The Shulgins' Self-experiments
Between Medicinal Chemistry and Psychedelic Humanities

On a late summer day in 2004, I began my ethnographic research on the revival of psychedelic science. From the Berkeley campus, where I had just enrolled in the PhD program in medical anthropology, I took the BART train into the field. Alexander Shulgin picked me up at a station in the parched Oakland Hills and drove me to their farm. A decade earlier, I had first discovered *PIHKAL: A Chemical Love Story* at a bookstore in Cambridge, UK, during a brief and abortive stint in the university's Natural Sciences Tripos. Had I known then that a psychedelic renaissance was underway, I might well have continued to pursue my original goal of becoming a neuroscientist. Instead, I dropped out, went to art school in London, was drafted into the German military, and eventually studied medicine and philosophy in Berlin. That there were still scientists studying the psychoactive effects of psychedelics in humans was something I only discovered later, in a seminar at the Institute for the History of Medicine on the history of self-experimentation. We read Kurt Beringer's *Der Meskalinrausch* (1927), and the instructors mentioned that a group of German neuropsychiatrists had resumed experimental research on hallucinogenic drugs—using Beringer's old stash of mescaline. In that moment, I decided I would write a book about what would come to be known as the psychedelic renaissance.

In honor of Alexander Shulgin's 100th birthday, I would like to ask what remains of the work he and his wife Ann undertook—and what future inquiries it might inspire in both the sciences and the humanities. Their importance to the history of psychedelic research can hardly be overstated. In the 19th century, Europeans and Americans knew only the mescaline-containing peyote cactus. When the original psychedelic era began in the 1950s, Western cultures became familiar with dozens of compounds. Then Shulgin entered the scene and emerged as the central figure in a dispersed network of chemists—many of them operating underground—who continued to innovate and synthesize new compounds even after psychedelic science collapsed under prohibition. By the end of the 20th century, they had invented more than two hundred additional psychedelic substances. At a 2006 panel discussion, Shulgin extrapolated that, if this exponential growth continued, there would be 2,000 psychedelic drugs by 2050 (Langlitz 2012, 38).

I would have loved to chronicle this unique chapter in the history of science: What form did drug discovery take outside academic and corporate research? Alas, I had arrived too late for a laboratory ethnography of the Shulgin lab. When we got out of his small green car, Shulgin showed me his succulent garden. Having lost his license to work with controlled substances, he was now exploring psychoactive compounds isolated from cacti—not with the aim of discovering new psychedelics, of course, since that would have violated the Controlled Substance Analogue Enforcement Act. Instead, he hoped to find antidepressants; and if he happened to stumble upon a new psychedelic, he would document its structure and activity and move on. While it was clear that the Shulgins' psychonautic expeditions were still underway, it was equally clear that the center of gravity had shifted elsewhere. I decided to write my dissertation on the resurgence of academic research that sought to bring psychedelics into the mainstream of science and society. After all, it is this effort to carve out an institutionalized space for psychedelics in late modern culture that has come to define the psychedelic renaissance.

When I first entered the field during the preclinical phase of the psychedelic renaissance, Shulgin's creations played almost no role in the laboratories I visited. Some researchers were personally familiar with drugs he had invented, but their academic work focused on a small number of well-known compounds, such as psilocybin and DMT. No one had the funding to develop 2C-B, DOM, or 5-MeO-DiPT to the point where these substances could be administered to human subjects.

Since then, as the psychedelic renaissance has entered its clinical phase and market approval for psilocybin has become a far-from-certain but realistic possibility, both academic and corporate laboratories have begun to reinvest in psychedelic drug discovery. The promise of patents for novel molecules, optimizing their side-effect profiles for specific clinical applications, and devising entirely new treatment strategies has attracted significant venture capital. In this context, Shulgin's centenary offers a timely opportunity to take stock and consider his place in the history of science.

What Remains of Shulgin's Methods in Psychedelic Science?

I have two answers to the question of Shulgin's legacy—one concerns the history of psychedelic science, the other the history of the psychedelic humanities. In psychedelic science, Shulgin was a pioneer. He was by no means the only chemist to develop novel psychedelics—Albert Hofmann and David Nichols also made major contributions—but Shulgin undoubtedly secured his place among the most prolific drug designers. Remarkably, he did so not in a modern laboratory but in a small shack on his farm, often described as an alchemist's den.

