

# Structuring of Water H<sub>2</sub>O and it's relationship to Quartz SiO<sub>2</sub>



## Laboratory Notes

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# Water

## Introduction

Dr. Charles W. Littlefield discovered, at the turn of the century, that when water evaporates, the evaporating water produces a distinct but weak magnetic field, and according to him, this magnetic field is sensitive to the vibrational patterns of the mind of an individual.

In dowsing for water, Dr. Tromp discovered that a moving body of water in an aquifer also produces a magnetic field and that this magnetic field can be sensed by the body of the dowser and that a reaction can be obtained in the body, causing the dowsing rods to twist or jerk at the proximity of the area of the moving body of water.

## Methods of Measurement for Observing the Structuring of Water

From the work we have done in our laboratory it is felt that changes can be made in the fluidic water which may be permanent or impermanent, depending on the nature of the force and the combination of events acting on the water.

In our laboratory we first used dowsing rods to detect this type of charge transfer to water. The very first experiment we did in 1984 was to hold a glass of water in both hands, focus on it intently, place it on a table and put a control sample of the same water on the table two feet away from the test sample. Approaching each sample with the dowsing rods, we obtained a deflection of the rods with the sample that was held in the hand and no deflection from the control sample

A most important experiment was next done. We stood at the point of deflection of the dowsing rods, stared at the sample and drew our breath in. When this was done the rods returned to neutrality. Testing this water we detected no change. **Purely by intention and breath the charge was removed from the water.**

We could do this as well with the water that was poured from one vessel to another to charge it. Following the procedure given above, the charge could be removed by intention and breath and the water brought to a state of neutrality. From this we learned that:

1. The operator must be neutral in his thoughts.
2. In transferring vessels, the experimenter must maintain control of his breath. This means that before touching the vessels, the breath must be held. After the vessel has been transferred, the breath can then be released.

<sup>1</sup>Quantum physics deals with the movements and changes of matter and energy at the tiniest levels of existence we know of: the world of atomic and subatomic matter. Probably the most

important discovery of quantum physics was the **observer effect**. This showed that how an observation was performed - what the physicist brought to bear on the observation of matter - disturbed that matter in uncontrollable ways. This disturbance wasn't simply the result of an error caused by the maladroit experimenter. It involved, instead, a fundamental new discovery that there **had** to be unexpected results, no matter how carefully the physicist performed the experiment. This was due to a new principle at work in the physical universe - the Heisenberg uncertainty principle."<sup>1</sup>. This was only the beginning of our search to measure and quantify the charge transferred to water.

## The Omega 4 and Omega 5 Instruments

These were instruments designed by Daniel Perkins to detect the fields stored in crystals and fluidic materials. They will be described in detail in the section on Radionics.

Working with water and crystal we found parallel results with both the dowsing rod and the Omega 4 or 5. The moment a charge was lost in the water, the Omega 4 or 5 instrument was able to detect this loss of charge

What is this charge? We really do not know, but a G.E. Magnetometer was rented and when we obtained significant results in the water by spinning the water around a crystal charged with thought, the Magnetometer gave permanent readings to the water and an increased reading was noted on the Omega 4 or 5.

The following graphs will show some of the early results we obtained. In Fig. 4-1 we see the effect on water in being modified by both sound and temperature. The ordinate is the number of passes a unit volume of water is passed around the double terminated 4-sided crystal cut and faceted by us.

The abscissa is the reading we obtained from the water sample so treated. The numerical values are readings taken from the dial settings from the Omega 4 unit. We see:

1. An increasing value for each pass of the sample around the crystal.
2. There is a significant increase when the temperature is lowered.
3. An even greater increase when we play a cassette recording of trumpet music at 16° C.

We measured the magnetic field of the water at the same time we were passing the water around the crystal Fig. 4-3. We detected no magnetic field at 23° C, and at 16° C 0.04 Gauss, and at 16° C + trumpet 0.07 Gauss.

This was truly a surprising result. This was only the beginning of the story.

<sup>1</sup> *The Body Quantum*, Fred Alan Wolf, Macmillan Publishing Co. N.Y., 1986

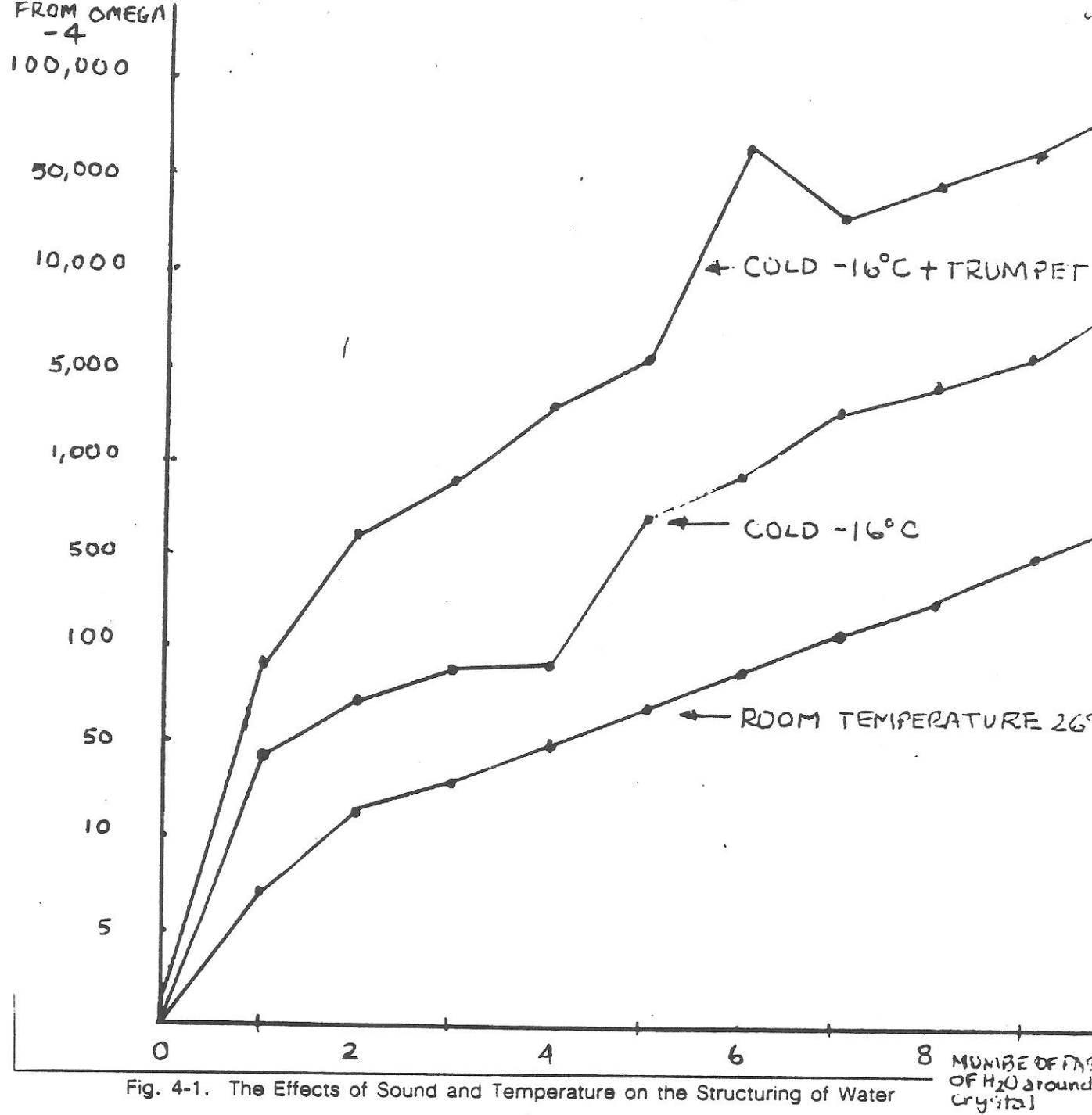


Fig. 4-1. The Effects of Sound and Temperature on the Structuring of Water

### Effect of Impurities

We then did the next set of experiments. Question: Could we detect the charging of the crystal with intention and breath.

Fig. 4-2 shows a graph in which we passed water 10 times around the crystal (4 sided double terminated). The first set was with the crystal not charged and the second set with the crystal charged - all other conditions being the same. After the fourth pass, the difference of 22,500 units. In subsequent work we have further confirmed this work and have found changes in pH and U.V. and I.R. spectra.

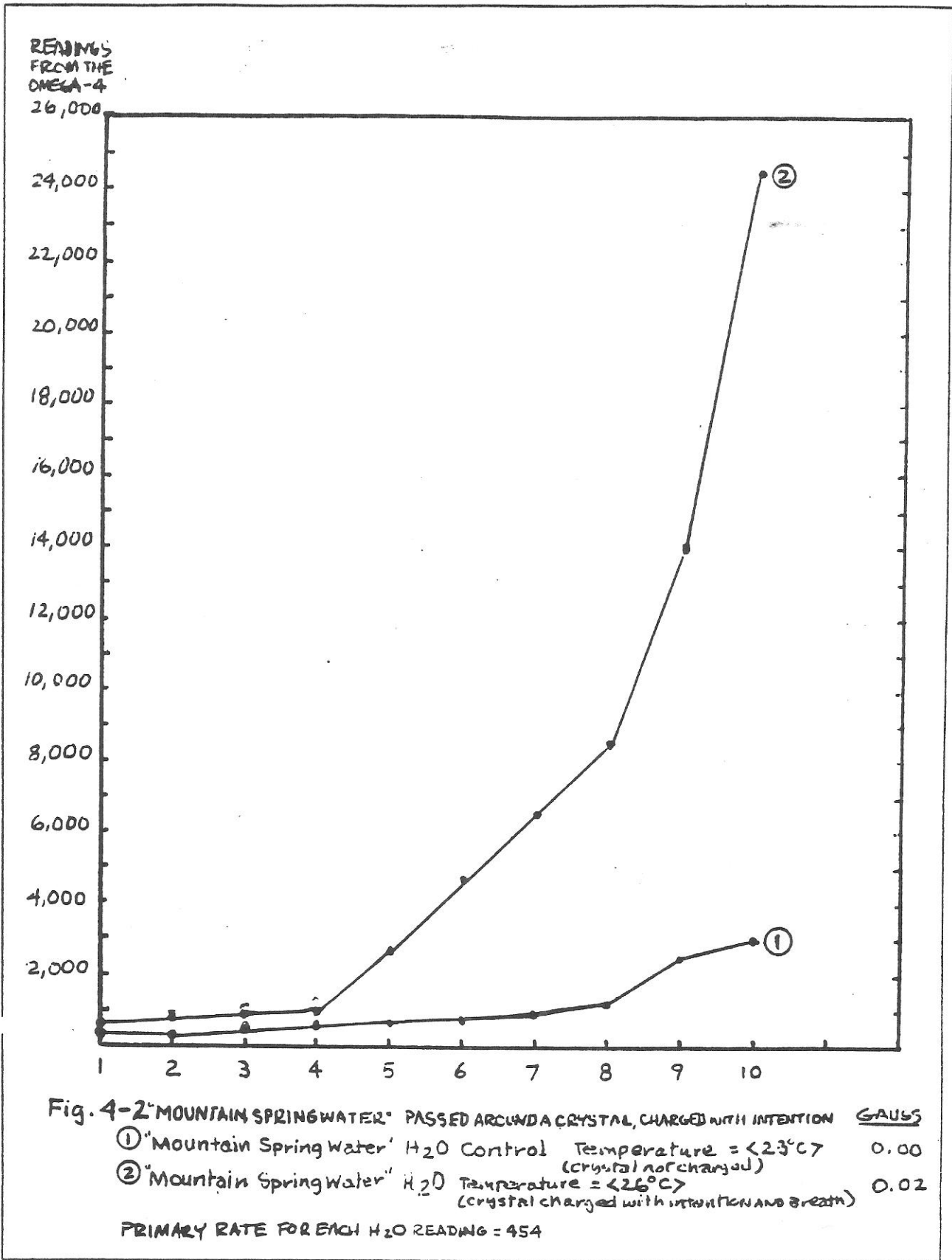


Fig. 4-2. Mountain Spring Water Passed Around Crystal Charged with Intention

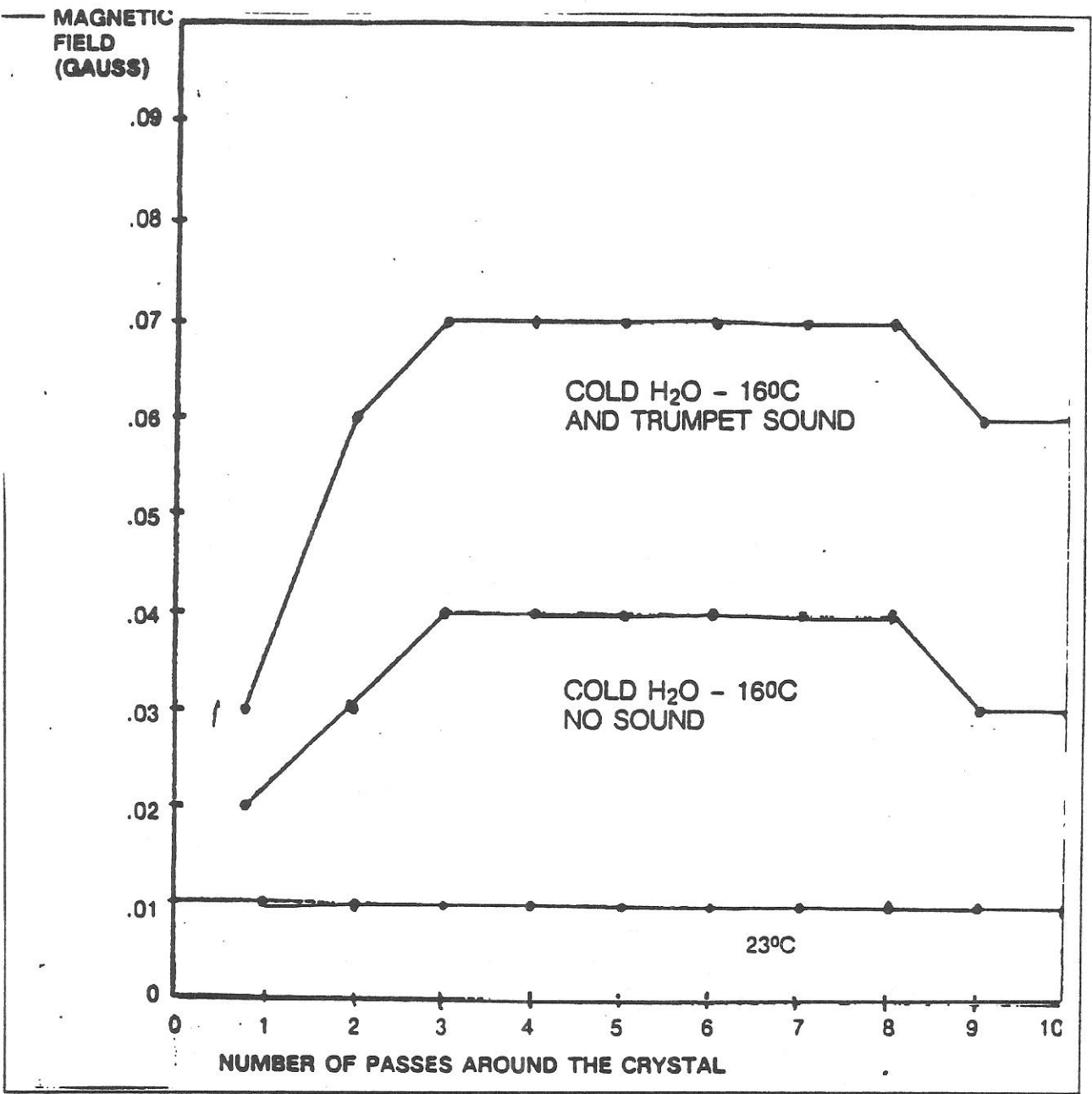


Fig. 4-3. The Effects of Sound and Temperature on the Structuring of Water

In Fig. 4-4 we see the effect of the addition of 0.01% Silica in the form of powdered Silica from the flat laps used for grinding our crystals. We compared this to clay and an organic compound sucrose. The most dramatic result came from silica addition and the least from clay. There was some interaction with sucrose after the fifth pass. There is an energetic exchange which we have no explanation for. It is reminiscent of water flowing on sand at the seashore and the use of sand beds in the purification of water. The effect was dramatic at the first pass and the measured value was greater than any of the other readings we had.

In our investigation and research we are dealing with the bulk property of water and of reasonable volumes of the water (100 cc's to 1000 cc's). As each one of these variables open up the complexity of planning and doing repeatable experimentation becomes more difficult.

The weaker forces in water decayed spontaneously the stronger forces remained in the water and a change took place which we call the structuring of water. This is distinct and different from the early work by the Russians on what is called poly-water. Poly-water is created from the vapor state of water and exists in minute quantities in the microcapsules used in preparing them. That water may aggregate together and form a polymeric structure has been an ongoing question and controversy since the re-discovery by Fedykin in 1961-62 of the anomalous properties of water condensed into glass and quartz capillary tubes.

He had postulated that the molecular arrangement of water was being controlled by the surface of the glass or silica capillary resulting in a structure different from the bulk water. The name **polywater** was given to this new state of water. There was a renewed interest in this work and even by 1967 there was not yet fully established a firm experimental basis for a new state of water. The reason for this was extremely small sample size (in the micrograms) and the possibility of contamination of the sample with impurities and extrication from the walls of the capillaries.

We are dealing with the bulk property of water itself to store energy in much the same way a battery stores an electric charge. When a proper charge is given to the water, a change in state takes place - holding this charge and transferring this charge in time to maintain the proper entropic balance.

It is my belief that when food breaks down in the body of a human, the binding energy of the form geometry of the food is stored in the water. When the chemical breakdown takes place, that transformation also is stored in the body fluid and is carried by the bloodstream throughout the body. When there is stress in the body, these fluids become bound or structured and cannot return to their normal ground state. This is a theory which we are working in our laboratory to build a data base.

In an historic experiment which we did in our laboratory in 1984 we decided to see if we could structure water by pumping the water around a crystal (a four-sided double-terminated healing crystal), and observe the effects in the water after we had done the experiments.

The first experiment was done with the firing tip of the four-sided healing crystal facing downward, and we constructed a coil of quarter inch pyrex tubing with seven turns on it. We passed the water around the crystal through the tubing and collected the water in a beaker. The detecting device we used at this time was a dowsing rod, and with the dowsing rod we detected a small field in the first pass. We repeated this. In the second and third pass the rods were deflected at greater and greater distances, and when we got to the fifth and sixth pass of the same water, we were out ten to fifteen feet from the coil which surrounded the crystal. When we increased this an additional number of passes, the deflection was beyond detection by the dowsing rods. We then tasted the water and the water had a distinct different taste to it against the water that was not treated. It tasted smoother, less acid and left a magnificent taste in the mouth of the individual tasting the water.

We then tried reversing the crystal, with the rear of the crystal facing downward and poured the water through the coil. I was standing about three feet from the coil, observing what was happening. As the water passed around the crystal, I was hit with a burst of energy coming from the apparatus. My eyes were burnt and my body was physically pushed back against the wall, many feet away. The next morning my eyes were shut with a yellowish pustulation, in much the same effect as if one were exposed to an intense radiative field. This was witnessed by four other people. We then placed the crystal and coil in a wooden box and then enclosed the entire system in another protective box.

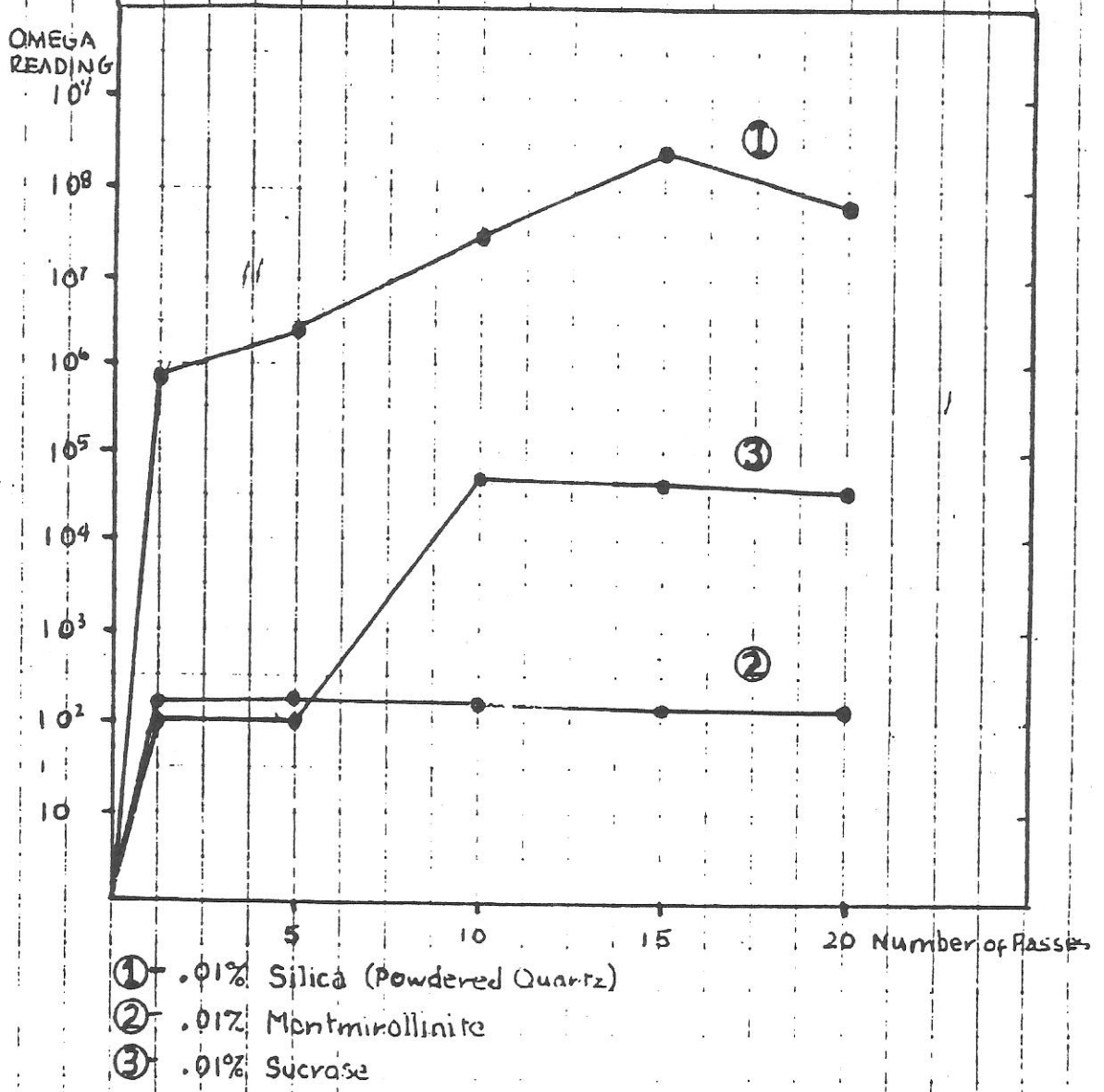


Fig. 4-4 HOW SOLUTIONS STRUCTURE WATER.  
 Omega 5 Radonic readings for water circulated around a crystal with substances added.

