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The Heart: A Pulsing and Perceptive Center

C R A I G H O L D R E G E

We and Our Bodies: The Problem of Physiology

IN MY TWENTY YEARS as a high school biology teacher, I was always most apprehensive about teaching human physiology. Not because the subject might bore the students. And not because I knew I didn't know enough—that was a problem in all subjects. What worried me was a question that continually gnawed at me during preparation: Am I teaching the students about reality, or about “facts” colored and distorted by models, theories, and prevailing habits of thought?

One problem with physiology is that it rarely deals with direct phenomena. Who can observe the blood flowing through the blood vessels? Who can observe the liver making bile and secreting it into the gall bladder? Most of the “facts” of physiology are in reality conclusions based on experimental or indirect evidence. Today science and medicine make use of sophisticated imaging techniques such as CAT scans and the MRIs. But these images too must be interpreted—they are not the phenomena themselves. Moreover, human physiology textbooks

are full of descriptions based on observations made in animal experiments. But do they apply to human beings?

Another difficulty—which I primarily want to address here – concerns physiology’s narrow scope. When we discuss the workings of internal organs as if they just happen, removed from their living context within us as sentient, thinking and active human beings, then we’re dealing with a phantom. To put it drastically: to teach physiology by itself is to teach a lie. Over the years I struggled with this problem—and you can now see why I wasn’t overly eager to jump into the classroom, although the heart, the lungs, the liver, and the brain fascinated me. But I didn’t want to teach about them as isolated things. I didn’t want to teach about them as mechanisms.

So I asked my students, by way of introducing a course in human biology, “What do we need to take into consideration if we are interested in a comprehensive scientific understanding of the human being? What might a true science of the human being encompass?” Since this was a biology course, it was natural to think first of the body. We should know anatomy—how the body is membered into parts and how these parts are structured, connected, and ordered within the body. Anatomy (which literally means “to cut”) involves dissection and is best done on corpses. It means taking apart the body, finding structure within structure. Anatomy brings clarity and order, but it lacks life. What do we need to understand life? At a minimum we need to understand how organs grow, develop, and function and how all these functions are interrelated. We need the sciences of physiology, developmental biology, and ecology, to mention a few.

This is already a tall order, but even if we could describe all these processes and functions, would we then have understood the human being? Is that all that belongs to and determines us? High school students, at least, have a clear answer to this question: No! The sadness a boy feels after being dropped by his girlfriend is not physiology (although it expresses itself in body). Feelings are not to be found in the organs. It soon becomes clear that much of what is most essential and closest to us—our thoughts, feelings and hopes—is not directly sense perceptible. We all have inwardness, an interior, a soul—whatever term we choose as a label—which is a very real and important part of the human being, even if it is not physically tangible.

Any thorough study of the human being must take this inner world into account. Simply put, we need a science of psychology. We can do a phenomenological study of the soul through introspection and through relating experiences with other individuals. But we can also study, say, how emotions affect blood pressure or intestinal function, or how the latter affect emotions. Every student is crystal clear about the fact that you can't understand blushing merely as a dilation of superficial blood vessels in the facial skin. You have to take into account the person who was embarrassed. Without the feeling of embarrassment there would be no change in physiology in the face. A miraculous and mysterious connection. We've arrived at the mind-body problem, which has perplexed but also stimulated the human mind for centuries. Framed in more modern terms, we're dealing with psychosomatics—the relations and interactions between the soul and the body. Or to put it less dualistically, how our interior and exterior are different aspects of our being.

But is this enough? Imagine a doctor who treats you for an illness. He might have a good foundation in anatomy, physiology, psychosomatics, and psychology, but still not treat you well. Why not? Because he didn't see you as an individual, as a unique person. Every patient is keenly aware of being treated by a physician as an instance of a disease. I remember being treated by an ophthalmologist and thinking after the visit: "He would have liked it much better if I could have sent him my eyeball all by itself. The rest of me, it seemed, was just getting in the way." Every illness, for all its generality, has an individual dimension. It occurs at a particular time of life under particular inner and outer conditions. The illness also presents a task for the individual. Evidently we need a science of the individual, an approach toward the human being that allows us to recognize and understand how the myriad features of being human live differently and uniquely in each of us.

Against this background it is not hard to see how I came to the view that teaching physiology by itself, especially within the narrow framework of modern textbooks and college instruction, fosters not only an inadequate but also false picture of the human being and our human bodies. Of course we cannot address all the layers of the human being when we discuss a given organ. But we can recognize

that this multilayered understanding is, in the end, our goal and that every step we take is part of a work in progress.

