Part I — Soft tissue memory

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In Swann's Way, a taste of a small cake, a petite Madeleine, causes Marcel Proust to be flooded with memories from his past. At first he is baffled, but he then remembers his aunt giving him Madeleines when he was small. Obviously, the association triggered his memory.

Most of us have had similar experiences, in which a glimpse of some long-forgotten place or object, or a particular odor, taste, sound, or even a movement, elicits the recall of a scene from our distant past. This article concerns a related phenomenon that is frequently experienced by massage therapists and other bodyworkers.

Massage therapists, acupuncturists, Rolfers and other somatic practitioners frequently report uncanny experiences in which vivid images flood into their consciousness as they are working on some part of a client's body. Sometimes there is a transient sensation that "something has happened" within the body they are touching. An avalanche of detailed sensory material may be triggered. The images may be so striking that the practitioner asks the client about them, only to discover that their client is simultaneously having a similar or identical "flashback." Rolfer Randy Mack describes this as "the recall of deeply repressed, highly charged emotional material with full sensory detail, possibly including visual, auditory, tactile, gustatory, and olfactory components."

Practitioners who repeatedly have these "somatic recall" experiences with their clients begin to suspect that "memories" of traumatic or other events may be stored in or accessed by the soft tissues of the body. Sometimes the "flashback" is associated with erasure of the memory. When this happens, the emotional "charge" surrounding the memory may disappear. The client may even forget, by the end of the session, that the recall occurred. In other cases, the recollection begins a therapeutic process that resolves the associated trauma, pain, or psychological attitudes. In other instances, the "flashbacks" may occur a day or two after a session of massage or other bodywork.

It has long been recognized that our individual memories shape our sense of who we are as well as what we do and how we do it, on a moment to moment basis. Our personal identity, our comprehension of the world around us, our place in that world, what we can and cannot accomplish, our every act and decision—all are referenced to what we have learned and remembered. If these references are to traumatic past experiences, and to the resulting pains, fears, angers, judgments, secrets, mis-truths, guilt, narrow attitudes or beliefs, our physical and behavioral flexibility are limited. Freedom of movement and thought, and awareness of what is happening inside and outside of us are compromised. To the extent that our mental lives influence our physical bodies, and vice versa, any therapeutic practice that has an effect on memory can have a profound, dynamic, and multidimensional influence on every attribute of the organism.

The study of memory and consciousness are among the most fascinating and controversial topics for scientific inquiry and somatic exploration. Reports that touching someone can release memory traces and even communicate them to another person are of great interest. Of course, conventional science labels such experiences as anomalies or hallucinations, as they do not fit with our normal theories about how the brain and nervous system work. However, we have talked to enough practitioners who report similar experiences that we have come to regard somatic recall as a frequently occurring phenomenon. Some massage therapists have these experiences daily. Not only is somatic recall widespread, but we think it is an important clue about unsolved mysteries of learning, memory, consciousness, the ways parts of the body communicate with each other, and the effects of touch.

In this two-part essay, we explore somatic recall in the light of recent progress in biophysics and cell biology. New discoveries are pointing to a simple yet scientifically logical explanation for a variety of phenomena relating to massage and other kinds of bodywork. The emerging concepts have far-reaching implications for scientific and philosophical inquiries into the nature of consciousness, and for a variety of approaches to the body. (This article is a summary. For a more thorough treatment, see our other recent articles.)

An expanded view of the living matrix

For a number of years we have been exploring the molecular anatomy of the body from a new perspective. Papers published in 1981 and 1984 showed that the connective tissue, the basic construction fabric of the organism, is continuous with the cytoskeletons of cells throughout the body. The cytoskeleton is the molecular scaffolding that gives each cell its characteristic shape and ability to move about. Our new view arose from an important discovery made by a number of cell biologists. The fibers and filaments that form the cytoskeleton do not end at the cell surface. Instead, they extend across the cell membrane, and connect to the extracellular fabric, classically referred to as connective tissue. Linking the two
systems together are molecules called glycoproteins, anchor proteins, integrins, and cadherins, as well as calcium ions and sugar-rich proteins called proteoglycans. [Fig. 1]