Fig. 4-4. How Solutions Structure Water



On subsequent experimentation we found that the water was sensitive to structuring by sound and light. The most effective sounds we found at first were those of the beating drums of the Shamanistic drums and the light we found very effective was the light of a strobe flash pulsing at varying frequencies. We built this all into an apparatus where these multiple activities could be applied to the flowing water around the crystal. A G.E. Magnetometer was rented and we repeatedly detected the advent of magnetic fields appearing in the water when a crystal was charged with thought and intention. When the crystal was not charged, the magnetic fields were exceedingly weak. In Fig. 4-2 there is a strong interaction between the rotating fields in the coil and the field that was stored in the crystal by thought. Over the next four years we did multiple experimentation on the effect of sound, light, programming the crystal with and without thought, and tested the resulting fluid of water with an ultraviolet spectrophotometer and an infrared spectrophotometer, we measured also the pH, conductivity of the fluid, and the surface tension of the fluid by a DuNoys tensiometer.

A patent has now been filed with the United States government on the discoveries that we have made in our laboratory. A number of important observations have been made and are listed below:

1. Wines can be structured and rapidly aged, bringing about a finishing of a wine in the matter of minutes instead of the years that are required for wines to age in a bottle or barrel.
2. Degasification of the water will take place.
3. Disassociation of the water into hydrogen and hydronium ions can be affected.
4. The solubilization of substances difficult to bring into solution, i.e., silica, and their resultant crystallization can be done with the structured water.

The Russians, who have done extensive research into the structuring of water, refer to those changes in their water as "poly-water." a water that is polymorphous in structure, rather than amorphous. This water is described as having been structured into a form that has a greater hydrogen bonding between the molecules. Most researchers in this field explain this bonding as being caused by electron spin changes. That is changes in electron spin number which, according to Puchkov and Kislovskii allow for the intramolecular electrons to move throughout a more crystalline-like lattice structure which now exists for the entire mass than of the water molecule.

### Theories of Formation of Structured Water

Trincher, in his research on "Structured Water Adjoining the Surface Layer of Erythrocytes", speaks of water being an aggregate of two continuously inter-convertible micro phases; the one consists of structured or liquid crystalline water and the other of unstructured or amorphous water. The internal energy U of water at room temperatures is

$$U = \int_0^{300} S_{\text{stand}} dT = 16.7 \cdot 300 \approx 5 \text{ kcal/mole,}$$

Where  $S_{\text{stand}}$  = standard entropy of water (T = 293)  
This equals about 16.7 cal deg<sup>-1</sup> •mole<sup>-1</sup>

T = absolute temperature

Pauling states that the energy of a hydrogen bond  $E_{H...O}$  is about 4.5 kilocalories per mole<sup>-1</sup>. Most liquid water contains micro phases which are stabilized by hydrogen bonds. Microphase transitions in water should naturally take place in either direction with equal probability. When liquid crystal states take place in a fluid we have observed the phenomena of super cooling taking place. In other words, the structured or liquid crystalline state will remain at temperatures below that of the normal transition temperature. Utilizing a heating stage with a polarizing microscope, we observed a liquid crystal system at both the forward and back transition temperature of water. There was on cooling a water that had been structured, a super cooling or reduction in the freezing point of the water. The water goes into the 0° C. temperature, which is normally the freezing point, a liquid crystal state highly birefringent but mobile and liquid at the same time, and then anywhere from 10 to 40° C. below zero, an abrupt transition into the freezing into a solid form of the water takes place. Structured water develops a unique, distinct liquid crystal phase which does not exist in the original sample of water. The entropy of the system water does not increase but a negentropy state has come into being which is independent of thermal fluctuation. We find also evidence of this state in the measurements of the UV and IR spectra before and after structuring. The fluctuation in thermal energy in water results in continuous phase transitions between the liquid crystalline state and the liquid microphases.

Liquid water does contain, at room temperature, some microphases which are stabilized by hydrogen bonding. A contradiction that we note can be resolved by the fact that the energy of a hydrogen bond is locally fixed in the crystalline structures while the thermal energy fluctuates. The latter energy is distributed non-uniformly over the molecules of the liquid microphases. The fluctuations in thermal energies in water results in continuous phase transitions between crystalline and the liquid microphases, these not requiring energy exchange with ambient media. Microphase transition between crystal and liquid take place in water without the participation of an external heat source, and it is likely that the transition can take place in either direction with equal probability.

Let us look now at how the water is structured. What is done is the following:

A four-, six-, or eight-sided healing crystal is held in the hand of an operator and cleared first by the pulsed breath clearing process. It is then held in the right or left hand. A deep breath is taken and the mind focused on the crystal and a pulse is given to the breath to produce a charge. The charge then is measured with the Omega-5 to see the level of charge in the crystal and that is recorded. The crystal is placed into a specially designed holder within the glass coil, with the firing tip facing down. The dimension of the crystal encompasses the seven right-hand spirals of the tubing. The lid is placed onto the inner and outer chamber, and water now is passed through the coil. A sample is taken for each pass: 1, 5, 10 and 20 passes of the water are made and each sample now is taken and studied for the pH conductivity, surface tension, ultraviolet and infrared spectrophotometric changes. We also do a time study in which we take the initial measurement and then allow the sample to set in both a closed and open vessel for a period of time encompassing a number of days and we plot the variation or change that we observe in the conductivity and pH changes that are note.

## Theory

What we believe takes place is that the first step involves ionization. This produces an increase in conductivity for the water which now is able to conduct electricity more easily. This is consistently shown in the data that we have noted with the samples of water that we have studied. Once hydrogen has been ionized, it is then free to form additional bonds with adjacent water molecules. These bonds are intermolecular in nature. They exist over certain bands or ranges of the

electromagnetic spectrum and have been the subject of many scientific papers without total agreement as to their meaning up to now. The most significant bands for water occur between 3,000 - and 3,700 $\text{cm}^{-1}$ . This is the absorption band where groups of water molecules absorb energy. The second absorption band occurs in the vicinity of 1,650 $\text{cm}^{-1}$ , and a third around 750 $\text{cm}^{-1}$ . The most significant values for these bands are listed below along with a quote from one of the Russian researchers. "It must be pointed out that the band in the vicinity of 3,000 $\text{cm}^{-1}$  had been studied by many scientists whose explanations are often contradictory."

Important Absorption Values:

Mikhailov and Zolotarev: 3756, 3620, 3490, 3420, 3280, 3080, 1690, 760.

Sidorova, Kochnev, Moiscova, Khaloimov: 8500, 6900, 5200, 3400, 2130, 1645, 740, 175, 60.

Eisenberg: 3942.53, 3832.17, 3755.79, 3656.65, 1648.47, 1594.59.

### The Structuring of Water and Its Influence by Both Electric and Magnetic Fields

"It was discovered that water exposed to a magnetic field was less hard and produced less scale than ordinary water. This effect has found practical application in steam boilers. The method of magnetic treatment is very simple. The water flows through a glass tube a few millimeters in diameter at a fairly high (0.3-0.6 m/sec.) velocity between the poles of a magnet or a series of magnets."<sup>1</sup>

"Investigations conducted in recent years have shown that other properties of water are also altered by my exposure to a magnetic field; these effects depend upon the exposure condition. The effect of a magnetic field on the amount of deposit was determined by evaporation of the water (to .2 of its initial volume) and weighing the deposit (scale) and suspended particles. The effect (A) was assessed by the relationship below:

$$A = \frac{a_0 - a}{a} \cdot 100,$$

where  $a_0$  and  $a$  are the weights of the scale from the untreated and treated water, respectively."<sup>2</sup> What the researchers have found was that the two field strengths of 1,500 and 4,500 Oersteds give the optimum effect.

"The reduction in the amount of scale depended also on the speed of flow of the water in the magnetic field and was greatest in the range of 0.4 - 0.5 m/sec. At lower and higher speeds the effect was weaker. Chemical analysis of the scale and suspended particles in the water treated with a magnetic field consisted of crystals of rhombohedral and other shapes whereas needle-shaped crystals usually predominated. A very important component part of the scale and suspended particles was calcium carbonate, which is usually released in the form of the stable crystalline modification calcite. The treated water contains a certain amount of unstable modification aragonite.

Changes in the physiochemical properties of water due to a magnetic field have also been investigated in experiments with distilled water. These experiments showed an increase in surface tension, viscosity, and electrical conductivity of the water, and again the effects were most pronounced in certain optimum field strengths"<sup>3</sup> (See Fig. 4-6).

Using a magnetic field also affects the dielectric constant of water and the effect was greatest at 1,500 Oersteds. Exposure to magnetic field strengths of zero to 1,500 Oersteds also affects water in its absorption of light. A change in absorption of light by the water was measured ten minutes after its exposure to the magnetic field. The graph below shows "that at all the employed field strengths the absorption maxima occurred at the same wavelength. This means that the magnetic field does not lead to disassociation or association of molecules."<sup>4</sup>

Plant	Experimental group	Height of plants, mm	Thickness of stem, mm
Sunflower	Control	38.4 ± 0.58	8.0 ± 0.0
	Experiment	46.7 ± 0.29	9.28 ± 0.93
Corn	Control	22.0 ± 16.8	2.3 ± 0.21
	Experiment	41.2 ± 1.12	6.0 ± 0.58
Soybean	Control	53.35 ± 11.27	4.0 ± 0.47
	Experiment	74.5 ± 11.27	4.15 ± 0.11

Effect of distilled water exposed to a magnetic field of 1000 Oe on the growth of some plants by the 12th day after sowing

Fig. 4-5. Magnetic Field Effects on Distilled Water

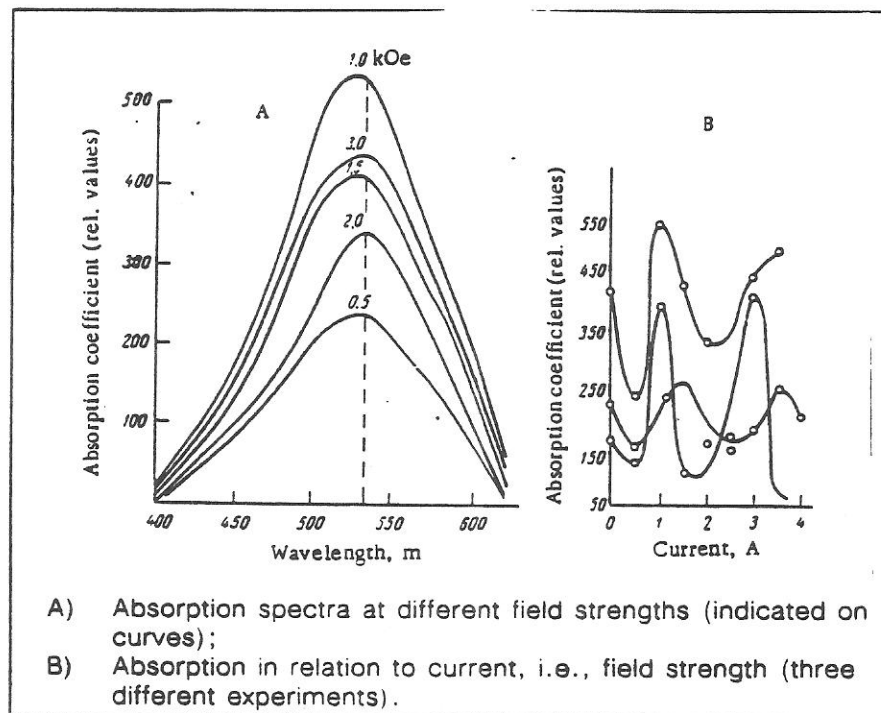


Fig. 4-6. Absorption of Light in Distilled Water Flowing in a Magnetic Field

Water treated by magnetic fields can affect the behavior and vital activity of living organisms. "Experiments with mice showed that the animals were given an intravenous injection (1 mil per 20 grams of weight) of water which had been exposed to a magnetic field of 1,000 to 1,500 Oersteds, there was increased urination in 63% of cases in comparison to animals which had received an injection of ordinary water."<sup>5</sup>

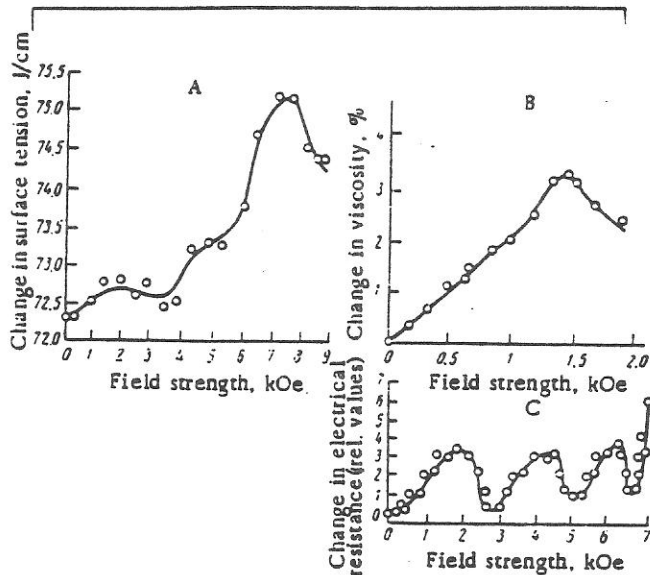
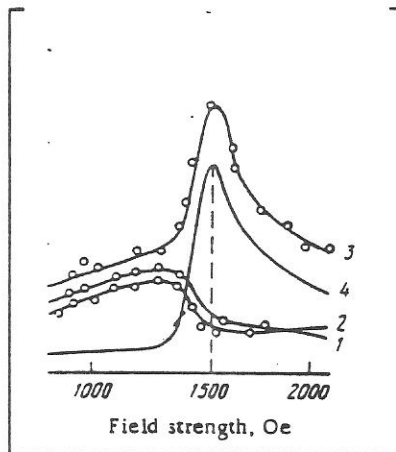


Fig. 4-7. Change in physicochemical properties of water due to magnetic field in relation to field strength. A) Surface tension; B) viscosity; C) electrical resistance.

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Fig. 4-7. Change in Physicochemical Properties of Water



Change in dielectric constant of water due to magnetic field. 1) and 2) Still distilled water and tap water, respectively; 3) flowing distilled water; 4) difference in curves 3 and 1.

Fig. 4-8. Change in Dielectric Constant

Dardymov discovered that magnetically treated water, between using a magnetic field of 1,000 to 1,500 oersteds and using this water to water sunflower, corn and soybean seedlings, 100 milliliters per plant per day, led to an accelerated growth. "In a second series of experiments the effects of magnetically treated distilled and tap water on the development of soybean were compared. In each case there was a significant acceleration of the growth of the plants in comparison with the control and this effect was more pronounced in the case of tap water."<sup>6</sup>

In 1966, Dr. Neprimerov suggested that ortho to para transitions may take place in water molecules in a magnetic field. The magnetic field energy required for this "is very low, for instance 100 times less than for the breakage of weak hydrogen bonds in a molecule. Ortho to para transitions in aqueous solutions can give rise to regions with parallel orientation of the spins and this will lead to the expulsion of dissolved substances from such regions."<sup>7</sup>

## Structured Water

One of the principle things that we are studying at P.R.I. is the relationship between water and the quartz crystal. We are most interested in the changes that take place in water that has been circulated around a specially cut quartz crystal.

We refer to this process as the **structuring of water** with a quartz crystal, and to the water that has undergone this process as being **structured**. Structured water has also been studied by several Russian researchers, who have described many of its physical properties as well as how and why structured water differs from unstructured or **bulk** water. Additional work that we will refer to has been done by scientists working for the United States Navy.

Water consists of one oxygen (O) atom and two hydrogen (H) atoms that bond together to form a single water molecule (H<sub>2</sub>O). All water molecules are held together by very strong bonds, a bond being an actual physical force that holds atoms together. Physicists call these bonds **weak nuclear forces**, while chemists call them **covalent bonds**. A bond is an actual physical force, similar to that of gravity, that acts between atoms to hold them together.

The most basic definition of **structured water** is that it is water that has a greater degree of bonding between adjacent water molecules than unstructured water. These bonds become stronger in a fashion that is similar to that which is found in the formation of ice. Structured water is often referred to as water that is in an "icelike" state or condition, and some of the physical changes that it undergoes are identical to the changes that water undergoes as its temperature is lowered and it is frozen into ice.

In addition to increased bonding between molecules, structured water molecules can form into a crystalline-like structure that consists of elongated chains of molecules that can be differentiated from the surrounding water molecules by physical qualities that are consistent with those that are found in liquid crystals. These include a marked birefringence and a lowering of freezing point.

In liquids and solids, such as water and ice, respectively, other bonds or forces form between molecules. These are called **ionic bonds** by chemists because they are formed by ions, which are atoms which have either lost electrons (negatively charged particles) or gained electrons, and as a result have become electrically charged.

**Covalent bonds** and **ionic bonds** are produced when adjacent molecules share some of their electrons and bond together to form either solid or liquid groups of molecules. Fig. 4-10A and 4-10C show that atoms are composed of a nucleus of protons and neutrons with a cloud of electrons that orbit at precise distances from the nucleus. The outer electrons that are either added to an atom or subtracted from it are known as "valence" electrons. Covalent bonds involve the sharing of valence electrons by the atoms that make up molecules. Fig. 4-10B shows the covalent bonding structure that exists between the two hydrogen and one oxygen atom of one water molecule, and Fig. 4-10C shows the ionic bond that exists between adjacent water molecules. Notice that *the covalent bond has the physical effect of pulling the oxygen and hydrogen atoms closer together than the ionic bond*. The closer the atoms are together, the stronger are the bonds or forces that exist between them.

In Fig. 4-10D, it may be seen that the ionic bond forms when the oxygen atom of one water molecule bonds or attaches itself to the hydrogen atom of the next or adjacent water molecule. This is called a **hydrogen bond**. The hydrogen bond forms when the oxygen and hydrogen atoms come together. This bonding may occur for a very long period of time and become permanent, as in the case of the covalent bonding of one molecule, or it may last for only a very short period of time, as is the case for the ionic bond that forms between water molecules. Most of these bonds last for less than a billionth of a second, and are in continual state of formation, breakdown, and reformation.

Density is the weight per unit of volume. The density of water is one gram per cubic centimeter at 4°C. It is less than 1g/cc at higher temperatures. As the temperature of water is lowered, the distance between molecules decreases, and the bonding force increases. **Cold water is therefore more tightly bonded than is warm water. This is also a feature of structured water.**

The phenomenon of increased hydrogen bonding in water also occurs at the surface of water where it meets the air. This results in an increase in surface tension for the group of water molecules that are found here, and it may readily be seen by closely examining a drop of water, where you will notice that it appears to be held together in a round or oval shape by some invisible tension on its surface that acts as if it were an actual sack or membrane. This is an example of the structuring of water at the interface or surface where it meets the atmosphere. The water molecules at this location have been structured into a condition of increased hydrogen bonding. If you were to continue observing the drop of water as its temperature was lowered, you would notice that the surface tension of the drop would continue to increase.

Many water researchers believe that all structured water has a lowered temperature, although they have been unable to prove this with actual measurements. The structured water that occurs at an interface, such as the surface of a drop of water, could have a lower temperature than the remaining water molecules, but this is difficult to measure because it does not appreciably affect the temperature of the group of water molecules as a whole. As water structures, the molecules pull more tightly together and as they do so, they may radiate heat and have their temperatures lowered.

## The Ionization of Water

The first step in the process of the structuring of water is the ionization of the water. This happens when the water molecule is broken down with electromagnetic energy, such as light or static electricity, into one negatively charged hydroxyl ion and one positively charged hydrogen ion. The **hydroxyl ion** consists of one hydrogen atom and one oxygen atom along with one extra electron which gives it its negative charge. It is written as: OH<sup>-</sup>, the minus sign indicating the negative charge. The **hydrogen ion** is a hydrogen atom without its electron and is written as: H<sup>+</sup>, the plus sign indicating its charge. The formation of these ions is shown in Fig. 4-10C.

When these two ions are combined, a water molecule of neutral charge is produced. When they remain separated, however, the water takes on an electrical charge or potential that may be measured in volts. This charge is identical in nature to the charge that exists in an automobile battery, with the exception that it is not as easily taken out and used as is the stored electrical charge within the battery.

**One of the principal effects of the increased ionization of water is that it makes the water more electrically active.** The water becomes alive with energy and it is able to react with impurities that are in the water to neutralize them.

The hydroxyl ion will react with acids and neutralize them, and the hydrogen ion will react with alkaline substances and neutralize them. When two hydroxyl ions come together, one hydrogen peroxide ion is formed. It has the chemical formula,  $H_2O_2$ . These ions (electrically charged atoms) are very unstable, that is, they break apart easily, but they also react strongly with other molecules. The "extra" oxygen atom on the hydrogen peroxide molecule [ $H_2O_2$ ] acts to oxidize any hydrocarbons that may be in the water. This reaction takes place in the human body when structured water, with its additional oxygen, burns off or oxidizes excess hydrocarbons, and fats that have accumulated in the body's cells. The oxygen that is found in structured water may also be useful in treating waste products such as raw sewage.

The water molecule may be ionized by exposing it to ultraviolet light in a process known as **photoionization**. Wavelengths in the range of 1800 to 2000 Angstroms are particularly important in this process. When this light energy strikes a water molecule, it knocks off an electron and ionizes it, breaking it down into one hydroxyl ion and one hydrogen ion. This is the reason that sunlight can be used to kill off bacteria that have grown in water, as sunlight contains a great deal of ultraviolet light of these wavelengths. The sunlight ionizes many of the water molecules and these ions, in turn, neutralize the bacteria through oxidation. The combination of air and sunlight also acts to oxidize bacteria. In this case, there is more oxygen available in the air than in water that has been exposed to ultraviolet light, so the purification process will operate at a much faster rate.