A Goethean Approach

Few people know that Goethe coined the term morphology [20, p. 216]. He used the word in short essays he wrote at the end of the 18th century that were first published in 1817 [4, pp. 57-69]. He was not just interested in introducing a new term for already extant work. Rather, he envisioned a new focus within biology. Morphology was for him not a new content, but a new way of looking. Here's how Goethe describes morphology:

Morphology may be said to include the principles of structured form and the formation and transformation of organic bodies.... The Germans have a word for the complex of existence presented by the physical organism: *Gestalt* [structured form]. With this expression they exclude what is changeable and assume that an interrelated whole is identified, defined, and fixed in character.

But if we look at all these *Gestalten*, especially the organic ones, we will discover that nothing in them is permanent, nothing at rest or defined—everything is in a flux of continual motion. This is why German frequently and fittingly makes use of the word *Bildung* [formation] to describe the end product and what is in process of production as well.

Thus in setting forth a morphology we should not speak of *Gestalt*, or if we use the term we should at least do so only in reference to the idea, the concept, or to an empirical element held fast for a mere moment of time.

When something has acquired a form, it metamorphoses immediately into a new one. If we wish to arrive at some living perception of nature we ourselves must remain as quick and flexible as nature and follow the example she gives. (4, p. 57 and pp. 63-64).

Morphology uses the information provided by anatomy, chemistry and other relevant sciences. But it uses scientific data “to portray rather than explain” (4, p. 57). Goethe strove for a living understanding of

the organism that brought the dynamic wholeness of the organism to light; he was not interested in explaining it through scientific models, which have the remarkable characteristic of taking life out of what they represent.

Since morphology, in Goethe's sense, deals with how organic structures form and transform, it clearly leads into physiology. But just as Goethe went beyond the confines of anatomy in envisioning morphology, so also does he go beyond what we today call physiology:

The existence of organic nature is possible only insofar as organisms have structure, and these organisms can be structured and maintained as active entities solely through the condition we call "life." Thus it was natural that a science of physiology should be established in an attempt to discover the laws an organism is destined to follow as a living being....

In thinking of an organism as a whole, or ourselves as a whole, we will shortly find two points of view thrust upon us. At times we will view man as a being grasped by our physical senses, and at times as a being recognized only through an inner sense or understood only through the effects he produces.

Thus physiology falls into two parts which are not easily separated, i.e., into a physical part and a spiritual part. In reality these are inseparable, but the researcher in this field may start out from one side or the other and thus lend the greater weight to one or the other. (4, p. 59)

The essays in this book are inspired by this Goethean view of the organism and of science. They are an attempt to "portray rather than explain." Some essays give precise descriptions of physiological processes, while others portray the heart and circulation within broader developmental and evolutionary contexts. In this way we can at least begin to intimate the intricacies of the circulatory system and begin to see its place within the whole human being.

A Goethean approach to organisms, and especially to human physiology, still stands at a beginning. The contributions in this book are an effort to present the fruitfulness of this approach in respect to the morphology and physiology of the human heart and circulatory system.

But they are only a beginning. I say this not to detract from the years of work that these efforts represent, but to emphasize how much more work is needed. For example, these essays just begin to enter the realm of what Goethe called spiritual physiology, and the areas of psychology and the individual that I discussed above. Hopefully, they can provide stimulus for further work in these fields. If you as a reader come away feeling that you have gained a more living portrayal of the heart and circulatory system that enkindles your desire to understand more deeply, then we'll know the book was worth writing.

But getting this far means overcoming a substantial hurdle, namely the limitations of the mechanical way we've come to view life over the past centuries.

Mechanical Metaphors

Mechanical metaphors present one of the greatest hindrances to understanding human physiology—the liver is a chemical factory, the kidney is a waste treatment plant, the heart is a pump and the brain is a computer. Especially the last two metaphors conjure up the image of a central causative power or command center from which all activity issues. It is the mechanomorphic mind that interprets the phenomena in light of metaphors that are easily accessible and understandable to it. We need to be clear that it is *our* mind that determines how we look at the phenomena. If we lived in a poetic and not a technological age, the metaphor “the heart is a rose” might be felt to be much more powerful and adequate to the phenomena. A mind at home in the mechanical world of cause and effect can hardly avoid seeing the heart as a pump circulating the blood through the body. We can interpret all sorts of data in terms of this model and even create astounding devices such as the artificial heart. But that doesn't mean that, by itself, this model is adequate.

The strange thing about mechanical models is that they tend to be exclusive and occupy the mind at the expense of other metaphors or ways of viewing. A high school or college student doesn't usually learn “the heart has functions that can be interpreted in terms of a pressure pump,” rather they learn “the heart is a pump,” meaning that's all it is. That's what often happens to mechanomorphic metaphors in science.

