Zygon®: Journal of RELIGION & SCIENCE

Miller, Gordon L. 2024. "The Soul of the Frog for a Postmodern Age: Updating a Classic Debate." *Zygon: Journal of Religion and Science* 59 (3): 609–37. DOI: https://doi.org/10.16995/zygon.16572

Open Library of Humanities

The Soul of the Frog for a Postmodern Age: Updating a Classic Debate

Gordon L. Miller, Professor Emeritus of Environmental Studies at Seattle University, Seattle, WA, USA, glmiller@seattleu.edu

The history of modern science bears abundant witness to the fact that the humble frog has yielded myriad insights into the intricacies of anatomy and physiology far beyond frogs, producing several Nobel laureates in the process. A concurrent but less heralded inquiry and debate, however, has wrestled with the harder question of, as Thomas Henry Huxley put it in 1870, "Has a Frog a Soul?," with frogs serving as convenient experimental subjects for issues of the human soul and body. Here, I present highlights from this debate among leading eighteenth- and nineteenth-century scientists representing animistic and burgeoning mechanistic views, with the latter effecting a significant contraction of soul, ending with William James in 1890. I then bring the inquiry up to date by showing how Alfred North Whitehead's philosophy of organism and some recent physiological research offer promising and constructive postmodern hope for addressing the dispiriting loss of soul, on various levels, that afflicts much of modern life.

Introduction

In the late seventeenth century, the great Dutch anatomist and microscopist Jan Swammerdam (1758, 105) declared that "there is a much greater number of miracles, and natural secrets in the Frog, than anyone hath ever before thought of or discovered." With the fine details of development and muscular action he highlighted in these rather lowly animals, he linked together the realms of insects, amphibians, and human beings and challenged the traditional belief that animal anatomy and physiology lack relevance for humans, arguing instead that a single set of divine laws governs them all (Sleigh 2012b). Swammerdam was not alone in recognizing the promise of the frog, for it certainly became the organism of choice from his day to our own for a vast range of often revolutionary biological inquiries into, for example, the heart, the lungs, muscle contraction, nerve conduction, visual perception, and ecological degradation. The great significance of these studies is due largely to the venerable and scientifically productive assumption, championed by Swammerdam, that the frog can, in many ways, serve as a useful model or microcosm of mammals, most notably of human beings (Burggren and Warburton 2007; Gilbert 1965, 3–13; Holmes 1993).

The distinctive physical qualities of frogs (representing the Anuran order of amphibians) have served researchers well in their varied anatomical and physiological pursuits throughout much of the history of modern science. But what of the frog's nonphysical qualities, assuming such exist? Has modern science achieved insights into the mysteries of nature on this front as well, affording notable revelations regarding the workings of mind, or consciousness, or what has traditionally been called the soul? Thomas Henry Huxley ([1870] 2015) posed the basic question directly in an influential speech titled "Has a Frog a Soul?" But Huxley's inquiry was merely a penultimate foray in a public debate that had gradually played out in Europe from the mid-eighteenth century to the dawn of the twentieth. In this empirical and ideological contest, the contrasts between animistic and mechanistic views were clearly drawn, and in the supporting series of experimental studies, the frog proved, primarily because of its amazing tenacity of life even in extreme conditions, to be an ideal experimental subject, offering insights into the nexus of body and soul through methods unthinkable with humans. And as with the more purely physiological investigations noted, the longsuffering frog in this case as well was clothed in larger significance in the minds of many as a homologue for humans, this time regarding whether, where, and in what way *we* might have a soul.

An inquiry into questions of the soul in the early decades of the twenty-first century is complicated by the fact that, despite the presence of a multitude of firm believers, many among us are no longer so sure that even we humans have what might properly be called a "soul." We are obviously quite sure we have a mind, and perhaps a self, but the idea of a soul comes trailing suggestions of

immateriality and immortality, notions widely questioned or rejected in current Western culture (Crabbe 1999, 1–7; Sorabji 1999). And recent work in biology, neuroscience, and cognitive science has offered abundant experimental evidence regarding the anatomy and physiology of functions traditionally attributed to the soul and has thus set many to thinking, or concluding, that even the mind or the self are at bottom nothing but material processes (Murphy 1998, 11–19). But what of the unconscious mind, which many of us are also fairly certain is part of ourselves? Is this more shadowy realm of passions, portents, and symbolism perhaps more soul-like in nature? Perspectives obviously differ on all these points.

In the early twentieth century, Carl Jung (1933) saw the growing interest in depth psychology, paranormal phenomena, and spirituality as evidence that many moderns were apparently "in search of a soul." But as the century wore on, other thinkers suggested that the search had evidently not enjoyed widespread success, with Jacob Needleman (1980) writing of "the lost doctrine of the soul" and Thomas Moore (1992, xi) declaring that "the great malady of the twentieth century . . . is 'loss of soul.'" This contemporary cultural atmosphere, beset with uncertainty regarding the nature or existence of a human soul, makes it a challenging place from which to see clearly into the further question of animal souls.

While there are undoubtedly many meanings of soul in every age, something that becomes clear from a historical perspective is that in the premodern era, and even somewhat into the eighteenth century, the extent of soul, in some form, was generally considered much broader with regard to both its place in the human body and its presence in the nonhuman natural world. Whereas the dominant modern coordinates generally limit it to the conscious mind—often only of humans—and its corresponding brain, in the ancient world, for example, *psyche* was seen not only as the fire of consciousness but more fundamentally as the force of life itself. In his influential three-part theory of the soul, Plato prioritized the brain and spinal cord as the seat of the immortal and uniquely human rational soul (*Timaeus* 73b–d), while the other parts of the soul, although somewhat subservient to the dictates of the head, were also indispensable and more extensive. He located the spirited or emotional part of the soul, shared with other animals, in the chest and the appetitive part, associated with physiological needs and desires and shared with both animals and plants, in the abdomen, particularly the liver. The Platonic soul thus pervades the body to some degree and exists as a microcosm of an infinitely more expansive soul—the universally animating World Soul, an animistic or panpsychic conception also evident in previous Greek thought that envisioned a thoroughly ensouled natural world (Lorenz 2009; Skrbina 2017, 37–52).

Aristotle also proposed a tripartite scheme, but in place of Plato's spirited and appetitive souls, he envisioned sensitive and nutritive functions respectively

and saw them as animating all an organism's vital and responsive processes—nutritive in plants and nutritive plus sensitive in animals. In animal and human bodies, he located these essentially in the heart, with the heat in this region signifying an active soul. Regarding the rational, distinctly human aspect of the soul, he thought, contrary to Plato, that it, though dependent on the nutritive and sensitive functions, did not reside in any specific organ or region of the body (Lorenz 2009; Frede 1995). The burgeoning of anatomical knowledge derived from animal and human dissections in third century BCE Alexandria, particularly the neurological discoveries, fostered a fuller grounding of the soul in the details of anatomy and physiology. Galen continued this general approach into the third century CE, placing Plato's tripartite emphasis on the brain, the heart, and the liver on a firmer anatomical foundation and, contra Aristotle, designated the brain as the primary seat of the soul (Debru 2015).

Part One: The Classic Modern Search for Soul

The influence of thinkers from classical antiquity, especially Plato and Aristotle, regarding the nature and location of soul reached through the succeeding centuries and has been felt in various ways in the modern experimental search for the soul in the accommodating physiology of frogs. But before launching their inquiries, these eager experimentalists needed to deal with the other preliminary challenge facing inquirers at the outset of their search—determining the most reliable outward signs of a soul. Again they looked to the ancients. Plato expressed a widely held view in his suggestion that "self-generating motion" is the defining feature of soul (*Laws* 896a–c). Aristotle also considered motility a very basic sign of the animal soul but emphasized as well that, at the various levels of his three-part soul, the nutritive functions of metabolism and growth (in all living things), the sensitive functions of perception and movement (in animals), and the singularly human activity of rational thought were also indicative of soul. Considering that the inquiries into frogs in more recent centuries were pursued in the context of experimental physiology, the perception and movement disclosing an animal soul were not the unprovoked self-motion observed in field settings evoked by natural stimuli but rather the sensitivity and muscular response to a stimulus or test imposed by the experimenter. And, as I also discuss later, some participants in the modern debate found that a more specific criterion—not mere motility but distinctly *purposive* self-movement—was better suited to their needs in signifying the presence of some measure of coordinated inward experience constituting mind or soul.

With an at least working assumption that the primary bodily seat of the soul is most likely the brain, though perhaps with some degree of ensoulment in other regions, and that self-generated movement of various grades is its most reliable sign, the search began in earnest with scalpel and probe. Aristotle (*De Anima* 411b) had observed that plants as well as certain animals "go on living

when divided into segments," meaning that "each of the segments has a soul in it" because "the segments for a time possess the power of sensation and local motion." Accordingly, the general strategy in later centuries for testing the accuracy of these assumptions in the actual physiology of a frog was to excise or otherwise disconnect or destroy the presumed seat from the surrounding soma and then see what signs of soul remained, an operation apparently first documented by Leonardo da Vinci around 1485 in his own search for the soul (Del Maestro 1998). This typically involved the traditional and torturous procedure of pithing, in order to sever the spinal cord and scramble the brain, and often the even more gruesome technique of decapitation, rendering the frog essentially brain dead but otherwise still alive. (In recent decades, these procedures have been discouraged or disallowed in laboratory settings in many countries or permitted only on previously anesthetized animals. For a brief sketch of ethical considerations regarding experimentation with frogs from the perspective of the philosophy of organism as presented in this article, see the conclusion.)