A great deal of sewage and other organic waste products, as well as many types of toxic chemicals, are currently present in the water that is found in our lakes, streams, and wells. The problems that this form of pollution is presenting us is a formidable one, but it may be solved if we find a means of increasing the oxygen content of water by first ionizing it into hydroxyl and hydrogen ions, and then bonding these ions into groups of water molecules, i.e., by structuring them. Once a certain percentage of water molecules has been converted into ions, either by ultraviolet light or by electrostatic ionization, they must remain in the water if they are to be useful in the process of purification through oxidation. **This is where the process of structuring them into chains of water molecules becomes important, for these chains provide a physical structure, similar to that of a crystal, with which the hydroxyl and hydrogen ions may bond.** Once they have bonded or attached themselves to these chains, their viability (the time that they will remain in the water) becomes much greater. If the hydroxyl and hydrogen ions are not bonded into chains, rings, or similar structures, they will either leave the water through degasification or reform back into water molecules.

Currently, the most popular means of adding oxygen to water is through the process of aeration. Air or pure oxygen is pumped through water. This process is used in fish tanks and aquariums and by bottled water companies. When an air bubble moves through water, it may become trapped there because of the bonding forces or interactions that occur at the surface of the bubble. An air bubble in water behaves the same way that a drop of water does in the air. Hydrogen bonds are formed at the interface surface that is between the air and the water. **These bonds are produced by the structuring of the water at these interfaces into crystalline-like chains or rings,** and these chains are able to bond the oxygen that is in the air into their structure. In the case of an air bubble in water, only the interface or surface of the bubble would be capable of structuring oxygen into the water. The remainder of the oxygen that was in the bubble would not be added to the water. For this reason, the oxygenation of water by aeration is not a very efficient process.

If aeration processes and technologies are combined with the structuring process, then significantly greater amounts of oxygen may be added to water. We hope that in the future, the structuring process that we have developed at PRI will be used for the purpose of purifying water.



## Structured Water, A Lyotropic Mesophase

In the previous section, we discussed the relationship between water and oxygen. Structured water has been defined as water that has a higher degree of hydrogen bonding, ionization, and chain formation than ordinary or bulk water. We have shown that this type of water will have many future applications in the area of water detoxification and purification. In this section, we shall describe structured water in more specific terms.

Structured water may be described as a **lyotropic mesophase**. "Lyo" means "in water" and "meso" means "mid" or "middle". A Lyotropic mesophase is a middle or halfway phase. When used to describe water, it implies a phase for water that is midway between the liquid and solid states. This term is used to describe liquid crystals that are in water. The structured water mesophase is a transition phase that lies midway between the liquid and solid states. The unstructured water that surrounds the structured water is in a liquid state while the structured water is part way into a solid state.

Liquid crystals consist of complex organic molecules, such as fats and cholesterol, that are in water. The physical condition of a liquid crystal can be likened to that of a piece of well-cooked spaghetti. This common food substance is composed of fats and carbohydrates that have a semi-solid consistency.

One of the features of the water mesophase is that of lowered temperature. Structured water chains are tighter than unstructured water in its amorphous form, and these chains will radiate heat energy away and thereby have their internal temperatures lowered. This feature can be seen by measuring the temperature gradient of lake water, that is, the temperature of the water is taken as one moves to progressively lower levels within the lake. When this is done, it is found that the water is cold at the surface, then it warms up to its maximum temperature before it falls to its lowest temperatures as the depth increases. Each layer of lake water can be regarded as a mesophase with different internal temperature.

The cold temperatures at the surface seem contradictory with what would be expected, because the heating action of sunlight would be the greatest at the surface, however, the ultraviolet in the sunlight is acting to structure the water into microphases that have the property of lowered temperatures. The water that is near the surface would also have the highest oxygen content. As one drops to a greater depth in the water, the temperature increases for a certain distance until it once again begins to fall due to the lack of sunlight and heat. The description of the temperature gradient of lake water is consistent with what fishermen know about the behavior of fish that are found in lakes. It is known that fish generally remain in deep water during the day and that one must fish at these depths in order to catch them at these times. At daybreak and sunset, however, they will come to the surface to feed on insects and that this is the best time to catch them. The fish are either found at the bottom of a lake or at its surface during feeding times, and in either case, they usually remain in the water that is the coldest, the most structured, and that has the highest oxygen content. This oxygen is vital for the life processes of the fish.

The lyotropic mesophase for water is in a constant state of change and transition. The structured water molecules are continually forming, breaking, and reforming their bonds. We have described the rates at which this process occurs in terms of "bond formation times" for the water molecule.

Substance	Bond Formation Time
unstructured water	one one-hundred billionth second
ice	one one-hundred thousandth second
collagen(cartilage proteins) in water	one one-hundred millionth second
erythrocytes(red blood cells) in water	one billionth second
sodium and lithium dissolved in water	one billionth second
calcium and magnesium dissolved in water	one one-hundred thousandth to one one-hundred millionth second
iron and aluminum particles or oxides in water	one second to ten hours
carbon and silicon particles or oxides in water	one day to ten days

Fig. 4-9. Bond Formation Times

Fig. 4-9, shows the bond formation times for water that is unstructured, for ice, and for water that is found with different types of molecules, both organic and inorganic. It can be seen that ice bonds will last about one million times longer than the bonds of unstructured water. The exact bonding time for structured water varies according to the nature and type of substance that it is bonding with, so the water mesophases would also vary. Only those water molecules that are in actual contact with other substances will have their bonding times increased, so the lyotropic mesophases will vary greatly in their formation times. A formation time can be regarded as a life-time or lifespan for the water molecules that are in this bonding process.

The exact nature of the bonding process for structured water is not known, but it is possible that only very small amounts of carbon, silicon, or iron would greatly influence the bonding process and increase substantially the lifespan and viability of the structured water mesophases.

When silicon is present in water, its bonding time becomes very long, and from this it may be inferred that substances that contain silicon, such as ordinary sand, which is silicon dioxide (Si O<sub>2</sub>), will structure water to a high degree. We have been able to confirm this in our work at PRI. When we added a very small amount (.01%) of silicon in the form of silicon gel, silicic acid, or powdered quartz to water, we found that it structured the water to a much higher degree than if we did not put the silicon in the water. The fact that sand will greatly enhance the structuring of water gives us a clue as to the purity of water that is found in rivers and streams that flow over this very abundant material.

Whenever water moves over sand, the sand can be said to grab onto the water as it goes by. This happens because the oxygen atoms that are part of the silicon dioxide (sand) form hydrogen bonds with the hydrogen atoms of the water molecule. The water will literally stick to the sand.

The momentum of the water wants to carry it along, while the weight of the sand wants to slow it down, and the result of these two actions is that the water molecules may break apart into hydroxyl and hydrogen ions. Once this occurs, these ions will bond into the structured water microphases and be available for oxidation reactions. In addition to this action, the structured water forms bonds with a silicon-based molecule, and this will increase the lifespan for the

water molecules. This happens because of the long bond formation time for water when it is bonded to silicon (see Fig. 4-9). In the future, we may see a technology that purifies water by combining aeration with filtration through beds of sand. As the sand interacts with the air and water, the oxygen that is in the air would not only bond to the water molecules but would do so for longer periods of time.

The Collagens and Erythrocytes are organic molecules. Whenever water comes in contact with them, or other organic molecules, it becomes structured to a high degree, and the water microphases have increased (longer) formation times or lifespans. Several Russian researchers conducted experiments that showed that the water that was extracted from living tissue had a highly structured nature. It reportedly did not freeze until a temperature of  $-40^{\circ}\text{C}$  was reached, as compared to  $0^{\circ}\text{C}$  for normal water. It also had other physical characteristics that are only found in water that is below  $4^{\circ}\text{C}$  in temperature or frozen into ice. The physical changes that occur in structured water also occur for water at low temperatures, and for this reason, structured water is said to be "icelike" in nature. These changes are described in greater detail in the following sections of the book.

The organic molecules that are found in the body are composed of a large number of atoms. The DNA molecule that contains the genetic coding for the body has over 250,000 atoms in its spiraling, double helix structure. When water comes into contact with these molecules, it becomes structured into its lyotropic mesophase and has its hydrogen bonding increased. This type of water has been extracted from living tissues by various Russian researchers, who then examined it for changes in its surface tension and freezing point. They then discovered that this water has a depressed freezing point and greater surface tension.

The Russian work on water that was extracted from living tissue has been subjected to a great deal of criticism by other researchers and scientists, who have pointed out that this type of water probably has a large amount of salt in it, and that this salt would lower its freezing point. This criticism is true in so far as it goes, however, what was not said was that the salt that was in the tissue water was also bonded or attached to the water molecules, and that this was the reason that the water showed a depressed freezing point. If salt is added to water, it usually saturates the solution and begins to fall to the bottom of the container very quickly. Only a small percentage of salt can be absorbed by water, but in structured water, and in structured tissue water as well, much higher percentages of salt can be added to water without it precipitating out of the solution (falling to the bottom of the container). This is the feature of structured water that the critics of the Russian work failed to take into consideration.

The organic molecules that are found in the body bond a large number of water molecules onto their molecular chains or structures, so the water that is found in a living organism is very highly structured. If structured water was used in the body, then these organic molecules would not have to expend as much energy and time in bonding them onto their structures. For this reason, structured water should be of benefit to all living things.

The degree of structuring of water is related to the presence of the various impurities that are found in it and to their bond formation times as well. But a long bond formation time for a particular mineral impurity does not in itself ensure that the water will become structured. Most minerals will begin to saturate solutions of water when they are present in amounts as low as one-tenth of a percent of the total solution.

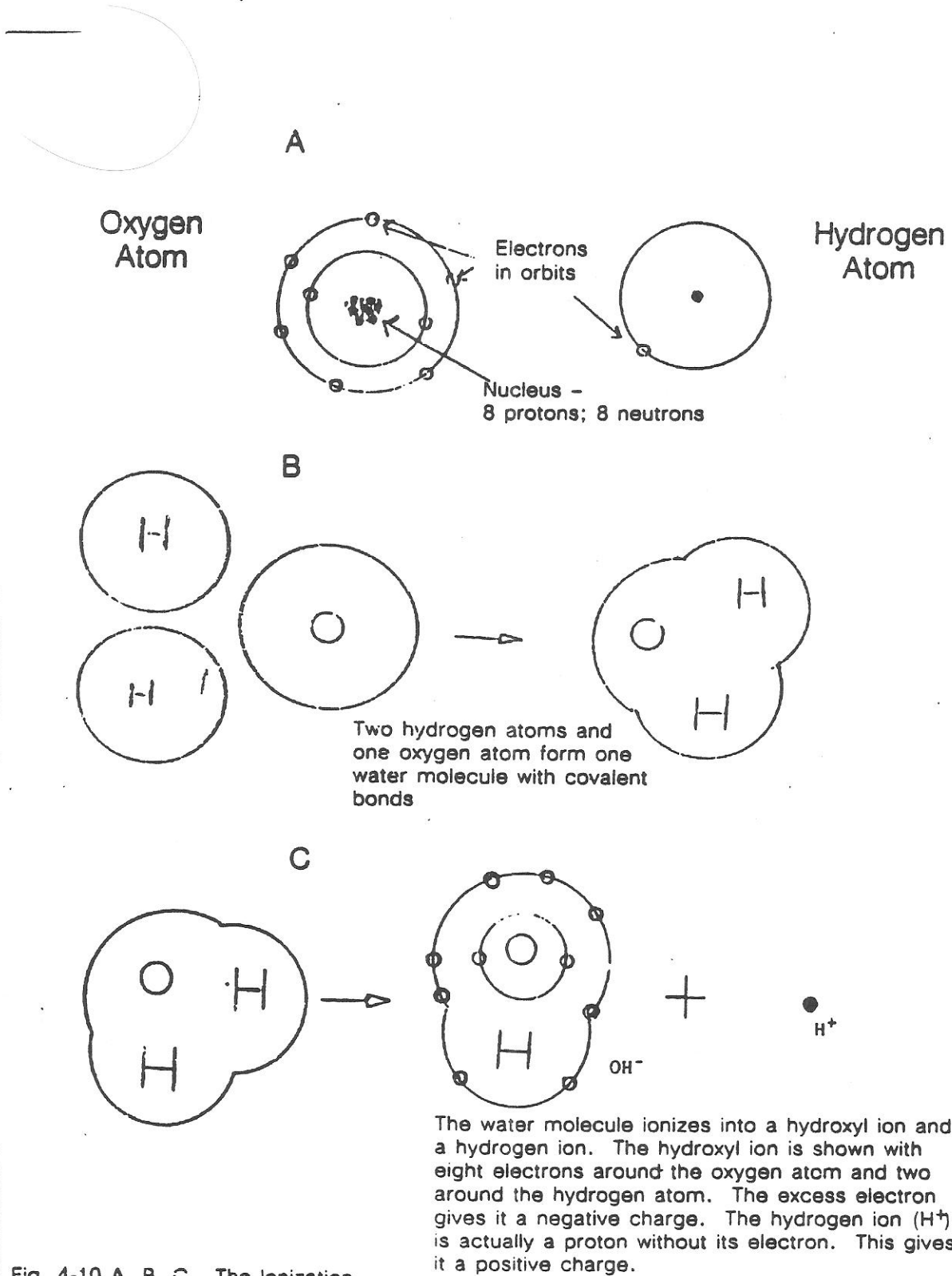


Fig. 4-10 A, B, C. The Ionization of Water - Intramolecular Bonding

Fig. 4-10 A,B,C The Ionization of Water - Intramolecular Bonding

water

When we were studying the effects of silica (powered sand or quartz) on the structuring of water, we used a solution of only one-hundredth of a percent. This means that even though the mineral impurities that are found in water are able to increase the degree of structuring of the water, this effect is limited by their solubility. At some point, it does no good to continue to add minerals to water, as they will only leave the solution through precipitation.

When these facts are taken into consideration, we can see that if we were to plot two graphs that depicted the degree of structuring that the various impurities are able to impart to water, one plot would show an increase in structuring as minerals and organic molecules were added, and the other would show a decrease in structuring due to a decline in their solubility. Even though the carbon and silicon minerals that are added to water increase the extent of its structuring, they begin to precipitate out of water at low concentrations. They are only able to form bonds with a small number of water molecules. On the other hand, the organic molecules, because of their size, are able to bond a large percentage of the water molecules that they are in solution with, so they may be the greatest enhancers of the structuring process. Possibly, solutions that contain a mixture of organic molecules and salts and other minerals in the proper proportions would show the greatest degree of structuring.

## Atoms, Molecules, and Molecular Structures

It's important to understand how the elementary particles, the proton and electron, align themselves to produce atoms, and then how these atoms come together to form the groups of molecules that are known as crystals. This last step occurs when water becomes structured into its liquid crystal-line phase.

Figs. 4-10A, B, C and D show atoms, molecules and molecular structures.

Fig. 4-10A shows an oxygen and hydrogen atom. The oxygen atom has eight protons (of positive charge) in its nucleus along with an equal number of uncharged neutrons. It also has eight negatively charged electrons that orbit the positively charged nucleus in two "shells" or orbits that are at precise distances from the nucleus. The oxygen atom has a radius of 1.4 Angstroms, and the hydrogen atom is a radius of 1.2 A (Angstroms). One Angstrom is equal to one ten-millionth of a millimeter.

Only a certain number of electrons may orbit within a particular shell. The shells are referred to by letters according to the sequence "K, L, M, N," for the first four shells, starting from the one that is closest to the nucleus and moving outward. The "K" shell may only have two electrons in it while the "L" and "M" shells can have as many as eight electrons. The "N" shell may have eighteen electrons. The shells are considered to be full when they have these exact numbers of electrons in them. Full shells are not capable of taking any more electrons.

It can be seen that oxygen has only six electrons in its second or "L" shell. This shell is capable of holding two more electrons, or eight in all, and the oxygen atom can easily pick up these two extra electrons from other atoms. When it does so, the two excess electrons give it an excess negative charge of minus two. When it does this, the oxygen atom becomes electrically charged into an oxygen ion, and it is written as:  $O^{-2}$ .

The hydrogen atom that is drawn in Fig. 4-10A has only a single proton in its nucleus, and therefore only needs a single electron in the first shell. The reason that water bonds into such a tight molecule is that the single electrons of the two hydrogen atoms fill up or "saturate" the second shell of the single oxygen atom and complete its natural structure. When the hydrogen atom loses its single electron, it becomes ionized into an ion with a positive charge of one. The hydrogen ion is written as:  $H^{+}$ .

Fig. 4-10B shows the manner of formation of one water molecule from two hydrogen atoms and one oxygen atom. The electrons from the hydrogen atom are drawn into the orbits of the oxygen atom, and when this occurs the atoms are pulled into a close alignment where their individual spherical shapes are merged into the irregular, oval-shaped mass of the water molecule. This is an example of covalent bonding.

The weak nuclear force pulls atoms together into molecules against the force of electrostatic repulsion that exists between the many negative charges of the electrons. Electrostatic forces arise when charged particles, either electrons of negative charge or protons of positive charge, come into close proximity with each other. If opposite charges (positive and negative) are involved, then an electrostatic force of attraction is produced, but if like charges are involved (negative and negative, or positive and positive), then a force of electrostatic repulsion is produced. Since electrons are found on the outside perimeter of atoms, these perimeters always have a negative charge, which means that atoms will have a tendency to push away from one another with the force of electrostatic repulsion that these charges produce. In order to overcome this force of repulsion, a much stronger nuclear force develops that attracts and holds atoms together. This force produces the covalent and ionic bonds that hold water molecules together.

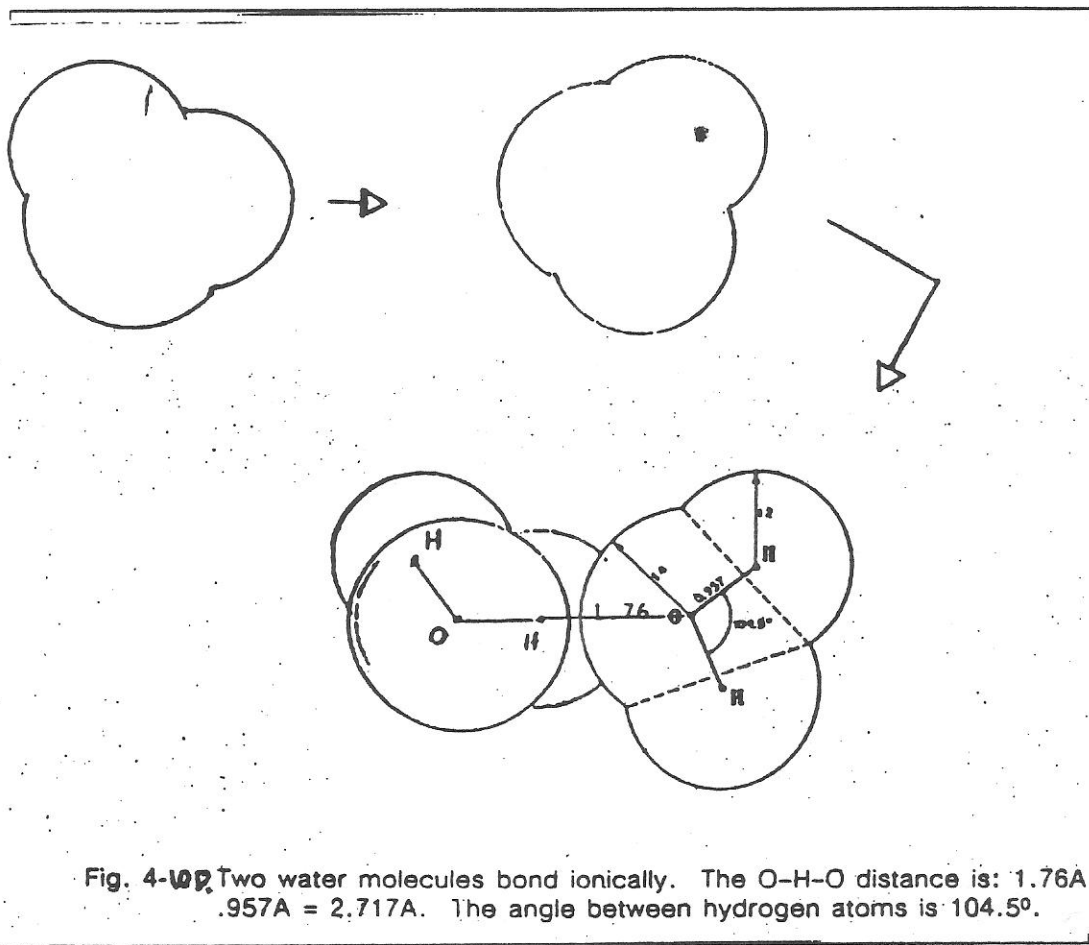


Fig. 4-10D Two water molecules bond ionic. The O-H-O distance is:  $1.76\text{Å} + .957\text{Å} = 2.717\text{Å}$ . The angle between hydrogen atoms is  $104.5^\circ$ .

Fig. 4-10D Intermolecular Bonding

Fig. 4-10D shows the manner in which two or more water molecules come together and bond into a group of water molecules. The "OH" or hydrogen bonds that exist for a single water molecule now hold groups of water molecules together. The difference between the type of bonding that occurs for a single water molecule, as seen in Fig. 4-10B, and a group of water molecules, as seen in Fig. 4-10D, is that the strength of the bond for the single water molecule is much greater and the distance between the oxygen atoms is much less. The covalent bond of the single water molecule pulls the oxygen and hydrogen nuclei to within .957 Å of each other while the ionic bond that forms between adjacent water molecules does not pull the oxygen and hydrogen atoms nearly so close together. The length of the ionic bond is 1.76 Å. These bond lengths, as well as the respective oxygen and hydrogen atoms are shown in Fig. 4-10D. The combined length of the covalent and ionic OH-bond is:  $.957\text{Å} + 1.76\text{Å} = 2.717\text{Å}$ . This is referred to as the "O-O" distance.

The closer that atoms and molecules come to one another, the stronger the bonds between them become. One of the most important features of structured water is that the OH bonds between adjacent molecules become stronger as the molecular chains or groups of molecules draw closer together and become tighter. This also occurs for water as its temperature is lowered toward the formation of ice. The following graph (Fig. 4-13) shows the change in the O-O distance as a function of temperature for water. Seven different curves have been plotted for water that is at seven different temperatures in degrees Centigrade (water freezes at 0°C, and boils at 100°C). The curves show the number of water molecules with specific O-O distances in Angstroms. The peaks in each curve show where the greatest number of molecules have their O-O distance at a specific temperature for the water. You can see that the peaks move from a maximum near 2.75 Å at 4° C to a maximum of about 2.95 Å at 200° C. This means that as the temperature of water is lowered, the O-O distance decreases and the molecules are drawn closer together.