They become fixed and literal, losing their vibrancy and openness as metaphors that suggest relations. This makes them easier and clearer to apply. Unfortunately, it also moves them away from life.

Once such metaphors have become fixed in the mind, it can then be difficult to loosen these images so that something of the richness of reality reenters the mind. One aim of this book is to contribute to this loosening, to look at the heart and circulation in broader and more dynamic terms.

The Fluid Heart

One of the most striking features of the circulatory system is its dynamism. While the brain rests firmly and still in its protective casings, rhythmic movement, transformation, and the ability to mediate extremes characterize the circulatory system.

The anatomy of the heart alone shows that it is a dynamic organ. Most of the heart consists of muscle fibers (myocardium). These fibers are joined in bands that “present an exceedingly intricate interlacement” (5, p. 468). What may at first appear to be more or less distinct layers of lengthwise (longitudinal), diagonal (transverse), and horizontal (ring) musculature are in reality connected bands of complex spiraling fibers.

The nineteenth-century English anatomist J. Bell Pettigrew discovered the spiraling course of muscle fibers [described in 18]. He spoke of untying the Gordian knot of anatomy. In order to understand the “unusual and perplexing” arrangement of the fibers, Pettigrew had to carefully separate the different layers of fiber from each other. Since muscle tissue does not easily separate, he had to boil the heart for six hours and then leave it in alcohol for two weeks. Only then could he easily separate the different layers. He discovered in the ventricles seven layers—three outer, three inner and a middle layer.

Through careful dissection he discovered that the layers of muscle fibers were interconnected. In other words, the layers of fibers were not like layers of onion skin, but rather continuous sheets of spiraling fibers. 20th Century German anatomists Benninghof and Goertler carried Pettigrew’s investigations further. I will follow their description ([1]; see figures 1 and 2).

8 THE DYNAMIC HEART AND CIRCULATION

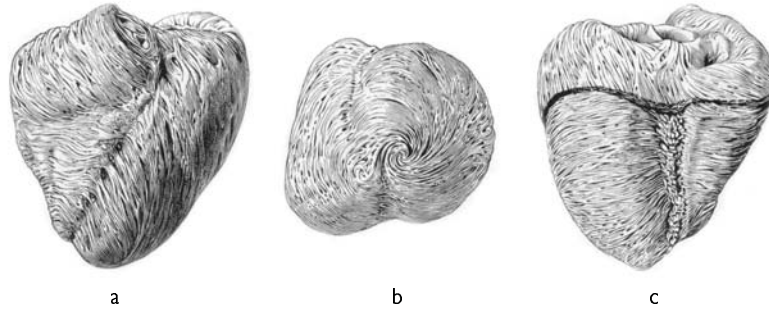


Fig. 1: The heart muscle fibers in the ventricles. a) viewed from the front (ventral), b) viewed from below; note the vortex formed by the fibers (*vortex cordis*), c) viewed from behind; the superficial fibers are partially removed to show the deeper muscles [after I].

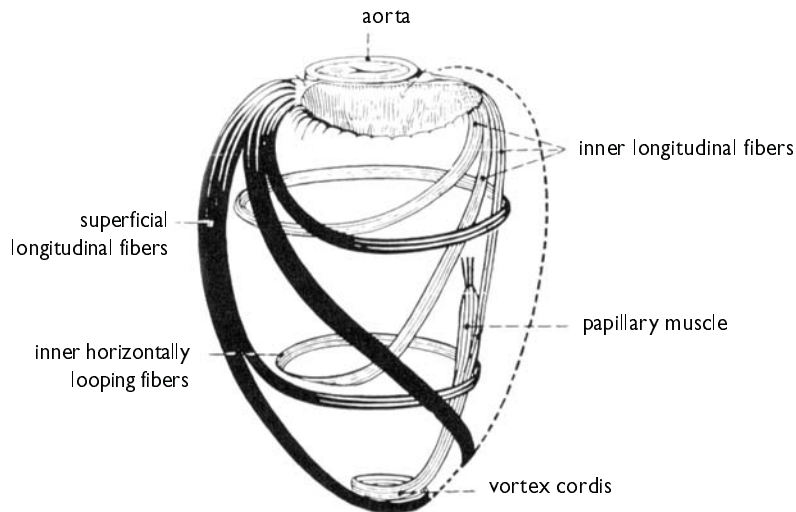


Fig. 2: Schematic representation of the spiraling heart fibers in the left ventricle. See text for description [after I].

