WHY THE HEART IS MUCH MORE THAN A PUMP

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According to standard dictionaries, the heart is:

> A hollow muscular organ that pumps the blood through the circulatory system by rhythmic contraction and dilation.
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> The organ in your chest that pumps blood through your veins and arteries.
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> The chambered muscular organ in vertebrates that pumps blood received from the veins into the arteries, thereby maintaining the flow of blood through the entire circulatory system.

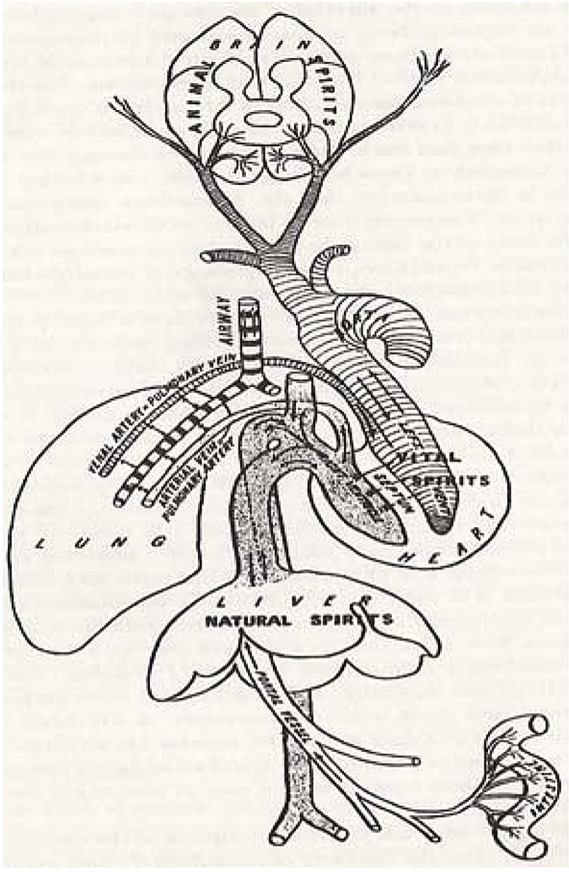
None of these definitions are correct, since it is impossible for the heart to pump blood through the entire circulatory system. Ventricular contraction forces blood into the aorta and pulmonary artery, but these vessels become progressively smaller and end in 25,000 miles of capillaries. Some of these have a diameter not much larger than a red blood cell, and if laid end to end, the capillary system would cover the area of three football fields. The heart could never pump air through this complicated network, much less a viscous fluid like blood, since this would require a force or pressure capable of lifting a 100-pound weight 1 mile high.

The Medieval "Medical Pope" Who Dominated Western and Muslim Medicine

The ancient Greeks, and especially Claudius Galen, attributed all diseases to some imbalance in the four humors: blood, phlegm, black bile, and yellow bile. All of these circulated throughout the body due to the innate heat (*calidum innatum*) generated by the heart. The heart's heat was also responsible for extracting each humor from various foods in order to maintain a healthy equilibrium. Galen believed that "vital blood" was made by the heart and flowed through the arteries to carry the vital spirits. This was different from "nutritive blood", which was made by the liver and carried through veins to body organs that consumed it to provide energy. He also believed that blood passed through the septum of the heart from one ventricle to the other through tiny invisible pores, rather than arteries. Blood flowed from the liver to the right ventricle of the heart and nourished the lungs via the veins. The left ventricle nourished the rest of the body through arteries that he thought were air pipes, but also

contained vital spirits. In addition, the heart did not pump blood, but sucked it in from the veins. The rise and fall of the pulse came from a contraction and relaxation that originated in the arteries rather than from any pumping action of the heart.