The metaphysical engine driving much of this research, especially with the impetus provided by Descartes, was the rising energy of the mechanist's quest to determine what regions of the living world, if any, can be explained simply by the known laws of physics. Such thinkers thus hoped to expand the domain within which they could apply their version of a "Newtonian physiology" without worrying about presumably unpredictable influences from mind or soul. This left unresolved, however, the persistent conundrum of how such a nonmaterial entity like the human soul (as the Cartesian dualists envisioned it) could causally interact with a material body presumably devoid of any such psychic qualities. The animists on the other hand challenged the mechanists with their arguments that many forces of nature clearly display the qualities of mind or soul, which are particularly evident in the energies of living organisms but are also perhaps minimally present in ostensibly inanimate objects (Roe 2003, 400–8; Demarest et al. 2021). Such philosophical animism thus denotes the view that all things have at least some degree of inherent life or even inward experience.

The Eighteenth Century: Sensitivity and Irritability

The pioneering experiment of Leonardo, or a version of it, was repeated in the 1730s by Scottish physician Alexander Stuart, who provided a classic illustration (Figure 1), and by English cleric and physiologist Stephen Hales. These experiments influenced the thinking of Scottish physician Robert Whytt (pronounced "white"), perhaps the leading neurophysiologist of his time. The publication of his *Essay on the Vital and Other Involuntary Motions of Animals* in 1751 (with a second edition in 1763) marked the point at which the search for the soul became a public, philosophically nuanced, and occasionally acerbic debate

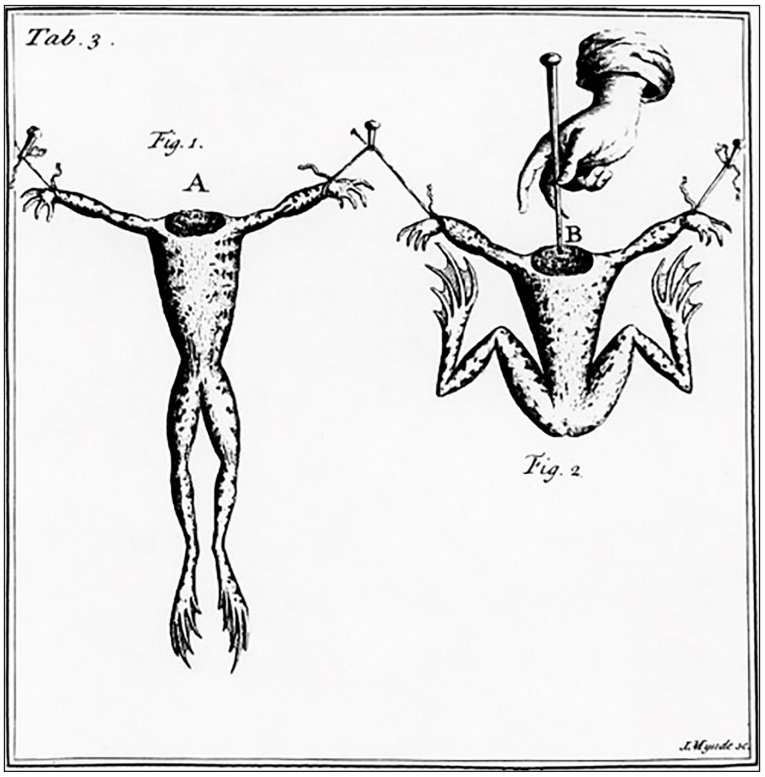

Figure 1. Stuart 1739, facing p. xxxvii.

embodying the modern confrontation between animism and mechanism. Whytt represented the animistic view, with the mechanistic perspective championed by renowned Swiss physiologist and physician Albrecht von Haller. Both scientists were devoutly religious in their dealings with the soul but distinctly at odds in their religious perspectives.

Whytt ([1763] 1768, 140ff) gathered from his and others' experiments with frogs, among other animals, that the brain and spinal cord were the primary seat of the soul or "sentient principle." He also held, however, that the sensitivity and responsiveness of muscles and organs even when detached from the brain meant that the soul is actually coextensive with the body, for "a frog lives, and moves its members, for half an hour after its head is cut off; nay, when the body of a frog is divided in two, both the anterior and posterior extremities preserve life and a power of motion for a considerable time" (Whytt [1763] 1768, 203). Since he was convinced that "matter, of itself, and unactuated by any higher principle" could never generate motility, he argued that the "motions and other signs of life which are observed in the body and limbs of a frog" deprived of its head or divided in two "are to be attributed to the sentient principle" still active in these isolated parts (Whytt [1763] 1768, 205).

Because of his seminal research on involuntary bodily movements (heartbeat, respiration, digestion, pupillary light response, etc.), processes in the domain of Aristotle's nutritive and sensitive functions, Whytt is known for his apparent contributions to the notion of reflex action. But Whytt (1751, 2) was far from

accepting the ascending Cartesian conception of the reflex and, accordingly, the image of an animal as, in Whytt's words, "a mere inanimate machine," a view that entails "a notion of the animal frame too low and absurd to be embraced by any but the most MINUTE philosophers!"

True to his animism, Whytt ([1763] 1768, 144) countered the notion of reflex action as purely automatic, and the general and growing mechanistic thinking of his time involving dualistic explanatory schemes, with his parsimonious proposal that "all the motions of animals, involuntary as well as voluntary, are some way owing to the mind." He rejected the common contemporary notion of two distinct psychic principles working in humans—the *anima* (the vital and sentient soul) and the *animus* (the rational soul). Instead, he argued for relative continuity, proposing that the *anima* and the *animus* are "one and the same principle acting in different capacities" (Whytt [1763] 1768, 148). He cited in evidence the fact that while many muscles in the body—such as the diaphragm in breathing and the eyelids in blinking—are generally subject to involuntary control far from consciousness (processes traditionally ascribed to the *anima*), they can often and quite easily be controlled voluntarily (under the auspices of the *animus*), and vice versa, such as when a sudden fright or a strong flash of light overrides efforts to consciously control these same muscles. The crucial distinction Whytt made between these different capacities is that while the soul acts with relative freedom in the case of conscious, voluntary movements (centered in the brain), when it comes to involuntary movements, it acts "necessarily, unconsciously and on the whole 'wisely'" (French 1969, 35) according to the "laws of union of body and soul"(French 1969, 149–60) and in service to the wellbeing of the organism. Whytt thus "replaced the mechanism of matter with a quasi-mechanical animism" (French 1969, 82), which gave full recognition to the rule of regular, lawful, reflex-like processes in the body, but argued that the soul was nevertheless present here, though lacking the liberty enjoyed in its higher expressions. He attributed both types of action to the "sentient and intelligent principle with which the Creator has animated our bodies" (Whytt [1763] 1768, 160).

Seeing such continuity between the *anima* and *animus* in human beings, Whytt also saw a "beautiful gradation" between ourselves and the larger animal kingdom, suggesting that "in brutes of the lowest kind there is evidently a sentient principle: but it seems to be wholly devoid of reason or intelligence: in those, however, of a higher class, we can perceive faint traces of something like what we call reason and reflection in man" (Whytt [1763] 1768, 171, 149–50). Thus again in contrast to Descartes, he proposed that the souls of animals and human beings differ in degree but not essentially in kind (French 1969, 118) and was therefore surprised that Descartes and his followers described animals as "so many curious pieces of clockwork" (Whytt [1763] 1768, 153). He was also surprised that some "theological writers," having accepted thoroughly

mechanistic explanations even of higher animals, "should not have been aware that the ascribing every action in man to no higher a principle, would be a natural and easy consequence" (Whytt [1763] 1768, 153), a conclusion drawn by many Cartesians.

Albrecht von Haller launched his main criticism of Whytt's physiology in his 1755 *Dissertation on the Sensibility and Irritability of the Parts of Animals*, four years after the Scotsman's signal publication. Whereas Whytt thought the sentient principle, implying at least some measure of feeling or sensitivity, was involved in all bodily movements, Haller made a sharp distinction between "sensibility," involving the soul, and "irritability," being in his view an inherent and merely mechanical capacity of the muscles to contract independently of soul. He saw the soul *in toto* as limited to the confines of the cranium and as initiating only voluntary bodily movements (Haller [1755] 1936, 658f; French 1969, 71). The many vital but involuntary and typically unconscious functions, on the other hand, are ruled by the mechanical irritability or contractility of the muscles themselves. Because Haller ([1755] 1936, 691) considered it a certainty "that the seat of the soul is in the head, and that it has no command over the rest of the body, after the nerves have been cut or destroyed; and farther, as the Irritability remains intire after the head is lopped off," he thus interpreted the muscular motions of decapitated frogs as evidence that such presumably involuntary movements are fully separate from soul. To argue otherwise, he thought, would be to "introduce an insensible sensation, and involuntary acts of the will, that is to say, to admit contradictory propositions" ([1755] 1936, 692).

Whytt thought it both unnecessary and unparsimonious to attribute fundamentally different modes of causation—soulful and mechanical, respectively—to voluntary and involuntary bodily activity. Since "nature never multiplies causes in vain," why should we, in explaining the movements of muscles, "have recourse to any hidden property of their fibers, peculiar activity of the nervous fluid, or other unknown cause, when they are so easily and naturally explained, from the power and agency of a known sentient PRINCIPLE" (Whytt [1763] 1768, 140). One of the experimental findings he marshaled in support of this view was the fact that for about fifteen minutes after decapitation, while the frog is apparently in psychic shock from the procedure, none of its muscles will respond to stimulation, whereas if the response were purely mechanical, this should surely occur as usual (Whytt [1763] 1768, 303–4). It seems that Haller was somewhat stumped on this point (French 1969, 74).