The outer muscle fibers begin at the upper part of the heart (called the base in medical terminology) and sweep down in counter-clockwise curves to the tip (apex) of the heart. There they loop around and form the so-called heart vortex (*vortex cordis*, see Figure 1, middle drawing). Those fibers that begin at the front (ventral side) of the heart enter the heart vortex at the back (dorsal side) of the heart

while those that begin at the back sweep around to the front. These outer fibers loop around each other, creating the vortex pattern, and then continue into the inside of the muscular wall and spiral back upward. Some of these fibers radiate in the papillary muscles that move the atrio-ventricular valves.

Fibers that lie deeper at the top of the ventricles spiral down—in contrast to the superficial fibers—clockwise. These fibers coil in more tightly and form nearly horizontal loops around the body of the ventricles before they sweep upward again to the top of the heart.

The best way to form a picture of this complex fiber arrangement is to study figure 2 and then try to recreate the spiraling with your hands. With repeated effort you begin to get a sense of the heart's dynamic structure, which Pettigrew described as “exceedingly simple in principle but wonderfully complicated in detail” [18, p. 514].

Since a muscle like the heart retains its form, we generally think of it as being solid. Of course we know that it can change its shape, but when we realize that muscle consists of about 75% water, we begin to think of it in more fluid terms. The spiraling and looping pattern of the heart fibers, including the beautiful heart vortex, is an image of fluid movement. Pettigrew made casts of the heart cavities. Figure 3 shows the cast of the left ventricle of a deer. One can see spiraling forms here as well. The ridges in the cast represent grooves in the actual cavity. These grooves are separated by the bands of papillary muscles that move the atrio-ventricular valves. As Pettigrew writes,

The importance of these grooves physiologically cannot be over-estimated, for I find that in them the blood is moulded into three spiral columns... The spiral action of the mitral valve and the spiral motion communicated to the blood when projected from the heart, are due to the spiral arrangement of the muscoli papillares [papillary muscles] and fibres composing the ventricle, as well as to the spiral shape of the ventricular cavity. [18, p. 510]



Fig. 3: A cast of the left ventricle of a deer [after 18].

The blood streaming through the heart also creates loops and vortices. Like the fibers of the heart this movement is very complex and intricate. In a sense, what the blood does as a fluid has become formed in the muscular structure of the heart.

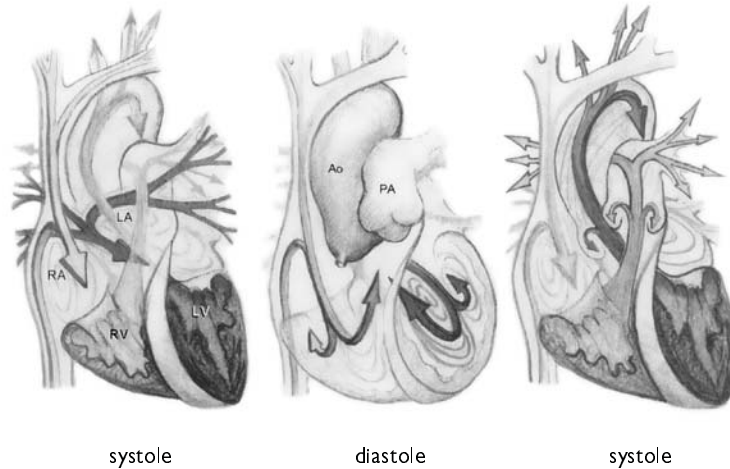


Fig. 4: Changes in blood flow direction through the heart, viewed from the front. Systole has been shown twice to show inflowing and outflowing blood. RA: right atrium; RV: right ventricle; LA: left atrium; LV: left ventricle; Ao: aorta; PA: pulmonary artery. (Drawings by P. Kilner; reprinted with his permission. See [9 and 10].)

To build up a living picture of the blood flow through the heart we have to recognize that the direction of blood flow is radically altered by the heart. Venous blood enters the right side of the heart through the superior and inferior caval veins, which are vertically oriented (see Figures 4 and 5; see also Appendix A). From the right atrium the blood streams down into the right ventricle and then back upward into the pulmonary artery, which immediately branches horizontally to the right and left to enter the lungs. In contrast, the blood that enters the left side of the heart comes horizontally from the pulmonary veins. From the left atrium it flows downward into the left ventricle and loops upward into the ascending aorta. At the aortic arch three arteries (innominate, left subclavian, and left common carotid) ascend into the head and arms, while the vertically descending aorta serves the rest of the body. Thus the right side of the heart brings vertically flowing

blood into the horizontal and the left side of the heart brings horizontally flowing blood into the vertical. This change in orientation is clearly evident in the drawing of the cross that is formed by the caval veins and the pulmonary veins (Figure 5).