It is impossible to overestimate the power Galen has had over medicine. He was such an unquestioned authority that he was later referred to as "The Medical Pope of the Middle Ages". Few of his writings had at the time been preserved for physicians, although they were translated into Arabic in the 11th century, particularly by Ibn Sina, or Avicenna as he was later known in the West. Avicenna was a child prodigy who memorized the Koran and Arabic poetry by the age of 10, was fluent in several languages, and wrote some 400 books or tracts. The most famous was his *Qanun*, or The Canon of Medicine, completed in 1025. Its 14 volumes containing over one million words covered every conceivable aspect of medical practice gleaned from ancient Persian, Indian and Arabic texts, but it was primarily a tribute to all of Galen's teachings and views. Its 1593 publication in Rome made it one of the first Arabic books to be printed and further enhanced Galen's authority, because it was now widely available. From the 12th to 18th century, the *Qanun* was the most important medical text in the world because of its encyclopedic comprehensiveness and systematic arrangement. It is believed to have influenced Leonardo Da Vinci. Sir William Osler wrote, "The *Qanun* has remained a medical bible for a longer time than any other work", and the Encyclopedia Britannica described it as "the single most important book in the history of medicine, East or West".



A Galen illustration of the internal organs depicting his concepts of anatomy and spirit.

The natural healing principles described in the *Qanun* were studied by Samuel Hahnemann, founder of homeop-

athy, as well as Father Sebastian Kneipp, who established naturopathy. Some of Galen's recommendations to restore the balance of the four humors, such as bleeding, cupping, leeches, purging and sweating were standard practices well into the 19th century. George Washington's quinsy (bad sore throat) was treated by bleeding, and he had an additional two quarts of blood removed on the day he died in December, 1799. The 1899 edition of the Merck Manual, the most popular textbook of the day for physicians and pharmacists (for $1.00), included bleeding as an accepted treatment, and this and others such as cupping are still widely used in parts of the world. Even some alleged folk remedies of rural Afro-Americans have been traced back to medicinal recipes from Avicenna's *Qanun,* or Canon as it is often referred to. Phlebotomy, or bleeding, is currently used to treat hemochromatosis to remove excess iron, and surgeons often utilize leeches when reattaching severed body parts such as fingers, after tissue grafts, and to reduce hematomas following plastic surgery.

William Harvey's *De Motu Cordis*, Ibn al-Nafis, Michael Servetus, and the Church

The belief that the heart pumped the blood through the arteries and veins is usually attributed to William Harvey, but this is also erroneous. In his famous 1628 *Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus* (On the Motion of the Heart and Blood in Animals), Harvey demonstrated (a) that it was the contraction, not the dilatation of the heart that coincided with the pulse; (b) that the pulse was not produced by the arteries enlarging and contracting but by being filled with blood with each contraction; (c) there was no pulsation in the veins, but rather a constant stream of blood from the periphery to the heart; (d) the blood in the arteries was the same as that in the veins; (e) there were no pores in the septum between the ventricles; (f) the action of the right and left auricles and ventricles and the valves between them is the same with respect to the reception and propulsion of liquid, not air, since the blood on the right side, although mixed with air, is still a liquid; and (g) blood in the right ventricle is sent to the lungs, returns to the left atrium via the pulmonary veins and is then sent into the arteries and returns through veins that empty into the vena cavae, which return it to the right side of the heart to complete its circulation. Simply put, blood flowed in one direction throughout the body and it was in the lungs where the transformation of venous blood to arterial blood took place. Whereas Galen believed that the liver was the center of circulation, Harvey found no evidence that blood was manufactured in or secreted by the liver, and calculated that if Galen had been correct, the liver would have to produce 540 pounds of blood daily.