Haller's notions of sensibility and irritability perfectly illustrate the religious and philosophical motivations and implications of this debate. His restricting of the soul, with its conscious sensibility, to the brain, while attributing other bodily processes to mechanical irritability, was motivated at least in part by a theological commitment common to many Cartesians to keep the presumably immortal soul distinct from the mortal body (Boring 1950, 35–36). Whytt (quoted

in French 1969, 150) considered such dualism unnecessary and unwise, arguing that "mechanical connections are finite, and must at last terminate in a first cause," which he saw ultimately as God manifested in an embodied form as the pervasive soul acting via conscious or unconscious perception in all physiological processes. Haller countered this reverent regard for the extensiveness of the soul with the pious retort that "I have doubts about this spirit [Whytt's sentient principle] being the cause of motion. I derive all from God," (quoted in French 1969, 69), explaining that "we are inquiring into machines made by the hand of God" (Haller 1751, in Cunningham 2003, 73).

Whytt and Haller exchanged several further volleys in their writings over the ensuing decade, presenting refinements and elaborations of the basic issues summarized above. In the end, the debate between these two leading lights of eighteenth-century anatomy and physiology was essentially unresolved. Haller's approach, however, at least the mechanistic aspects of it, certainly found greater resonance with the advancing mechanical rumble of the contemporary Enlightenment zeitgeist and, much to Haller's dismay (though in line with Whytt's expectation), gave unwitting support to the rising tide of scientific materialism. French physician and philosopher Julian Offray de la Mettrie saw Haller's concept of irritability as a way of extirpating the notion of a purely spiritual soul from the domain of physiology, a key element of his project of eliminating religion from the conduct of life (Brooke 1991, 172–73; Riskin 2016, 158–61; Roe 2003, 404).

The Nineteenth Century: Frogs on Purpose

The nineteenth century introduced a new theme into this continuing controversy as the focus shifted somewhat from the details of physiological function and responsive movements to the closely related question of purposive behavior in pithed or headless frogs. In 1853, German physiologist Eduard Pflüger, whom Huxley ([1870] 2015, 183) called "a vehement advocate of Whytt's views," published the results of one of the most notable experiments in this regard, launching a challenge to the sequestering of the soul in the brain and the resulting mechanical conception of extracranial activity. He, like Whytt, believed that sentience or consciousness is coextensive with the nervous system throughout the body and that its identifying mark is movement, particularly purposive movement (Fearing [1930] 1970, 162–63). So, he designed an ingenious (if brutal) experiment to demonstrate just such behavior (see Klein 2018, 894–96). As illustrated in Figure 2a, Pflüger would suspend a decapitated frog (with the spinal cord intact) and irritate its right flank with a bit of acetic acid. The frog would then bend its right leg up in an effort to reduce the irritation by wiping off the acid. Next Pflüger would wash off the acid and sever the right leg, as shown in Figure 2b. Then, after acid is reapplied to the same spot on the right flank (not shown in this 1907 illustration), the frog first moves the

stump of its right leg in a vain attempt to wipe the acid. But then a different solution appears—it bends its *left* leg up and reaches across its body to remove the irritation.

A contemporary and sympathetic commentator, English philosopher and physiologist George Henry Lewes, who had repeated and modified Pflüger's experiment many times, saw a human analogy here, suggesting that "[t]his is very like the action of the tickled child, who always uses the right hand to rub the right cheek . . . But when the child's right hand is prevented from rubbing, the left will be employed" (Lewes 1860, 246). He was also convinced that these experiments offered evidence that something beyond a simple reflex or "unconscious mechanism" was at work here, not only in this alternative action of the frog but also in the fact that "the frog does not *always* hit even on this plan" (1860, 247). Indeed, after a series of experiments in which Lewes irritated the frog's thigh instead of its flank, he reported that the frog "sometimes bends its irritated leg more energetically, and likewise bends the body towards it, so as to permit the spot to be rubbed against the flank—just as the child, when both his hands are held, will bend his cheek towards his shoulder and rub it there" (1860, 247). Lewes concluded from these examples of novel responses or spontaneity that "it is difficult to resist such evidence of *choice* as is here

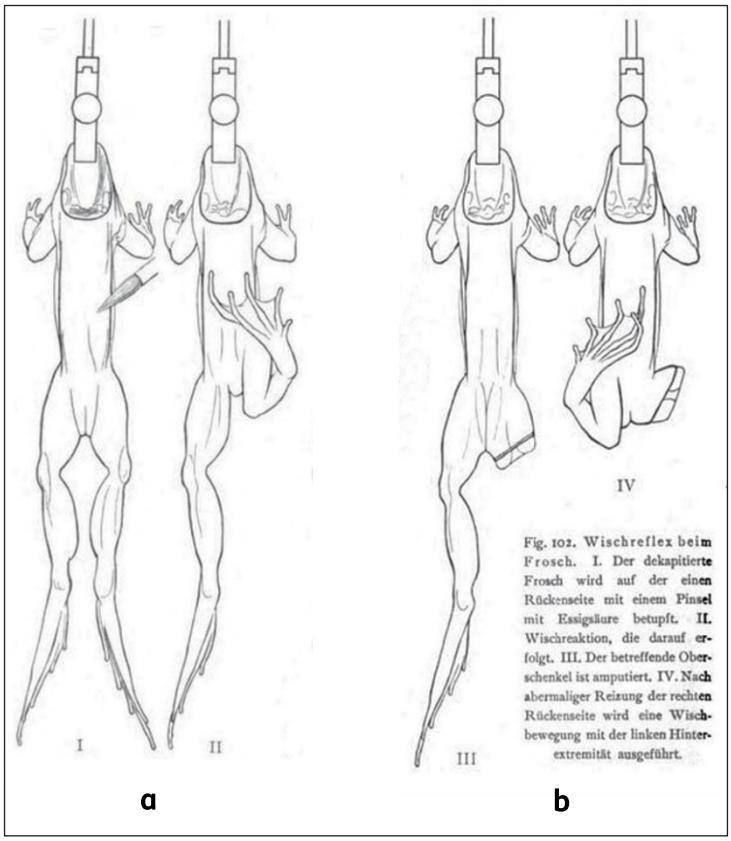

Figure 2 (a and b). One of Eduard Pflüger's decapitated frog experiments (from Verworn 1907, 198).

manifested. The brainless frog chooses a new plan when the old one fails, just as the waking child chooses" (1860, 246–47).

Some other thinkers, however, had little difficulty resisting such a conclusion. German philosopher and psychologist Hermann Lotze suggested that the apparently intelligent movements of the frog's legs in Pflüger's experiment were due to the previous life experiences of the intact animal when "under the influence of the soul life an association has once been formed" and repeatedly reinforced between a stimulus and the appropriate response, a pairing that becomes inscribed in the spinal cord and can then presumably function mechanically as an unconscious reflex (Lotze 1853, in Fearing [1930] 1970, 164). But while this explanation might reasonably be considered in the first case of the right leg rising to wipe off the acid on the same side, it is more difficult to think that a frog, in the course of its former life, would ever have encountered and risen to the challenge of the second case, of reaching for the acid with its opposite leg, and surely not often enough for this response to become stamped into the spinal marrow. Huxley ([1870] 2015, 179) emphasized this point with further evidence several years later.

Some of the most interesting and original laboratory contributions following Pflüger were those of German physiologist and prudent experimentalist Friedrich Goltz, who agreed with Whytt and Pflüger that the soul—or more specifically sensation, and with it the capacity to execute adaptive responses—is not limited to the brain. He found, for example, that if a brainless frog is released deep in a container of water, it will swim to the surface to breathe. It is also capable of selecting a female and rejecting a male for a mating embrace (Fearing [1930] 1970, 166). And further and more surprisingly, he discovered (see Figure 3) that if an inverted jar filled with water is placed in the frog's path to the surface, it will swim to the top of the jar and, finding no breathing space there, will swim back down out of the jar to gain the surface in the normal way after this unusual detour (Goltz 1869, 70). As did Pflüger before him, Goltz argued that it is difficult to see how such behavior could be the product of simple reflexes without some measure of sensation and consciousness.