Inside each cell, elements of the cytoskeleton attach to the nuclear envelope, and therefore connect to another matrix, called chromatin, that fills the nucleus and envelopes the DNA. Even the mitochondria, the tiny “powerhouses” within cells, contain matrices. [Fig. 2]

Hence the body as a whole, the organs, tissues, cells, organelles, including the nucleus, and the strands of genetic material, DNA, can be viewed as a continuous and unbroken fabric: a matrix within a matrix within a matrix. We refer to this continuum as the connective tissue/cytoskeleton/nuclear matrix, or, simply, the living matrix. Pienta and Coffey, at Johns Hopkins University School of Medicine, refer to it as a “tissue tensegrity-matrix system.” They use Buckminster Fuller’s word “tensegrity” to emphasize the fact that the human body is a continuous network of tensional elements (ligaments, tendons, fascia, muscles, and cellular microfilaments) with discontinuous compressional elements (bones and cellular microtubules). A fascinating aspect of a tensegrity design is that a vibration introduced at one point is quickly conducted throughout the entire system.

The living matrix gives the body its overall shape and features, defines the form of each organ, tissue, and cell, and extends into every nook and cranny of the organism. All movements are generated and conducted within this substance. The expanded view of the connective tissue provides a physical, physiological, energetic, and conceptual substrate for a communication network that extends throughout the organism. The nervous system is the most widely studied communication system in the living matrix, but it is by no means the only one.

The division of the body into organs, tissues, cells, and molecules separates the study of life into sub-disciplines. [Fig. 3] We believe the division of biomedical inquiry into areas such as physiology, cell biology, pharmacology, genetics, molecular biology, and bioenergetics has slowed our comprehension of the universal integrating principles that must exist for an organism to maintain unity of function at all levels. Chronic disorders and diseases such as cancer, AIDS, atherosclerosis, osteoporosis, stroke, and heart disease persist because our understanding of whole-system physiological integration is incomplete. The consuming and expensive search for new and profitable pharmaceuticals has closed off other potentially useful avenues of investigation. As a result, wound healing, regeneration, and recognition of self and non-self continue to be poorly understood phenomena. What they have in common is that they involve communications within the living matrix. Massage therapists and other bodyworkers have been exploring these communications for a long time and have made valuable insights about them. A partial list of pioneers in this area includes F.M. Alexander, Mantak Chia, Moshe Feldenkrais, Dolores Krieger, A. Lowen, F.A. Mesmer, B.J. Palmer, Wilhelm Reich, Ida P. Rolf, Fritz Smith, Andrew T. Still, Randolph Stone, W.G. Sutherland, and Milton Trager. Some scientists who have contributed along these lines include Robert O. Becker, Harold Saxon Burr, Valerie Hunt, Hiroshi Motoyama, Candace Pert, Bruce Pomeranz, Albert Szent-Gyorgyi, and J. E. Upledger.

Continuum communication

In terms of both massage therapy and biomedicine, the most exciting property of the tensegral living matrix is the ability of the entire network to generate and conduct vibrations. The vibrations occur as mechanical waves or sounds, called phonons, electrical signals, magnetic fields, electromagnetic fields, heat, and light. For the most part, these forms of energy obey established laws of physics that describe fields from any source. Signals are produced and distributed throughout the body because of properties that are common to all of the components of the living matrix:

1. semiconduction: All of the components are semiconductors. This means they can both conduct and process vibrational information, much like an integrated circuit or microprocessor in a computer. They also convert energy from one form to another.

2. piezoelectricity: All of the components are piezoelectric. Waves of mechanical vibration moving through the living matrix produce electrical fields, and vice versa, i.e. waves of electricity moving through the lattice produce mechanical vibrations.

3. crystallinity: Much of the living matrix consists of molecules that are regularly arrayed in crystal-like lattices. This includes lipids in cell membranes, collagen molecules of connective tissue, actin and myosin molecules of muscle, and components of the cytoskeleton.

4. coherency: The highly regular structures just mentioned produce giant coherent or laser-like oscillations that move rapidly throughout the living matrix and that are also radiated into the environment. These vibrations, called Frohlich oscillations, occur at particular frequencies in the microwave and visible light portions of the electromagnetic spectrum. A number of scientists have detected these signals (Popp and others).