### Structured Water as a Crystalline Microphase

In this section, we shall discuss the manner in which water structures into a crystalline-like form, and then we shall compare this form to the structure of the quartz crystal.

In the previous section, structured water was described as a lyotropic mesophase with bond formation times, that is, as a liquid crystal with a periodic rate of formation and break-down. A microphase differs from a mesophase in that it refers to the actual molecular structure instead of the condition of that structure. Microphase, or microstate, refers to the angular, geometrical alignments that water molecules have when they move into the structured condition.

The quartz crystal, which we shall compare to the structured water molecules, exhibits a microstate but not a mesophase, as its structure is permanently solid rather than transitionally liquid and semi-solid. When we examine the various angles that occur for the quartz crystal, we shall discover a possible basis for its compatibility with water, and the reason why we have used it to enhance the structuring of water.

The basic geometrical structure for both quartz and structured water is that of the tetrahedron. Fig. 4-11A shows this structure for a group of five water molecules. Four molecules, numbered "1, 2, 3, and 4," form the vertices or points of the tetrahedron while a fifth molecule may occupy the position at the center of the tetrahedron. This central position can remain unoccupied or it can be filled by one of the many molecules that can be found in water. These molecules can be the oxides of many different types of elements such as iron, carbon, silicon, or aluminum, or they can be dissolved salts such as sodium chloride, magnesium sulfate, etc.

When water molecules bond together, they form tetrahedrons in one direction or alignment of the group molecular structure and another alignment, that of the "puckered hexagonal ring", in another

direction. These puckered rings are shown in Fig. 4-11B. The reason for the puckered or tilted rings is that the bonding angle that exists between any three water molecules is  $109.5^\circ$ . A regular, flat hexagon has angles of  $120^\circ$ , so if water molecules, with their smaller angles, are to be formed into a hexagon, then the hexagon must have an uneven or crumpled structure that is not in a flat plane but is instead a three dimensional object.

Fig. 4-11B also shows the placement of the four water molecules that formed the points of the tetrahedron in Fig. 4-11A. It can be seen that the tetrahedral bonding structure acts to hold successive layers of hexagonal rings together. Actually, every water molecule is bonded to its three nearest neighbors, but the complexity of this bonding is difficult to picture, so it has been simplified in the drawing.

The most important factor in the bonding of water molecules is not the number of bonds but their strengths. Stronger bonds correspond to more tightly packed molecules, and this is the main feature of the structured water microphase.

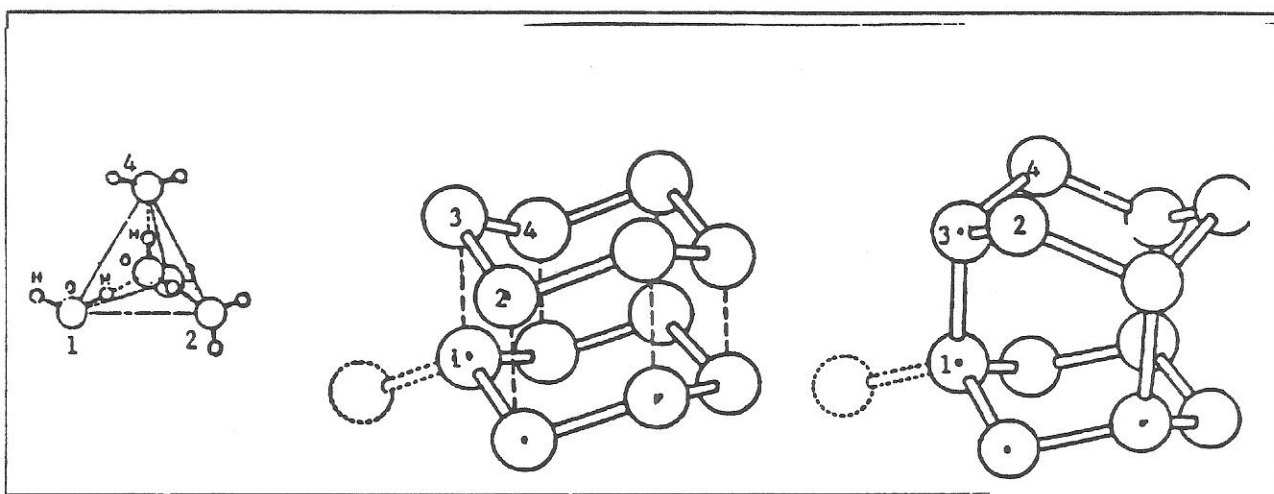


Fig. 4-11A. Water Tetrahedrons

Fig. 4-11B. Hexagonal ring rotation of closed rings produces open rings

Davis and Litovitz propose the two hexagonal arrangements that are shown in Fig. 4-11B. The closed-backed rings occur when the high and low molecules in the layered rings are directly over one another. It is as if the hexagonal rings were in a crumpled condition, and when one ring is slid over another, these crumples or puckers fit exactly onto one another. The second diagram in Fig. 4-11B shows the open-packed arrangement where one ring has rotated through a  $60^\circ$  angle and the low spot on one ring is directly over the high spot on the ring above or below it. In this case, the rings push apart and a void or space forms between them.

The open ring arrangement is the one that fits most closely with the concept of the formation of structured water. It could also be the manner in which water forms into snowflakes, as all snow shows this  $60^\circ$ , perfect hexagonal ring formation. Each  $60^\circ$  arrangement of a snowflake is produced by a series of these  $60^\circ$  ring rotations that occur as the closed-packed ring is transformed into the open-packed ring. The rotation through  $60^\circ$  also occurs very suddenly without the molecules stopping at any lesser angles. This feature is characteristic of the formation of liquid crystals, where the microstate transitions occur very suddenly.



Fig. 4-11C also shows how the interlattice angle forms as the crystalline rings rotate up onto one another. The first two drawings show four of the six molecules that form the hexagonal rings that are shown three-dimensionally in Fig. 4-11B. The remaining two molecules in the rings would be behind the middle two molecules that are drawn in Fig. 4-11C.

The four dark circles represent the molecules that are found in one ring, and the four light circles are those that are found in the next ring below.

The rings can rotate as they do in Fig. 4-11B, but they can also rotate and translate or move such that they are no longer directly over one another. This is shown in the first two drawings of Fig. 4-11C. When this translational movement occurs, the layered rings move up onto one another and a void is created. In the second drawing in Fig. 4-11C, the void is filled with a different molecule, as indicated by the lined circle.

The entire hexagonal rings are drawn in the third drawing of Fig. 4-11C. This is a top view that shows how two of the layered rings would appear after they have undergone a translation into their crystalline shapes. The rings are no longer directly over one another, and an angle has formed between them. This has been designated as the "interlattice angle."

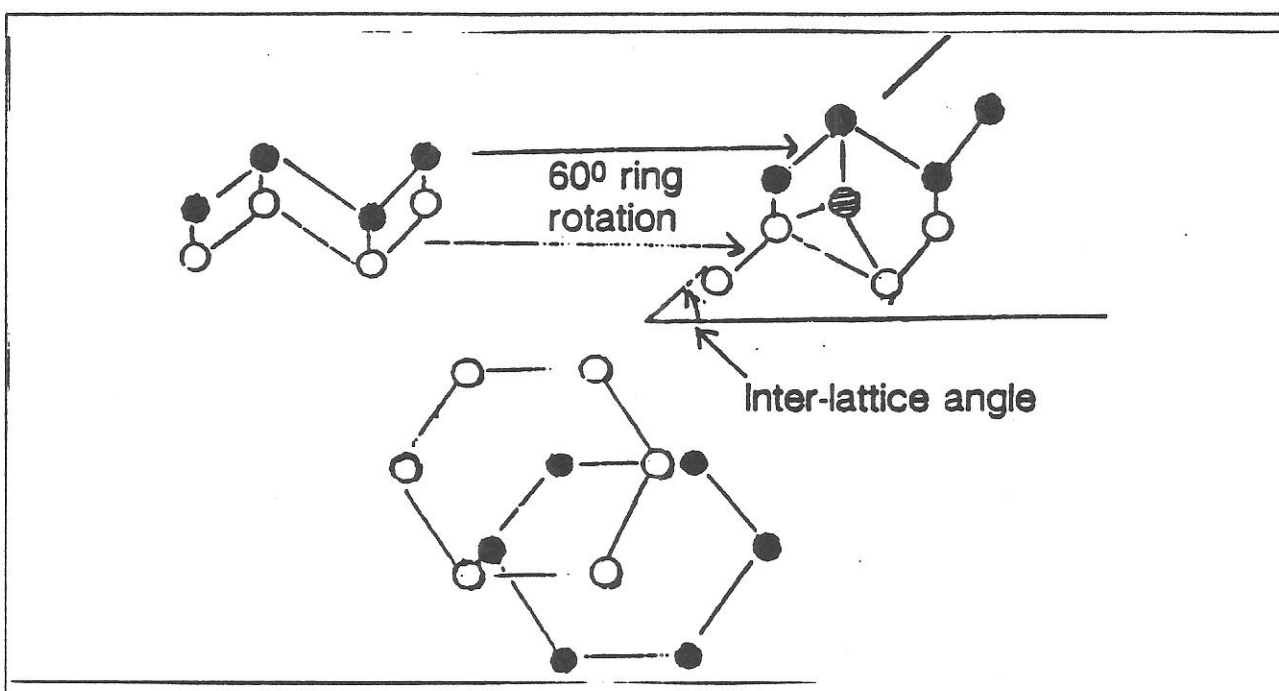


Fig. 4-11C. Crystal Formation

In the science of crystallography, the interlattice angle is related to the basal angle (Tutton), which is defined as one-half of the angle of the tip of a crystal. The interlattice angle would be  $90^\circ$  minus the basal angle. For the quartz crystal, the basal angle is approximately  $38^\circ$ , so the interlattice angle would be  $52^\circ$ .

You may have noticed that we have changed from talking exclusively about the crystalline structure of water to talking about crystalline structures in general and about quartz in particular. This is not without purpose, because there exists a definite similarity between the solid crystalline form that is known as quartz and the liquid crystalline form that we refer to as structured water.

The apparent differences between quartz and water seem great, but they have many similarities in their crystalline structures. Crystallographers know a great deal about quartz because it is a solid substance that can be studied under microscopes and other laboratory equipment. Water on the other hand, is in a continual state of flux and change with the individual molecules bonding together and breaking apart. These bonding rates were listed in Fig. 4-9.

The fact that water is a liquid makes it difficult to study. Much of the knowledge that we have about water has been inferred from measurements that do not give us a clear picture of the actual formation of groups or layers of molecules, but instead only show us some of the physical changes that are associated with these groups.

There is some evidence from electron microscopic studies that groups of water molecules can form into long strings that can be easily differentiated from the larger mass of water molecules that they have been observed in. Despite this, we still do not know the exact crystalline structure that water molecules have formed into, but we can infer something about this structure, and the angles that are involved in it, from the descriptions of water molecules that are available in the existing scientific literature.

It has been mentioned that the angle of the tip of the natural quartz crystal is  $52^\circ$ . This is the angle that each edge of the quartz crystal forms with the imaginary plane that is perpendicular to the axis (length) of the crystal. If the tip of the crystal could be cut off flat and the sides of the crystal eliminated, then the crystal would look like a six sided pyramid, and the angle that each edge formed as it intersected the base of this pyramid would always be  $52^\circ$ . Coincidentally, but perhaps not, this is the same angle that the edges of the Great Pyramid at Giza make with the base of the pyramid.

The interlattice angle for quartz is  $52^\circ$ . This angle can be related to angles that are found in the intramolecular (within one molecule) and intermolecular (between adjacent molecules) bonds of the water molecule. The intramolecular bonding angle for the water molecule is  $104.5^\circ$  (see Fig. 4-10D). This is the angle that exists between the two hydrogen atoms of each water molecule. It is almost exactly double the interlattice angle for quartz.

Another important angle for the water molecule is the intermolecular angle that is known as the "hydrogen bond bending angle". This is shown in Fig. 4-12, which is a more accurate representation of the nature of the bonding between adjacent water molecules than is Fig. 4-10D. In comparing these two figures, you will notice that the angle between the two molecules is slightly different. In Fig. 4-10D the hydrogen atom is directly in line with the two oxygen atoms, while in Fig. 4-12 it is slightly off line or tilted away from the O-O line. The degree of this tilt is called the **bending angle**. In Fig. 4-10D, the bending angle would be  $0^\circ$ . In Fig. 4-10D, the bending angle is  $0^\circ$ .

In Fig. 4-12, the bending angle is shown as  $26^\circ$ . The bending angle can be any where between  $20^\circ$  and  $60^\circ$ , but the most common angle is  $26^\circ$  (Pople in Eisenberg and Kauzman). This angle develops because it happens to be where the intermolecular bond becomes the strongest. This angle is exactly half of the interlattice angle for quartz, as the intermolecular angle was almost exactly double. The second most common bonding angle is  $54^\circ$  (Franks), and this too is close to the quartz crystal's interlattice angle of  $52^\circ$ .

It appears that the water molecule has bonding angles that are almost exact harmonics or ratios of the interlattice angle for the quartz crystal. This can hardly be a coincidence. Instead, there seems to be a fundamental, although unrecognized, similarity and compatibility between the quartz crystal and the water molecule. This similarity allows the electromagnetic and acoustic (sound) fields of energy that are introduced into the crystal to be transferred through resonance to the structure of groups of water molecules. This compatibility of structures can also be seen in the very long bond formation times that exist for silicon that is found in water (see Fig. 4-9).

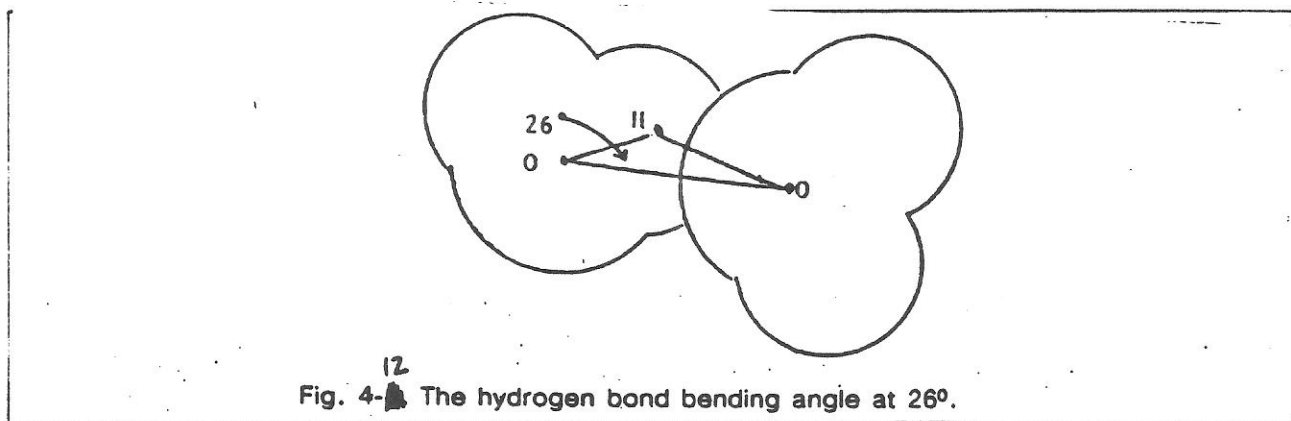


Fig. 4-12. The Hydrogen Bond Bending Angle

The structure of the quartz crystal can replicate itself in water because of a resonance transfer that is based upon structure. This structure may produce specific frequencies or frequency patterns, also called **harmonics**, that are able to transfer to the water molecule. Only small amounts of energy are required for this transfer, as the most important factor here is structure or form rather than energy. In the experiments that were done at PRI, significant structuring of water occurred by spinning it around a cut quartz crystal. The only energy that was present in these experiments was that of the water as it fell, under the influence of gravity, through the structuring device. Later, small amounts of energy in the form of low frequency sounds and pulsed lights were added and a greater degree of structuring was produced.

Although the exact physical mechanism or means of action is not known, a mutual resonance appears to develop between the quartz crystal and the spinning water, a resonance that is based on structure and frequencies and small amounts of energy, and the water takes on the same crystalline structure that the quartz already possesses.

We have studied the relationship between the quartz crystal and the water molecule at PRI by spinning water around a cut quartz crystal. Our work may be the first to study this relationship, and it may be the initial work in a new science which will study the relationship of crystals in general to biological (living) systems.

Water is essential to all living things. It comprises 70 to 80 percent of the total weight of the human body. All of the vital chemical ingredients that the body is made up of are carried throughout the body by water. If the quartz crystal is able to affect this water and alter its internal structure and some of its physical properties, then other crystals may be able to do so as well. If the water that is in a living organism can be changed, then it is reasonable to assume that the organism itself will be changed. If structured water is able to bond oxygen more strongly, then it is likely that it is also able to bond other substances such as the mineral salts, proteins, vitamins, and carbohydrates more strongly.

All of these substances are essential if the living cell is to grow and reproduce. Structured water may be able to bring them to the cell more efficiently than unstructured water, and the cell may be able to use them more efficiently if they are bonded into structured water.

We believe that a future technology that is based on the structuring of water by circulating it around quartz crystals will be of great benefit to our society. We have discussed some of its possible applications in the field of water purification and oxygenation, but the much larger discipline of medical research and applications remains to be explored.

## Structural Changes for Water

As water forms into ice, it not only becomes a solid instead of a liquid, but it undergoes a structural change as well. This change involves the movement of the water molecules away from one another and the formation of much stronger hydrogen bonds between them. The movement of the molecules accounts for the fact that ice is less dense than water and will float on it. The movement of the adjacent molecules can be seen in Fig. 4-13, where the O-O distance (the distance between the oxygen atoms of adjacent water molecules) decreases as the temperature of the water decreases.

The minimum O-O distance is reached at a temperature of 4°C, but what the chart does not show is that the O-O distance at 0°C is slightly larger. Ice reaches its maximum density and minimum O-O distance at 4°C, and as it freezes into ice this distance increases slightly.

The transition from water to ice involves the transition from a liquid to a solid, but the transition from water at 4°C to water at 0°C (ice) involves the formation of a lyotropic mesophase or liquid crystal system. Ice becomes solid slowly during this transition, and becomes fully solid at 0°C.

As water freezes into ice, the energy that has been stored in the atomic structures, most likely the electron spin alignments, is converted into a force field which acts through the small distances that exist between adjacent molecules. This force field, called the **weak nuclear force** or **electroweak interaction**, acts to hold all atoms together as they form into molecules and into the larger molecular structures that are known as crystals.

In the next section we shall discuss the specific electromagnetic frequencies that water is sensitive to and is able to absorb in large amounts. For now, we shall only consider the ultraviolet frequencies that water is sensitive to. These frequencies have wave lengths in the range of 1800A to 2400A, with maximum rates of absorption occurring at 1900A.

In a previous section, it was stated that ultraviolet radiation was able to ionize the water molecule into one hydroxyl ion and one hydrogen ion during the process of photoionization. But the ultraviolet frequencies that produce photoionization can also be stored in the molecules and their energy used for the ionic bonding force. The transition between energy and force, that is, the conversion of energy into force, is a process that is not yet understood by modern science, but the physical reactions and changes that occur for the lyotropic mesophase for water give us a clue as to the nature of this important physical process, what is referred to in liquid crystallography as a "change of state".

Energy is equal to force times distance. When you lift an object, its weight can be considered a force, and the distance that it is lifted through, when multiplied by its weight, will give you the energy that has been stored in the object. If you were to drop the object, this stored energy would be released as a force when it finally hit whatever was below it.

Since the conversion of energy into force involves the force moving through a distance, and since adjacent water molecules move apart as they freeze into ice, it is reasonable to assume that the distance that the water molecules move is related to the force that is now holding them together in their new configuration. If this concept is actually a physical law that applies for all atoms and molecules, then all crystals, liquid or solid, should also expand when they form. In other words, crystals should be less dense than their non-crystalline counterparts.

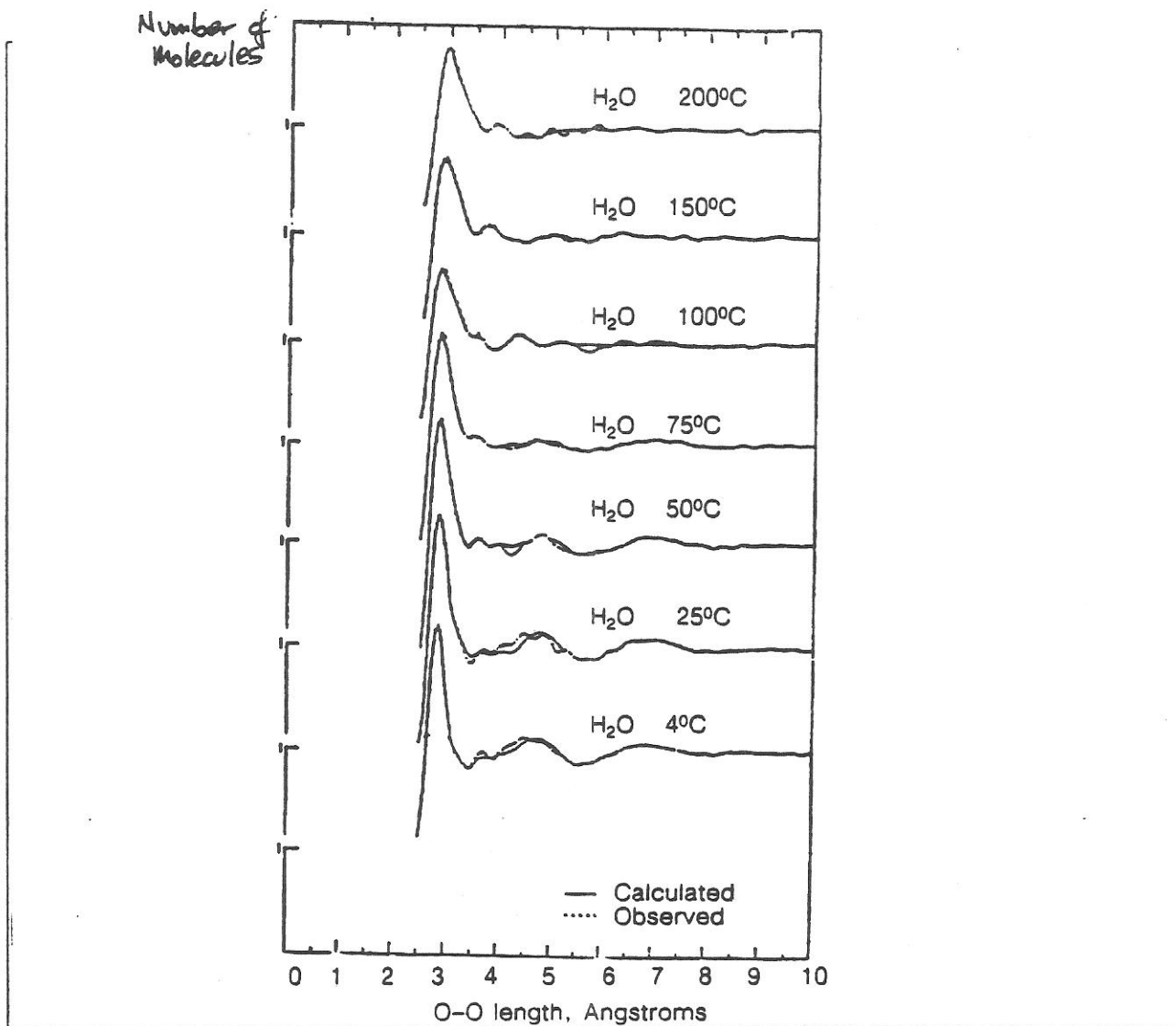


Fig. 4-13. Temperature Effects on Water

This statement seems to be a contradiction of the previous assertion that the crystalline microstates for water are tighter and more compact than is the surrounding, non-crystalline water. However, this contraction or tightness only occurs for the adjacent molecules that are found in one hexagonal ring structure. When successive rings rotate over one another (see Figs 4-11C and 4-11B, a void is created as they are forced away from one another. This movement produces the true crystalline state which is three dimensional.