Huxley lent his distinctive voice to the debate first with his 1870 address before the Metaphysical Society of London, entertaining the question "Has a Frog a Soul, and of What Nature is that Soul, Supposing It to Exist?" (Huxley [1870] 2015), and then with his more substantial 1874 essay "On the Hypothesis That Animals Are Automata, and Its History" (Huxley 1874). In both these works, Huxley recounts the contributions of some other leading participants in the controversy—including Whytt, Haller, Pflüger, and Goltz—and notes that he had personally confirmed some of their results on the surprising behaviors of decapitated frogs, even accepting Pflüger's finding of purposive behavior in headless frogs. But he concludes even so that "I am unable to see in what

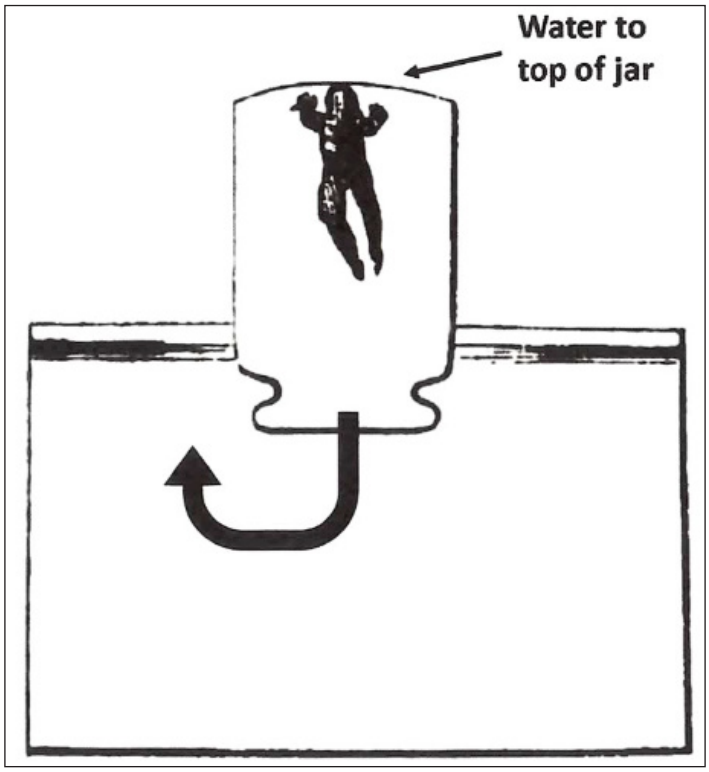

Figure 3. After Goltz 1869, 70.

respect the soul of the frog differs from matter" (Huxley [1870] 2015, 183, 184). He also considered it obvious "that had Descartes been acquainted with these remarkable results of modern research, they would have furnished him with far more powerful arguments than he possessed in favor of his view of the automatism of brutes" (Huxley 1874, 568), a view noted before in Haller with his "irritability," i.e., that the complexity of presumably unconscious behavior proves that mind or consciousness is not required for it.

Although Huxley says that the "frog walks, hops, swims, and goes through his gymnastic performances quite well without consciousness, and consequently without volition, as with it," he nevertheless accepts the possibility that they might indeed have souls:

> If they possess immaterial subjects of consciousness, or souls, then, as consciousness is brought into existence only as the consequence of molecular motion of the brain, it follows that it is an indirect product of material changes. (Huxley 1874, 576)

Hence:

> The consciousness of brutes would appear to be related to the mechanism of their body simply as a collateral product of its working, and to be as completely without any power of modifying that working as the steam-whistle which

> accompanies the work of a locomotive engine is without influence upon its machinery (Huxley 1874, 575).

Thus was born "epiphenomenalism"—the theory that consciousness has no causal efficacy over the body—and Huxley's 1874 essay is probably the most seminal and influential statement of this position. What makes this view, also dubbed the "helpless spectator theory" (Jaynes 1976, 11–12), so significant and Huxley's exposition of it so innovative and important is that he takes the bold step of invoking the venerable frog-human analogy even in this case, concluding that "if these positions are well based, it follows that . . . We are conscious automata" (Huxley 1874, 577). In other words, both we and frogs might indeed have souls in some sense, but such a phenomenon makes little or no practical difference in our embodied lives; it is merely "epi"—a shadowy byproduct hovering over or outside the solely effectual neural machinery.

Based on these and other examples, Huxley followed Descartes but went beyond him by extending the philosophy of mechanism to all aspects of human behavior. In the end, however, he perhaps managed, at least in his own mind, to steer clear of outright charges of heresy by equivocating on the question of whether a frog or a human being *actually has* a soul, saying merely that modern empirical science could get along quite well without it. He was thus true to form as the leading agnostic of the age, a term he coined the year before his Metaphysical Society address.

Pioneering American psychologist and philosopher William James offered the final authoritative statement on the phenomenon of headless frogs in the waning years of the nineteenth century. He famously introduced psychology as "the science of mental life" in the first line of his *Principles of Psychology* in 1890. And while he strove to remain strictly non-metaphysical in this work, he saw the limits of purely mechanistic theories and maintained an open mind for possible spiritual realities, though emphasizing that "if there be such entities as Souls in the universe, they may possibly be affected by the manifold occurrences that go on in the nervous centres" (James 1890, 181).

It is not surprising, then, that in his efforts to bring the mind within the sphere of natural science, James's first forays into zoology and nerve physiology involved the recent research on frogs. He recounted the investigations of Pflüger, Goltz, and others mentioned earlier because, with their evidence of purposefulness or final causation, he found support for a principle he adopted as a guiding premise for his project—that "*the pursuance of future ends and the choice of means for their attainment are thus the mark and criterion of the presence of mentality* in a phenomenon. We all use this test to discriminate between an intelligent and a mechanical performance" (James 1890, 8). He also suggests that this test figures decisively into "the deepest of all philosophic problems," for "if we find ourselves, in contemplating [the Kosmos], unable to banish the impression

that it is a realm of final purposes, that it exists for the sake of something, we place intelligence at the heart of it and have a religion. If, on the contrary, in surveying its irremediable flux, we can think of the present only as so much mere mechanical sprouting from the past, occurring with no reference to the future, we are atheists and materialists" (James 1890, 8). Although he did not pursue these considerations further in *this* book, his guiding metaphysical sensibilities are, of course, fully evident in the *Principles of Psychology*.

James dealt more directly with Huxley's conscious automaton theory in an 1879 essay titled "Are We Automata?" but also and more fully in a chapter in the *Principles*. There, he describes the difficulty in deciding between the competing interpretations. From Huxley's perspective, "we start from the frog's spinal cord and reason by continuity, saying, as that acts so intelligently, *though unconscious*, so the higher centres, *though conscious*, may have the intelligence they show quite as mechanically based," even in the case of humans (James 1890, 134). But the exactly opposite counterargument "urged by such writers as Pflüger and Lewes" is also based on continuity but starts with the performances of the hemispheres and says that "as *these* owe *their* intelligence to the consciousness which we know to be there, so the intelligence of the spinal cord's acts must really be due to the invisible presence of a consciousness lower in degree (James 1890, 134). And since arguments based on continuity can be used either to level up or level down, he notes that "such arguments as these can eat each other up to all eternity" (James 1890, 134). He does, nevertheless, argue for the usefulness and thus the causal efficacy of consciousness based on a variety of evidence, and in the end concludes that "the automaton-theory must succumb to the theory of common sense" (James 1890, 144).

The mechanical theory as a whole, however, did not succumb to the simple logic and evidence of common sense. It seems, indeed, that mechanistic physiology as well as psychology had at least partly won the day and eagerly envisioned great new triumphs on the horizon at the dawn of the twentieth century (Coleman 1977; Boring 1950). As has been the case from the eighteenth century to the twenty-first, the practical and programmatic value of mechanistic materialism to the further progress of the scientific enterprise is so great that its undeniable benefits have been widely welcomed while its philosophical limitations have been downplayed. The primary shortcoming is the inability to explain how two such ontologically distinct entities as a nonmaterial mind or soul and a merely material body could possibly interact, which is what drove Huxley to resort to epiphenomenalism and has delivered a seemingly intractable challenge to modern philosophy since the seventeenth century. It is thus the legacy of materialism at the base of the modern outlook that has made the mind-body problem such a knotty issue and the problem of consciousness so very hard. Another aspect of this legacy is its contribution to the contracting and "loss of soul" in the modern Western psyche.

Part Two: A Postmodern Search for Soul—Updating the Classic Debate

In the 1920s, Alfred North Whitehead, building on William James's quite radical 1904 (James 1904) proposal that consciousness and the physical world are derived from the same primal stuff—namely, "pure experience"—began formulating his distinctive postmodern alternative to the central conundrums of modern science and philosophy arising from the underlying mechanical philosophy. His "philosophy of organism" (probably better known as "process philosophy") is clearly in the animist tradition and was informed, in part, by his deep knowledge of early twentieth-century physics. This expertise led him to broaden the notion of "organism" because "the atom is transforming itself into an organism," and therefore, "science is taking on a new aspect which is neither purely physical, nor purely biological. It is becoming the study of organisms. Biology is the study of the larger organisms; whereas physics is the study of the smaller organisms" (Whitehead 1925, 103).

By using the life of organisms rather than the operation of machines as his epistemological starting point, Whitehead created a rigorous and thoroughgoing panpsychism that challenged the twin Cartesian tenets of a natural world consisting fundamentally of mere matter and of an independent and ontologically distinct human mind or soul. In contrast, Whitehead saw various degrees of psyche from top to bottom of the natural world, thus accommodating the reality of soul in an expanded naturalistic framework instead of considering it a perhaps *super*natural endowment. He suggested, therefore, that "it is not a question of having a soul or not having a soul. The question is, How much, if any?" (Whitehead 1933, 208). Charles Hartshorne (1950, 442), innovative cofounder with Whitehead of this school of thought, explained accordingly that "'souls' may be very humble sorts of entities—for example, the soul of a frog—and panpsychists usually suppose that multitudes of units of nature are on a much lower level of psychic life even than that." Because of its emphasis on levels or gradations of sentient experience rather than on well-developed psyches, this approach is more accurately termed "panexperientialism" (Griffin 1998, 78).

Process philosophy is thus postmodern in that it challenges—and provides positive alternatives to—basic scientific and philosophical ideas that have informed the modern world, and various thinkers, beginning in the 1940s, have designated it as such (see Griffin 2007, 3–5). To distinguish it from more recent deconstructive postmodernism, David Ray Griffin (2007) calls it *constructive* postmodern thought. Because Whitehead unearthed and productively analyzed foundational modern concepts, his approach could perhaps also be tagged as "nonmodern," although this newer term lacks the sense of historical context that Whitehead was quite conscious of. Interestingly, one of the leading advocates of this term, Bruno Latour (1993), though very critical of the unexamined *modern* assumptions of deconstructive postmodernism, eventually came to embrace and endorse Whitehead's philosophy (Latour 2011).

