. This implies that the physics and mathematics of frequencies in water can be used to produce frequency signatures to match chemical structures without any chemical being present.

To follow the forward transcription pattern in water the DNA imprint is succeeded in a frequency determined from measurement in a Caduceus coil leading successively through the frequency signatures of m-RNA and t-RNA to the frequency signature of the amino acid. Succussions using a different set of frequencies will take the amino acid frequency pattern in water back to that of the original DNA. It appears that frequency signatures in water can be taken in an anticipatory manner through the paths that would be followed if the actual chemicals had been present and H-bonded to their vicinal water.



### 3.3 Anticipation in Archived Biopsy Material

There is sufficient vicinal water remaining in a prepared microscope slide for meaningful measurements to be made of their frequency signatures. If the frequency signature is copied from a slide into water and the resonances measured in a Caduceus coil, this frequency can be applied by succussion of the copy to access previous memory states. It can also be used to be predictive of future memory states which would occur if there was no intervention. If the Caduceus frequency is imprinted by succussion into water in the D-chirality, previous memory states are accessed as shown in the 'minus' columns of Table 2. If the L-chirality is used, predicted future states are found. When the Caduceus frequency no longer changes, this indicates that all the available memory states have been accessed. This technique also can be applied to body field frequency imprints made by patients. The course of the disease stress from "health" to the present level of disease can be followed. It is often possible to identify stress in a body organ through stress on its acupuncture meridians by the appearance of their endogenous frequency signatures in the whole body field. The frequency signature of a toxic chemical may be found such as mercury from dental amalgam. It will predict the pattern which would develop from that imprint in the absence of any intervention. Table 2 shows as an example the frequency pattern measured from an archived slide of biopsy material - myeloid leukaemia blood. The column labelled 'Slide' was measured from the actual slide. The columns labelled 'minus' are previous memory states and those labelled 'plus' are predictions from the pattern of the 'Slide' column. In Table 2, the first and last frequencies in the columns are stimulatory of biological activity (L-chirality) these alternate with D-chirality frequencies which are depressive of biological activity.

A few brief comments starting from Column -3: this is almost the normal Heart meridian's endogenous frequency 7.801 Hz which one would expect to find in a healthy person. In Column -2, a stress at 50 Hz has appeared putting stress on the Heart meridian (7.801 Hz) and the Sanjiao meridian (6.001 kHz). The appearance of 50 Hz or 60 Hz indicates possible addiction to power supply frequencies but it also indicates stress on the body's melatonin which has resonances at both these frequencies. In Column -1, the frequency  $3.001 \times 10^{-1}$  Hz indicates stress on the parasympathetic branch of the autonomic nervous system, it is also characteristic of mercury metal toxicity. The Heart meridian activity is depressed. The Heart meridian not only relates to the heart and circulation but also to mental activity and emotion. The  $1.88 \times 10^{-5}$  Hz indicates stress on the sympathetic branch of the autonomic nervous system. Moving to Column +1 and Column +2, there is an increase in the number of stress frequencies. Of particular note is the continued stress on the Heart meridian and the 50 Hz of melatonin and the ubiquitous 50 Hz power supply.

For therapy purposes, a homeopathic potency of Sulphur might be prescribed. At the bottom of Table 2 the frequency signature of Sulphur 30C is listed followed by a measurement made with the leukaemia slide and the potency in close proximity. The result was an erasure of all but one of the stress signatures, a healthy Heart meridian frequency was not quite achieved.

**Table 2: Strong and Weak Anticipation - Myeloid Leukaemia Biopsy Slide**

+2	+1	Slide	-1	-2	-3
Hz	Hz	Hz	Hz	Hz	Hz
$2.113 \times 10^{-3}$					
$5.602 \times 10^{-2}$	$3.104 \times 10^{-2}$				
	$2.313 \times 10^{-1}$	$3.022 \times 10^{-1}$	$3.001 \times 10^{-1}$		
$6.002 \times 10^{-1}$	$8.612 \times 10^{-1}$				
$7.801 \times 10^0$	$7.801 \times 10^0$		$7.801 \times 10^0$	$7.801 \times 10^0$	$7.800 \times 10^0$
$5.000 \times 10^{+1}$	$5.000 \times 10^{+1}$	$5.000 \times 10^{+1}$	$5.000 \times 10^{+1}$	$5.000 \times 10^{+1}$	
	$4.123 \times 10^{+2}$				
$3.001 \times 10^{+3}$	$2.314 \times 10^{+3}$				
	$6.001 \times 10^{+3}$			$6.001 \times 10^{+3}$	
	$2.40 \times 10^{+5}$	$1.88 \times 10^{+5}$	$2.40 \times 10^{+5}$		
$5.50 \times 10^{+5}$	$5.50 \times 10^{+5}$		$5.50 \times 10^{+5}$		
	$1.23 \times 10^{+6}$		$1.23 \times 10^{+6}$		
	$2.10 \times 10^{+6}$		$2.10 \times 10^{+6}$		
	$6.80 \times 10^{+5}$		$6.80 \times 10^{+5}$		
	$1.04 \times 10^{+7}$				
	$2.60 \times 10^{+7}$				
<b>Caduceus</b>	<b>Caduceus</b>	<b>Caduceus</b>	<b>Caduceus</b>	<b>Caduceus</b>	<b>Caduceus</b>
$6.313 \times 10^{-1}$	$6.313 \times 10^{-1}$	$1.617 \times 10^{-1}$	$4.000 \times 10^{-1}$	$6.000 \times 10^{-1}$	$6.000 \times 10^{-1}$
		<b>Sulphur C30</b>			
		$1.317 \times 10^{-2}$			
		$2.313 \times 10^{-1}$			
		$5.000 \times 10^{+1}$			
		$1.78 \times 10^{+5}$			
		$3.30 \times 10^{+5}$			
		<b>Slide + Sulphur</b>			
		$7.992 \times 10^0$			

#### 4. Conclusion

This paper has attempted to show the importance of physics and mathematics concepts in the anticipatory biological system. Weak anticipation comes through the predictive capacity of the memory. Strong anticipation comes through the system's memory through the frequency signatures of its constituent chemicals with vicinal water and information programmed into the dynamic water memory. The body seems to retain a template for its former healthy state even though this is not being implemented. The concept of Rowlands (2007) that the 'Dirac Equation' implies that mathematics is an intrinsic part of physical structure, encouraged this investigation.

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