Shulgin was a giant, and today others are standing on his shoulders. With his all-too-German sense of the tragedy of modern science, sociologist Max Weber observed in 1917 that the very meaning of scientific work is to be surpassed and rendered obsolete within ten, twenty, or fifty years: "To be superseded scientifically is not simply our fate but our goal." (Weber 2004, 11; see also Langlitz 2019) Shulgin clearly met this goal: today, chemists not only know far more than the 167 psychoactive phenethylamines he listed in 1991, but his entire approach to drug design is on the verge of being displaced by computational pharmacology. Rather than modifying a known molecular scaffold one atom or group at a time to produce mescaline analogs, researchers now rely on ultra-large virtual libraries that expand chemical space far beyond the small patch of actually existing compounds. Instead of manually testing each substance at the bench, powerful computers simulate trillions of interactions between drug candidates and their targets. In drug design, artificial intelligence promises to extend scientific imagination beyond its all-too-human limitations (Langlitz 2024). The open question is whether a neural network trained on large numbers of trip reports and clinical cases will eventually enable computational pharmacologists to devise substances that induce specific states of mind—and to accurately predict their clinical efficacy.

Shulgin was reasonably skeptical of the predictive power of animal models of psychiatric disorders. After leaving Dow Chemical Company in 1966 and retiring to his farm to focus on psychedelic drug discovery, he made a virtue of necessity by testing all substances on himself. Earlier psychedelic chemists like Arthur Heffter and Albert Hofmann had done the same, but from the 1960s onward, the practice became increasingly repressed. Yet Shulgin's approach—as laid out in "A Protocol for the Evaluation of New Psychoactive Drugs in Man"—continues to inform self-experimentation (Shulgin, Shulgin, and Jacob 1986). The practice persists both within and beyond academia and the pharmaceutical industry, even if it is no longer publicly acknowledged (Berning and Hardon 2016; Langlitz 2009; 2012).

Self-experiments may gain renewed importance, as it has become increasingly clear that testing new central nervous system agents in animals is a poor predictor of their clinical value. The medicinal chemists I interviewed cherished self-experimentation because it allowed them to gain a first-hand impression of a novel compound's psychotropic effects—without the delays involved in securing funding, writing applications, and collecting the toxicology data required to test a drug on human subjects. That process typically takes one to two years. By contrast, self-administration without IRB approval can yield information about a substance's subjective effects on the same day—or within a few days, if the researcher follows Shulgin's protocol: starting with a dose lower than

the expected active level of the drug's closest known analog and gradually increasing it from there, with rest days in between to avoid developing tolerance. As we enter a new era of psychedelic drug discovery, Shulgin's method may receive fresh recognition (Langlitz 2024).

And yet, most of the medicinal chemists I interviewed expressed epistemological caution. On the one hand, self-experimentation allowed them to assess basic pharmacological properties such as potency, onset, duration, side effects, and perhaps whether the drug affected particular sensory modalities. On the other hand, they distrusted richer phenomenological reports, which seemed too dependent on the setting in which the drug was taken and the user's mind-set. The latter could be shaped by suggestion, especially given that psychedelics are known to increase suggestibility. In this context, replication does little to validate a finding unless it occurs independently.

Yet the collective self-experiments that Shulgin conducted with his group followed what he called a "double-conscious" design: there were no placebo controls, and before administering a novel compound, he described to his friends—many of whom, one collaborator noted, worshipped him like a "demigod"—how he had experienced it at different dosage levels (Shulgin, Shulgin, and Jacob 1986, 317). While this practice functioned as a form of informed consent, it also primed participants to have similar experiences. For instance, if a subject was told that the substance elicited childhood memories, they were more likely to recall scenes from their own childhood.

It is striking that the literary genre of the trip report, which grew out of this culture of self-experimentation, rarely offers detailed narratives of inner experience. One self-experimenter, writing under the screen name *nervewing*, breaks down their sessions into time-coded snapshots (https://nervewing.blogspot.com). These offer glimpses of personal context but never cohere into full autobiographical storytelling. The focus remains on the drug, not the person taking it.

The Shulgins—and here it bears emphasizing Ann's role—developed a very different form of writing about their experiences. Preceding the "cookbook" sections that chemists still occasionally consult, the first halves of *PIHKAL* and *TIHKAL* read like memoirs—though memoirs in which human relationships and self-understanding are mediated by drugs, especially phenethylamines and tryptamines. Many chapters are titled after specific compounds, such as MMDA, Aleph-1, or MGS, and offer full-bodied autobiographical accounts of psychedelic experiences, the kind that medicinal chemists and psychopharmacologists have come to regard with caution. As a psychedelic therapist, Ann Shulgin brought significant psychological depth and nuance to their writing.

