the limits of our manual efficacy far in the direction of results, and saw results that were far beyond what we expected. Coming back to your question – of course the New Articular Approach includes dimensions of work with the brain.

AS: Do you have practical experience with this in your own practice?

PS: I feel that I am – once again – at the beginning. Like my colleagues and the teachers of the Munich Group, I am more and more confronted with clients suffering from serious dysfunctions at the level of the brain. When European Rolfers started this journey with our first Rolfing Structural Integration (SI) classes thirty-five years ago in Munich, we had no idea where it would take us. Nowadays, when we have to see what we can do for children diagnosed as being handicapped, when we work with people who have brain-function issues after accidents, the New Articular Approach is an essential part of our craft. Not because it is about joints, but because it illustrates in a convincing way how moving or not moving a joint is interrelated with all the voices of the 'orchestra' of the human organism.

AS: Coming back to the DVDs, do you really think our colleagues are able to study the New Articular Approach by watching them?

PS: To understand this work, to master this work, we need to experience it within our own bodies and with the full presence of our minds. And of course we all need the presence of a competent teacher. The DVDs help us by adding a sort of 'objective' frame to our subjective experience of the work. And they give information in such a precise way that we can refine what we learned in class. They are not videos made during class, they are high-quality studio productions with the importance and helpfulness of every aspect considered: camera angle, lighting, editing, and opening music . . .

AS: And does this New Articular Approach fit into a Rolfing session?

PS: That's an interesting question, and one that is simple to answer. When I started practicing thirty-six years ago, I was quite happy with what we could accomplish with classical Rolfing SI. But over time I was not always happy. Quite frequently I saw the limitations of our work concerning joint dysfunctions, and sometimes that was quite frustrating, not just for me. So some of us went in the direction of direct joint manipulation, and there was a sort of a battle about that – are we as Rolfers allowed to do that?; does our work need additional joint manipulation?

With the New Articular Approach we have a modality for the joints that fits well with fascial work. It gives us insight into the most significant details that determine joint function. It may add – by working on micro-restrictions – in a constructive way to what we as Rolfers are already doing with larger fascial connections.

AS: Do you have plans for a new project?

PS: I have been working with my dentist friend – Dr. Sebastian Schmidinger – on a DVD about temporomandibular joint (TMJ) dysfunctions. And in the fall Christoph Sommer and myself plan to make another DVD with Jean-Pierre Barral, this time on a very classical theme – Advanced Visceral Manipulation.

AS: Thank you for this interview.

The New Manual Articular Approach DVDs are available in the U.S. from http://barralinstitute.com (in the section Products & Specials). In Europe, they are available from www.munich-group-media.com.

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Biotensegrity: Paradigm Shift

A Consideration of Biotensegrity: The Structural Basis of Life *by Graham Scarr*

By Szaja C. Gottlieb, Certified Advanced Rolfer™

Author's Note: In 1975 Rolfer Ron Kirkby dedicated his article on tensegrity to his Rolfing® Structural Integration (SI) instructor Michael Salveson, who inspired the article. I would like to complete the circle and dedicate this article to Michael, who was also my instructor in both Unit lll and the advanced training, and who continues to be a sounding board and an inspiration as well.

In structural integration, tensegrity has long been a cornerstone of our conceptual system. Originated in the field of architecture by Buckminster Fuller, creator of the geodesic dome, the concept was appropriated into SI early in its development. In 1976, Dr. Rolf, in her annual message, mentioned a study group in the Rolfing community, who, in her words, "have spent their nights, their Sundays, their holidays, considering the application of the tensegrity model to consideration of the flesh and blood structure we have for thousands of years been calling a 'man'" (Rolf 1976). A major exploration of tensegrity written by Rolfer Ron Kirkby was published in 1975 in the *Bulletin of Structural Integration* and entitled "The Probable Reality Behind Structural Integration – How Gravity Supports the Body" (Kirkby 1975). The concept of tensegrity, of special structures that combine discontinuous compression in the form of struts (bones) with continuous tension in the form of cables (soft tissue) has been a staple within SI trainings for the past forty years as it explains how the human body can maintain buoyancy in gravity.

Enter Biotensegrity.

During this same period, Stephen Levin, an orthopedic surgeon, observed that bones did not compress across joint surfaces but instead seemed to float within the soft tissue matrix. In an address to the North American Academy of Manipulative Medicine in 1980, he called for the application of tensegrity principles to explain the biomechanical support for the human body. He referred to this idea as *biotensegrity*.