Regarding process philosophers' fidelity to empirical data, it is notable that Hartshorne, an accomplished ornithologist, included numerous references to the vocalizations of frogs in his book on bird song (Hartshorne 1973), proposing that, even though they lack the vocal virtuosity of birds, the Anurans nevertheless display in their rhythmic utterances some of the most primitive elements of music. He also emphasized that such sound production is typically controlled by voluntary muscles (Hartshorne 1973, 14), which implies some degree of agency and perhaps intelligence in this behavior—qualities, in addition to the phenomenon of voice itself, long associated with the presence of soul (see Riskin 2016).

An important implication of the "process" in process philosophy, aside from the general consideration that organisms on any level are always essentially processes or events, is that, more specifically, the soul or mind is not a timeless entity or unchanging "thing" but a process, an ongoing and sometimes evolving process of experiencing. So, in the philosophy of organism, the traditional notions of "the soul" and "the mind" are replaced by the idea of a succession of moments or "occasions of experience," Whitehead's more technical term being "actual occasions" (Whitehead [1929] 1978, 141). This postmodern soul avoids the traditional perplexity of the mind-body problem by being intimately and internally related to body.

Whitehead's approach was significantly influenced not only by the revolutionary insights of relativity and quantum theory but also by contemporary developments in biology, the field for which his work, in turn, probably has the greatest relevance (Henderson 1926; Needham 1951, 268, 271), especially for zoology and ethology (Agar 1951; Thorpe 1978), embryology (Waddington 1975), evolutionary biology (Wright 1964; Birch 1977), and theoretical biology (Birch and Cobb 1981; Sölch 2020). The most important biological contribution for Whitehead's concept of the soul was the cell theory introduced by botanist Matthias Schleiden and zoologist Theodor Schwann in 1839. For Whitehead (1925, 100), the pivotal significance of this theory, along with Louis Pasteur's microscopic studies of bacteria, is that it "introduced the notion of *organism* into the world of minute beings." Hartshorne ([1936] 1972, 54) went so far as to say that Whitehead's "philosophy of organism" presented "the first full-blooded, forthright interpretation of the cellular model" in its far-reaching metaphysical dimensions. Whitehead ([1929] 1978, 108) thus emphasized the animistic sentiment that "all the life in the body is the life of the individual cells. There are thus millions upon millions of centres of life in each animal body," or as is now known, about 36 trillion in an adult male human body (see Hatton et al. 2023). Hartshorne stressed further that "the cell cannot easily be regarded, even for a moment, as anything less than a concretely existent individual entity," ([1936] 1972, 41) these entities being, in other words, "low-grade fellow animals" (1934, 112).

Cells, regarded from an outward, physical perspective, organize into familiar tissues, organs, and systems. But from the inward, mental, or psychic point of view suggested by panexperientialism, these fellow animals form societies on many levels, in which smaller and simpler societies are integrated into larger and more complex societies. An important question, however, is whether in the society of "occasions of experience" within any body there is evidence of a *dominant* or *presiding* occasion present among the cells. Here, process philosophers make a crucial distinction among different types of living, and nonliving, things, describing these societies of occasions as either democracies or monarchies, with the quality of the relations among the constituent organisms in these societies, whether atoms or cells, making all the difference.

Whitehead characterized things such as rocks and clocks and tables and chairs as "corpuscular societies" ([1929] 1978, 35) or "democracies" (1933, 206; 1938, 24), groups of individuals that, so to speak, barely know each other, being bound together merely by their coexistence in space and their relatively monotonous continuity through time. Hartshorne ([1936] 1972, 57–59) called them "composite individuals" and Griffin (1998, 186) "aggregational societies." In contrast to these societies, Whitehead describes living entities such as frogs and human beings not as democracies but, as Hartshorne came to designate them, "monarchies" (1953, 38) with "compound individuals" at their head ([1936] 1972, 41–61). In other words, monarchies are societies of sympathetically related individuals in which, "by reason of this organization, an adjusted variety of feelings is produced in that supreme entity which is the one animal considered as one experiencing subject" with some measure of control over its constituent bodily subjects (Whitehead 1938, 23).[1] The essential idea is that the mutual sensitivity of the cellular individuals or occasions of experience give rise, most notably in those organisms with nervous systems, to a unified and "presiding occasion" capable of acting with some measure of purpose and freedom. Thus "in man, the living body is permeated by living societies of low-grade occasions so far as mentality is concerned. But the whole is coordinated so as to support a personal living society of high-grade occasions. This personal society is the man defined as a person. It is the soul of which Plato spoke" (Whitehead 1933, 208).[2] In a similar vein, Charles Sanders Peirce (1960, 182), another seminal postmodern philosopher and colleague of William James, stated around 1890 that "consciousness is a sort of community spirit among the nerve cells." We could perhaps also say, adapting the well-known African proverb to express this psychophysiological relationship, that it takes a village (of sentient cells) to raise a soul.

Whitehead ([1929] 1978, 21) saw evidence of a universal creativity in this emergence of compound individuals, for "the ultimate metaphysical principle is the advance from disjunction to conjunction, creating a novel entity other than the entities given in disjunction . . . The many become one, and are increased by one." The general principle here is that only monarchies, and not democracies, exhibit

marks of mind or soul. This important distinction means that charges of outright absurdity sometimes leveled against panpsychism for supposedly claiming that stones and telephones have souls do not apply to Whiteheadian panexperientialism.

Assessing the Evidence in the Postmodern Search for Psyche

As discussed, Whitehead emphasized that the dominant occasion of an organism may be more or less and the task of determining "how much, if any" governing psyche is possessed by a particular grade of organism rests on an empirical analysis of the observable signs of soul. Griffin identified the two basic marks of mind in process thought as "experience" and "spontaneity" (1998, 7, 78–79, 186), which are obviously similar to the ones employed in the classic debate. "Experience," embodied in "occasions of experience," is usually described by Whitehead in terms of "feeling," which is a general term for "any kind of acting or being acted upon, in such a way that the make-up of the subject is affected" (Emmet 1966, 142), emphasizing "both that *something* is felt and that it is felt *with affective tone*" (Griffin 1998, 128). But the only way we can know from the outside that an occasion of experience has occurred is that a correlative physical response takes place to whatever the stimulus might have been. Whitehead described the inward psychic process that occurs between a stimulus and a chosen response as "the intervening touch of mentality" (see Miller 2021).

The other basic sign of soul, "spontaneity," is the mark Whitehead (1933, 51, 258) saw as "of the essence of soul," defining it as "originality of decision." There are, however, many degrees of originality or spontaneity manifested across the vast range of organisms from amoebas to Einsteins. The merest hint of it can be seen in the various dynamic but reliably and rhythmically repetitive oscillations of electrons between positive and negative poles in basic electrical and magnetic processes, what Whitehead (1911, 103) called "the essential periodicity of things" that underlies the entire natural world. A bit more can be discerned when relatively higher organisms, maybe microbes and beyond, display some self-determination in their efforts to sustain and perhaps enhance their wellbeing. And probably the highest form is expressed in the exercise of human freedom when thought or action achieves significant independence from the constraining pull of the past (Griffin 1998, 163ff). If panexperientialism is correct in seeing a measure of mind throughout the natural world, some signs of experience and spontaneity should be present even in the individual cells that form the diverse society from which a presiding occasion in the body of a frog or a human being draws its life.

Mind in Microbes

One of the earliest significant scientific publications on this question is *The Psychic Life of Microorganisms*, published in 1888 by French psychologist Alfred Binet (1888, iii, 1), in which he presented experimental evidence that "psychological

phenomena . . . are met with in every form of life from the simplest cellule to the most complicated organism." Early in the twentieth century, American zoologist Herbert Spencer Jennings (1906, 336) stated that after many years studying single-celled organisms, he was thoroughly convinced that "if Amoeba were a large animal . . . its behavior would at once call forth the attribution to it of states of pleasure and pain, of hunger, desire, and the like, on precisely the same basis as we attribute these things to the dog." Around mid-century, Anglo-Australian zoologist W. E. Agar's *A Contribution to the Theory of the Living Organism* combined biological research on diverse animals, including amoebas and amphibians, with the philosophy of Whitehead and Hartshorne and argued that "all living organisms are feeling, experiencing, subjects" (Agar 1951, 1). Among other notable studies in the later twentieth century, philosopher Karl Popper and Nobel laureate neurophysiologist John Eccles affirmed Jennings's work and commented that an amoeba's sensitive interaction with its environment shows that in this unicellular entity there is a center "of curiosity, of exploration, of planning; there is an explorer, the animal's mind" (Popper and Eccles 1977, 30).