My second answer to the question of Alexander Shulgin's legacy is that he not only contributed numerous new molecules to psychedelic science but, in collaboration with Ann, also established a practice of self-experimentation—and a literary form for documenting and reflecting on it—that could and should inform the psychedelic humanities.

Self-experimental Humanities

While the psychedelic renaissance has been driven primarily by medical research, since the 2010s the humanities have played an increasingly important role in shaping how we understand psychedelics (Devenot 2013; Doyle 2011; Dyck 2008; Langlitz 2023; Noorani et al. 2024; Roberts 2017). Psychedelic experiences raise questions that scientific methods alone cannot answer—not least how we are to make sense of the often disorienting insights they yield, and what we value in these altered states of consciousness. Religious traditions offer one set of answers, and indeed we have witnessed a proliferation of psychedelic theologies. On the secular side, the psychedelic humanities pursue humanist and posthumanist inquiries into the meaning and value of psychedelic experiences, as well as the cultural contexts that shape them.

Since the late 19th century, when the sciences and the humanities were established as distinct branches of learning, their mutual incomprehension has been critiqued repeatedly—often in heated terms (Snow 1964; Burnett 1999).For example, when entomologist Edward O. Wilson (1998) proposed integrating these two knowledge cultures under the umbrella of sociobiology, philosopher Richard Rorty (1998, 33–34) rejected that vision and insisted on a division of labor: "When we know what we want but don't know how to get it, we look to the natural sciences for help. We look to the humanities and arts when we are not sure what we should want."

While Rorty's characterization captures the respective functions of science and the humanities, it never made much sense to me to silo them in separate faculties. In fact, what led me to Berkeley was an essay by my dissertation advisor-to-be, Paul Rabinow (1996), in which he envisioned a "third culture" that would bridge the life sciences and the humanities. The essay concluded with a quotation from Friedrich Nietzsche (1982[1886], 204), who argued that once we had given up belief in the immortality of the soul, we no longer needed to worry about heaven or hell and could instead give free rein to our curiosity—something Christians had sought to curb since the days of Adam and Eve: "We have conquered our courage for error, for experimentation, for accepting provisionally—none of it is so very important. […] We may experiment with ourselves!"

Here, self-experimentation does not simply refer to determining dose ranges and side effects; it amounts to an ethical practice. If we no longer believe in a divinely ordained moral code, and are uncertain about what we should want, we must explore our options—and occasionally try one out, even if it might prove a mistake. Experiments in living could once again become part of the humanities.

The historian of philosophy Pierre Hadot (1995) showed that ancient philosophy was not primarily about publishing theories in books or journal articles, as modern philosophy professors do, but was instead a way of life—or rather, a set of competing ways of life that sought different paths to tranquility, self-sufficiency, and cosmic consciousness. The psychedelic humanities could extend this tradition into the present, contributing to contemporary efforts to cultivate a scientifically informed consciousness culture (Langlitz 2016; Metzinger 2009).

PIHKAL and *TIHKAL* have become classical points of reference in the development of a neuropsychopharmacological *cultura animi*. While Alexander Shulgin's scientific articles in toxicology journals are on the verge of being superseded by advances in drug research, the books he and Ann co-authored are far more likely to be read fifty years from now—not as popularizations of psychedelic science, but as contributions to the psychedelic humanities. They offer a paradigm for an existentially oriented practice of self-experimentation.

A good case in point is the chapter "Tennessee" in *PIHKAL*, which recounts how Alexander Shulgin, after the death of his first wife, withdrew from his friends, contemplated becoming a hermit, and sought to drown his grief in work. He subjected himself to a "program of serious assaying" that ranged from MDMA to 4-thiomescaline (Shulgin and Shulgin 1991, 92). Even on the flight to Memphis—where he had been invited to lecture at the university—he tested a new dosage of 2C-B. While staying at the home of the head of the Department of Psychopharmacology, he conducted a self-experiment with 2C-E. After surviving a particularly difficult dinner with his hosts, he retreated to the guest room three hours and forty-five minutes into the experience, only to find himself confronting a vision of his future deathbed, where he lay all by himself, "because a long time ago, back when my wife had died, I had chosen to be alone." He described the harrowing episode as "a nihilist illusion, consummated by a nihilist organism—a nadir of nothingness" (94).