Contemporaneously, unbeknownst to Levin, a cell biologist, Donald Ingber, was applying the very same principles of tensegrity to the human body, but on a cellular level. The different parts of the cell, the cytoskeleton, were mechanically linked to each other as part of a tensegrity structure. In 1998, Ingber, an MD and PhD, published his landmark article in *Scientific American*, "The Architecture of Life" (Ingber 1998). Ingber, in fact, was the first speaker at the First International Fascia Research Congress in 2007.

In *Biotensegrity: The Structural Basis of Life* (2014) British osteopath Graham Scarr unifies and integrates Levin's macro approach and Ingber's micro approach and expands upon the implications of their discoveries, particularly in terms of motion and biomechanics. His objective is nothing less than establishing a new discipline in the field of science.

When current scientific models cannot explain certain phenomena, new paradigms, new conceptual models, emerge, according to Thomas Kuhn (1962) in his groundbreaking book *The Structure of Scientific Revolutions*. In the nineteenth century, for example, when Newtonian physics was found to be insufficient for explaining certain phenomena, Einstein proposed his general theory of relativity. The important point here is not that Newtonian physics was replaced, but that Einstein's theories explained phenomena Newtonian mechanics could not. Similarly, says Scarr, biotensegrity principles do not necessarily replace classical mechanics; biotensegrity simply explains certain phenomena better.

In the first three chapters of his book, Scarr explores the roots of tensegrity, first its history, particularly its origins in art and architecture, detailing the fascinating and complex relationship between architect Fuller and sculptor Kenneth Snelson. He then continues with a discussion of geometric structures associated with geodesic geometry, particularly the basic tetrahedron and the important icosahedron. The attraction of these structures is energy efficiency. The icosahedron, a twenty-sided polyhedron, for example, encloses the largest volume with the minimum surface area of any structure apart from a sphere. From an evolutionary point of view, life forms choose these structures simply as a matter of economy and efficiency.

In the fourth chapter, aptly named "The Problem with Mechanics," Scarr presents the difficulties encountered when applying traditional mechanics to living structures. Simply put, bodies are able to exert greater force and withstand greater stress than can be explained by classical mechanics as founded by Galileo and Newton in the sixteenth and seventeenth centuries. As opposed to inanimate structures that form the basis of classical mechanics, animate structures unexpectedly grow stronger and more resilient under stress. The bones of a dinosaur, for example, would not be able to withstand the compressive weight of the animal's body mass. A human body would not be able to leverage as much force as it does. Similarly, biomechanical explanations of movement are inadequate since they usually take up the joints in isolation and not in relation to one another.

In chapter 5, Scarr expands the concept of tensegrity to the microcosmic level with the research of cellular biologists, most importantly Ingber. The long-held view in cellular biology of the singularity of the cell, particularly membrane and nucleus, is challenged by Ingber's discovery that cells are part of the larger tensegrity structure that exists within and outside of the cell as part of one continuum, and that the components of this tensegrity structure and respond to mechanical force, i.e. changes of tension. When considering fascia, for example, the cells, usually fibroblasts, are only one component. What is critical is the tensioning *relationships*, which include not only the fibroblasts but also the surrounding fluid (largely water) and fiber (collagen), usually referred to as the extracellular matrix (ECM).When mechanical force is applied to an area, the change of structural tension signals electrical and chemical changes within the cell, which is called *mechanotransduction*.

It is this principle of mechanotransduction that forms the scientific underpinning for manual therapy, giving legitimacy to the claim of bodyworkers that they are able to change and transform bodies even at a cellular level. The implications for practitioners of structural integration are profound. While it is usual for SI practitioners to think of reorganizing the body in broad strokes – usually fascia, joints, and whole-body movement – the SI practitioner rediscovers him- or herself as a *structural integrator at a molecular, even at a genetic, level*, intervening within damaged structure and with his or her hands remodeling, reformatting, and reintegrating a damaged area so that it is confluent with the body's tensegrity architecture. No wonder the audience erupted in applause halfway through biologist Paul Standley's talk on the first day of the First International Fascia Research Congress in 2007: he had just described how manipulative techniques similar to Rolfing SI were used in his laboratory to resuscitate dying cells! (Grimm 2007).

In succeeding chapters Scarr tackles a variety of problems demonstrating the inadequacy of classical mechanics compared to explanations based on biotensegrity. The British osteopath first takes on the problem of joint motion (specifically the elbow); second, the embryological development of the cranial vault; and third, the avian lung. What emerges is biotensegrity as an integrated structural and functional hierarchy spanning geometry, anatomy, and biomechanics at multiple scales from molecules to the organism as a whole.

