

# INFRARED SPECTRA ALTERATION IN WATER PROXIMATE TO THE PALMS OF THERAPEUTIC PRACTITIONERS

Stephan A. Schwartz,<sup>1#</sup> Randall J. De Mattei,<sup>2</sup> Edward G. Brame Jr.<sup>3</sup> and S. James P. Spottiswoode<sup>4</sup>

Through standard techniques of infrared (IR) spectrophotometry, sterile water samples in randomly selected sealed vials evidence alteration of infrared (IR) spectra after being proximate to the palms of the hands of both Practicing and Non-practicing Therapy Practitioners, each of whom employed a personal variation of the Laying-on-of-Hands/Therapeutic Touch processes. This pilot study presents 14 cases, involving 14 Practitioners and 14 Recipients. The first hypothesis, that a variation in the spectra of all (84) Treated spectra compared with all (57) Control spectra would be observed in the 2.5–3.0  $\mu\text{m}$  range, was confirmed ( $P = .02$ ). Overall, 10% (15) of the spectra were done using a germanium internal reflection element (IRE), and 90% of the spectra (126) were done with a zinc selenide IRE. The difference in refractive index between the two IREs skews the data. The zinc selenide IRE spectra alone yield  $P = .005$ .

The authors believe the most representative evidence for the effect appeared in the sample group of Treated vs Calibration Controls using the zinc selenide IRE ( $P = .0004$ ). The second hypothesis, that there existed a direct relationship between intensity of effect and time of exposure, was not confirmed. This study replicates earlier findings under conditions of blindness, randomness, and several levels of controls. Environmental factors are considered as explanations for the observed IR spectrum alteration, including temperature, barometric pressure, and variations dependent on sampling order. They do not appear to explain the effect.

**Key words:** Infrared spectra, therapeutic intent, hydrogen bonding, healing, water

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## INTRODUCTION

Studies by researchers in a variety of disciplines, notably by biologist Bernard Grad at McGill University<sup>1</sup>; biochemist M. Justa Smith at Rosary Hill College and Roswell Park Cancer Hospital<sup>2</sup>; physicist Elizabeth Rauscher at University of California, Berkeley<sup>3</sup>; and psychologist Carroll Nash of St. Joseph's University,<sup>4</sup> reported increased vitality in Treated sub-populations of cell colonies, enzymes, and seedlings in comparison with controls. In each study, treatment consisted of some variation of an historical technique known as Laying-on-of-Hands, or a modern nursing program known as Therapeutic Touch. Critics argue, however, that the high variability of living systems, rather than the independent variable of therapeutic intent being studied, may account for the positive results reported in such experiments. Work done by Grad using near-infrared (IR) spectrophotometry has suggested a possible avenue for research defensible against such criticisms.<sup>1</sup> Dean and Brame<sup>5</sup> continued that line of research, and their results supported Grad's findings.

This earlier research suggests the existence of an objectively measurable infrared (IR) signature which is independent of measurements on living systems. However, the work has not been uniform in methodology or controls, making cross-study correlations and comparisons very difficult. Some of the work has also been subject to methodological criticism, i.e., how the bottles were filled, and whether tap water, used in several instances, could contain substances that might produce the effect. This pilot study incorporated such criticisms into its design to test the initial findings and, if they held up, to establish a database of sufficient size to guide future work.

The IR portion of the electromagnetic spectrum was selected for monitoring, based on the assumption that, although we do not know the mechanism, what we are observing is a change in the oxygen–hydrogen (O–H) bonding. The state of O–H bonding is best observed in the infrared where the fundamental stretching frequency occurs,<sup>6</sup> although earlier research suggests that overtones and combinations of overtones of the phenomenon occur at higher frequencies up to the ultraviolet (UV) region.<sup>7</sup> Because these UV bands are overtones, they are weaker and less clearly defined.

What exactly is the physical parameter being measured in these studies and what is known about the physics of the system giving rise to it? We provide a brief sketch of infrared spectroscopy and its use for determining the structure of water.

1 Distinguished Consulting Faculty, Saybrook University.

2 Senior Researcher, Mobius Society.

3 Dr. Brame is deceased.

4 Chief Scientist Geonet Technologies.

# Corresponding author. Stephan A. Schwartz, P.O. Box 905, Langley, WA 98260, USA.

e-mail: saschwartz@earthlink.net

The infrared is a region of the electromagnetic spectrum or range of frequencies of electromagnetic oscillations. For any frequency of radiation, there is a corresponding wavelength; shorter wavelengths correspond to higher frequencies. Frequency is usually measured in waves per centimeter ( $\text{cm}^{-1}$ ) and wavelength in micrometers. The infrared portion of the spectrum extends from  $2.0\ \mu\text{m}$  (5000 wave numbers) to  $16.0\ \mu\text{m}$  (625 wave numbers). This experiment focused on the  $2.5\text{--}4.0\ \mu\text{m}$  range (4000–2500 wave numbers).