The early twentieth-first century has proven to be a fertile period for research into the psychic qualities of single cells, with too many studies to mention here (see, for example, Ben-Jacob et al. 2011; Krumbein and Asikainen 2011; Reid and Latty 2016). In one particularly interesting 2019 project, a research team at Harvard Medical School replicated a crucial 1906 experiment of Jennings, mainly to challenge some apparently illegitimate debunking of it from the 1960s. The Harvard team confirmed Jennings's findings that these cells display complex decision-making that "reveals unexpected depths in the cognitive capabilities of singly nucleated cells" (Dexter et al. 2019, 4327).[3]

Finally, in some ingenious recent experimentation with the cells of frogs, researchers in 2021 removed clumps of skin cells from embryos of the African clawed frog and placed them in petri dishes with a mild saline solution. Within thirty minutes, each group of cells had formed into a unified spherical organism, obviously without a nervous system, and these new organisms demonstrated, among other qualities, rapid self-healing after damage and registration of their experiences of colored light by changes in their own fluorescence. But the most remarkable finding was that after four days, the spheres became mobile by means of cilia on their surfaces, tiny hairs that, when such cells remain hidebound in the frog, work only to move mucus and thus eliminate foreign material, *but are never used for locomotion*. With their newfound freedom, however, this novel behavior emerged, and the spheres swam actively about their environment, navigating mazes and collectively removing particles and creating piles of debris (Blackiston et al. 2021). It is almost as if the "identity" of the cells had shifted from one of fulfilling their native role in the maintenance of the frog's crucially permeable skin to one of exploring and maintaining their larger environment.[4] This idea that the encompassing context affects

a microorganism's identity and behavior is indeed developed by one of the researchers (Levin 2019, 2021). It was embraced as well by Whitehead (1925, 79) a century earlier as a basic feature of his philosophy of organism, saying that "the plan of the *whole* influences the very characters of the various subordinate organisms which enter into it," so that on some occasions, even very simple organisms consisting of only one or a few cells can display the spontaneity and freedom that are reliable marks of mind.

A Postmodern Soul of the Frog

What then of a frog as a whole, or at least a relative whole? How would the experimental evidence provided by the classic debate about frogs be interpreted from the perspective of process philosophy? Although process philosophers have not dealt specifically with the historic debate regarding the souls of frogs, relevant connections between the two streams of thought are not difficult to find. In reviewing this debate here, I freshly interpret evidence of the basic signs of soul—experience and spontaneity—while also bearing in mind Whitehead's emphasis on "how much, if any." Some preliminary facts to keep in mind are that scientists for centuries have productively pursued physiological analogies from frogs to humans and that recent research has confirmed that the Anuran and human nervous systems and body plans are homologous in significant ways (Ewert and Arbib 1989, xi; Handrigan and Wassersug 2007). So, if one accepts the notion that our network of bodily cells contributes substantively to our conscious experience, it bears remembering that frogs have a similar, though much simpler, bodily society of cells.

The phenomenon of headless frogs was of course a centerpiece of the long controversy regarding the soul of the frog, with mechanists such as Haller and La Mettrie assuming that losing the head entails losing the soul, while the animists like Whytt, Pflüger, Goltz, and Lewes thought this meant losing only the *primary* but not the more *pervasive* seat of the soul. Pertinent to this issue of decapitation, Whitehead (1938, 24), with democracies and monarchies in mind, notes that usually, at least in highly complex organisms, "if the dominant activity be severed from the rest of the body, the whole coordination collapses and the animal dies." More democratic societies, however, which he saw exemplified in plants, can be divided and subsequently flourish. But there is not a clear-cut distinction between plants and animals, because "some traces of dominance can be observed in vegetables, and some traces of democratic independence can be found in animals. For example, portions of an animal body preserve their living activities when severed from the main body. But there is failure in variety of energy and in survival power" (Whitehead 1938, 24). Such independence is well displayed, for example, in the renowned ability of the isolated leg muscles of frogs to energetically contract upon stimulation for hours following separation from the body (see Sleigh 2012a, 102–7). Whytt, as noted, also reported that a

frog can live and move its legs for half an hour after losing its head. Further, regarding the failure of survival power in such circumstances, Pflüger and Lewes note that a headless frog, in contrast to an intact frog, makes no attempt to escape from a gradually heated tank of water (Lewes 1873).[5]

A Whiteheadian organismic perspective on the classic eighteenth-century experiments regarding sensibility and irritability would find some significant similarities, to a certain degree, with the animist interpretation of Whytt. The "sentient principle" that Whytt saw as seated primarily in the brain and spinal cord but also as extended secondarily throughout the body and active in both voluntary and involuntary bodily motions accords quite well with Whitehead's emphasis, following the cell theory, on "experience" or "feeling" in the myriad cellular centers of bodily life that are integrated through the nervous system and brain into a compound individual, a presiding mind or soul. His approach would, of course, be quite at odds with Haller's limitation of "sensibility" to the brain alone, as well as his proposal that merely mechanical "irritability" reigns in the rest of the body.

There are also shades of Whytt in Whitehead's methodological commitment to the principle of parsimony. Whytt ([1763] 1768, 2), inspired by Isaac Newton and observing that nature apparently "delights in simplicity and uniformity," endeavored to show that all bodily movements, voluntary as well as involuntary, are explicable by a single principle, that they are in some way "owing to the mind." He therefore placed the traditional *anima* (sensitive functions) and the *animus* (mental functions) on a continuum. Similarly, Whitehead proposed his notion of "occasions of experience" or "actual occasions," which oscillate between physical and mental poles, as the single fundamental form of causal processes or events active throughout the world. Both recognized, however, that these basic principles or processes operate somewhat differently in different bodily contexts. Whytt therefore proposed that in conscious, voluntary movements, the soul or sentient principle enjoys relative freedom, while in involuntary and largely unconscious movements, it acts rather mechanically and reflex-like, thus making for Whytt's "quasi-mechanical animism." Whitehead, in turn, suggested that the degree of spontaneity and freedom increases with the growing complexity throughout the hierarchy of organisms, but that "an individual entity, whose own life-history is a part within the life-history of some larger, deeper, more complete pattern, is liable to have aspects of that larger pattern dominating its own being" in relatively lawful ways. This is the essence of his thoroughgoing "theory of organic mechanism" (Whitehead 1925, 80, 106–7).

There is a fundamental issue, however, on which Whytt's eighteenth-century animism is quite distinct from Whitehead's twentieth-century philosophy of organism. Whytt, as well as Haller, inherited Newton's notion of physical (nonliving) matter as thoroughly passive or inert. Whytt therefore argued that matter, due to its inherent inactivity, needed to be actuated by a "higher

principle," a sentient principle, to render it capable of sensation, perception, pleasure and pain, or motility. This Newtonian concept of inert matter was, however, the principal target that Whitehead ([1929] 1978, xiii), in light of relativity and quantum theory, took aim at in his rejection of the belief in "vacuous actuality"—that mere, nonexperiential matter actually exists—and that his panexperientialism was designed to replace.[6] Whyt was thus saddled with the challenge of mind-body dualism, while Whitehead was able to unsnarl the stubborn world knot with his postmodern metaphysics.

The nineteenth-century experiments of Pflüger and Goltz that raised the debate over the soul of the frog from the presence of sentient experience or feeling to the capacity for purposive action find ready interpretation in terms of the Whiteheadian concept of spontaneity, specifically in the form of decision-making and self-determination. The case of the headless frogs that used their far leg to wipe away acid after their near leg was amputated, as well as the frogs that, when their route to the surface of a water tank was blocked by an inverted jar, swam back down out of the jar and then to the surface, are obvious examples.

An issue that came to a head at this time in the progress of this debate concerns the specific place and precision of the pithing of these spinal frogs (see Klein 2018, 898–900). In trying to pin down the neural correlates of purposive action, experimenters found, as Huxley reviewed in his essay, that severing the brain and spinal cord at slightly different locations along the brain stem generally corresponded to the loss of specific behaviors such as jumping, swimming, or turning right side up from its back, so that the lower the cut the greater the loss. From the perspective of process philosophy, this finding would be seen as an indication that reducing the number of especially critical neural cells in this integrated society of actual occasions results in a diminished and less effective soul. It would involve, so to speak, a strategic dismantling of the reigning monarchy.

So, what of Huxley's epiphenomenalism? Although he acknowledged, after considering a range of evidence, that a frog, and of course a human being, might indeed have a soul, he argued that such an entity is physically ineffectual. He was driven to this conclusion because of the seeming impossibility of understanding how something purely immaterial could interact with a merely material body, which is, of course, the apparent mystery at the bottom of the mind-body problem. It is curious here that Huxley accepts that the nervous system somehow generates or causes the subjective experiences of the mind or soul but rejects the idea of causality in the opposite direction, from mind to body. Process philosophers offer a fairly radical resolution to this logical glitch grounded in their concept of both body and soul as societies of dynamic individual centers of life and experience. First, in accord with James's suggestion that "the automaton-theory must succumb to the theory of common sense," Whitehead (1938, 155–56) argues that we are, in fact, "*directly* conscious of our

purposes as *directive* of our actions," which is an element of what Griffin (2007, 52–53) calls "hard core common sense," the type of knowledge that everyone inevitably assumes in practice even though some occasionally deny it in theory. It is an assumption that is obviously part of the bedrock of ethical and legal systems, for in an imaginary epiphenomenal legal order, "to indict the thief for stealing [would be] analogous to indicting the sun for rising" (Whitehead 1938, 155–56).

To account for the operation of such conscious influence, Whitehead (1938, 24) reminds us that the "bodily organization is such that the unity of feeling, which is the one animal as a sentient being, receives its complex variety of experience from these bodily activities." And Hartshorne (1962, 229), addressing both directions of causality between body and soul, explains that "cells can influence our human experiences because they have feelings that we can feel. To deal with the influences of human experiences upon cells, one turns this around. *We* have feelings that *cells* can feel." He concludes that this theory of mental causation "in principle solves the mind-body problem . . . The rest is detail" (Hartshorne 1962, 229). With this resolution, these thinkers offer a reasonable foundation for understanding the gradations of spontaneity, self-determination, and freedom often displayed by simpler organisms even in extreme states and by more complex organisms and humans to a much greater degree in the daily conduct of their lives. So yes, Professor Huxley, it seems reasonable to conclude that not only does a frog indeed have a soul, in some measure, but also that this panpsychic theory of mental causation aligns quite well with the venerable theory of common sense.