5. hydration: Water is a dynamic component of the living matrix. On average, each matrix protein has 15,000 water molecules associated with it. Since many of the proteins are highly ordered, as we have just seen, the associated water molecules are also highly ordered. Water molecules are also polarized (dipoles). The living matrix organizes the dipolar water molecules in a way that constrains or restricts their ability to vibrate or rotate or wiggle about in different spatial planes. Water molecules are only free to vibrate or spin in particular directions.

6. continuity: As we have seen, the properties just listed are not localized, but are spread throughout the organism.
While we may distinguish individual organs, tissues, cells, and molecules, the living matrix is a continuous and unbroken whole.

A consequence of continuum communication is that every process taking place anywhere in the organism produces a characteristic pattern of vibrations that travels throughout the living matrix and distributes regulatory information. In terms of electronics, the signals are FM (frequency modulated) rather than AM (amplitude modulated). The frequency changes every time a cell moves or alters its shape, an organ shifts its functional state, a muscle contracts, a gland secretes, a nerve conducts an impulse, or a cell metastasizes. Transmission of vibratory signals through the living matrix imparts unity of function to the organism.

According to the continuum communication model, the living matrix creates a veritable "symphony" of vibratory messages that travel to and fro, alerting each part of the organism about the activities taking place in each other part. What we refer to as "consciousness" is the totality of these vibrations. Disease, disorder, and pain arise within portions of the vibratory continuum where information flows are restricted. Restrictions occur locally because infections, physical injury, and emotional trauma alter properties of the fabric.

The living matrix retains a record or memory of the influences that have been exerted upon it. When vibrations pass through tissues, they are altered by the signatures of the stored information. In this way, our consciousness and our choices are influenced by memories stored in soft tissues.

An important property of the living matrix is an ability to regenerate or to restore itself. Massage therapy and other kinds of bodywork facilitate these processes.

Cellular memory

In the past, memory has been attributed to the nervous system, but biologists are realizing that all cells in the body have the capacity to store information in their cytoskeletons (reviewed by Hameroff). The cytoskeleton is frequently referred to as "the nervous system of the cell." Since the cytoskeleton is continuous with all of the other molecular networks in the body, as we have seen above, memories stored within any individual cell are accessed and communicated via the living matrix.

The cytoskeleton is made up of a number of components, each of which can store and process information. Most of the focus has been on microtubules, which are relatively stiff rods. Microtubules are the structures that give each cell its characteristic shape, much like the bones which give form to the body as a whole.

Hameroff describes in detail how the microtubules can act like computers. Microtubules are made up of monomeric subunits known as tubulin. These subunits are polymerized into microtubules at specific sites known as "microtubule organizing centers." Microtubules are polymers (poly=many), formed when many identical units, called tubulin monomers (mono=one) join together. [Fig. 4]

Each tubulin monomer is polarized, and has two different ways of fitting into the polymer. Additional proteins, called "microtubule associated proteins" or MAP's, can attach to the microtubule. Information is stored by the orientation of the tubulin monomers and by the position of attachment of the MAP's. The result is a record of the conditions in the cell and in the environment at the time of microtubule assembly. [Fig. 5]

Remarkable studies have used immunogold tracers that stick to proteins attached to the microtubules. Because of its density, the gold shows up in the electron microscope. This method reveals a variety of different patterns of MAP's attached to microtubules (Burns and others). [Figure 6] shows two different patterns of MAP's, representing two different sets of information, attached to microtubules.

Hameroff describes how the patterns of microtubule subunits form "information strings" comparable to those in the word processor we are using to write this article. In the computer the information is stored on a magnetic medium in the form of a series of magnetic particles that can be oriented in either of two polarities, "north-south" or "south-north." The disk drive can read these digital "character strings" and reproduce the sequence of letters and words of our manuscript. Similarly, information is stored as the orientation of tubulin monomers along microtubules. The information is in strings that can move along the microtubules. In nerves, very long microtubules and associated neurofilaments can function as devices that are known in computer terminology as string processors (Jablonka).

Erasing memories and releasing toxins

I can erase the character strings in my computer disk drive with a magnet that turns all of the magnetic particles to the same orientation. The information stored on a microtubule can be erased by depolymerizing it (making it fall apart) into its monomeric units.