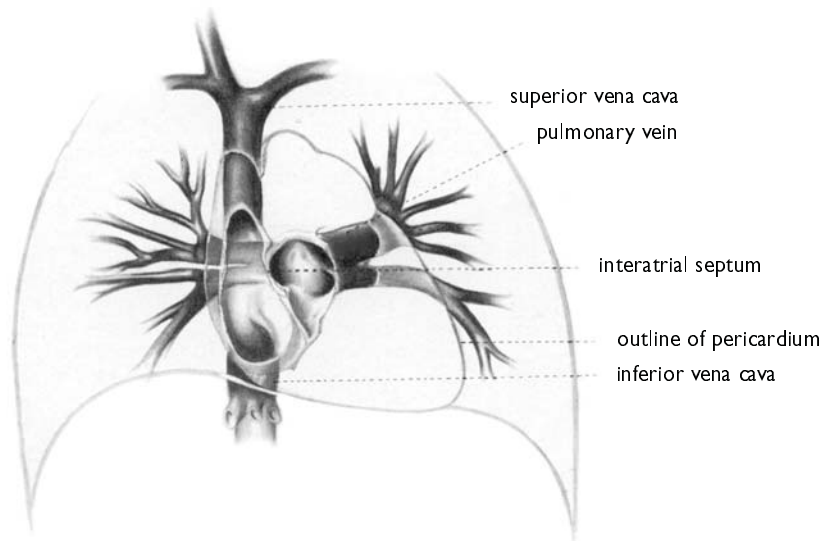


Fig. 5: Crossing of the caval and pulmonary veins [after 1].

Recently, with the help of sophisticated imaging techniques, Philip Kilner and his colleagues have provided a more concrete idea of how the blood streams through the heart itself [9, 10]. Blood flows into the atria when the atrio-ventricular valves are closed and the ventricle muscles contract (systole). The streams of blood entering the right atrium from the superior and inferior caval veins do not collide, but turn forward and rotate clockwise forming a vortex. The blood streaming into the left atrium also forms a vortex, but it turns counterclockwise—another contrast between the right and left sides of the heart. (To imagine this hold your index fingers close together, pointing downward in front of your chest; rotate the right index finger clockwise and the left finger counterclockwise.)

When the atrio-ventricular valves open, the blood streams into the relaxed ventricles (diastole), again rotating, forming vortices that

redirect the flow of blood. For a short moment the blood does not flow further and then the semilunar valves (which separate the ventricles from the outgoing arteries) open and the blood streams into the pulmonary artery and the aorta.

We've arrived at a picture of the intricate streaming, turning, looping blood flow through the heart that follows a different pattern in each of the four chambers. The coiling, looping heart fibers create contractions that mirror and facilitate this dynamic coursing of the blood. The heart muscle does not work, as we often imagine it does, opening and closing as we can do with our fist, first forming a fist (systole) and then relaxing the fist (diastole). Rather, the heartbeat (cardiac cycle) includes a much more complex array of movements. During systole the heart moves downward and oscillates slightly to the sides and also rotates around its own axis [8, p. 360 ff.; 13,14]. During diastole it moves upward and rotates back in the opposite direction. Only the heart's interwoven spiraling muscle fibers can produce this kind of complex motion.

We see that blood flow, the form of the heart and the pattern of its fibers, and the heartbeat are intimately entwined. We can't think of one without the others. When we go back to the origin of the blood and the heart in embryonic development, it is no simple matter to say what came first (see Brettschneider's preface to Woernle's chapter in this book). Maybe it's also just our mechanical way of thinking that wants to see a clearly directional cause and effect relation between the heart and the blood instead of a more living relation of mutual dependency.

This mutuality shows itself during the embryonic development of the heart. Early in its development the heart begins to form loops that redirect blood flow. But before the heart has developed walls (septa) separating the four chambers from each other, the blood already flows in two distinct "currents" through the heart [1]. The blood flowing through the right and left sides of the heart do not mix, but stream and loop by each other, just as two currents in a body of water. In the "still water zone" between the two currents, the septum dividing the two chambers forms. Thus the movement of the blood gives the parameters for the inner differentiation of the heart, just as the looping heart redirects the flow of blood. Blood movement and heart differentiation belong together.

Pulsing Interplay

From the above considerations we can see how the heart is the center of the circulatory system. It connects the upper and lower parts of the body as well as, through the pulmonary circulation, the outer (air) with the inner.