In the process of ring contraction and layered ring expansion, some of the molecules in the layered rings move closer together while others move further apart and a void between the layers is created. The overall effect of the ring movements is to produce a crystalline structure that is less dense than its amorphous, non-crystalline counterpart, even though they are both composed of exactly the same atoms and molecules. The difference between crystals and non-crystals is the manner in which adjacent molecules bond to one another. This is as true for crystalline water as it is for solid crystals such as quartz.

The study of water and its physical properties should give us a great deal of evidence about the process of crystalline formation. The concept of converting ultraviolet energy into a bonding

force has just been discussed, but even more revealing knowledge can be gained by looking more closely at the relationship between the O-O distance for the water molecules, the energies that correspond to these distances, and to the structural changes that groups of water molecules undergo as their bonding energies are increased.

## Microstates

The process by which water freezes into ice as its temperature is lowered from 4°C to 0°C gives us an example of the formation of liquid crystal microstates. These states are valid for all types of liquid crystals, not just the structured water mesophase. If we look at the body of any animal, we see many types of liquid crystals with varying degrees of solidity. Body fluid is very close to the liquid crystal state that is currently known and recognized, while much more solid tissue such as muscle and bone are liquid crystals of a different order, as they are more solid and rigid than body fluids, but they are still a lyotropic mesophase as they too consist of organic molecules in water. The difference between the liquid crystals that make up the blood or body fluids, and those that are muscle and bone, is only one of degree, that degree being their solidity as determined by the percentage of water that is found in either type of system.

The varying degrees of solidity for different liquid crystal systems can be seen in the varying degrees of solidity that occur for water as it is frozen into ice between four and 0°C. As this occurs, the water becomes progressively more solid as its temperature is lowered, moving from a true liquid to a gelatin-like soup and finally to a solid.

The formation of the structured water or liquid crystal microstate can take place as the temperature of the water is lowered, but the formation of the microstate can also take place without an overall lowering of temperature. This is what occurs with oxygen at the surface of a body of water. In these cases, the water that is structured actually undergoes a lowering of temperature, but the structured water only amounts to a very small percentage of the total molecules that are in the larger group of water molecules, so the temperature change for this larger group is very small. The formation of the mesophase also results in an increase in the surface tension of the water, and both of these changes can be measured and compared to the surface tension and temperature of unstructured water.

If water can have its bonding forces increased without lowering its temperature, then we have discovered a technology that will be able to improve the quality of water without the use of large amounts of energy. If the only way to structure water was to lower its temperature, then we would only have discovered a process which would be very expensive in terms of energy usage, as lowering the temperature of a large body of water would entail large amounts of energy. The same would be true if we were to add oxygen to water and remove minerals from it through the process of electrical ionization. This is currently done in the production of purified water. It is quite an expensive process, and is the reason for the high cost of this type of water. The process of circulating water around a quartz crystal should prove to be inexpensive in comparison with the existing process of electrical ionization.

If greater amounts of energy can be stored in the interlattice vibrations of water, then stronger intermolecular bonds can be formed. Stronger bonds mean a greater degree of structuring or chain formation, so the structuring of water is directly related to the amount of energy that can be absorbed and stored by the water molecules.

Fig. 4-14A and Fig. 4-14B show the relationship between the amount of energy that can be put into a hydrogen bond for adjacent water molecules, the length of the O-O separation between

adjacent molecules, and the bending angle that was shown in Fig.4-12. The energy of the bonds is in kilocalories per mole (kcal/mol), the O-O length (R) is in Angstroms (A), and the hydrogen bond bending angle (B) is in degrees. A kilocalorie is one thousand calories, and a calorie is a common unit of energy that is used (among other things) to measure the energy content of food. A mole is the number of molecules that can be found in one liter.

The total energy for all of the hydrogen bonds for all of the molecules in one liter of water is listed in the right hand column. If this energy value is divided by the number of molecules that can be found in one liter, then the amount of hydrogen bond energy for each water molecule can be found.

Bending Angle (B) in Degrees	O-O Distance (R) in Angstroms	Energy in kcal/mole
0	2.55	7.3
10	2.60	7.2
20	2.60	6.8
30	2.65	6.2
40	2.70	5.3
50	2.75	3.4
60	2.8	3.1

Fig. 4-14A. Energy and O-O Distance at Different Hydrogen Bond Bending Angles

As the bending angle decreases, the O-O distance decreases, and the amount of energy for bonding increases. A decrease in the O-O distance means that the hexagonal rings that the water molecules are aligned in are being compressed into smaller sizes, and a decrease in the bending angle means that successive rings are drawing closer to one another.

The values for the O-O distance that are listed in Fig. 4-14A reach smaller minimums than those that are shown in Fig. 4-13. This is because that latter are the average distances that exist for a large group of water molecules, while the former are the distances that can be achieved for small groups of molecules. When we are dealing with structured water, we are only considering those molecules that are able to achieve O-O distances and bending angles that are less than the norm. What we are also contending, however, is that these minority molecules can have their numbers increased by the structuring process of spinning around a quartz crystal, and that the entire mass of water molecules will have their average O-O distances and bending angles decreased as well.

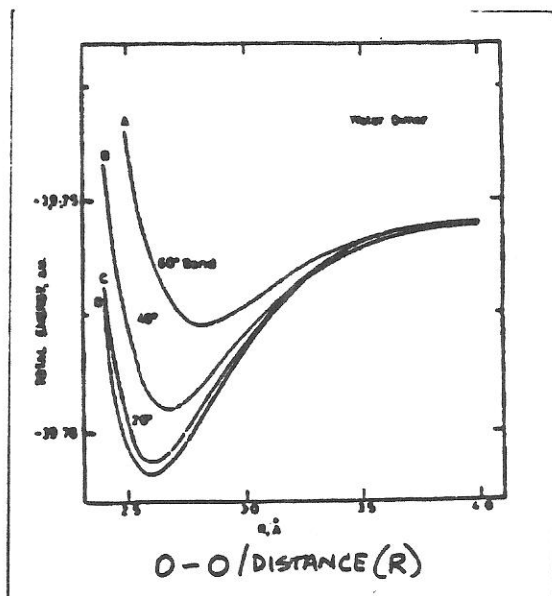


Fig. 4-14B. Graph of Energy and O-O Distance at Different Hydrogen Bond Bending Angles

### Hydronium Chains

Whenever the O-O distance goes below the average value of 2.7Å, water molecules are ionized into a positively charged hydronium ion and a negatively charged hydroxyl ion. This only occurs when two adjacent molecules are so tightly bonded that they act as a single molecule. The formation of the hydronium ion is shown in Fig. 4-15. One hydrogen ion (one proton) is added to a water molecule and a hydronium ion is formed. The extra proton attaches itself to the water molecule with an ionic bond that has a greater OH distance than the covalent bonds that exist between the oxygen atom and the two hydrogen atoms of the water molecule. The actual process of formation for the hydronium ion involves Fig. 4-10C and Fig. 4-15. A single water molecule (Fig. 4-1C) is first ionized into a hydroxyl ion and a hydrogen ion or proton. The proton then attaches to another water molecule and the hydronium ion is formed (Fig. 4-15). The hydroxyl ion remains with the hydronium ion so that the total charge for these two ions is zero.

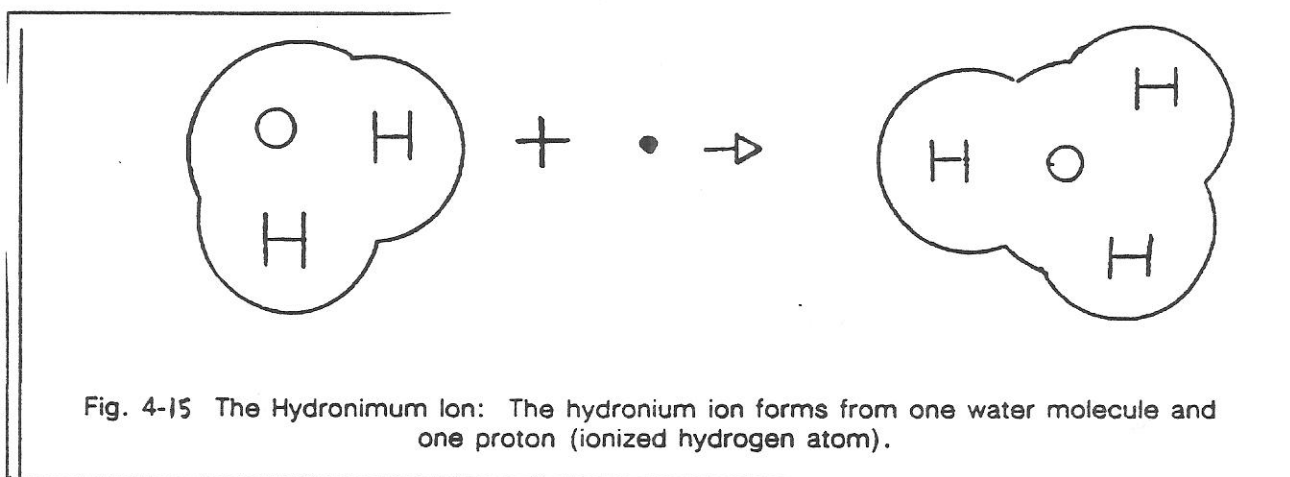


Fig. 4-15 The Hydronium Ion: The hydronium ion forms from one water molecule and one proton (ionized hydrogen atom).

Fig. 4-15. The Hydronium Ion



The hydronium ion is written:  $\text{H}_3\text{O}^+$ .

The formation of one hydronium ion and one hydroxyl ion from two water molecules is written:



Hydronium ions continue to form as the O-O distance moves below 2.7Å to 2.5Å, and as the bending angle moves from  $40^\circ$  to  $0^\circ$ . Below 2.5Å and  $0^\circ$ , the water molecules change their vibrational patterns as their bending angles become negative, in effect moving in the opposite direction (see Fig. 4-12). In terms of the structure of the group of water molecules, this means that the hexagonal layers, which up until now had been compression, are now moving away from one another. However, the hexagonal rings continue to compress, so a change in the normal pattern has taken place. Above 2.5Å, the microstates are compressing in two directions, but below this distance, one direction (that of the diameter of the rings) continues to compress, while the other direction (that of the length of the ring structure) reverses itself and starts to expand. This expansion probably is the same expansion that water undergoes as it freezes into ice, or that any liquid crystal undergoes as it forms into larger structures. This process also occurs during the process of crystal growth, as solid crystals expand or grow in the direction of their successive or layered ring structures.

As the O-O distance continues to decrease, larger hydronium ion groups begin to form. At a distance of 2.4Å, the  $\text{H}_5\text{O}_2^+$  ion forms. This is a combination of one hydronium ion and one water molecule. At these small distances, the normal ionic hydrogen bonds are approaching the same bonding strength as the covalent bonds of the single water molecule. If the O-O distances continued to decrease, then it is reasonable to assume that even larger groups of water molecules and hydronium ions would form at the same high ionic bonding levels. These molecular groups would have the formula:  $\text{H}_3\text{O}^+$ ,  $\text{H}_5\text{O}_2^+$ , . . .  $\text{H}_{(2n+1)}\text{O}_n^+$ . This could describe the formation of layered rings of water molecules. These layered rings could be of any length, as determined by their number (n) in the above equation.

## Water Polymers

Additional verification for the formation of water molecule and hydronium ion chains comes from an examination of the mathematical models that are used to predict the amount of energy that can go into the formation of "water polymers". Water polymers are groups of adjacent water molecules that have bonded together into definite alignments or patterns. Some of the angular alignments for the water molecules have been discussed in a previous section. Any three consecutive molecules in a hexagonal ring (see Fig. 4-11B) will have an angle of  $109.5^\circ$  between them. In terms of water polymer calculations, this arrangement is known as a "water trimer", the term "trimer" referring to a group of three molecules.

There are five different water polymers - dimers, trimers, tetramers, pentamers, and hexamers - and each one corresponds to successive groups of two, three, four, five, and six water molecules that have bonded together. In addition to the five different types of polymers, there are two orders of polymers, the "open" and the "cyclic." The open polymer is a group of molecules that is not strongly bonded to the next adjacent group of molecules, having a loose or open structure. A cyclic polymer is a group that bonds much more strongly to identical adjacent groups. The cyclic structure repeats itself and the open does not.

The conclusions that water researchers have drawn from the two mathematical models, known as "CNDO/2" and "Ab initio," are not definite. This is because the water chains are in constant motion, and it is currently impossible to take an accurate picture of these chains or groups of

molecules that would experimentally verify their structure in terms of the predictions of the mathematical models. Instead, the calculations are used to predict the time duration and stability of the individual group structures or polymers.

The chart in Fig. 4-14C lists the calculated O-O distances (R) and bonding energy of the different water polymers. Where a calculation was not performed, it is indicated with four dots (....). The previous chart in Fig. 4-14A lists the CNDO/2 calculations for the water dimer (two water molecules) only. All of the polymers have symmetric vibrations except those that are indicated as having asymmetric ones (Asym.). The symmetric and asymmetric vibrational modes for the water molecule will be discussed in greater detail in the following section. The chart shows that the formation of larger water structures (pentamers and hexamers) occurs when greater amounts of energy are stored in the hydrogen bonds, and that this also corresponds to decreasing O-O distances.

The calculations predict that the cyclic polymers are more stable than the open polymers. This supports the theory of the lyotropic mesophase for water, that is, that water naturally wants to form into chained structures that are cyclic in nature. However, another prediction from the calculations is that the asymmetric vibration tends to be more stable than the symmetric, and this is in contradiction to the ideas that will be put forth regarding the nature of structured water, which states that it is produced by the symmetric vibrational mode. While it is true that the asymmetric mode is more stable than the symmetric, it is the instability of the latter that allows water molecules to be in continual states of transition between the crystalline mesophase and the non-crystalline phase.

The mathematical models also predict that the Cyclic Trimers will create an environment that is favorable to the bonding of successive hydroxyl ions onto the trimer's structure.

Water Polymer Groups	CNDO/2		Ab initio	
	O-O	Energy	O-O	Energy
Open Trimer	2.60A	9.5	----	4.7
Cyclic Trimer (Asym.)	2.80A	3.0	----	4.9
Cyclic Trimer	----	----	2.56A	6.2
Open Tetramer	2.60A	9.8	----	----
Cyclic Tetramer	2.45A	9.5	2.47A	10.6
Open Pentamer	2.60A	9.9	----	----
Cyclic Pentamer	----	----	2.45A	10.6
Cyclic Pentamer (Asym.)	2.50A	8.9	2.45A	11.6
Cyclic Hexamer	2.45A	10.8	2.44A	12.0

Fig. 4-14C.

## Vibrational Modes

An increase in bonding energy is only one of the physical changes that occur as water molecules are structured into chains or microstates. A decrease in the minimum O-O distance is another, and changes in the bond bending angle yet another. But the most important change that water undergoes as it structures is one that involves its "vibrational modes," that is, the coordinated patterns of direction and motion that the atomic nuclei have as they vibrate back and forth.

All atoms are in a constant state of vibrational motion unless they have temperatures close to absolute zero ( $-273.16^{\circ}\text{C}$ ;  $-459.69^{\circ}\text{F}$ ). These vibrational motions have regular, repeatable patterns to them and can be said to be a "mode of vibration." At the critical minimum distance of  $2.4\text{\AA}$ , where chains of water molecules and hydronium atoms form (as has been described above), there is a change in the vibrational mode for many of the water molecules that have this O-O distance.

The three most important modes for the water molecules are shown in Figs. 4-16A, 16B, and 16C. Fig. 4-16A shows the symmetric vibrational mode, Fig. 4-16B the asymmetric mode, and Fig. 4-16C the deformation mode for the water molecule. The single, larger circle is the nucleus of the oxygen atom, and the two smaller circles are the nuclei of the hydrogen atoms. The arrows show the simultaneous directions that these nuclei are moving toward during one particular phase of the vibrational mode, these arrows would reverse their directions during the next phase of the vibrational mode. The length of the arrows is meant to correspond to the total movement or displacement that the nuclei undergo. The oxygen nucleus, being much heavier than the hydrogen nucleus, moves through a much smaller distance as it vibrates.

The vibrational motions of the water molecule occur at regular rates or frequencies. These frequencies are well known and have been the subject of much discussion and analysis in the existing literature on water and ice. In a later section, we shall discuss the frequencies that we have dealt with in our work at PRI.

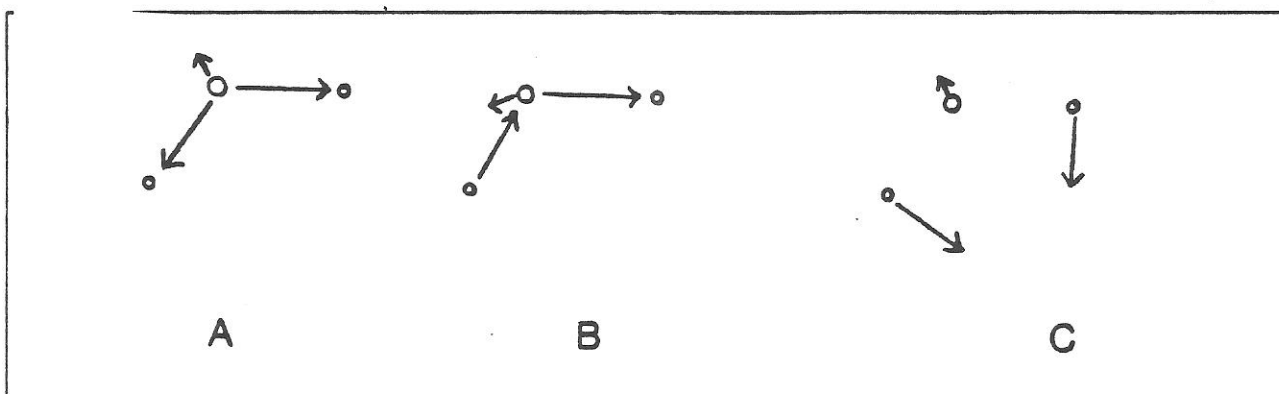


Fig. 4-16. The Symmetric (A), Asymmetric (B), and Deformation (C) Vibrations for the Water Molecule.

When the O-O distance for adjacent water molecules goes below  $2.5\text{\AA}$ , there is a reversal in the vibrational mode from asymmetric to symmetric (from Fig. 4-16B to 4-16A). For distances that are greater than  $2.5\text{\AA}$ , all of the hydrogen bonds have asymmetric vibrations, but for those that are less than this distance, a certain percentage of the vibrations become symmetric. The change from asymmetric to symmetric coincides with the formation of the hydronium ion chains that are characteristic of structured water. It is likely that the structured water mesophase has a different vibrational mode than the unstructured, amorphous state of water. If it does, then this

probably accounts for its structural integrity and its general separation from amorphous, unstructured water.

A more careful examination of the differences between the symmetric and asymmetric modes gives us further insight as to the differences between structured and unstructured water. The symmetric vibration in Fig. 4-16A shows us that the motions of the two hydrogen atoms occur synchronously, that is, they move away from the oxygen atom, and then move back toward it in sync (at the same time). If each water molecule can be thought of as a small radio transmitter, then this synchronous movement will produce a series of waves or vibrations that will reinforce one another. The energies of each of the hydrogen atoms will be added together to produce twice the original energy. In the case of the asymmetric vibration, however, the vibrational modes are out-of-sync with one another and the energies that are coming out of these atoms will tend to cancel one another. The symmetric vibration produces in-phase energy and the asymmetric vibration produces out-of-phase energy.

If asymmetric vibrations were occurring simultaneously in adjacent water molecules, as is the case for unstructured water, then the internal energy would move around the hexagonal ring structures and between the layers of rings as well. This would have the effect of broadcasting the energy throughout the entire group of contiguous water molecules and would tend to put all of the molecules at the same energy and bonding levels. This could only reduce all of the molecules to the same amorphous, unstructured condition. Conversely, the symmetric vibration would tend to concentrate internal energy within individual hydrogen bonds where they would build up to high levels. This is consistent with the description of structured water bonding, where individual bonds have had their energies increased.

The symmetric vibration would tend to produce increased hydrogen bonding between molecules, but the organization of these molecules into precise structures would not necessarily result from the imposition of the symmetric vibrational mode. We must look to another mechanism if we are to provide a basis for the structural integrity of the water mesophase.

## Proton Translocation

Implicit in the formation of the hydronium water chains is the phenomenon of **proton migration** or **proton translocation**. This is shown in Fig. 4-17. Proton translocation is known to occur for large organic molecules. What occurs is that extra protons, usually from ionized water molecules, jump back onto the water molecules and migrate or move throughout their structures. As they do this, they help bond these molecules together. Proton translocation is a means of holding large molecules together, and it could also be a way of holding chains of water molecules together. In chains of water molecules, the protons would be provided by the hydronium ions extra hydrogen atom.