Although Harvey announced his discovery in 1615, he waited 13 years before publishing his results, since it was considered sacrilegious to challenge Galen. Any contrary opinions were considered to be so heretical that they would not only quickly end one's career, but could result in being burned at the stake. The celebrated physician and anatomist Andreas Vesalius had published his *De Humani Corporis Fabrica* in 1543, which disputed Galen's description of the heart and liver, and was condemned by the church for dissecting a human corpse. In 1553, a Spanish doctor and theologian, Michael Servetus, published *Christianismi Restitutio* (The Restoration of Christianity), which also opposed many of Galen's ideas. This was during the Spanish Inquisition. He was burned at the stake, together with a copy of his book, for his heresy. It seems likely that Servetus was strongly influenced by Ibn al-Nafis, Chief Physician at the Al-Mansouri Hospital in Cairo and physician to Egypt's Sultan. As with many other Muslim physicians of his time, not only did Al-Nafis excel in medicine, but he was also well versed in several languages, philosophy, Islamic law, and history, and wrote numerous works disputing both Galen and Avicenna.

One of Al-Nafis' most important books, the 20-volume *Commentary on Anatomy in Avicenna's Canon*, written in 1242, explained that there were only two ventricles, not three; there were no pores through the interventricular septum, and the ventricle received its nourishment from the coronary vessels, not, as Galen and Avicenna had claimed, from blood deposited in the right ventricle. His premonition of a precursor to capillary circulation was due to his discovery that "the pulmonary vein receives what comes out of the pulmonary artery, this being the reason for the existence of perceptible passages between the two." Al-Nafis was an early proponent of experimental medicine, postmortem autopsy, and human dissection, at which he excelled. He drew several diagrams of his new physiologic system, some of which have been preserved, but his skill and ingenuity are evident in the following excerpt.

> The blood from the right chamber of the heart must arrive at the left chamber, but there is no direct pathway between them. The thick septum of the heart is not perforated and does not have invisible pores as Galen claimed. The blood from the right chamber must flow through the pulmonary artery to the lungs, spread through its substances, be mingled there with air, pass through the pulmonary vein to reach the left chamber of the heart, and there form the vital spirit. The heart has only two ventricles . . . and between these two there is absolutely no opening. Also dissection gives this lie to what they said, as the septum between these two cavities is much thicker than elsewhere. The benefit of this blood (that is in the right cavity) is to go up to the lungs, mix with what is in the lungs of air, then pass to the left of the two cavities of the heart.

Al-Nafis also disproved Galen's theory that "every part of an artery pulsates "simultaneously" and that the motion of the pulse was due to "the arteries expanding and contracting naturally". He attributed the pulse to the force of cardiac contraction, noting that "the arteries and the heart do not expand and contract at the same time, but rather the one contracts while the other expands" and vice versa. He also recognized that the purpose of the pulse was to help disperse the blood from the heart to the rest of the body. All of these observations were made almost 400 years before Harvey, who was unable to explain how blood was transferred from arteries to veins. None of these important observations were known in Europe until 1547, when Andrea Alpago translated some of Al-Nafis' writings into Latin. Six years later, Michael Servetus described the pulmonary circulation in his book: "air mixed with blood is sent from the lungs to the heart through the arterial vein; therefore, the mixture is made in the lungs. The bright color is given to the sanguine spirit by the lungs, not by the heart." This was almost word for word what Al-Nafis had written centuries earlier.

Harvey's Concern About the Church and His Aristotelian Concept of Circulation

There is no evidence that Harvey was aware of the Servetus book or Al-Nafis, but he was enrolled at the University of Padua in 1598 where Galileo was a tutor, and there is little doubt that he was highly influenced by Galileo's thinking. In 1616, Galileo was also persecuted and convicted of heresy for teaching that the earth revolved around the sun and was not the center of the universe. (It was not until 1992, almost 400 years later, that Galileo was officially vindicated by Pope John Paul II). Harvey, having announced his discovery the preceding year, prudently waited until 1628 to publish his book. His hesitation to openly defy Galen proved justified. Most physicians rejected his book because he could not explain how the arteries and veins met. If organs did not consume blood, how did different parts of the body obtain nourishment? If the liver did not make blood from food, where did blood originate? Why was blood blue in veins but red in arteries? It was over three decades before Harvey's achievements received proper acknowledgment. Another reason was that the discovery of capillaries, which were invisible even with the microscopes available at the time, was not made until 1642, by Marcello Malpighi, over two decades after Harvey's death.