Depolymerization of microtubules occurs every time a cell divides. In essence, the cytoskeleton falls apart temporarily so the DNA can replicate and the daughter cells can separate. When this happens, all of the information encoded as the direction of orientation of tubulin monomer units and as patterns of MAP's, is lost. Obviously, tissues whose cells divide rapidly, such as in the digestive tract, cornea, and skin, will not be able to retain information for long periods, in contrast to tissues that have a low rate of cellular "turn-over." [Fig. 7]
In Rolfing and in the Cyriax method, deep cross-fiber friction breaks the adhesions and restores mobility. As in Weiss's blood clots, normal tensions are needed to facilitate resorption of unnecessary collagen fibers after an injury. Particularly important for athletes and other performers, who strive to achieve optimum control and efficiency of motion. These effects are sometimes for many years. We can now suggest that one of the effects of Rolfing, massage, and other methods is to allow the structure to reorganize, soften, lengthen and become more flexible.

Repeated cycles of reorganization, triggered by the therapist's precise, systematic, and intentional application of pressure to tissues, have structural and emotional consequences, and can bring about the release of toxic materials that have been stored within the tissues for many years. When we use the term "toxins" we are referring to foreign substances that have become trapped in the connective tissue meshwork. This meshwork traps substances because it has many electrically charged components that toxins can stick to, and because it has many tiny pockets in which toxic molecules become lodged. Therapists with a keen sense of smell often detect odors of alcohol when they work with tissue that has been sterilized prior to insulin injections, or of ether when working with the tissues of someone who has been anesthetized, or of insecticides when working with someone who has been repeatedly sprayed. This process in connective tissues is called "storage excretion," and involves the trapping and storage of toxins to prevent them from entering the blood and from being carried throughout the body.

We have described how temporary gel-to-sol changes can release toxic material that has been stored in the tissues, sometimes for many years. We can now suggest that one of the effects of Rolfing, massage, and other methods is to cause reversible gel to sol transformations both in the connective tissue ground substance and in cytoskeletons. The result is release of both stored memories and toxic substances. The latter are then released into the environment, or are carried away by the circulatory system and are broken down or excreted. [Fig. 8]

Soft Tissue Memory

Microtubules are not the only components of soft tissues that are capable of storing information. A highly respected physiologist has described how records of the ways the body has been used (or misused) are incorporated into the structure of connective tissue. In his well-known book, The Life of Mammals, J.Z. Young provides an eloquent account of the plasticity of connective tissue and its ability to store information.

Young states that the structure of any tissue depends both on how it developed and on the forces exerted on it by other tissues and by the environment. Collagen is deposited along the lines of tension in connective tissues, such as fascia, tendons, bones, ligaments, and cartilage.

Paul Weiss studied tissue cultures and healing wounds, and documented the phenomenon Young described. Wound repair begins with the formation of a clot containing fibrin filaments. At first, the fibers are oriented randomly. As the clot dissolves, fibers that are not under tension are dissolved first, leaving behind a web of oriented fibrin fibers. Fibroblast cells migrate into this web, become oriented along the fibers, and deposit collagen, primarily along tension lines. Any collagen fibers that are not oriented along tension lines are removed by a process similar to the readjustment that took place in the clot. The result is a tissue composed of fibers oriented in the direction that is appropriate to the tensional forces produced by normal movements. [Fig. 9, next page]