We cannot understand the heart's activity unless we consider the blood, peripheral circulation, and the metabolic activity of the other organs. A rapidly beating heart only brings more blood into the arterial system if it is receiving more blood from the veins, which in turn is dependent on the metabolic activity of the organs and muscles [see Lauboeck's essay in this book]. The heart is continually adapting its activity to the needs and state of the body and person as a whole.

In strenuous activity, for example, we need more blood flowing to the muscles, which are using greater amounts of oxygen. To accommodate this need, the heart expands more in the diastolic phase (when it receives blood) and also increases its beating rate, which together allow more blood to pass through the heart and into the lungs and muscles. But the heart is not simply pushing this blood into the body. The lungs take in up to three times the amount of oxygen during exercise, not only because of the increased diffusing capacity of oxygen, but because both lung alveoli (where diffusion occurs) and the lung capillaries dilate, letting more blood pass through the lungs [6, p. 481ff.]. Similarly, in the muscles the blood vessels actively dilate, allowing more blood into the muscles fibers.

If, over an extended period of time, an organ needs more oxygen, it stimulates, via growth factors, the blood vessels in the organ to grow [2, 12]. This is another example of how the impulse to change and adapt comes from the periphery. The whole circulatory system, from center to periphery, is involved in getting more blood into the tissues that need it.

When the blood moves through the organs, it is continually changing. After we've eaten, for instance, the blood passes through the intestines and takes up nutrients. The blood then enters the liver, which draws nutrients out of the blood. The liver also detoxifies the blood, removing, for example, bacteria or alcohol. The blood ascends to the right side of the heart and then enters the lungs. There the

blood spreads out in fine capillaries where it is enriched with oxygen. This oxygen-rich blood returns to the left side of the heart and then, via the systemic arteries, enters into all the organs of the body. In each organ something unique to that organ happens to the blood. In the brain, large amounts of sugar and oxygen leave the blood. The kidneys remove metabolic waste products and water from the blood, but also secrete hormones that regulate the production of red blood cells. The blood is truly a special fluid in its ability to take in and give off substances that it moves through the body. It is in unceasing change and thereby helps the body maintain its physiological balance and coherence.

The blood spreads out into all recesses of the organs and into the periphery of the body via arteries and capillaries. Through the capillaries, exchange of substances occurs. The blood then recollects in the heart via the veins. We thus need to think of the circulatory system as a polarity of center and periphery connected by movement. The periphery is an active and not passive part of the circulatory system. One recent discovery shows an unexpected kind of activity. Scientists discovered that the peripheral blood vessels, before they are fully functional in the embryo, induce the development of organs like the pancreas and liver [19]. Evidently, the circulatory system has its mediating role already at a very early time.

Changes in the blood's pressure, viscosity, warmth, and biochemical composition are communicated to the heart. This communication is mediated by the nervous system, hormones, and heart and blood vessel sensory receptors. The heart therefore exists as a perceptive center for the body via the circulation. Steiner spoke of the heart as a sense organ for the organism, enabling it to perceive what transpires in the upper and lower poles of the body [21].

The heart does not just perceive what comes to it via the blood. It also alters its activity. We've discussed how it alters its volume and beating rate when more blood is needed in the body. In the 1980s researchers discovered that the heart secretes a hormone in response to the changing consistency of blood. If the blood is too viscous, the heart secretes this hormone (natriuretic peptide hormone) into the blood, and the hormone stimulates the kidneys to secrete more water into the blood. With time researchers will probably discover ever more

ways in which the heart functions as a perceptive and adaptive center of our bodies.

One further feature of the interplay of heart and peripheral circulation we shouldn't overlook is the maintenance of body warmth. As Liesche points out, only the warm-blooded mammals and birds have the completely four-chambered hearts (see chapter 5 in this book). The internal differentiation of the heart corresponds to the organism's ability to maintain a high constant body temperature despite radically fluctuating inner and outer conditions. The heart muscle itself is a source of warmth for the blood, while the peripheral circulation can expand and contract to give off or contain warmth.

Considering these diverse functions lets us recognize qualities of the heart's activity that are overlooked when we focus too exclusively on its role in blood movement. This more comprehensive view shows the heart to be a receptive, perceptive center that continually modulates its activity in accordance with the needs of the whole organism.

Into the Soul

It's illuminating to think of the many words and expressions in the English language that relate to the heart. Here are a few:

Heartfelt	Take that to heart
Heartless	Have a heart
Hearty	Lose heart
Heartrending	Heavy heart
Heartbreaking	Warmhearted
Heartache	Coldhearted
Fainthearted	Hardhearted
Lighthearted	Heart sick (sick at heart)
Heartsore (sore hearted)	Search your heart
Wholehearted	Put your heart at rest
Heart-to-heart	Near to my heart
Take heart	You are all heart

When you go through each expression and feel it, you enter a very richly-nuanced world. The feelings that are associated with these expressions are often deep (heart sick, heart-to-heart) and span polarities (cold and warm hearted; faint and light hearted, and so on). They are mostly related to feelings that touch or encompass our inner core and are central to us. It's one thing to search your brain for something or to put your mind to something and a very different matter to search your heart for something or put your heart into it. What comes from the heart is authentic and whole. The heart is literally in-dividual; it is unity and when that unity loses its center or begins to dissolve, it's, well, heartrending.