Harvey never viewed the heart as a pump, but likened it to a bellows that lifted water by means of clacks (valves). "From the structure of the heart it is clear that the blood is constantly carried through the lungs into the aorta as by two clacks of a water bellows to raise water." This is the only mechanical analogy he ever offered, and was based on Aristotle's: "It is necessary to regard the structure

of this organ [the lungs] as very similar to the sort of bellows used in a forge, for both lungs and heart take this form." Harvey's concept of circulation was also consistent with the Aristotelian view that it was cyclical (such as the apparent movements of celestial objects), rather than being perfectly circular. The example Aristotle gave was the cycle of the sun causing evaporation of water that condensed into clouds, then fell as rain, and was again evaporated. Thus Harvey writes in *De Motu Cordis*, "We have as much right to call the motion of the blood circular as Aristotle said that the air and rain emulate the circular movement of the heavenly bodies." It was the notion that as water gives life to land, so blood gives life to the body. Harvey needed this air-water-air analogy to explain the transfer of blood from arteries to veins, since capillaries had not yet been discovered.

There are numerous other reasons why the heart should not be viewed as a mere pump. An efficient pump would be designed to work directly on the system with the greatest volume, and the veins contain over five times more blood than the arteries (65% compared to 12%). The aorta bends during systole, when it should straighten under the higher pressure. More importantly, replacement by a mechanical pump only works for a limited time, in contrast to heart transplants, which can function normally for more than two decades. This became apparent in January 1985, when despite the adequate pumping of William Schroeder's artificial heart for over a month, his doctors reported that he had an "unusual excess of fluid retention" (around 30 lb) that could not be explained and was difficult to reduce. He had suffered one stroke and subsequently had two more that left him in a vegetative and bloated state for over a year, at which point he died from a lung infection. In a letter published in The New York Times entitled "Can an Artificial Heart Have its Reasons?" *[Dr. Rosch's letter can be found at* http://www.nytimes.com/1985/01/07/opinion/l-can-an-artificial-heart-have-its-reasons-194202.html *-Ed.]*, I noted that the heart, in addition to being a pump, was also an exquisite endocrine organ that secreted powerful atrial natriuretic hormones that responded to excess fluid loads and lowered blood pressure faster and more profoundly than any known drugs. Deprived of this homeostatic mechanism, it was not surprising that Schroeder suffered an accumulation of excess fluid that his doctors said "could squash the blood vessels, slowing the circulation, thus increasing the chances for clots to form". Since that time, it has been found that the ventricles also secrete a similar blood pressure-reducing hormone, and that all four chambers of the heart can make and secrete oxytocin, the "bonding and cuddling" hormone.

Where Do Emotions Originate, and Do We Have More Than One Mind or Brain?

The Ebers Papyrus suggests that as far back as 3000 B.C. the Egyptians considered mind and body to be inseparable. It included a treatise on the heart, which explained that the heart is the center of the blood supply, with vessels attached for every member of the body. The Chinese *Huangdi Neijing*, or Yellow Emperor's Classic of Internal Medicine, dated around 2500 B.C., similarly states, "The heart is the root of life and causes the versatility of the spiritual faculties." Aristotle and Virgil also taught that the heart, rather than the brain, was the seat of the mind and emotions. Harvey clearly recognized that the heart was much more than a mechanical pump, and reflected emotions and feelings, when he wrote, "Every affection of the mind that is attended either with pain or pleasure, hope or fear, is the cause of an agitation whose influence extends to the heart." His contemporary, the celebrated philosopher, scientist and mathematician René Descartes, respected Harvey and agreed that the blood circulated through the body in a closed system of arteries and veins contrary to Galen's teachings. But Descartes argued that the heart was not a pump, but a furnace. It heated small particles in the blood, causing them to expand, which forced the atrioventricular valves to close and opened the valves to the aorta and pulmonary artery. When the heated blood was released into the arteries, it caused them to expand, and when it cooled and took less space, the arteries and veins collapsed. It was the heated blood that animated the system rather than the heart.