Substances absorb electromagnetic radiation at specific frequencies, and these features of their spectra are called absorption bands. Such absorption of energy occurs when the frequency of the radiation coincides with the natural frequency of oscillation of some part of the molecular structure of the substance. This is an example of resonance and the infrared is of particular interest because many chemical bonds have resonances, and hence absorption bands, in this region. For instance, the frequency of the fundamental stretching oscillation of the covalent bond between the oxygen and hydrogen atoms in a water molecule occurs in the infrared region at a frequency of  $3400\ \text{cm}^{-1}$ .<sup>8</sup>

The covalent bond, however, is only one of two distinct types of chemical bonding present in water. So-called hydrogen bonds also exist between molecules in close proximity. These hydrogen bonds, although much weaker than covalent bonds, still exert considerable influence on the properties of water at ambient temperatures and pressures when the thermal energy of the molecules is comparable to the hydrogen bond energy (Figure 1).

The fundamental stretching frequency of the O–H bond in water is particularly affected by the amount of hydrogen bonding, and considerable literature exists on the exact shape of this absorption band. Discussion of this subject though is carried out within the context of one or another of two broad classes of models of the structure of water: (1) mixture and (2) continuum.<sup>9</sup> In mixture models, it is assumed that hydrogen bonding between single water molecules (monomers) groups them into dimers (two linked), trimers (three linked), and so on up to higher analogs. Thermal agitation causes breaking and reforming of the hydrogen

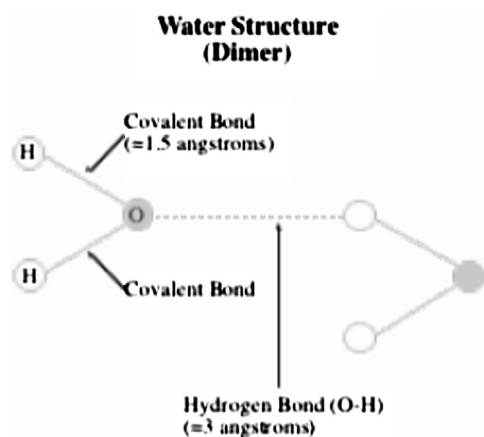
bonds in these groups, and a dynamic equilibrium exists among these multi-molecular species and single water molecules at a given temperature and pressure. In contrast, in continuum models, it is proposed that all possible hydrogen bonds are formed but that there is a range of bond strengths.

Regardless of the explanatory model employed, the absorption occurring at this frequency is very intense, and it can only be studied in thin films of liquid or by reflection methods. Thin-film transmission techniques are technically more difficult than those used in reflection, which has an additional advantage. Reflection methods, particularly the multiple internal reflection (MIR) method used in this study, measure absorption in the thin layer of molecules near the surface of the liquid. In terms of the mixture model, it is here near the surface that the smaller molecular species of water molecules, monomers, dimers, and trimers, are concentrated. These smaller molecular species contain a higher percentage of unbonded O–H groups than is found in higher analogs.

The earlier research suggests that the alteration produced in water samples acted upon by Therapeutic Practitioners affects the hydrogen bonding, either by changing the strengths of the bond, as in the continuum model, or by affecting change in the proportion of hydrogen bonded molecules, as the mixture model would have it. Whichever model is used to explain these changes, IR internal reflection spectroscopy is particularly sensitive to O–H variations and is the appropriate technique for this measurement. We should also note that there is a possibility that what we are seeing is an entirely different interaction that happens to present itself in the infrared at the same frequency as the O–H bonding. It is, however, likely that the observed effect is a result of O–H bond changes rather than some unknown influence which happens to generate a similar absorption band.

In this experiment, the beam of infrared radiation used to measure the absorption reflects off the interface between a substance of very high refractive index and the liquid water, which has a lower refractive index. When this occurs, the electromagnetic wave penetrates a very short distance into the material of lower refractive index. To minimize this distance, in which the absorption is being measured, it is desirable to use the largest angle of incidence relative to the perpendicular and to have as high as practical a refractive index in the internal reflection element. Since the penetration depth can be made very small by these techniques, on the order of a single wavelength of the infrared radiation, the absorption incurred during each reflection is slight. Therefore, it becomes essential that the infrared beam undergo many reflections and absorptions in order to accumulate an easily measurable total absorption. The MIR unit used in this study routes the infrared beam through 25 reflections.

With these considerations in mind, and in view of the earlier research on Therapeutic Touch effects on the IR spectrum of water, we attempted to design an experiment that would show the largest obtainable effect and measure it accurately and reliably. The Practitioners were motivated by placing them in a real healing session. The design of the experiment incorporated multiple levels of controls and produced a data set of sufficient size and consistency for statistical evaluation.



**Figure 1.** The water structure of two linked molecules, called a dimer. It is the hydrogen bond that is presumed to be affected.

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