The quality of warmth is central to the heart. Someone who is heartless is also cold-hearted. When we have a heartfelt concern, then soul warmth streams out from us, but we remain part of this warmth stream (it doesn't leave us and dissipate). When we take heart, then the warmth enkindles our courage. (The word courage comes from the French and is related to the word heart in French (coeur) and in Latin (cor).) And when we're gesturing to someone to take heart, we might emphatically raise up our arm and ball up the fist in front of our chest. Taking heart means gathering at our center and from there expanding into the world through our actions.

Not only the heart moves between the polarities of contraction (systole) and expansion (diastole). Rhythmic movement between poles, and mediating and balancing between extremes, characterizes the circulatory system as a whole. The blood gathers in the heart and then flows out into the periphery, changing and exchanging with this periphery, and then moving back to the center.

When we've grasped the circulatory system qualitatively in this way, it's not surprising to discover its intimate connection to our inner life in feelings. Feelings of awe and love allow us to flow out into the world. We connect, give and learn from the world and bring the fruits of this interaction back to a center. We experience satisfaction and contentment. Our joy leads us back into the world. Or our experience of the world might enkindle fear, anger, or even hate. We draw back into ourselves when such feelings capture us, and then the healthy oscillation of the soul between inside and outside, between self and other, is disturbed. Just as we can become completely isolated through hate, so

also we can lose ourselves in unceasing rapture. It's clear that the main danger in modern culture is getting caught in feelings of antipathy like hate and anger; we tend much less toward losing ourselves in expansive feelings (if we don't take into account alcohol and drug-induced experiences).

The healthy life of the soul depends, as does the circulation, on continual movement, on the ability to flow out and gather in. Or we can also speak in terms of the other middle system in our bodies, the respiratory system: we need the ongoing pendulum swing between breathing out and breathing in.

With progress in developing relatively noninvasive devices to record physiological processes, it has become easier to demonstrate outwardly what we all experience from the inside, namely, that our feeling life is directly connected to our mental and physical well-being. People were asked, for example, to self-induce feelings like anger or compassion by imagining some previous situations in which they had the feeling. There were marked changes in heart activity ([7, 15]; see Figures 6 and 7). Our soul life and physiology are inseparable.

It is well known how stress (which means we are inwardly driven and contracted with little inner breathing room—our soul can't oscillate) has its physiological correlate in hypertension, where the blood, like the soul, is under abnormally high pressure. A Swedish study found that women who lived alone, had very few friends, and also no one to call on if they needed help, tended to have heart rates that varied very little over the course of the day [16]. Such low variation in heart rates is correlated with heart disease susceptibility and early death. Less socially isolated individuals have a more varied heart rate, corresponding to their more varied lives that include more support from other people. Here again we see the healthy gesture of movement and interaction, while isolation brings not only emotional monotony but also has tangible effects on the circulatory system and on health.

Clearly, the path to real understanding and to a comprehensive approach to health involves seeing bodily processes as an expression or outer aspect of what we are inwardly. We need to get beyond considering or treating the body as a thing by itself.

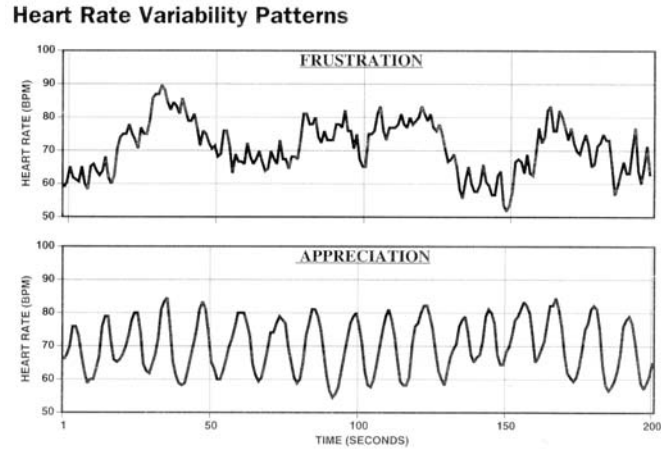


Fig. 6: Contrast between the heart rate variability patterns in subjects experiencing self-induced feelings of frustration (top) and appreciation (bottom) [from 7].