Descartes viewed the human body as a complex machine, comparable to a complicated clock or the spectacular statues in French water gardens, that moved in response to changes in hydraulic pressure. Illness occurred when the body's machinery broke down and it was the physician's duty to find the source of the problem and repair it. As with most other machines, this could best be accomplished by gaining a better knowledge of the body's smallest working parts. Descartes also believed that man was unique because nothing else on earth had a mind or soul. In his *The Passions of the Soul,* he argued that like all other devices that produced motion, the machinery of the body obeyed the laws of physics. However, since mind/soul was a non-material and motionless gift from God, it was separate from the material mechanics of the body and not subject to any known laws. Mental disorders were also a mystery and beyond human comprehension. Like many other illnesses, they were often viewed as a punishment from God for some sin, or possibly even due to possession by an evil spirit that required exorcism. As a result, mental and emotional problems were more properly within the province of the Church, and should be treated by priests rather than physicians. For Descartes, the heart was simply part of the

machinery of the body. It had nothing to do with the mind or soul. The latter he thought resided in the pineal gland—which he erroneously believed was found only in man, since other animals did not have souls—and connected the intellect with body. The pineal was also the connection between the mind and the heart, since if the heart was acting independently and not controlled by thought, it must have its own separate mind/soul.

Harvey was appalled at Descartes' purely mechanistic interpretation of his research. Others also disagreed with Descartes, especially with respect to emotions like love and faith in God. As the 17th-century mathematician and scientist Blaise Pascal wrote, "The heart has reasons that reason knows not of. We feel it in a thousand things . . . Do you love by reason? It is the heart which perceives God and not the reason. That is what faith is: God perceived by the heart, not by the reason." For Pascal, the heart was "the intuitive mind" rather than "the calculating (reasoning) mind". Where do emotions originate? William James proposed that an external stimulus leads to physiological responses and the resultant emotion depends upon how you interpret those responses: "The bodily changes follow directly the PERCEPTION of the exciting fact, and that our feeling of the same changes as they occur IS the emotion."

This theory was generally accepted until Walter Cannon showed that "fight or flight" responses to stress were due to stimulation of the sympathetic nervous system and secretion of hormones like adrenalin. If awareness of trembling, palpitations and other responses was what caused fear, then inducing these artificially in the absence of any threatening stimulus should have the same effect. But when he injected adrenalin into normal volunteers, although it produced the identical visceral responses, the subjects experienced no specific emotions. It was only when he discussed disturbing topics like sick children or their dead parents, and then injected adrenalin, that an emotion was induced. In another experiment, cats were kept alive and healthy after having their sympathetic nervous systems completely removed. However, this had little effect on their emotional responses. Cats displayed the typical signs of terror in response to a barking dog, while organs whose connections to the brain had not been completely destroyed reacted normally. In addition, the sympathetic nervous system's response to different emotional states such as fear and rage as well as stressors such as lack of oxygen and extremes of temperature is the same. If emotions resulted from these responses, one would expect fear and freezing to induce the same feelings, which is not the case.

With respect to whether feelings cause emotions or vice versa, subsequent theories have combined aspects of both or suggested they occur simultaneously but independently. The problem in evaluating these theories is the difficulty in defining exactly what constitutes an emotion, and how the term differs from others such as feelings, mood, affect, and temperament. The use of the word