In essence *Biotensegrity* is about patterns, patterns that repeat themselves in nature, particularly in organic life. The book seems like a direct descendant of D'Arcy Thompson's (1961) *On Growth and Form* first published in 1917. Like this classic, *Biotensegrity* explores shape in the natural world and Illustrates patterns and designs of an unexpected beauty and hypnotic effect. With approximately 130 diagrams in its 130 pages, *Biotensegrity* sometimes seems as much a visual and aesthetic exploration as a scientific treatise. Nevertheless, a science treatise it is. Scarr bounds back and forth – seemingly effortlessly – across the boundaries of biology, chemistry, physics, mathematics, and art, forging biotensegrity into a discipline that is coherent and integrated, visionary.

Scarr's breadth of knowledge is encyclopedic. For the scientifically challenged such as myself, the book is hard work, bitten off in small morsels with considerable rumination. The density of the book is such that subheadings, sometimes multiple subheadings, exist on just about every page in every chapter. Chapter 10, "Complex Patterns in Biology" encompasses rhombic dodecahedrons, the Fibonacci sequence and the Golden Mean, quasi-equivalence and spherical viruses, Penrose tiling, fractals, quasicrystals, and hyperbolic geometry – all in ten pages!

By virtue of being the first book on its topic, *Biotensegrity* is an automatic classic – a tough read, but a must-read. I must confess to referencing many other sources on the Internet to aid my comprehension. The best of these is an article by another osteopath, Randel Swanson (2013), "Biotensegrity: A Unifying Theory of Biological Architecture with Applications to Osteopathic Practice, Education, and Research – A Review and Analysis." The virtue of this article is that it covers much of the same ground but not quite the same depth. Swanson also discusses manual osteopathic practices involved with fascia, practices that are similar to SI.

Another resource is a very good recent interview/podcast that Rolfer Brooke Thomas (2015) conducted with Stephen Levin about biotensegrity. Reprinted articles by Stephen Levin, in fact, have appeared in this Journal, the earliest in 1982 (Levin 1982). For visual learners, Tom Flemons has an excellent website illustrating human anatomy according to tensegrity principles (http://www.intensiondesigns.com/). I would also like to mention the fine contributions of Rolfer Sherri Cassuto, who has authored several articles on tensegrity systems (e.g., Cassuto 2009).

Paradigm shifts by definition create upheaval. While biotensegrity will certainly cause a major questioning in biomechanical practices like physical therapy and chiropractic, it will also cause a major reexamination of even modalities like SI that are in alignment with this new worldview. While fascia is the ground of the edifice that is SI, biotensegrity is its firmament. As the nexus between art and science, the perceptual and the conceptual, movement and structure, biotensegrity mirrors SI perfectly in its paradox and creativity. This new scientifically based discipline is our new field of inquiry, and we may have to reexamine our concepts and practices accordingly, sometimes with consternation. Our Little Boy Logo, for example, may be very effective in communicating our work to potential clients metaphorically. It is, however, not really accurate literally, according to biotensegrity principles: the human body is simply not a stack of blocks organized by a 'Line'. What about words like 'energy' and 'structure'? – biotensensegrity requires a scientific definition, not simply an intuitive one. The future may be fraught with challenge.

For the moment, however, SI can bask in the knowledge that its conceptualizations and practices, which often invited skepticism to its claims of improved human function, are now firmly rooted in contemporary science. When Kirkby wrote "The Probable Reality Behind Structural Integration" in 1975, he captured the historical moment: SI was a modality that was without a secure epistemological foundation. "One lack we all face," wrote Kirkby (1975), "is the absence of comprehensive investigations of the fascial networks of the body. But even assuming we had these details, would they show that the structure of the human body is an analog to Fuller's Tensegrity structures? The final answer to this question must wait, I am afraid, upon a mathematical analysis of the fascial networks of the body." Now, forty years later, with the work of Levin and Ingber and their cohorts, the fascial research of the intervening years, and the mathematical modeling by cellular biologists, all marked and unified by Graham Scarr's visionary offering, the final answer to Kirkby's question has arrived and its name is biotensegrity.

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In Memoriam

Structural Integration: The Journal of the Rolf Institute® notes the passing of the following members of our community:

Miraa Joanne Neill,
Certified Advanced Rolfer™

Mark Twiss,
Certified Rolfer