Conclusion

The panexperientialism at the heart of the philosophy of organism obviously entails a significant expansion of the notion of soul from that entertained by most of modern science and philosophy. It thus represents a path toward reversing the contraction and loss of soul so prevalent in the modern world. It can also perhaps support the human search for a psychic center with sufficient depth and breadth to productively integrate the diverse and often disparate elements of ourselves—mind and matter, consciousness and the unconscious, head and heart, intention and action—that Jung and the other thinkers noted earlier had in mind. The extended debate over the soul of the frog illustrates these trends in microcosm, holding implications for the human body and soul at every turn. The generally accepted basis for frog-to-human analogies, as emphasized throughout the history of modern science is the set of significant homologies or evolutionary convergences in body, brain, and behavior between these two very distant phylogenetic relatives. These considerations, in light of the cellular model, suggest the prospect of re-ensouling or reenchanting not only human beings but also nonhuman beings on many levels.

The expansion of inward experience and soul also means the extension of value or worth to the teeming multitudes of individuals or "actual occasions" on all these levels—intrinsic value, or "the sense of existence for its own sake, of existence which is its own justification" (Whitehead 1938, 109). While this sweeping view of value might seem to suggest a simplistic and crippling egalitarianism ranging from microbes to humans, Daniel Dombrowski (2021, 195) argues that Whitehead recognized both "the continuity of value in nature that goes all the way down" and "the existence of certain thresholds that are crossed that lead to qualitative changes," analogous to the changes in water that is heated to boiling or cooled to freezing. The most significant such threshold was crossed with the (gradual) appearance of central nervous systems, which afforded richer inward experience or sentiency, both pleasurable and painful, or, in other words, a fuller sense of soul. Below this threshold lies the "microscopic sentiency" of individuals that are worthy of our concern and contribute to our own lives but do not rise to the level of possessing actual moral *rights* (see Dombrowski 2021, 177–97).

Frogs live well above this threshold, which raises the important question of whether the philosophy of organism would countenance or condemn the experiments with frogs recounted earlier. It is beyond the scope and space of this article to fully explore this question or the related one of ethics in the dissection of frogs in biological education, but I would merely mention, as Henning (2023) has emphasized, that Whitehead (1938, 111) situates ethical decisions in a broad context of value, noting that "everything has some value for itself, for others, and for the whole." The multiple concerns of this "triadic theory of value" (Henning 2023, 42f) suggest that its adherents would take quite seriously the suffering of the frogs in these experiments. But they would also consider the clarity such research has perhaps provided regarding mind, consciousness, or soul and its association with matter throughout the natural world, especially in the human domain. No easily digestible answers here, but much food for thought.

Many, though certainly not all, process philosophers, in the spirit of William James reasoning from purposiveness in frogs and other creatures to the prospect of religion, have extended the argument from analogy between nonhuman and human beings far beyond earthbound organisms. This thinking proceeds on several levels, recognizing first that the humble soul of a frog can exert some global influence over the society of cells in the archetypal amphibian body. Then, highlighting correspondences at the human level, it accepts our common daily experience that "the soul of which Plato spoke," while at least vaguely feeling the pains and passions of the vast multitude of cells in the human body is also somewhat of a monarch over them. Further extending and enlarging these considerations, these thinkers ultimately suggest that the larger soul of which Plato spoke—the Soul of the World, has a similar relation to the sum total of

sentient constituents in the cosmos. As Hartshorne (1984, 59) explains, "God, the World Soul, is the *individual integrity* of 'the world,' which otherwise is just the myriad creatures. As each of us is the supercellular individual of the cellular society called a human body, so God is the super-creaturely individual of the inclusive creaturely society." This also means, as Plato proposed as well, that the physical universe is the divine body (Hartshorne 1984, 52–53, 133–36). Griffin says succinctly that the universe is thus "a compound individual with God as its dominant member" (Griffin 2001, 142; see also Dombrowski 2005). The analogy is not fully exact, however, primarily because it does not, of course, take a village of sentient creatures to raise a presumably preexistent or primordial World Soul. But the essential point is the emphasis on the mutually affective relation between creaturely souls and the World Soul, an essential interdependence that Hartshorne (1934, 168) characterizes as love, noting that "there is but one love, the participation of life in life, of feeling in feeling."

A contemporary Plato scholar, reflecting on the prominence of similar cosmological ideas over many previous centuries in the history of Western thought, has said that "there are few other concepts that so encapsulate the gulf between us and our philosophical inheritance as that of the world soul" (Wilberding 2021, 2). With its encompassing vision, the philosophy of organism can perhaps also contribute to remedying this most profound loss of soul and to fostering a reenchantment of the world within a naturalistic framework that can deepen the dialogue between science and religion and occasion a sweet reunion of body and soul.

Notes

[1] Based on our own experiences of the varying degree of influence we as presiding entities exert over our bodies, it seems that the nature of our personal monarchy varies from time to time from absolute to constitutional.

[2] Whitehead here is referring specifically to Plato's rational soul. Regarding such a soul's probable continued life after bodily death, see Griffin (2001, 230–46).

[3] For a video from this research, see https://www.youtube.com/watch?v=E8oIitQN2M4.

[4] For an excellent video produced by the researchers, see https://www.uvm.edu/news/story/scientists-create-next-generation-living-robots; and another one, with Whiteheadian resonances, on cellular cognition and collective intelligence: https://www.youtube.com/watch?v=0a3xg4M9Oa8.

[5] Goltz's experiments in the 1860s were apparently the original source of the analogy between unresponsive frogs in warming water and unresponsive people to evidence of climate change. Later experiments demonstrated that if the temperature is raised slowly enough, even intact frogs will not react. The speed of warming makes all the difference. Perhaps we can hope that the accelerated rate of climate change now underway will awaken and energize many more people, with brains fully intact and alert, to respond wisely.

[6] Galen Strawson (2017, 382–83, 386) points out that more recent physics also provides no support for the notion of mere nonexperiential matter and he argues that there is no good evidence that such a thing actually exists.

References

Agar, W. E. 1951. *A Contribution to the Theory of the Living Organism*. Melbourne: Melbourne University Press.

Ben-Jacob, Eshel, Yoash Shapira, and Alfred I. Tauber. 2011. "Smart Bacteria." In *Chimeras and Consciousness*, edited by Lynn Margulis, Celeste A. Asikainen, and Wolfgang E. Krumbein, 55–62. Cambridge, MA: MIT Press.

Binet, Alfred. 1888. *The Psychic Life of Micro-Organisms*. Chicago: Open Court.

Birch, Charles. 1977. "Can Evolution Be Accounted for Solely in Terms of Mechanical Causation?" In *Mind in Nature*, edited by John B. Cobb and David Ray Griffin, 13–18. Washington, DC: University Press of America.

Birch, Charles, and John B. Cobb. 1981. *The Liberation of Life*. Cambridge: Cambridge University Press.

Blackiston, Douglas, Emma Lederer, Sam Kriegman, Simon Garnier, Joshua Bongard, and Michael Levin. 2021. "A Cellular Platform for the Development of Synthetic Living Machines." *ScienceRobotics* 6 (eabf1571): 1–13.

Boring, Edwin G. 1950. *A History of Experimental Psychology*. New York: Appleton-Century-Crofts.

Brooke, John Hedley. 1991. *Science and Religion*. Cambridge: Cambridge University Press.

Burggren, W. W., and S. Warburton. 2007. "Amphibians as Animal Models for Laboratory Research in Physiology." *ILAR Journal* 48 (3): 260–69.

Coleman, William. 1977. *Biology in the Nineteenth Century*. Cambridge: Cambridge University Press.

Crabbe, James. 1999. "Introduction." In *From Soul to Self*, edited by James Crabbe, 1–7. London: Routledge.

Cunningham, Andrew. 2003. "The Pen and the Sword." *Studies in the History and Philosophy of the Biological and Biomedical Sciences* 34 (1): 51–76.

Debru, Armelle. 2015. "Galen's Approach to Anatomy and the Soul." *History of Medicine* 2 (2): 127–31.

Del Maestro, Rolando. 1998. "Leonardo da Vinci: The Search for the Soul." *Journal of Neurosurgery* 89 (5): 874–87.

Demarest, Boris, Jonathan Regier, and Charles Wolfe. 2021. "Animism and its Discontents: Soul-Based Explanations in Early-Modern Natural Philosophy and Medicine." *HOPOS: The Journal of the International Society for the History of the Philosophy of Science* 11 (2): 494–501.

Dexter, Joseph P., Sudhakaran Prabakaran, and Jeremy Gunawardena. 2019. "A Complex Hierarchy of Avoidance Behaviors in a Single-Celled Eukaryote." *Current Biology* 29 (Dec. 16): 4323–329.