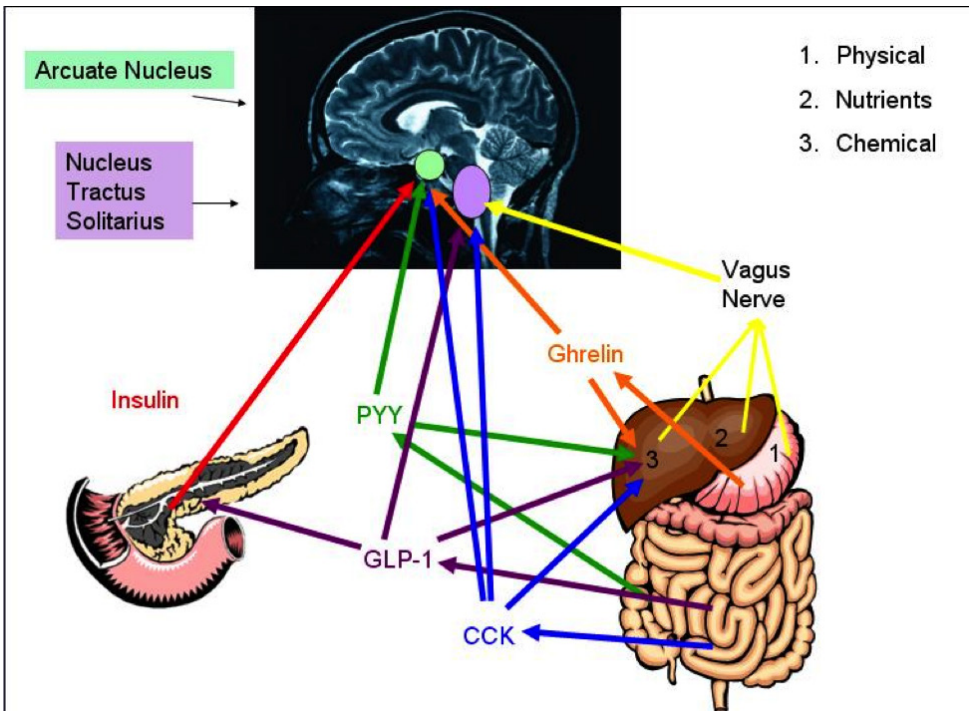
emotion dates back to the 16th century, when it was adapted from the French verb émouvoir, meaning "to stir up", and its derived noun émotion. This in turn dates back to the classical Latin phrase *motus anima*, to physically move out, or excite the spirit. "Emotion" was initially used only in its literal sense of physically moving or agitating something or someone, and it was not until the late 18th century that the meaning of "strong feeling" began to replace this.

In his 1649 *The Passions of the Soul*, Descartes wrote, "*The principle effect of the passions (emotions) is to move and dispose the soul to want the things for which they prepare the body. Thus the feeling of fear moves the soul to want to flee, that of courage to want to fight, and similarly with the others*." Today, emotions are viewed as consistent responses to any internal or external event that has a particular significance for that specific individual. Feelings are best understood as a subjective representation of emotions that also differs for each of us. Moods are diffuse affective states that generally last for a longer period of time and are less intense than emotions. Affect is an encompassing term used to describe emotion, feelings, and moods together, although all of these are often used as synonyms. As illustrated above, there are similar semantic problems with mind, spirit and soul, which are also commonly used interchangeably, especially when translated from something written centuries ago in Greek, Latin, Arabic or French.

Even English words like mind and brain have become synonyms, although they are obviously quite different. The brain is a physical organ that can be seen and touched. It is located in the head, has a characteristic shape, and contains nerve cells and blood vessels. Specific areas of the brain have been shown to control seeing, hearing, talking, thinking, memory and various motor and sensory functions, and many believe that emotions originate or are stored in the brain, particularly the thalamus, amygdala and other components of the limbic system. In contrast, the mind is invisible, intangible and shapeless. It is responsible for attributes such as how we perceive things, how we know the difference between right and wrong, a firm and constant faith in some religious belief or healer, or why we love someone. Brain signals are transmitted via nervous system and humoral pathways, but we do not know how the mind communicates, and there is evidence that its location as well as that of the brain may not be limited to the confines of the skull. There is a "second brain", in the gut, that contains some 100 million neurons—more than in either the spinal cord or peripheral nerves. The gut's nervous system secretes 30 different neurotransmitters that affect the brain and other structures, and since 95% of the body's serotonin is found in the gut, it is no surprise that gastrointestinal complaints are the most common side effects of antidepressant drugs that inhibit serotonin metabolism. Irritable bowel syndrome, which may affect some 24 to 45 million Americans, is thought to be due in part to an excess of serotonin in the gut, and

is regarded by some as a "mental illness" of this second brain.