Therapists from many disciplines know that it is beneficial to resume normal use of the body as soon as possible after an injury. Normal motion helps guide appropriate deposition of collagen fibrils. In immobilized tissues, randomly oriented fibers persist and disused muscles begin to stick to each other, particularly where there has been damage or scarring. James Cyriax refers to this as the formation of adhesions, and Ida Rolf calls it "gluing." Both terms describe a random web of connections that form between the myofascial layers of adjacent muscles. This webwork compromises the thin layer of lubricating fluid that normally allows adjacent muscles to slide over each other. When a muscle contracts it therefore tends to drag adjacent muscles along with it, reducing muscular efficiency and precision of motor control. These effects are particularly important for athletes and other performers, who strive to achieve optimum control and efficiency of motion. As in Weiss's blood clots, normal tensions are needed to facilitate resorption of unnecessary collagen fibers after an injury. In Rolfing and in the Cyriax method, deep cross-fiber friction breaks the adhesions and restores mobility.
From Young's work we can see these as examples of the way the organism makes predictions or "forecasts" that promote future survival. Genetic information programs the fibroblasts to deposit collagen in the direction of tensions, and forces from the environment generate those tensions. Disuse or injury promote a more random deposition of fibers, and this causes adjacent layers to adhere or become glued to each other. Of course, this gluing has a biological purpose: as muscles atrophy from lack of use, they tend to stick to each other, forming a sort of built-in "crutch" to stabilize and support the injured part of the body.

Connective tissue structure is therefore a record or memory of the forces imposed on the organism. This historical record has two components. The genetic part recapitulates the story of how our ancestors successfully adapted to the gravitational field of the earth. The acquired component is a record of the choices, habits, and traumas we have experienced during our individual lifetime. The collagen fibers orient in a way that can best support future stresses, assuming that the organism will continue the same patterns of movement or disuse.

It is widely thought that the phenomena Young described are not confined to healing wounds (reviewed by Bassett). Readjustment of collagen deposition takes place in all portions of the living matrix all of the time. This readjustment is the primary method by which body structure adapts to the loads imposed on it and the ways the body is used (see Oschman's article on how the body maintains its shape). Young stated that memories are stored not only in the collagen network, but in the elastin fibers and even in the various cells found throughout the connective tissue: histocytes, fibroblasts, osteoblasts, plasma cells, mast cells, fat cells, etc.

Young's concept of memory in connective tissues and cells provides a physiological basis for the way the stresses of life, injuries, diseases, muscular holding patterns, emotional attitudes, and repeated unbalanced movements can influence the form of the body. It also explains some of the dramatic effects of various movement therapies. One has the impression that every movement of the body is recorded in the living matrix. Repeated or habitual movements result in a particular connective tissue architecture. Any change in those habits, no matter how slight, will forever alter that architecture.

But can "memories" encoded in connective tissue and cytoskeletal structures lead to a conscious mental image of past events? How might such information be "released" during massage or other kinds of bodywork? And how is such information communicated from the tissue being worked upon to the consciousness of both the client and the practitioner? The second part of this essay will begin to answer these questions.

Conclusions

Massage therapists and other bodyworkers report remarkable experiences of physiological integration in action. Intuition and sensitivity have led to practical methods for interacting with fundamental and evolutionarily ancient communication systems in the body. These communication systems integrate and unify structure and function. The integrity of these systems is profoundly important in the healing of injuries of all kinds. From the information presented so far, we can see how massage and other methods can simultaneously open lines of communication, clear the body of toxic materials that have been stored for a long time, help resolve memories of emotional and physical traumas, restore flexibility, and reduce pain.

Historically, physiological integration has not been a topic of great interest for biomedical research, which focuses on parts rather than wholes. Recent work of biophysicists around the world is now providing a context in which the experiences of massage therapists and other bodyworkers can be validated scientifically. And the experiences of the practitioners can provide important clues for researchers as well.

The realization that the cytoplasmic matrix is but an extension of the connective tissue, and vice versa, opens up a whole new dimension for research. It also resolves a long-standing confusion about the fundamental unit of life. The dilemma began in 1839, when Schwann declared that the extracellular matrix is the source of all life, and that cells are created within it "according to definite laws." In 1859, Virchow disagreed. The extracellular matrix depends on the cells, which are the truly elementary units, the "atoms" of life. This idea was shattered by the discovery that fermentation could take place in a cell-free extract, composed only of molecules and enzymes. There arose a molecular prejudice: living matter, being built of molecules, must have at its basis a set of molecular reactions. Others, such as Albert Szent-Györgyi, have found this point of view inadequate, and have looked to electrons, protons, and other subatomic particles as building blocks, units of energy and information, and components of consciousness. Our inability to cure major diseases stems from our failure to include such phenomena in our thinking about structure and function.

Biophysics is now progressing rapidly because of a whole-systems perspective. The search for fundamental units is replaced by study of the web of relations between the various parts of the whole. Inquiries at all levels are equally relevant and important.