The extra protons that produce hydronium ions move from one water molecule in the chain to the next molecule in the chain, weaving an invisible thread of energy around and throughout their structures.

Translocating protons tend to move through the voids that exist in the structured water chains. Fig. 4-11C shows where these voids occur in the structure of water. The mineral impurities that are usually found in water accumulate in these voids or holes, and the translocating protons that are found there can help these minerals bond into the water chains by loosely associating with them and forming a long string of protons and ionized minerals. This may in part account for the long bond formation times of the mineral salts that are found in water.

A common salt such as sodium chloride ionizes into one sodium ion and one chlorine ion when it is dissolved in water. These ions occupy the structured water voids that are produced by the hexagonal ring rotations that were shown in Fig. 4-11C. For every hydrogen ion (proton) that moves throughout a water chain, there is one hydroxyl ion that attaches itself to the outside of the chain.

Both of these ions are produced by the ionization of one water molecule (see Fig. 4-10C). The total number of positive hydrogen ions (protons) and negative hydroxyl ions must be equal in a group of water molecules if their net electrical charge is to remain at zero. Otherwise, the molecular group takes on a charge. This is something that may occur in water that has been highly structured, as the high degree of ionization of this type of water would allow for this possibility because at any moment in time there could be a charge imbalance that was produced by an excess of either positive or negative ions.

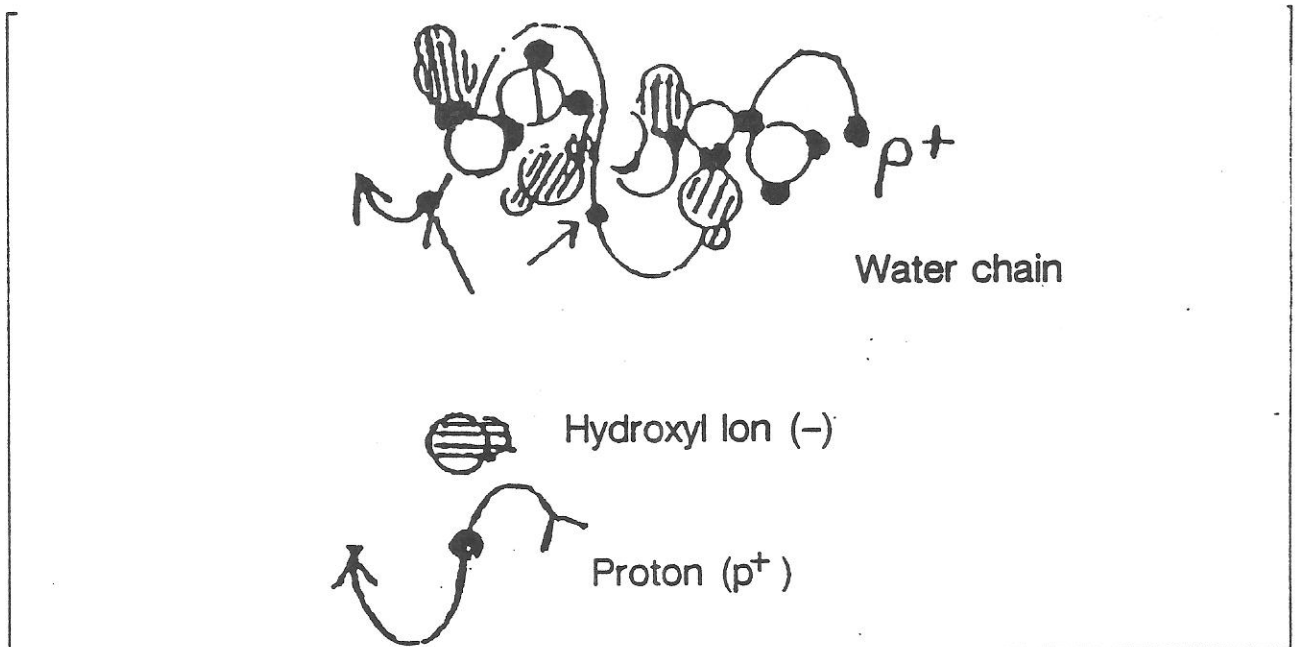


Fig. 4-17. Proton Translocation: The Proton Moves throughout a Chain of Water Molecules and Hydroxyl Ions.

Although it is generally acknowledged that proton migration or translation could exist for water molecules, little else is known about this phenomenon with respect to its influence on the bond formation times and patterns for the water molecule. The energy that is involved in the proton movements is so small that it has not yet been isolated or identified with respect to the overall frequency patterns or spectra of the water molecule.

The movement of protons throughout the water structure has been described in terms of the **action time**, that is, the time that it takes for protons to act or move throughout one water chain or contiguous structure. This is the same as saying that the protons have rates or frequencies to their movements. Most researchers think that the action time for the translocating protons is fairly long. In other words, they have low frequency motions within the water structure or mesophase.

We have been able to confirm, in our experimental work, that low frequency fields will enhance the structuring of water. When Xenon strobe light is pulsed at low frequencies, or when low frequency drum music is played over speakers as the water is circulated around the quartz crystal, there is increased structuring in the water.

## Quartz and Water

One of the changes that occurs as water is structured is that of a lowering of temperature for the new microstate. Another and possibly more important changes involves the actual interlattice structure of water molecules. Some of these changes were discussed in a previous section and were illustrated in Figs. 4-11B and 4-11C. The rotation of one puckered ring onto another, as shown in Fig. 4-11B, will produce a crystalline system which is organized into layers. Each layer is a two-dimensional plane that is only loosely bonded with the planes that are above and below it. This type of organization can be seen in the solid crystalline form of sugar quartz which has a layered structure similar to a sandwich. When these same rings are translated or moved through a distance, as in shown in Fig. 4-11C, then a three dimensional organization is produced. For both water and quartz, this organization produces a septahedron (a six-sided pyramid). In this case, the successive layers are strongly bonded to one another. This type of organization can be seen in the quartz crystal, which comes to a definite point of termination, something that does not occur for the layered sugar quartz. This type of organization is produced by the interlattice angle that forms between the layered rings. This angle is formed by the transfer, through resonance, of a portion of the bonding energy of the entire mass of molecules. This transfer is related to the various bonding angles of the water molecule through a system of harmonics that are almost exact multiples or fractions of the interlattice angle.

The bond bending angle for two water molecules tends to stabilize at  $26^\circ$ , while the permanent angle between the two hydrogen atoms of one water molecule is  $104.5^\circ$ . The interlattice angle between successive layers or quartz is  $52^\circ$ , and if this angle also exists for water molecules, then it is an harmonic of the bending angle, which is equal to half of its value, and an harmonic of the hydrogen interatomic angle, which is equal to twice its value.

The interlattice resonance between the quartz microstate and the lyotropic mesophase is the determining factor in the formation of the latter, and is the reason that water can be structured by spinning it around a quartz crystal. This resonance transfer occurs without introducing large amounts of energy into the structuring system.

The similarities between the interlattice structure of the quartz crystal and the internal structure of water provides us with an example of the compatibility that exists between the inorganic system of the crystal and a substance(water) that is active in organic systems. It is at least indirect evidence that crystals can influence organic molecules through energy exchanges that are in resonance with both systems. Energy can be transferred when two vibrating systems or structures are in resonance. An example of this is the mutual resonance that exists between two violins. When one violin is played, the other will pick up the sound and will actually resonate with it even though it is not being bowed or played directly. When the crystal is resonated, the frequencies and energies of this resonance can be transferred to the water molecule, which is in resonance with the quartz crystal because they have similar internal alignments.

The phenomenon of resonance transfer occurs because the energy waveforms, that is, the waves that are coming out of the vibrating substances(the water and the quartz) have (nearly)identical phase relationships. The phase relationships of a resonating system can be de-

fined in terms of the angular separations that exist between adjacent molecules. If, for instance, the six water molecules that form one hexagonal ring structure are in mutual resonance, then they will vibrate in sequence around the circle that the ring structure defines. The first molecule in the ring will vibrate or broadcast its energy on a wave that has a particular frequency, then the second molecule will begin to broadcast or transmit its wave at the same frequency after a precise interval of time has elapsed, and then the third molecule will begin to vibrate and so on around the circumference of the ring. The time intervals between successive broadcasts (the beginning of the wave for each molecule) results in a phase delay between successive waves. The time delay between waves becomes a phase delay which can then be converted into a phase angle. Successive waves come out of oscillating systems (such as the ring structure of six water molecules) with phase angles that are equal to the angular separation that exists between the members of the system (the ring structure). Fig. 4-18 shows the phase angle or time delay that exists for three successive sine waves. This would be the pattern that would exist for three of the water molecules in the hexagonal ring structure. In the case of the vibrating ring of water molecules, the phase angle for this system would be  $60^\circ$  because there are six molecules within the ring structure, and the  $360^\circ$  circle that the ring makes must be divided by six to obtain the phase angle. If there were seven molecules in the ring, then the phase angle would be  $360^\circ$  divided by seven, or  $51.43^\circ$ . This is the principle phase angle for the quartz crystal and the water molecule, because most of the internal angles of these substances are either fractions of this angle or multiples of it.

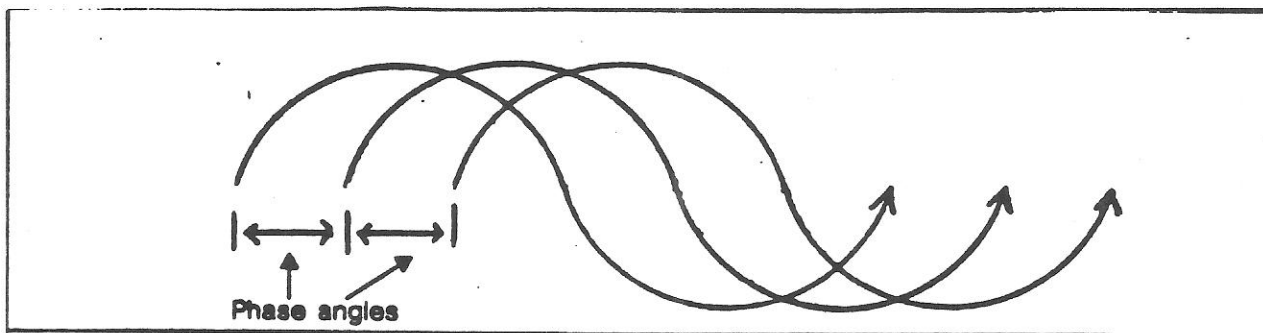


Fig. 4-18. Three Successive Sine Waves Have a  $60^\circ$  Phase Angle Between Them

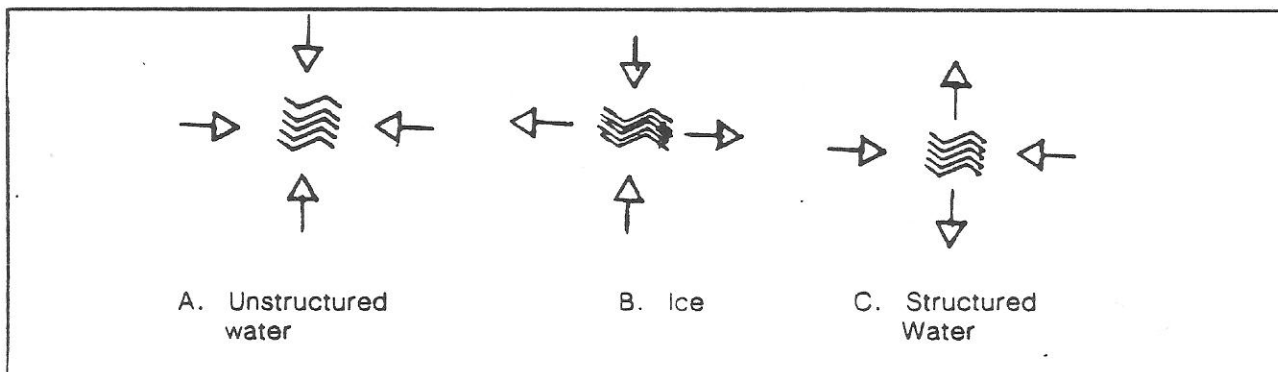


Fig. 4-19 A, B, C. Water Transitions from  $100^\circ$  C to  $-40^\circ$  C

## Formation of the Microstate

The following is the description of a proposed model for the structuring of water in terms of most of the physical changes that were described in this section. The chart in Fig. 4-19D describes the difference between water that is being cooled to a temperature of 4°C (Fig. 4-19A), water that is unstructured and is forming into ice (Fig. 4-19B), and water that is structuring into the liquid crystal form (Fig. 4-19C).

Figure	State	Temperature	R(O-O)	B-Angle	Vibration
4-19A	Water	100° C to 4°C	3A to 2.7A	60° to 8°	Asymmetric
4-19B	Ice	4°C to 0°C	2.5min & 2.7max to 2.72A	8° to 0°	Asymmetric
4-19C	Mesophase	4°C to -40°C	2.5A to 2.35 ?	0° to 9° ?	Symmetric

Fig. 4-19.

The hydrogen bond bending angle(B) determines the distance between successive layered rings. This angle causes an additional crumple or pucker in the ring structure, and the greater the angle, the greater the distance between layers of the puckered hexagonal rings. As the temperature of water decreases, this angle also decreases and the rings move closer together (see Fig. 4-19A and 4-19B). One of the distinguishing features of structured water is that there is a reversal in this pattern and the successive layers move away from one another (see Fig. 4-19C). The exact magnitude that the new bending angle has is not known, but it is probably less than 10°. It has been shown as 9° in Fig. 4-19, with its uncertainty indicated by a question mark.

The O-O distance(R) determines the size(area) of the hexagonal rings. This distance decreases with temperature down to 4°C, but reverses at this temperature and increases (see Fig. 4-19B). This reversal occurs as water freezes into ice and expands in the same plane that the ring structures are in. This means that when a body of water freezes, it will expand horizontally and push outward. This action can be seen when a dish of water freezes and the ice "heaves" or pushes against the sides of the container. Structured water rings do not expand as their temperature falls from 4°C to 0°C, but continue to contract toward smaller O-O distances. The minimum O-O distance that occurs for adjacent structured water molecules is not known, but it is at least as small as 2.35A. This is the value that is listed in Fig. 4-19, but its uncertainty is indicated by the question mark. There is a direct relationship between this distance and the number of water molecules that can form into the hydronium chains. Longer chains are produced as the molecules move closer together and their O-O distances continue to decrease.

Structured water has a lower temperature than the surrounding water. This condition continues to hold as it has its temperature lowered to the normal freezing point of water, 0°C. The water microstates maintain their structural integrity at this temperature and do not freeze until a much lower temperature has been reached. This temperature varies from -10°C to -40°C, depending upon the degree of structuring and by the total energy that is stored in the water chains. The reasons for this are complex, and would require a careful examination of the spectral frequency patterns that are characteristic of structured water versus those that are characteristic of bulk water. This is something that we have partially undertaken in our work at PRI, but a great deal remains to be done.



Before proceeding with a more detailed nature of the reasons for the unique physical characteristics of structured water, it is necessary that the electromagnetic emission spectrum be described. All substances absorb electromagnetic energy such as heat, light, microwaves, X-rays, and radio waves, at specific frequencies and only at these frequencies. The frequency patterns are called spectra and amount to a unique signature for each atom and molecule. When these frequencies occur in groups they are referred to as bands. Because every substance has its own set of frequencies, a close examination of these frequencies can accurately predict what substances are present in any particular sample of a material. This is done when a sample of ore, for instance, is assayed for its specific mineral content. The frequencies of energy that exist for a particular mineral will show up on an instrument that is called a "spectrophotometer", which is used to measure the amount of energy that substances absorb and emit at specific frequencies or wavelengths. The presence of frequencies that are particular to a specific atom or molecule will tell us that this atom or molecule is present in the sample of the material that is being measured.

Bulk water has more of its energy concentrated in the infrared (heat) portion of the spectrum than does structured water, but the latter develops additional spectral bands in frequency ranges that are both lower and higher than the infrared. The symmetric vibrations of the structured water chains allow their internal energy to oscillate over wider frequency bands than do the asymmetric vibrations of bulk (unstructured) water. The inphase vibrational mode for structured water broadcasts this energy throughout an of the structured water molecules, so structured water has several frequency bands in the microwave and radio wave range that unstructured water does not have. These much lower frequencies are probably related to the long action times that the translocating protons have within the water microstates. These frequencies are not sensitive to changes in temperature, that is, they do not absorb or emit infrared (heat) frequencies of energy, so when the temperature of the microstates is lowered, these extra vibrations are not affected. They continue to vibrate throughout the microstates, and their effect is to keep the microstates moving so that they will not freeze at 0°C.

Some of the internal energy in structured water is translated into lower frequency patterns, but some is also converted into a high frequency emission in the visible range of electromagnetic energy. This emission occurs at about 5000Å of wavelength, which is blue-green light. This light emission is characteristic of structured water. It can be seen coming out of very cold, clear mountain lakes that have highly structured water, while lakes that have blackish, impure water do not emit this frequency of energy.

The emission of visible light is a characteristic feature of liquid crystal formation. At the instant that a liquid crystal forms, it emits visible light. The phase transition of liquid crystals can be observed and measured by the emission of this light, which occurs at specific frequencies. That fact that these crystals emit light at specific frequencies or colors means that they could be used to make a liquid crystal color television, with different crystals producing the different colors. This technology is currently being developed. The fact that very pure and highly structured water emits a specific frequency of light is further evidence that water has a liquid crystal state.

## Subtle Energy and Structuring

The amount of energy that can be stored into the hydrogen bonds of the water molecule is one of the determining factor in its structuring. The normal hydrogen bond for the water molecule contains 4.5 kcal/mole, but the chart in Fig. 4-6A makes it clear that much larger amounts of energy can be stored into the water bonds. These larger amounts of energy correspond, or are related to, smaller O-O distances and smaller bending angles. If enough energy can be put into

water molecules so that they form into chains of hydronium ions, then the water has become structured. The degree of structuring is determined by the length of these hydronium chains, and by the cooperative bonding that exists between the chains. More energy means greater structuring.

If water can be structured by energy, then the lyotropic mesophase should be easily attainable, as energy can be easily added to water. But we have found in our work at PRI that this is not the case, as it is not a question of how much energy must be added to water to get it to structure, but what is the manner in which this energy is added. If it were only a matter of adding energy to water, then it should structure when it boiled, however, we have boiled water and found that this actually unstructures it by breaking down and reforming the existing hydrogen bonds. We have discovered that in most cases, boiled water will structure more readily than unboiled water, but the act of adding energy through boiling does not structure water.

What we have discovered about the process of structuring water is that the energy must be added slowly and gradually. The pulsed strobe light and drum music that is in sync with the proton movements is an example of an effective way of structuring water. By moving the proton along gently, we use it as a carrier of the energy that we are trying to put into the intermolecular bonding structure. This does not mean that the rate and degree of structuring cannot be increased, only that this increased energy must be added to the water in a manner that is in sync with the natural movement or action times of the protons that are in the water.

The structuring of water is influenced by very subtle effects and by small amounts of energy. One of these subtle effects is that of the mind and emotions of any person that happens to be close to the structuring equipment at the time that it is being used to structure the water. We have noticed in our work at PRI, that the water samples that we are working with will not structure if the person that is performing the experiment is in a negative state of mind or else is upset emotionally or is suffering from disease or injury. In the case of disease or injury, it can be assumed that these conditions will produce negative emotional and mental states in the individual who is either operating the structuring device or is in proximity to it. This observation has not been experimentally verified, as it is difficult to objectively determine when a person is in one of these "negative states of mind or emotion", but we believe that we have enough evidence to at least put forward this idea as a possibility.

If the mind and emotions of people are able to interact with the structuring process, then this must occur in some manner that is physical, definable, and provable. It must come under the realm of natural, although unknown, physical law. It is not the purpose of this paper to prove what this physical causation is, only to state an idea or a theory as to what it could be.

It is our belief that the link between the mind and matter lies in the ability of the mind to influence and even control the electron spin alignments that ultimately determine the degree of crystallization of any substance. In the beginning of this paper, the position of the electron in the atom was described, but nothing was said about the exact alignment that this particle takes as it orbits around the atomic nucleus. If these alignments are random, then the atom or molecule will be in an amorphous, non-crystalline state, but if they are aligned in regular patterns, then those same atoms and molecules will be transformed into their crystalline state. The regular alignment of electrons would produce an intermolecular bonding pattern that also would be regular and repetitive, and adjacent molecules and atoms would bond together more strongly. Modern physics only uses electron spin values or numbers to account for "unexplained irregularities" in the electromagnetic spectrums of the atoms. These irregularities occur in all atoms. But electron spin values cannot account for all of these irregularities, so it appears that this is an example of an "ad hoc" theory, that is, one that is made up to nearly fit the facts of the situation, but fails to do so completely or satisfactorily.

The irregularities that the electron spin values are used to explain are very small differences in energy and frequency that exist for specific bands or groups of frequencies that can be found in the electromagnetic spectrums of virtually all atoms. These frequency bands consist of either two or three very distinct frequencies that are very close to one another. The difference between these frequencies is usually quite small. When two of these frequencies occur together, the band is called a spectral "doublet," and when three of them occur together, they are referred to as a "triplet."

The different electron spin values are currently used to account for the existence of these spectral doubles and triplets, but a more viable theory would be to account for them by stating that they are produced by much lower frequency waves which are the rate of spin for the electrons. The frequency of an electron spin wave would be equal to the heterodyned frequency that existed between the original spectral doublets or triplets. A heterodyne is the difference in frequency that exists between any two frequencies. For instance, the heterodyne that is produced by a wave with a frequency of 5125cps (cycles per second) and another wave with a frequency of 5135cps is equal to 10 cycles, i.e.,  $5135 - 5125 = 10$ . Heterodyned frequencies are sometimes called "beat" frequencies because they are the low frequency beats that are produced when two frequencies oscillate at the same time.

The frequencies that make up the electromagnetic spectrum for an atom are produced as the atoms move between electron shells (see Fig. 4-10A). Whenever an electron jumps to another shell it emits a small amount of energy that is called a "quanta". A quanta of energy shows up in the spectrum of the atom as a dark, straight fine. This dark line indicates one of the many frequencies that this particular atom is sensitive to and will absorb. Often these absorption frequencies will occur in groups of two (doublets) or three (triplets) that have their frequencies very close to one another. When these close frequencies are combined or heterodyned, they produce another frequency which could be the frequency of the electron as it spins.