The two brains have a common source and are intimately connected. During early fetal development, the esophagus, stomach, small intestine and colon, as well as the nervous system, develop from the same clump of embryonic tissue. When that divides, one section grows into the central nervous system (brain and cranial nerves) and the other into the enteric nervous system or "gut brain". During later stages the two brains become connected via the vagus, the largest of all the cranial nerves, but 90% of its fibers carry messages to the brain rather than the reverse. These may influence mood and emotions, and may explain why electrical stimulation of the vagus is FDA approved for treating drug resistant depression. Drugs like morphine and heroin also attach to the gut's opiate receptors, and the "gut brain" can become addicted to opiates. Our brain and gastrointestinal tract are so interconnected that both have natural 90-minute "sleep cycles". In the brain, slow-wave sleep is interrupted by periods of rapid eye movement (REM) during which dreams occur. The gut has corresponding 90-minute cycles of slow-wave muscle contractions, and as with the brain's REM



Gut–Brain Signaling Pathways: Proteins and hormones activate brain pathways in different ways, either by eventual vagal activation or through peripheral circulation. The nucleus tractus solitarii and the arcuate nucleus are then activated. Source: http://en.citizendium.org/wiki/Gut-brain_signalling

feel "butterflies" in the stomach prior to an important interview or examination. Since stress can also cause chronic indigestion, GERD, peptic ulcer, and spastic colon, "gut feelings" may be much more than a metaphor.

Researchers have also discovered a functional nervous system in the heart that is so sophisticated it is referred to as the "little brain". Its elaborate circuitry of neurons, support cells and neurotransmitters identical to those found in the cranial brain allows it to sense, learn, and remember on its own. The heart's "little brain" contains some 40,000 neurons that detect circulating hormones and neurochemicals and sense and respond to changes in heart rate and blood pressure. This information is transmitted to the medulla, which regulates autonomic nervous system activities, as well as higher brain centres that can influence perception, decision-making and other cognitive processes. In addition to nervous system connections, the heart can communicate with the brain through hormonal secretions and biophysical (pulse wave) signalling, as well as its powerful electromagnetic fields. Under normal circumstances, information is transmitted to and from the brain via afferent and efferent nerve fibers in the vagus and spinal column. These nerve connections are severed in a heart transplant and may never grow back. Nevertheless, a transplanted heart can function quite well independently for decades, possibly because its "little brain" has found alternate communication pathways.

Do Emotions Come From the Heart and Body Rather Than the Head?

The early Egyptians certainly esteemed the heart and body. They reasoned that if the Nile and all vegetation could rise again, so could humans. Their elaborate embalming process was designed to preserve anything that might be needed in the next world or to facilitate resurrection. The abdominal organs were removed and placed in protective jars near the corpse, but the brain was discarded since it was considered useless. The only organ that was not removed was the heart, since it was believed to be the seat of the soul. Aristotle also viewed the heart as the site of the soul, rather than the brain, as well as the source of emotions and intelligence. He defined anger as a "seething heat in the region of the heart" along with "a desire for retaliation". While "brain" does not appear in the King James Bible, "heart" is mentioned almost 900 times, often in association with moods, emotions, or the ability to reason or think: "Why reason ye these things in your hearts?" (Mark 2:8). "Mind" is mentioned 96 times, and frequently in conjunction with heart—"which is in mine heart and in my mind" (1 Sam 2:35). "Love" appears 508 times in the Old Testament and 697 times in the New Testament, also often in conjunction with the heart: "And thou shalt

love the Lord thy God with all thine heart, and with all thy soul, and with all thy might" (Deuteronomy 6:5). According to Buddha, "The way is not in the sky. The way is in the heart," and Shakespeare's King Henry IV said, "My crown is in my heart, not on my head."