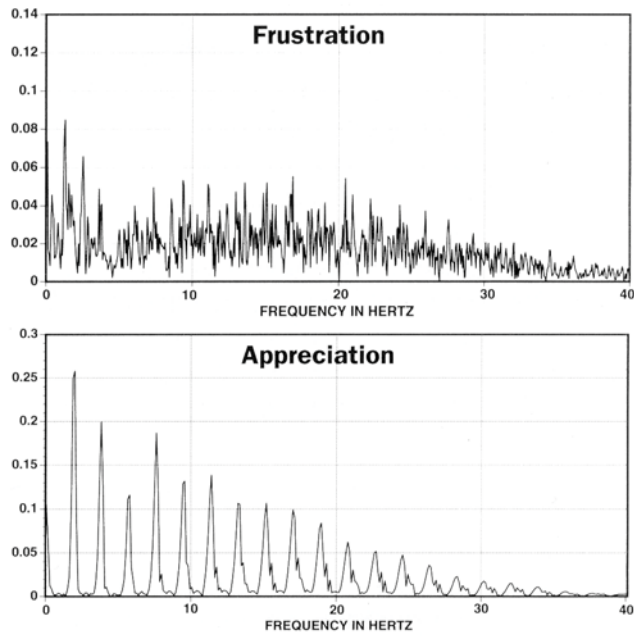


Fig. 7: The graphs image the electrical frequencies generated by the heart (ECG Frequency Spectra) over a ten second period in subjects experiencing self-induced feelings of frustration (top) and appreciation (bottom) [from 7].

Conclusion

The kind of picture of the heart and circulation we carry within us has consequences. First, of course, there is the question of truthfulness. Mechanical models may be helpful to understand partial functions of an organ or system, but when they become exclusive, the partial truth becomes falsehood, because we end up making the heart much *less* than it really is. If we are aware of this problem and strive for a many-sided and multi-leveled view of the heart and circulation, then we can begin to approach its many-sided reality. Of course our picture will not be adequate, but it will be open-ended so that the depth and breadth of full-blooded reality are fully recognized, if not yet understood.

The pictures we carry within us determine how we view ourselves and the world. They bear a qualitative stamp. One image is that of a central power center that forces blood through the body and thereby maintains the body. This is, if you will, an egocentric view of the heart – the forceful doer around which things revolve. The pump just keeps on working until it wears out—or, as in the case of the artificial heart, keeps beating even when the person has died.

I couldn't help having ambivalent feelings reading articles in the summer and fall of 2001 reporting on the first patients to receive the AbioCor artificial heart, which completely replaces the patient's heart. On the one hand, I could only marvel at the technology and surgical ability of the doctors. On the other hand, I was disconcerted by the way in which fascination with the machine and technological progress came so starkly to foreground.

Mr. Robert Tools was the first patient to receive the AbioCor artificial heart. After the operation in July, Mr. Tools recovered quite well and was able to leave the hospital. He suffered a stroke on November 11th. Patients with an artificial heart are always susceptible to strokes, because the blood more easily clots when it comes in contact with the artificial material of the valves. Normally a patient receives blood thinners to prevent clot-formation, but this was not possible in Mr. Tools' case, since he had a tendency to bleed internally.

After the stroke, Dr. Laman Gray, who carried out the surgery, reported that Tools' condition "is probably a little better than a person with a [real] heart, since we don't have to worry about the heart itself"

(*New York Times*, November 15, 2001). Gray went on to comment about another patient who had received the AbioCor artificial heart. This patient was making slow progress, due to a high fever that may have damaged his organs, but, as the reporter paraphrases Gray, “Mr. Christerson’s [artificial] heart has been working well” (ibid.).

On November 30, Mr. Tools died due to internal bleeding. *The Los Angeles Times* reported (December 1), “‘Tools’ death in no way means the experiment failed,’ said Dr. Mehmet Oz Indeed, Tools’ doctors noted that the heart continued to beat flawlessly even as he died.” Here we see the mechanism enthroned in a sad separation from the person. The pump still continues to beat as if nothing had changed, while the person dies. And as long as you focus on the mechanism, and the pump continues to work, the experiment cannot be called a failure, although the patient died.

Very different is the view of the living, dynamic heart and circulation. Here we see give and take, and continual change and adaptation through interactions. We see a dynamic, perceptive center that maintains coherence and integrity. This image is not only truer than the mechanical one. It also imbues us with a sense of connectedness to our image of what it means to be human. From birth till death, the living heart shares in our life as ensouled beings.

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