One thing that is known about electron spins is that they are sensitive to very small amounts of energy. This is because they have much lower frequencies than the quanta that are produced by the electron jumps, and lower frequencies correspond to lower amounts of energy. But in addition, electron spins have alignments or specific locations and directions in the space that comprises the atom. This feature is also found in the lattice work of crystals, liquid or solid, and it is likely that it is the determining factor in the successful alignment of electron spins. A crystal is able to influence and align these electron spins because they both have this important physical feature in common. An extension of this idea would be that the organic liquid crystals that make up the human body are also able to influence electron spin alignments, and this is the reason that the electronic actions of the body, as seen in the changes that the body's liquid crystal system undergoes, are able to influence the crystallization (the structuring) of water.

## Summary

The process by which water forms into a lyotropic mesophase will someday be recognized as one of the most important change-of-states that this common substance undergoes. This new state for water is a true liquid crystal state which may be described in the following manner:

- 1) An increase in the ionic hydrogen bonding that exists between adjacent water molecules occurs, this increase being the result of increased absorption of ultraviolet energy.
- 2) There is an increase in the number of ionized water molecules. This is either caused by photoionization (the absorption of ultraviolet energy), or by electroionization (the effects of static electric fields).

- 3) There is a reorganization of the hydroxyl and hydrogen ions (which result from the ionization of water) into chains of hydronium ions. The hydrogen ion (proton) is added to a water molecule to form a hydronium ion, and hydronium ion chains are held together by these protons. Two hydroxyl ions form one hydrogen peroxide atom, and its extra oxygen atom makes structured water oxygenrich. (Hydrogen peroxide has two oxygen atoms while water has one). These hydroxyl ions bond strongly onto the water chains, so their oxygen atoms will remain in the water for a much longer period of time than will the oxygen that is found in the air bubbles that are found in water.
- 4) The water chains have longer bond formation times than ordinary water, and this is related to the long action times of the translocating protons which make-up the hydronium ions.
- 5) The adjacent molecules in the mesophase have smaller intermolecular (O-O) distances than those that are not in this phase. The chains are contracting in the planes that the hexagonal rings are within, and storing energy as well. This increased energy produces increased hydrogen bonding.
- 6) The adjacent molecules are expanding in the direction of the successive hexagonal rings (at  $90^\circ$  to the plane of the rings).
- 7) These two actions (5 and 6), indicate that structured water molecules have reversed the direction that normal (unstructured) molecules take as their temperatures are lowered toward the freezing point.
- 8) Simultaneous to these actions, a reversal in the vibrational mode from asymmetric to symmetric occurs within the mesophase.
- 9) The formation of water polymers also describes the formation of structured water. These polymers have increased hydrogen bond energies.
- 10) The reversed modes and directions (8) produce, or correspond to, a reversal in the normal process of freezing for the water mesophase, as it has a lower temperature than the surrounding water. At the normal freezing point for water, the mesophase continues to have a lower temperature and does not freeze. It will undergo a final phase transition to the solid (frozen) state, but only at temperatures that are well below  $0^\circ\text{C}$ .
- 11) The low frequency vibrations of the translocating, hydronium protons keep the structured water chains in a continual state of vibratory motion that prevents them from becoming solid at  $0^\circ\text{C}$ .

So far in this paper, we have taken the information, facts, and theories from the existing literature on the general subject of water that tend to support our theory of the formation of the lyotropic mesophase, the liquid crystal state for water. The possibility of this state occurring is only discussed in a small portion of this literature, principally in the papers of the Russian scientists, but in the works of Davis and Litovitz of the United States Naval Laboratory as well. But all of these descriptions, if taken together, do not adequately describe the formation of structured water. It is necessary to propose a theory that will more comprehensively describe the lyotropic mesophase.

## Septimer Bonding

In this lengthy discussion about water, it has become apparent that the existing theories that describe the formation of water-molecule groups, such as the water polymers or hydronium ion chains, come closest to describing the formation of the liquid crystal state for water. But these theories, which are supported by complex mathematical models, are not integrated with the theories that describe the formation of liquid crystal states. The mathematical calculations are carried out, and predictions about groups of molecules are made, without taking into consideration the important fact that the liquid crystal state for water is characterized by an abrupt change-of-state. This change-of-state is the mesophase transition where sudden physical changes occur, and these changes cannot be adequately described by existing mathematical approaches, which are based mainly upon the energy changes that are predicted by the existing Laws of Thermodynamics.

The Laws of Thermodynamics are used to describe the energy changes that occur as molecules and atoms move between their vapor and liquid states, or between their liquid and solid states. They fail to take into consideration the fact that all liquid crystal(mesophase) transitions are incomplete, that is, they do not leave the substance in an entirely liquid state, nor in an entirely solid state, but instead produce a midphase which has the physical characteristics of a liquid and a solid.

One of the most important characteristics of liquid crystal formation is that of luminescence. When liquid crystals form, they emit specific frequencies of electromagnetic energy that are in the visible range of light. This occurs at the instant of phase transition into the liquid crystal state. The liquid crystal will remain in the mesophase for a period of time, then it will undergo its transition back into its amorphous state. These transitions occur at definite rates or frequencies. The transition times are related to the bond formation times that exist for the entire liquid crystal solution.

Liquid crystals are organic molecules that are similar in structure to the organic molecules that can be found in the chart in Fig. 4-9. When these molecules are mixed with water, the bond formation time of the water becomes much longer than it would be if it did not have the organic molecules in it. The bond formation time will also become much longer if other substances are added to the water. These times or rates are related to the movement of protons throughout the liquid crystal structures, and so we have some indication that low frequency vibrations are important in the formation of liquid crystal systems. This idea gains further credence when one considers that the earth naturally produces ELF(extremely low frequency)waves and that many types of crystals, both liquid and solid, grow while they are under the influence of these low frequency waves.

Low frequency wave energies are important in the formation of the liquid crystalline state, but so are high frequency energies, as the increased hydrogen bonding of these states is produced by the increased absorption of high frequency, ultraviolet energy. What appears to be happening when a liquid crystal forms is that there is an increase in the absorption of both high and low frequency energies. The crystalline system absorbs energy over a wider band of frequencies than the non-crystalline system, and this energy is transformed into a bonding force which holds the crystal together. Simultaneous to the production of the bonding force, an emission of energy in the visible portion of the spectrum occurs. This is the luminescence that characterizes liquid crystal formation. The liquid crystal seems to have the ability, or perhaps this ability is inherent to its nature, of reorganizing energy into different frequencies. This is similar to the electronic circuit that can be found in any radio receiver or transmitter, where frequencies are received, modulated into different frequencies, and then amplified so that they can be heard by the listener. Liquid crystals, including the lyotropic mesophase for water, modulate the low frequency vibrations of the

proton translocations into visible light, and have this signal amplified by the high frequency energy of the ultraviolet. This too is similar to an electronic amplifier, where low frequency voices (audible waves) are modulated into high frequency radio waves. In this process, low energy electrons are used as the energy source instead of ultraviolet light.

The fact that liquid crystals (and solid ones as well) are shaped like small electronic coils, often consisting of strands of molecules that are wound into helical shapes, further adds to the impression that they are some type of miniature electronic system. The coils (liquid crystals) are constantly expanding and contracting, and as they do so, they are producing modulated electronic signals.

Modulated frequencies are ones that have been either increased or decreased according to a mathematical system of even multiples. This is also referred to as a system of harmonics, where higher frequencies are multiples of lower frequencies, and lower frequencies are divisors of higher ones. An example of a harmonic numerical series would be:  $n = 1, 2, 4, 8, 16, 32, 64, \dots$ . This series defines the octave harmonics that the fundamental that is given by " $n = 1$ " has. The octave sub-harmonics can be found by changing these values into their reciprocals, i.e.,  $n = 1, 1/2, 1/4, 1/8, 1/16, \dots$

Harmonic series such as these can be used when analyzing the spectra of many types of substances, including water. Most of the important frequencies that occur in the absorption spectrum of water are related to one another through a system of harmonic values. A close examination of these values is beyond the scope of this paper, but the concept of harmonic multiples is useful in describing the formation of the liquid crystal state.

One example of a harmonic system that occurs in the formation of the lyotropic mesophase is that of the water polymers that have already been discussed. Each successive polymer has bonding energies that are even multiples of the previous polymer. The water dimer is the first multiple (harmonic) of the single water molecule. The trimer is not an octave harmonic, but is still a harmonic of the single water molecule, while the tetramer is the first multiple of the dimer or the second multiple of the single.

The current system of water polymers stops at the hexamer, which is one hexagonal ring of six water molecules. If you stood at the center of the hexamer and looked outward, you would see six evenly spaced water molecules, each one  $60^\circ$  apart. As has been previously discussed, this can be seen in the formation of the snowflake. This  $60^\circ$  angle is related to the maximum bending angle, which is also  $60^\circ$ . The most common bending angles are  $26^\circ$  and  $52-54^\circ$ . This latter angle can be obtained by dividing the circle of  $360^\circ$  into seven portions (this value is actually  $51.43^\circ$ ). The reoccurrence of this angle throughout the bonding symmetry of the water molecule may yield a clue as to the manner in which structured water forms.

As energy is stored in the hexagonal rings (see Fig. 4-11B), the molecules that comprise the rings are drawn closer together. Successive layers of rings also move closer to one another. These combined actions increase the amount of stress that is placed upon the hexagonal ring structures, and at a critical moment this stress breaks the ring apart into a septimer (seven membered ring). But this septimer never actually forms, instead its bonding energy is held by a series of vibrations that have phase relationships that are multiples of  $26^\circ - 26, 52, 104, \dots$ . This accounts for the importance of these angles in the symmetry of water molecules. When the septimer forms, it does so at an angle of  $52^\circ$  to the plane of the original hexagonal ring. This produces the interlattice angle that was shown in Fig. 4-11C. Also, the hexagonal rings that constitute water and quartz translate or move so that they are off-center and over one another and the true crystalline state has been produced.

As the crystalline state comes into being, a luminescence occurs as the crystal's internal energy is modulated into a discreet frequency of light energy and transmitted away from the crystal-

line system. In the case of the formation of the lyotropic mesophase, a change in vibrational mode occurs as well, as the asymmetric vibrations of unstructured water are suddenly converted into the symmetric vibrational patterns of structured water. It is this change from asymmetric to symmetric that allows the water molecules to alter their overall vibrational patterns or spectra, as the symmetric vibration keeps the water molecule's energy contained within its own interior where it can be modulated upward or added to itself in a harmonic pattern. At some critical energy density, this energy breaks the ring structure down and the septimer polymer of structured water molecules is formed.

## The Work at PRI

The experimental work on the structuring of water with a quartz crystal encompasses a time period of three and one-half years. The experimental work was conducted by Hank Glover, who worked for one year, and Norman Mikesell, who was the principle investigator, working on the water experiments for almost three years.

The PRI water experiments consisted of hand-pouring a variety of water through wooden boxes that held Pyrex glass coils that had been specially fitted around the cut quartz crystals. Most of the water that was used was Alhambra Purified Water. The water was poured through the structuring device a specific number of times, either one, five, ten, fifteen, or twenty times. After a series of runs, the test sample of water was measured for changes in electrical conductivity, pH (acidity and alkalinity), and infrared and ultraviolet absorption of energy at specific wavelengths. The UV (ultraviolet) and IR (infrared) experiments produced the most significant and repeatable results.

## Ultraviolet Studies

This review of the PRI experimental work in the structuring of water will concentrate on the two most significant experiments that were conducted over the three year period from 1984 to 1987. These involved the careful examination and study of the changes in the absorption of infrared and ultraviolet energies that occur when water is circulated around a cut quartz crystal.

A sample of water, designated "control", is first measured on an ultraviolet spectrophotometer for the percentage of energy that it absorbs in the ultraviolet frequency range from 300 to 200 nanometers (nm) of wavelength (a nanometer is one-billionth of a meter or one-tenth of an Angstrom).

The absorption value for the control sample of water is set at zero percent on the chart recorder printout of the UV spectrophotometer. After this sample has been tested, another sample of the same type of water is run through the structuring device a set number of times, and then it too is measured for the percentage of ultraviolet that it absorbs. This is referred to as the "test" sample of water. The percentage of UV absorption at specific wavelengths for the test water is then superimposed over the percent absorption for the control water, and the two are easily compared because they are on the same graph. A sample of one of these graphs is shown in Fig. 4-20.

In a very high percentage of the total tests that were run on the UV spectrophotometer, the structured water samples showed consistently higher percentages of absorbed ultraviolet energy. The values for the percent changes in absorption that were used were those that occurred at 200 nm of

wavelength. It is likely that the ultraviolet energy that is absorbed by the water molecule goes into its hydrogen bonding, so an increased rate of energy absorption would mean an increase in the hydrogen bonding forces. This is consistent with the theory of the structuring of water, which states that structured water, among other things, has increased hydrogen bonding.

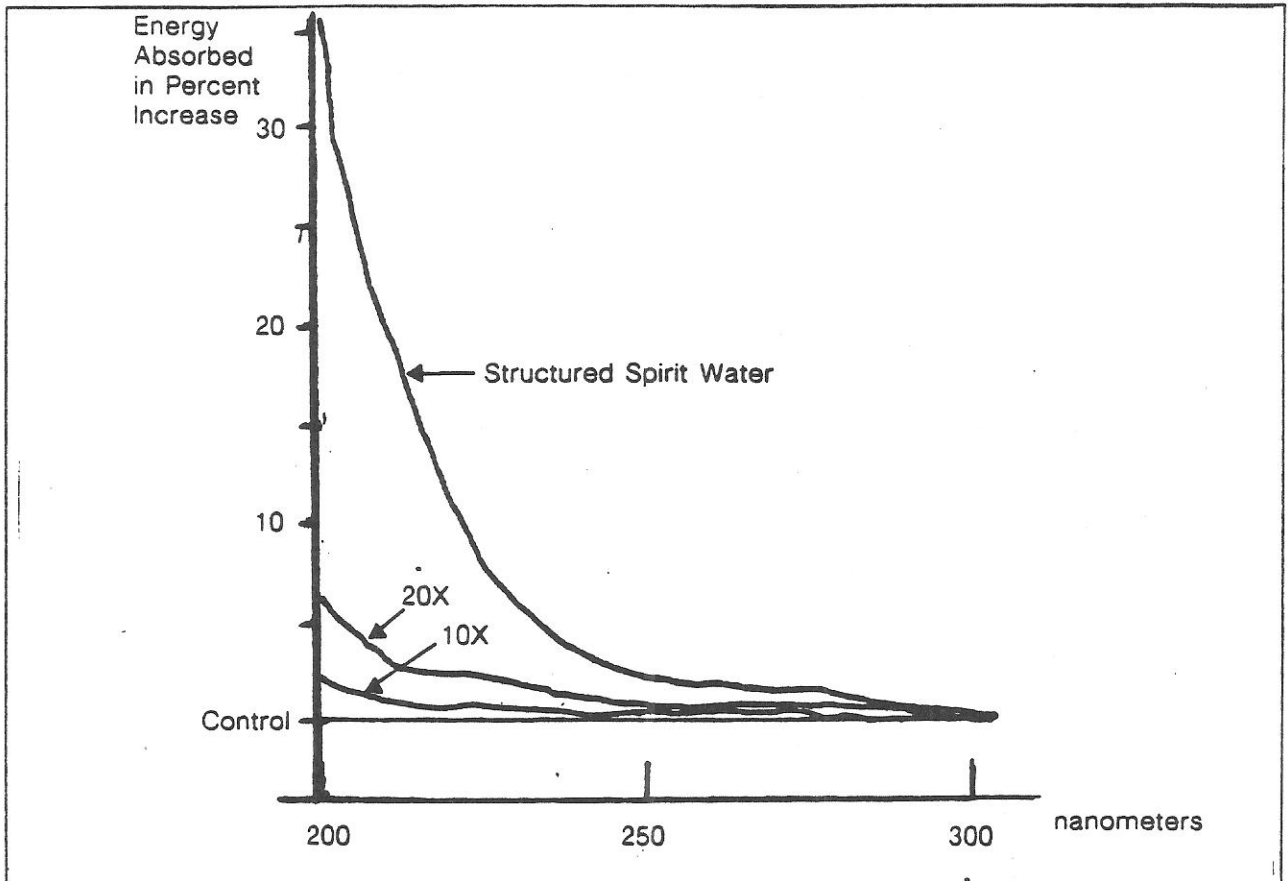


Fig. 4-20. UltraViolet Absorption Increases for Structured Water.

The graph that is shown in Fig. 4-20 shows absorption increases for the test water that are above the average. We consider this to be an example of very good structuring, as indicated by the high absorption increases of over two percent at ten times through the device (10x), and over six percent for twenty times (20x). Most of the tests that were conducted at PRI do not show UV absorption increases that are as high as those that are shown in the graph. The average increase in ultraviolet absorption was about three percent. However, a significant percentage of the tests produced increases that were between five and ten percent, and the graph is representative of this group of tests.

Over four-hundred tests that examined the ultraviolet changes that water undergoes as it structures have been conducted at PRI. All of these tests, except those that are in the special category under SSW (Structured Spirit Water), involve spinning the water around a quartz crystal. Many, however, involve subjecting the spinning water to other physical effects. These effects and their outcomes are summarized below. All of the water that was used was purchased from a bottled water company, and was charcoal filtered and deionized down to 3-5 ppm (parts per million).

1. Spinning water through a device with no crystal present showed a UVA (ultraviolet absorption) increase of 1% in 42 experiments.



2. Spinning water through a device with a four-sided healing crystal present showed average UVA increases of 2.5% in over 120 experiments.
3. Spinning water around crystal while a Xenon strobe was used showed a UVA increase of over 3% in 35 tests.
4. When the test water samples were measured in a plastic cuvette for 12 experiments, instead of the normal quartz cuvette, a decrease in UVA occurred in every experiment. This seems to indicate that water is compatible with quartz but not with plastic.
5. Spinning water around crystal with a solid 3.5 million gauss permanent magnet attached to the crystal showed no increase in UVA in 45 experiments until 15x or 20x was reached, and then an average UVA of 2% - 3% was produced.
6. Spinning water around crystal and a small ring magnet for 15 experiments, with or without a Xenon strobe, showed the same UVA increases as if no magnet were present.
7. Subjecting the crystal to a bulk demagnetizer for one minute before it was placed in the device showed average (2%) UVA increases for the water that was structured in 10 experiments.
8. Water that had been boiled before being structured showed good UVA increases of 4% average in 32 experiments. UVA rates of 9% occurred in two of the tests.

In the following experiments, the test water was not spun around a crystal, but was instead exposed to two different types of energy:

9. Water that was exposed to Kiva and Vita Lights, which are high in their emission of UV radiation, showed an increased UVA of 1% in 25 experiments.
10. Water that was treated through meditation, prayer, and singing, called "structured spirit water" (SSW) showed the highest UVA ever measured in our lab. In a series of 12 tests, UVA rates from 10% to 16% were measured, with one test showing a maximum UVA increase of 40%. For further information, see the section under "Structured Spirit Water."
11. Water that had a .01% solution of silicic acid added to it showed an average UVA increase of 4% in 12 tests.

### Failed Tests

In about eighty-five percent of the PRI ultraviolet tests there was an increase in the UV energy that was absorbed, but there was an apparent breakdown in the structuring process in the remaining tests, which either showed no increase in absorbed energy, or a decrease in absorbed energy. A test is judged to have failed if there is a UVA increase of less than one percent. Despite this criteria, it is sometimes difficult to decide whether a test sample of water has failed to structure. Out of the over four hundred structured water experiments that were examined and compiled for this report, about sixty fall into the category of failed tests.

These breakdowns are of concern to us, and a closer examination of these experimental failures led us to postulate the theory that the structuring of water is influenced by the mental and emotional condition of the experimenter. This may seem as if it is an ad hoc theory that has been devised to explain away our experimental failures, however, when we examined a set of experimental results that

all showed a failure to structure, we discovered that they had been conducted when the researcher who was performing them was suffering from a severe toothache. There is at least the possibility that the emotional and mental distress that this condition was causing him was also affecting the structuring process.

If the mind and emotions of an individual are able to influence the structuring of water, then this substance must be highly sensitive to the very low energy fields that the human body produces. We have been able to measure the magnitude of these fields on a standard voltmeter. If the wire leads of the voltmeter are connected to some type of dielectric substance such as a crystal or a plant leaf, the meter will register the voltage level of the body as these pick ups are brought close to the body. We have found that at distances of between one and two feet, the voltage level of the human aura or energy body can be as high as one-half volt. This voltage can vary a great deal from person to person, as it is a product of the physical vitality of the person that is being tested.

The fact that the voltage or energy level (voltage is a measure of electrical energy) of an individual's energy body can be measured does not mean that this quantity in itself can be used to determine the emotional or mental state that the individual happens to be in at that moment. We believe that this would require a far more subtle measurement than voltage. The measurement of mental and emotional conditions may be related to the changes in voltage that the body is constantly undergoing. We have noticed in our work that the voltage level of the aura is in a constant state of change of flux. It will rise to a certain maximum level of positive voltage, and then fall to an equal level of negative voltage. This indicates that the body's voltage level is not only undergoing changes in magnitude, but is undergoing changes in polarity as well. It appears that one side of the body will build up to a certain voltage level and then it will quickly drop to zero, only to build up to the same level but with an opposite polarity. The polarity reversals can probably be quantified in terms of frequency, that is, they must occur at certain rates or frequencies. We hope someday to be able to measure these frequencies.

If the body's voltage (energy) level has specific rates or frequencies, then it is possible that these frequencies are in turn related to the frequencies that can be found for the proton movements throughout a group of structured water molecules. It is possible that the body's energy changes are imprinted upon, and carried by, the water molecules that are found in the body. If, in turn, these energy and voltage changes are related to emotional and/or mental changes, then we can further postulate that the water molecules in the body carry the informational content or the memory of these emotions. If this is the case, then we can understand that emotions will have an effect upon the condition of the water that is found in the body, and that these same emotions can also affect the entire body.

These are some interesting although indirect evidence for the validity of this theory. A great number of cultures have the tradition of the ceremonial sweat, where members of the tribe or group will take prolonged steam baths. Among the North American Indians, there is a belief that these sweats have the effect of "renewing" the person's energy and of canceling out the negative or "evil" spirits that have invaded the person. These evil spirits could be no more than the negative emotional experiences that have been imprinted or stored on the structured water that is in the person's body. When this water is sweated out of the body, these imprinted patterns are removed and the person feels better because of this.