Still today we use heart rather than brain to describe someone's emotions, mood, character or temperament, in expressions like heart of gold, cold-hearted, warm-hearted, downhearted, stouthearted, heavy-hearted, light-hearted, heartbroken or heartsick. We learn something by heart, get to the heart of things to find out what's really important, have a change of heart when we decide to go a different way, have a heart-to-heart talk to explain how we really feel and why, pour our heart out when we want to confess something, or take heart to have courage. Something from your "heart of hearts" reflects your sacred innermost feelings, or comes from your soul. The heart has long been the symbol of love—perhaps the most desirable emotion—which is why valentines are heart-shaped and red, the color of blood.

I began this explanation of why the heart is much more than a pump with some dictionary definitions that failed to acknowledge this. I intended to include the quotation "Where the heart lies, let the brain lie also" toward the end, and needed to its source. It was not under "heart" in Bartlett's *Familiar Quotations*, *The Oxford Dictionary of Quotations* or *Familiar Medical Quotations*. I eventually confirmed it was from "One Word More", a poem by Robert Browning dedicated to his wife; it was one of the more than 16,000 entries in *The International Thesaurus of Quotations*. What amazed and intrigued me was that although there were 1,067 topics in alphabetical order to choose from, some of which were obscure, there were no quotations under HEART, just this simple message: "See 282. EMOTIONS". Since this book was published in 1987, using *heart* and *emotions* as synonyms should not be considered a quaint or antiquated notion.

A New Paradigm of Energy Communication, and the Heart as "King of Organs"

The health of all living systems depends on good communication, both among constituents and with the external environment. We currently view communication via a chemical/molecular model, in which hormones and neurotransmitters fit into specific receptor sites on cell membranes like keys in a keyhole. However, humoral communication on such a random collision basis could never explain the myriad "fight or flight" responses to stress that occur simultaneously all over the body in milliseconds. In the final analysis, all communication takes place at a physical/atomic level via weak electrical signals from receptor sites that stimulate intracellular enzyme systems. EEG and ECG

waves may not merely reflect the noise of the machinery of the brain and heart, but rather messages being sent to body sites that are tuned into them, much like a radio receives different messages depending on the transmitter station frequency it is tuned to receive. All living things have associated electromagnetic fields, and there is an emerging paradigm that posits illness as the result when these are disrupted. As illustrated in *Bioelectromagnetic and Subtle Energy Medicine*, due to be published later this year, correcting these abnormalities can result in remarkable improvement in patients with cardiomyopathy, metastatic cancer, drug resistant depression, Parkinson's, and other mental and degenerative neurological diseases. Doctors may soon be prescribing frequencies rather than pushing pills, because electromagnetic therapies are not only much safer, but also more cost effective.

The heart's electromagnetic field is estimated to be 5,000 times more powerful than the brain's. It permeates every cell in the body, and changes with different emotions. Since it extends several feet from the body, how you feel can affect someone who is nearby, especially if you are in physical contact with them, as noted below.

Women who work together for long periods of time also tend to have the same menstrual cycle, although this may be due to pheromones, and there may be other subtle energy communication mechanisms that have yet to be discovered. As previously emphasized, Arabic physicians have long considered the heart to be the most important organ in the body. They have also made significant contributions to our understanding of its role in circulation of the blood and human relationships hundreds of years before Harvey. And they are continuing to explore the mysteries of the heart and subtle energy communication in the biennial International Conference on Advanced Cardiac Sciences, founded in 2006 by Dr. Abdullah Al Abdulgader, Director of the Prince Sultan Cardiac Center, Hofuf, Saudi Arabia. I have been privileged to participate in and help organize the last three of these cutting-edge events, which—not surprisingly—are referred to as "The Heart, King of Organs Conference".

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