The realization that the cytoplasmic matrix is but an extension of the connective tissue, and vice versa, opens up a whole new dimension for research. The continuous living matrix, extending throughout the organism, is the context for the web of relations now under investigation. The living matrix has no fundamental unit, no central aspect, no part that is primary or most basic. The integrity of the network depends on the activity of all components, and all components are governed by relations with the whole.
The biophysical properties of the living matrix can explain a variety of phenomena that have been elusive in the past: learning, memory, consciousness, unity of structure and function. Unfortunately, most of the important biophysical research related to complementary medicine is not going on in this country. For example, four important books (edited by Frohlich; Popp, Li, and Gu; Endler and Schulte; and Ho, Popp and Warnke) contain contributions of 94 scientists from around the world, but only eight are from the United States (they are J. Schulte, East Lansing, MI; J.K. Pollock and D.G. Pohl, Milledgeville, GA; W. R. Adey, Loma Linda, CA; S.R. Hameroff, Tucson, AZ; R.P. Liburdy, Berkeley, CA; T.Y. Tsong, St. Paul, MN; and T.M. Wu, Binghamton, NY). A recent international symposium, edited by Allen, Cleary, and Sowers, contains contributions of well over a hundred authors, and, again, only a handful are from the USA. An accessible account of some of this literature can be found in *The Rainbow and the Worm* by Mae-Wan Ho.

While the concepts presented here are not yet a part of normal biomedicine, they have a sound scientific foundation. And they go a long way toward explaining some of the phenomena that arise in complementary medicine. We believe the bodywork practice is one of the best "laboratories" for testing these concepts. We look forward to hearing from those who find these ideas useful in refining and expanding your technique and understanding. Research is fun when it leads to new questions and opens us to new possibilities.

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This essay is dedicated to Joan Bisson and to others like her who embody our most ancient and natural healing instincts.

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by James L. Oschman, Ph.d. and Nora H. Oschman

- Somatic Recall Part 1 - Soft Tissue Memory
- Somatic Recall Part 2 - Soft Tissue Holography
- Excerpts and notes on the Oschman's book, *Readings on the Scientific Basis of Bodywork, Energetic, and Movement Therapies* - The writings represent 15 years of research on scientific discoveries from around the world relating to all clinical approaches; is highly organized, topic-linked.
- HOW HEALING ENERGY WORKS

Chart At Right: "System Interfaces in the Psycho-Physiology of the Fascia Memory Theory" - A flow chart very briefly illustrating the interfaces of the *Proprio-Neuro Fascia-Muscular, Motor Cortex, Adrenal Systems, Connective Tissue Cells, & Related Aspects* (Full size at Fascia-Memory Theory pages)
Body memory (BM) is a hypothesis that the body itself is capable of storing memories, as opposed to only the brain. While experiments have demonstrated the possibility of cellular memory there are currently no known means by which tissues other than the brain would be capable of storing memories. Modern usage of BM tends to frame it exclusively in the context of traumatic memory and ways in which the body responds to recall of a memory. In this regard, it has become relevant in treatment for PTSD. This memory recall is also related to our experience, at one time or another of experienced state-dependent sensory-based memory recall triggered by a song, taste, or smell. Hearing a memorable song or smelling a familiar aroma can trigger strong emotions and sensations—somatic memories—associated with specific events in
Massage as a Trigger for Somatic Memory. Massage and bodywork can trigger this state-dependent recall of the sensations and emotions of traumatic events, particularly if touch is itself a stimulus associated with the trauma. From neuroscience, a study found that the part of the brain that is in charge of processing our senses is also responsible, at least in part, for storing emotional memories. Soft tissue mobilization (STM) is a recognized intervention used to ameliorate pain, functional limitations, and impairments associated with somatic dysfunction. Graston Instrument Assisted STM (GISTM) is a specialized technique whereby the clinician uses stainless steel instruments to contact the tissue instead of the hands. Once a lesion is detected and patient tolerance is assessed, the GT Instruments are used to "break up" cross-links, fibrosis, or restrictions or adhesions by splaying fibers and augmenting the inflammatory process so that healing can occur.