## Infrared Results

The most important frequency bands for the water molecule, and those that have been studied the most in the existing literature, are in the infrared (heat) portion of the spectrum. Water is very

sensitive to heat, and the frequencies at which this energy is absorbed by the water molecules are subject to a great deal of change and variation as the temperature of the water is lowered and raised.

As the temperature of water is changed, very definite and well known changes appear in the spectral pattern of water. As the temperature is lowered, certain frequencies decrease while others increase. Generally, all of the frequencies that are associated with the intermolecular bonding of the water molecule, such as the symmetric, asymmetric, and deformation vibrations, will decrease, and all of the frequencies that are associated with the intramolecular bonding within one water molecule will increase. Fig. 4-21B shows where the maximum absorption of infrared energy occurs for water at specific temperatures. The frequency range is between  $2800\text{ cm}^{-1}$  and  $3800\text{ cm}^{-1}$ . " $\text{cm}^{-1}$ " is the number of waves per centimeter (cm). It is referred to as the "wave number" and is used when the infrared frequencies of the spectrum are being studied.

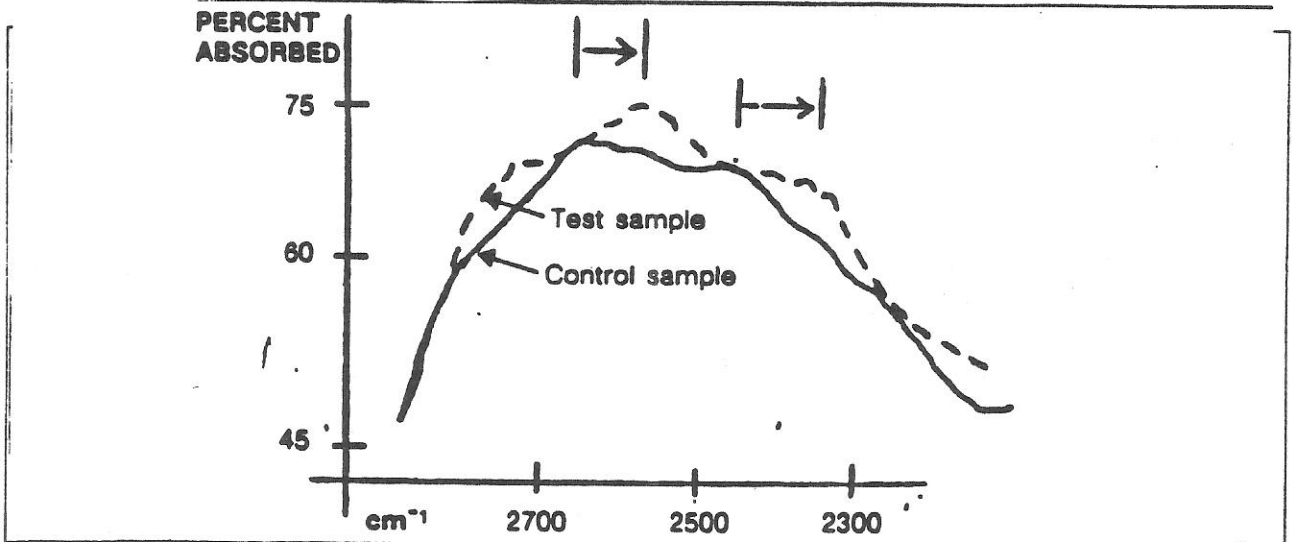
As the temperature of water decreases, the maximum absorption peaks for infrared energy shift in the direction of lower frequencies. This phenomenon is referred to as the infrared shifting of the spectrum for water. The frequency difference that exists between the successive peaks that are shown in Fig. 4-21B are known as the "phase shifts" or "phase changes" that the water molecules are undergoing as their temperature is decreasing.

We have been able to produce phase shifts that normally only occur in water that has had its temperature lowered, in the water that we have structured in our lab at PRI. By reproducing these shifts in water that has been spun about a quartz crystal, we have produced in the water an "icelike" condition without resorting to icelike temperatures. The physical interaction that occurs between the spinning water and the stationary quartz crystal produces the structured water chains or microstates which have, as one of their physical properties, a lower temperature than the surrounding water. This is the reason that the Russian researchers have referred to structured water as having physical qualities that are icelike in nature.

We have measured the infrared spectrum between  $400\text{ cm}^{-1}$  and  $4000\text{ cm}^{-1}$  for over 125 samples of water that had been structured. The same experimental protocol that was used for the UV experiments was also used for the IR experiments. The sample of control water was first measured for the percentage of energy that it absorbed over the tested frequency range. Another sample of identical water was then structured and it too was measured on the IR spectrophotometer for absorption at specific frequencies. The printout for the test sample was superimposed over that of the control sample, so the two could be easily compared for changes in absorption rates and for changes in the frequencies of maximum and minimum absorption of infrared energy. These latter changes are the phase shifts that indicate the formation of an icelike state.

Over fifty percent of the samples that had their infrared spectrum measured showed significant phase shifting in the region that lies between  $2300\text{ cm}^{-1}$  and  $2800\text{ cm}^{-1}$ . This is in the frequency range where the minimum absorption of infrared energy occurs in water. It has been found that the phase shifts that occur here are the same as those that occur in the frequency range of the maximum absorption of energy. Fig. 4-21B shows the maximum absorption range and Fig. 4-21A shows the minimum absorption range for the water molecule. The curves that they trace are almost identical, however, they have scales that are opposite to one another.

Fig. 4-21A shows an example of good structuring and phase shifting for a sample of water that was structured in the P.R.I. lab. The phase shifts that occur as the control sample is structured into a test sample are shown as arrows that occur between the peaks of the graph. These peaks are shifting in the direction of the infrared as the control sample is structured into a test sample. These phase shifts are actually heterodynes of the control and test frequencies, that is, these two frequencies are subtracted from one another to obtain the value for the phase shift.



Infrared phase shifts (arrows) are produced as water is spun five times around a quartz crystal. Test sample was subjected to a Xenon strobe light.

Fig. 4-21 A. Infrared Phase Shifts.

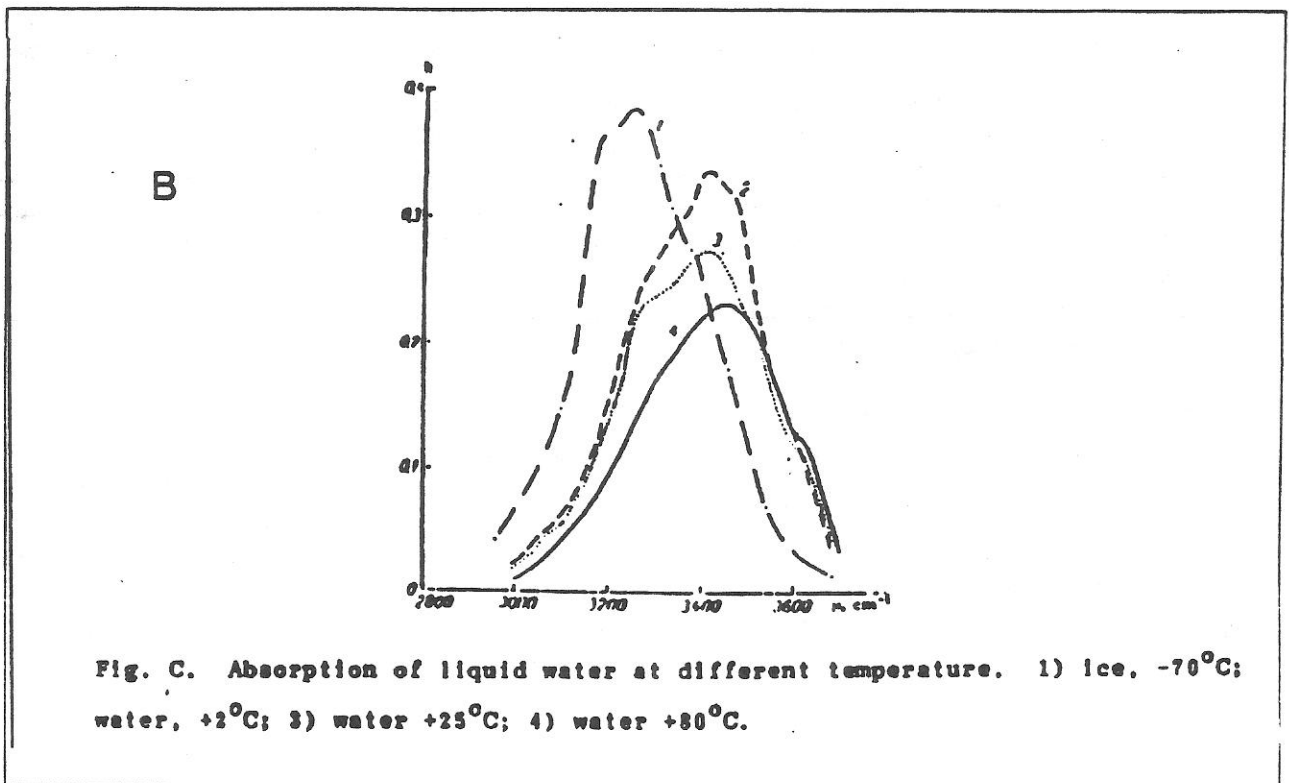


Fig. C. Absorption of liquid water at different temperature. 1) Ice,  $-70^{\circ}\text{C}$ ; water,  $+2^{\circ}\text{C}$ ; 3) water  $+25^{\circ}\text{C}$ ; 4) water  $+80^{\circ}\text{C}$ .

Fig. 4-21B. Absorption of Liquid Water at Different Temperatures. 1- Ice,  $-70^{\circ}\text{C}$ ; 2- Water,  $+2^{\circ}\text{C}$ ; 3- Water,  $+25^{\circ}\text{C}$ ; 4- Water,  $+80^{\circ}\text{C}$ .

The heterodynes that are produced by the structuring of water are most likely related to those that were discussed in the previous section on the formation of the microstate. We have found that their values lie between  $40\text{ cm}^{-1}$  and  $120\text{ cm}^{-1}$ , which is in the frequency range of the lowest intramolecular frequencies that occur for a single water molecule. These vibrations occur at about  $60\text{ cm}^{-1}$ . Apparently, the phase shifts which are produced during microstate transitions are able to resonate with the frequencies of a single water molecule, and as such are in resonance with all of the water molecules that are found in the sample of water. This resonance is also reinforced by the symmetric vibrational mode of the microstate, which has the effect of increasing the amplitude of the intramolecular vibrations of the water molecule. These low frequency vibrations are characteristic of the rates or frequencies of the translocating (moving) protons that were discussed in a previous section.

It appears that one of the characteristic features of the formation of the lyotropic mesophase is the production of low frequency vibrations that occur in:

1. the phase shifts of the infrared spectrum of the mesophase;
2. the phase transition rates for the mesophase;
3. the proton migration rates;
4. the intramolecular vibrations of a single water molecule.

Most of these features are unique to the mesophase, as they do not occur in ordinary or bulk water. Number one (1) does not occur in bulk (unstructured) water; number two (2) occurs in bulk water but at much higher rates (see Fig. 4-17); number three (3) only occurs in unstructured water to a very small degree; number four (4) does occur in all water molecules, but in unstructured water it is a singular, isolated effect that is not related to, and does not occur along with the other effects.

Our study of the infrared changes for the structured water molecule is by no means complete. In almost half of the tests that were conducted, no IR phase shifting occurred for the water sample. We have noticed that these phase shifts tend to develop after the water has been allowed to sit in the open air for a period of several hours. During this time period, there is some degasification of the water, and it is likely that the phase shifts are related to this phenomenon. One of the changes that occurs in structured water is that of ionization. A large number of the water molecules are ionized into hydrogen and hydroxyl ions. The latter attach themselves to the water chains while the former move throughout the chained structures. It is likely that the process of chain formation occurs over a period of time, in other words, the chains do not form immediately, but instead require some period of time for their formation. While this is happening, certain gases that are not compatible with the water chains, such as carbon dioxide, sulfur dioxide, and nitrous oxide, leave the water solution through degasification or evaporation, while the gases that are compatible with the chains, such as oxygen, remain in the water and attach themselves to the water chains. These chemical changes occur over a period of time. If the IR phase shifts for structured water do not occur until to processes of degasification and oxygen fixing have occurred, then they could not be immediately measured on the IR spectrophotometer. Obviously, a great deal of further experimentation is required before the exact relationship between the structuring process and the process of degasification and oxygen fixing is known.

If the IR phase shifting for structured water is time related and the UV absorption is not, then we have a reason for the inconsistency of the former and the consistency of the latter. The structured water molecules are able to absorb greater amounts of ultraviolet energy as soon as they have been structured, and this can be readily measured on the UV spectrophotometer, while these same molecules cannot go through their IR phase shifting process until a certain amount of degasification has taken place, so this process is time-dependent, and any measurements of the IR spectrums of the structured water that is performed before the degasification process is allowed to take place will not show the IR phase shifts.

## Structured Spirit Water

When Marcel Vogel was in Germany in the summer of 1987, <sup>ok</sup> ~~he obtained a bottle of water~~  
~~from THE TAP.~~ In the period from June 3 to June 6, he had the group of people that he was instructing charge this water in ceremonies that involved singing, meditating, praying, listening to instructions, and observing demonstrations. These combined activities apparently caused the water to go into a structured condition. When Marcel returned to his lab in California, he had samples of the water measured for changes in UVA. The results of this experiment are shown in Fig. 4-20.

This water, which we have labeled "structured spirit water" (ssw), shows the highest UVA increase of any sample of water that we have ever tested, almost 40% in one test. This test intrigued us, so we obtained another sample of water that had been treated by someone else in a ceremony that involved meditation and prayer. We tested this sample for increases in UVA, and discovered that it too had a much higher-than-normal value of 16%. We diluted both of these waters and remeasured them and found that although their UVA increases had declined, they were still at unusually high levels.

We did not perform enough tests on water that was structured by use of the "spirit" forces or powers of an individual or group of individuals to state categorically that these UVA increases are in fact repeatable and valid, however, our work does not stand alone, as other scientists have studied the infrared changes that various "healing" waters have undergone when they were treated by the practice of the laying-on-of-hands.

A well-known healer, Olga Worrall, was asked to "charge" some water with her hands. After she did this, the water was measured on an IR spectrophotometer for any changes in absorption patterns. The results of these measurements were fairly conclusive. They showed a small but definite change in the IR spectrum for the water that she had treated. The treated water had developed phase shifts in the infrared that were similar to those that were produced in our lab during the process of structuring water with a quartz crystal. A change in surface tension and bond formation times also occurred in the water samples that were treated by the healers. Our work with structured spirit water was confined to studying the changes in UVA, while the studies that were performed on the water that had been treated by healers involved IR changes. Despite this fact, there appears to be enough similarity between the two sets of experiments to state that they were both probably measuring the same physical phenomena.

Previously, it was stated that the connection between the emotions and the body lies in the information that is imprinted upon the water molecules that are found in the body. The connection between the mind and the material body may lie in the electron spin alignments that control the process of crystallization and produce crystals. Finally, the connection between the spirit and the body may lie in the permanent programs that are in the atomic nuclei of all atoms. The proton spin rates and alignments may be a product of these spin rates, and changes in these rates may be able to alter the nature of the atomic nucleus and of the atom that it is a part of. It is interesting to note that the proton too has a spin orientation that is close to the interlattice angle of the quartz angle. All protons, when influenced by magnetic fields, tilt over to an angle of  $51^\circ$  and begin to rotate. Their rates of rotation are proportional to the strength of the magnetic field. No one knows why all protons tilt to this angle, but it is close to the angle of the quartz crystal, and is equal to the one-seventh phase angle of  $51.43^\circ$  that is produced by dividing the circle of  $360^\circ$  by the number seven. This wave is formed when amorphous molecules and atoms are suddenly aligned into crystalline structures.

## Conclusions

We can only speculate on what the physical connection between mind, body, and spirit is, but it is the goal of our work at PRI to discover it, and to put these discoveries to good use in helping people to heal themselves by reintegrating their minds and bodies with their spirits. To this end, we believe that water is the vital link between the body, the mind, and the spirit, and that the study of the properties of water will be the first step in understanding the connection that exists between the material body and the subtle bodies which surround it.

The research that we have done leads us to conclude that there is a relationship between the quartz crystal and the water molecule. This relationship is based upon similarities of internal structure. When water is spun around a specially cut crystal, it develops a mutual resonance with it, and the lattice structure of the crystal is able to duplicate itself in the internal structure of the water. The solid microstate of the crystal produces a lyotropic mesophase in the water molecules, and the water becomes "structured". The transition times are the rates at which adjacent water molecules form and break their bonds to one another. These times are significantly longer for structured water than for unstructured water.

Structured water has a greater degree of ionization than unstructured water, and a greater degree of internal symmetry as well. The ions that constitute structured water bond into the chains or internal structures that distinguish this type of water from ordinary or bulk water. The combined effects of ionization and chain formation produce secondary changes that can be measured as increases in the absorption of ultraviolet energy and phase shifts in the infrared portion of the spectrum.

One of the ions that the water molecule breaks down into is the negatively charged hydroxyl ion. When this ion bonds to the structured water chains, it has the effect of adding oxygen to the water. Structured water is oxygen-rich water, and it can be used to remove impurities, organic as well as inorganic, from contaminated water through the process of oxidation.

The purification of water by quartz crystals will be accomplished by technologies that are not energy intensive, and will therefore be cost effective when compared with existing technologies that perform this same task. Water is currently purified by processes that consume large amounts of energy, such as the deionization process that uses electricity, the distilling process which requires the boiling of water, and the freezing process, which involves the lowering of its temperature. Even the process of charcoal filtration is costly, although less so, as the filters must be replaced periodically. The process of spinning water around a crystal will only require the energy that is necessary to lift the water to the top of the structuring device, and no filters or other replacement equipment will be necessary.

Water that has been spun about a crystal increases its rate of absorption of ultraviolet light and shows phase shifting in the infrared spectrum. However, these changes also occur in water that has:

1. had its temperature lowered
2. been treated by the laying-on-of-hands technique of people known as healers.
3. been subjected to ceremonies involving singing and meditation.
4. been extracted from living tissue.

The procedures that were described in numbers 2 through 4 above indicate that water can be altered into an "icelike" condition without the imposition of icelike temperatures. The change-of-state or mesophase that water undergoes as it moves from the liquid to the solid state can be found in water that has been subjected to these other physical effects and conditions.

The fact that water that is having its temperature lowered, and water that is being treated by healers, are undergoing the same changes, seems to indicate that this substance is capable of linking the material world of the atom, as seen in the mesophase transition from water to ice, with the non-material "thought-forms" that are the product of human thought and emotions, as witnessed in the ceremonies that link the individual to his higher or soulic nature.

A possible theory that describes this link between the soul and the body follows: The thoughts and emotions of individuals are first imprinted upon the body's liquid crystal molecules, such as the organic fats and cholesterol, and from here they are transferred to the structured water molecules that can be found within the body. This occurs whenever water molecules come into contact with organic molecules. This is the reason that the water that the Russian scientists derived from living tissue was highly structured, as they were able to measure phase shifts in the IR spectra and a depressed freezing point. After water has been imprinted with the signals that constitute the emotional and mental reactions of the body, it is reprocessed and reordered by the lymphatic system, and then circulated throughout the body in the bloodstream. The bloodstream carries these water molecules to many of the cells in the body, and the signals can be transferred to, or imprinted upon, these cells when the water molecules come into contact with them.

Structured water is of great importance to the body. If unstructured, "dead" water is taken into the body, then it must be put into a structured condition by the body's organic molecules, and this could become a burden to them, or possibly, the unstructured water is capable of bringing information (in the form of signals) to these molecules. These signals may be the basis of the spontaneous remission of serious illnesses such as cancer. Structured water may be capable of erasing the aberrant growth programs that produce cancer, and of restoring a normal pattern of growth to the body's cells.

Ultimately, a theory that would adequately explain the existence of structured water would also explain the connection between mind and matter, and would help support the philosophy of mind over matter as well. The medical sciences that currently explain the functioning of the body do not recognise that there is a direct physical connection between the thoughts of an individual, the emotional reactions that are produced by these thoughts, and the effect of these reactions upon the cells of the body.

We describe the physical processes of the body in terms of chemical reactions, but a far deeper and more significant level exists. The first level below that of the chemical reaction is that of the electrochemical reaction, the quantification of the body's chemical changes in terms of electrical changes. At this level, chemical reactions are described in terms of ion exchanges at certain voltages. The phenomena of proton translocation and hydronium ion formation are examples of electrical descriptions of chemical reactions. At an even deeper level, gross electrical measurements can be further refined into the times or rates of chemical reactions, and the energy exchanges that occur during these times. An example of this would be the proton translocation rates or frequencies that were discussed earlier in this paper. But the level below that of frequency would be the specific nature of the information that was encoded upon these frequencies. This is where we would finally approach the level where the mind influenced the cells of the body.

The frequencies of energy that motivate the cells of the body are composed of billions of other frequencies that have been modulated onto the initial frequencies, and billions of others in turn that have been modulated onto these frequencies. As these many frequencies oscillate through the organic molecules in the body, they would tend to stand still within the structure of these molecules. As they did this they would produce a standing wave within the molecule. Certain frequencies within this wave would have nodes (points of maximum amplitude) at certain locations within the molecule, and these locations would define points in space that would constitute the nodal structure of the molecule. This nodal structure could then be likened to the structure of



a crystal, where specific angles exist between atoms, and the atoms are organized into definite geometrical structures such as the six-sided quartz crystal.

Once we have reached the level of geometry, form, and structure, we are at the level of the spirit, or rather, the manifestation of the spirit into matter. This form can be seen in its simplest form in the electromagnetic spectrum of every atom and molecule, as each substance has a frequency pattern or spectrum that is unique to it and it alone. The simplest spectrum is that of the simplest atom, hydrogen, which consists of one proton and one electron. Very complex organic molecules, with thousands of atoms, would have very complex spectrums. The mind, with its output of billions of frequencies from its billions of cells, would influence these organic molecules, with the water molecule acting as a portable magnetic tape unit that recorded these frequencies and distributed them to the other organic molecules that make up the body's cells.

We know that many of the ideas that we have put forth about the relationship between the quartz crystal and the water molecule, the water molecule and the body's organic molecules, and the organic molecules and the thoughts and emotions that people have are theoretical in nature. We hope that they become food for thought for the many scientists that must eventually take on the task of researching and discovering the relationship between the crystal and the human body.

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