Dombrowski, Daniel A. 2005. *A Platonic Philosophy of Religion: A Process Perspective*. Albany, NY: SUNY Press.
———. 2021. *Process Philosophy and Political Liberalism: Rawls, Whitehead, Hartshorne*. Edinburgh: Edinburgh University Press.
Emmet, Dorothy. 1966. *Whitehead's Philosophy of Organism*. New York: St. Martin's.
Ewert, Jörg-Peter, and Michael A. Arbib, eds. 1989. *Visuomotor Coordination: Amphibians, Comparisons, Models, and Robots*. New York: Plenum.
Fearing, F. (1930) 1970. *Reflex Action*. Cambridge, MA: MIT Press.
Frede, Michael. 1995. "On Aristotle's Conception of the Soul." In *Essays on Aristotle's De Anima*, edited by Martha C. Nussbaum and Amélie O. Rorty, 93–107. Oxford: Oxford University Press.
French, R. K. 1969. *Robert Whytt, the Soul, and Medicine*. London: Wellcome Institute of the History of Medicine.
Gilbert, Stephen G. 1965. *Pictorial Anatomy of the Frog*. Seattle: University of Washington Press.
Goltz, Friedrich. 1869. *Bieträge zur Lehre von den Functionen der Nervencentren*. Berlin: August Hirschwald.
Griffin, David Ray. 1998. *Unsnarling the World Knot*. Berkeley: University of California Press.
———. 2001. *Reenchantment without Supernaturalism*. Ithaca, NY: Cornell University Press.
———. 2007. *Whitehead's Radically Different Postmodern Philosophy*. Albany, NY: SUNY Press.
Haller, Albrecht von. (1755) 1936. "Dissertation on the Sensibility and Irritability of the Parts of Animals." In *Bulletin of the Institute of the History of Medicine* 4 (8): 651–99.
Handrigan, Gregory R., and Richard J. Wassersug. 2007. "The Anuran *Bauplan*." *Biological Reviews* 82 (1): 1–25.
Hartshorne, Charles. 1934. *The Philosophy and Psychology of Sensation*. Eugene, OR: Wipf and Stock.
———. (1936) 1972. "The Compound Individual." In *Whitehead's Philosophy: Selected Essays, 1935–1970,* 41–61. Lincoln, NE: University of Nebraska Press.
———. 1950. "Panpsychism." In *A History of Philosophical Systems*, edited by Vergilius Ferm, 442–53. New York: Philosophical Library.
———. 1953. *Reality as Social Process*. Glencoe, IL: The Free Press.
———. 1962. *The Logic of Perfection*. LaSalle, IL: Open Court.
———. 1973. *Born to Sing: An Interpretation and World Survey of Birdsong*. Bloomington, IN: Indiana University Press.
———. 1984. *Omnipotence and Other Theological Mistakes*. Albany, NY: State University of New York Press.
Hatton, Ian A., Eric D. Galbraith, Nono S. C. Merleau, Teemu P. Miettinen, Benjamin McDonald Smith, and Jeffrey A. Shander. 2023. "The Human Cell Count and Size Distribution." *PNAS* 120 (39): e2303077120. https://doi.org/10.1073/pnas.2303077120.
Henderson, Lawrence J. 1926. "A Philosophical Interpretation of Nature: Review of *Science and the Modern World* by Alfred North Whitehead." *Quarterly Review of Biology* 1 (2): 289–94.
Henning, Brian G. 2023. *Value, Beauty and Nature: The Philosophy of Organism and the Metaphysical Foundations of Environmental Ethics*. Albany, NY: SUNY Press.
Holmes, F. L. 1993. "The Old Martyr of Science: The Frog in Experimental Physiology." *Journal of the History of Biology* 26: 311–28.
Huxley, Thomas Henry. (1870) 2015. "Has a Frog a Soul; and of What Nature is That Soul, Supposing It to Exist?" In *The Papers of the Metaphysical Society, 1869–1880*, edited by Catherine Marshall, Bernard Lightman, and Richard England, 177–84. Oxford: Oxford University Press.
———. 1874. "On the Hypothesis that Animals are Automata, and Its History." *Fortnightly Review* 16 (New Series, Nov. 1): 555–80.
James, William. 1890. *The Principles of Psychology*. Vol. 1. New York: Henry Holt.
———. 1904. "Does 'Consciousness' Exist?" *Journal of Philosophy, Psychology, and Scientific Methods* 1 (18): 477–91.
Jaynes, Julian. 1976. *The Origin of Consciousness in the Breakdown of the Bicameral Mind*. Boston: Houghton Mifflin.
Jennings, H. S. 1906. *Behavior of the Lower Organisms*. New York: Columbia University Press.
Jung, Carl. 1933. *Modern Man in Search of a Soul*. London: Kegan Paul.

Klein, Alexander. 2018. "The Curious Case of the Decapitated Frog: On Experiment and Philosophy." *British Journal for the History of Philosophy* 26 (5): 890–917.
Krumbein, Wolfgang E., and Celeste A. Asikainen. 2011. "Ancient Architects." In *Chimeras and Consciousness*, edited by Lynn Margulis, Celeste A. Asikainen, and Wolfgang E. Krumbein, 63–70. Cambridge, MA: MIT Press.
Latour, Bruno. 1993. *We Have Never Been Modern*. Translated by Catherine Porter. Cambridge, MA: Harvard University Press.
———. 2011. "What Is Given in Experience?" Preface to *Thinking with Whitehead* by Isabelle Stengers, ix–xv. Cambridge, MA: Harvard University Press.
Levin, Michael. 2019. "The Computational Boundary of a 'Self.'" *Frontiers in Psychology* 10:2688. doi: 10.3389/fpsyg.2019.02688.
———. 2021. "Life, Death, and Self." *Biochemical and Biophysical Research Communications* 564 (2021): 114–33.
Lewes, George Henry. 1860. *The Physiology of Common Life*. Edinburgh: Blackwood and Sons.
———. 1873. "Sensation in the Spinal Cord." *Nature* (Dec. 4): 83–84.
Lorenz, Hendrick. 2009. "Ancient Theories of the Soul." In *The Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta. https://plato.stanford.edu/archives/sum2009/entries/ancient-soul/.
Miller, Gordon L. 2021. "The Intervening Touch of Mentality: Food Seeking in Frogs and Whitehead's Philosophy of Organism." *Process Studies* 50 (2): 155–200.
Moore, Thomas. 1992. *Care of the Soul*. New York: HarperCollins.
Murphy, Nancey. 1998. "Human Nature: Historical, Scientific, and Religious Issues." In *Whatever Happened to the Soul?*, edited by Warren S. Brown, Nancey Murphy, and H. Newton Malony, 1–29. Minneapolis, MN: Fortress Press.
Needham, Joseph. 1951. "A Biologist's View of Whitehead's Philosophy." In *The Philosophy of Alfred North Whitehead,* edited by Paul Arthur Schilpp, 243–71. New York: Tudor.
———. 1980. *Lost Christianity*. Garden City, NY: Doubleday.
Peirce, Charles Sanders. 1960. *The Collected Papers of Charles Sanders Peirce*. Vol. 1. Edited by Charles Hartshorne and Paul Weiss. Cambridge, MA: Harvard University Press.
Popper, Karl R., and John C. Eccles. 1977. *The Self and Its Brain*. New York: Springer.
Reid, Chris R., and Tanya Latty. 2016. "Collective Behaviour and Swarm Intelligence in Slime Molds." *FEMS Microbiology Reviews* 40:798–806.
Riskin, Jessica. 2016. *The Restless Clock*. Chicago: University of Chicago Press.
Roe, Shirley. 2003. "The Life Sciences." In *The Cambridge History of Science—Vol. 4 Eighteenth-Century Science*, edited by Roy Porter, 397–416. Cambridge: Cambridge University Press.
Skrbina, David. 2017. *Panpsychism in the West*. Cambridge, MA: MIT Press.
Sleigh, Charlotte. 2012a. *Frog*. London: Reaktion Books.
———. 2012b. "Jan Swammerdam's Frogs." *Notes and Records of the Royal Society of London* 66 (4): 373–92. https://www.jstor.org/stable/41723322.
Sölch, Dennis. 2020. "Whitehead's Biological Turn." In *Whitehead at Harvard 1924–1925*, edited by Brian G. Henning and Joseph Petek, 100–15. Edinburgh: Edinburgh University Press.
Sorabji, Richard. 1999. "Soul and Self in Ancient Philosophy." In *From Soul to Self*, edited by James Crabbe, 8–32. London: Routledge.
Strawson, Galen. 2017. "Physicalist Panpsychism." In *The Blackwell Companion to Consciousness*, edited by Susan Schneider and Max Velmans, 374–90. New York: John Wiley & Sons.
Stuart, Alexander. 1739. *Three Lectures on Muscular Motion*. London: T. Woodward.
Swammerdam, J. 1758. *The Book of Nature*. Translated by Thomas Floyd, revised by John Hill. London: C. G. Seyffert.
Thorpe, William H. 1978. *Purpose in a World of Chance*. Oxford: Oxford University Press.
Verworn, Max. 1907. *Physiologisches Praktikum für Mediziner*. Jena, Germany: G. Fischer.
Waddington, Conrad. 1975. *The Evolution of an Evolutionist*. Ithaca, NY: Cornell University Press.
Whitehead, Alfred North. 1911. *An Introduction to Mathematics*. New York: Henry Holt.
———. 1925. *Science and the Modern World*. New York: Free Press.

———. (1929) 1978. *Process and Reality*. New York: Free Press.
———. 1933. *Adventures of Ideas*. New York: Macmillan.
———. 1938. *Modes of Thought*. New York: Free Press.
Wright, Sewell. 1964. "Biology and the Philosophy of Science," *The Monist* 48(2): 265–90.
Whytt, Robert. 1751. *An Essay on the Vital and other Involuntary Motions of Animals*. Edinburgh: Hamilton, Balfour, and Neill.
———. (1763) 1768. *The Works of Robert Whytt*. Edinburgh: Becket, Dehondt, and Balfour.
Wilberding, James, ed. 2021. *World Soul: A History*. New York: Oxford University Press.