Yet as he worked through feelings of guilt over his wife's death and the desire to end his own life, he resurfaced with a renewed sense of purpose. The decisions he reached were both

professional and existential. First, he resolved to abandon the exploration of MDMA analogs—which he had come to see as a waste of time—and "return to the world of meaningful exploration, the world of the MEM's and TM's and especially the 2C-E's." (96) Second, he chose not to isolate himself: "Mine was a world of exploration of new chemicals, and I could not be the only crucible. I thought, others will see things differently from me, and I must acknowledge their view as being equal in value to my own. I cannot, just by personal experience, satisfactorily define a drug. The definition of a drug's action can only come from a consensus amongst the users of that drug, and the larger the number of people contributing to that definition, the closer it will be to the truth." (97)

If the only goal had been to determine the pharmacological properties of 2C-E, this experience report would offer little value. After all, there is no reason to infer from the anecdote that 2C-E induces nihilist illusions—unless the user has just lost his spouse, is wracked with guilt over having fallen in love with someone else, feels alienated from friends and colleagues, and has further destabilized himself by trying different psychedelics and entactogens in rapid succession. Far too much depends on set, setting, and fluctuations in brain chemistry. Yet Shulgin understood his self-experiments differently.

The epistemology underlying Shulgin's practice of self-experimentation was not committed to objectivity. He recognized that the scientific object of neuropsychopharmacology was inherently relational: not the drug itself, but the effects it produced in a brain as it gave rise to conscious experience. The Shulgins were interested in the encounter between a specific substance and an individual person—and *PIHKAL* and *TIHKAL* introduced a new form of writing to capture such encounters.

This particularist perspective stands in sharp contrast to Aldous Huxley's perennial philosophy. The term *philosophia perennis* was coined in the 16th century by Vatican librarian Agostíno Steuco, who sought to counter the Reformation by claiming that all human beings—even pagans and Protestants—had access to an eternal wisdom, and that no real justification for schism existed (Schmitt 1966).When Huxley rearticulated this universalist philosophy, he not only bunched together various psychedelics but also argued that they produced the same physiological effects and metaphysical insights as self-flagellation, breathing exercises, fasting, or praying for long periods in uncomfortable positions. For Huxley, mescaline and LSD were simply shortcuts to the *unio mystica*, the transhistorical and transcultural centerpiece of all religions (Huxley 1956; 1974).

By contrast, Shulgin was not a lumper but a splitter. He cultivated a keen curiosity about the unique personality of every molecule he synthesized: "Every compound I've discovered and tried has a real character all its own." (Shulgin and Shulgin 1991, 237) In contemporary psychedelic science, this sensibility now finds its counterpart in human recepterome research, where the drugs' polypharmacology and functional selectivity are characterized in increasingly discerning ways. Rather than attributing *the* psychedelic experience to a single mechanism—such as activation of the 5-HT_{2A} receptor—researchers investigate each compound's distinct receptor binding profile, examining not only which receptors it engages, but also how it binds and differentially modulates intracellular signaling pathways (Ray 2010; Gumpper et al. 2025). In the psychedelic humanities, the Shulgins' attention to pharmacological diversity may help psychedelic culture move beyond the outsized influence of Huxley's universalist theology.

While Shulgin was interested in how different compounds *enabled* different experiences, he insisted they did not *determine* them. He realized this early on, in 1960, when he conducted a self-experiment with the mescaline analog TMA. Whereas mescaline had enabled him to perceive intense beauty, TMA evoked intense anger. Reflecting on both experiences, he concluded that the drugs had served merely as catalysts: "Mescaline no more produced beauty than TMA produced anger. Just as the beauty was always within me, so was the anger. Different drugs may sometimes

open different doors in a person, but all of those doors lead out of the same unconscious." (Shulgin and Shulgin 1991, 24)

Shulgin's approach differed radically from psychopharmacological methods that aspire to objectivity. He did not fear that his subjectivity might color his assessment of a novel compound's character—quite the opposite. "It is only with the development of a relationship between the thing tested and the tester himself that this aspect of character will emerge, and the tester is as much a contributor to the final definition of the drug's action as is the drug itself," he wrote (Shulgin and Shulgin 1991, xxi). "By the time I've explored the new compound through its active levels, its nature has become quite clear, and the 'entity' has accepted some of my inputs to its creation and its personality" (237). In Shulgin's epistemology of self-experimentation, subject and object are not separate: they mutually define one another.

Shulgin's approach differed radically from psychopharmacological methods that aspire to objectivity. He did not fear that his subjectivity might color his determination of a novel compound's character—quite the opposite: "It is only with the development of a relationship between the thing tested and the tester himself that this aspect of character will emerge, and the tester is as much a contributor to the final definition of the drug's action as is the drug itself," he wrote. "By the time I've explored the new compound through its active levels, its nature has become quite clear, and the 'entity' has accepted some of my inputs to its creation and its personality." (Shulgin and Shulgin 1991, xxi, 237) In Shulgin's epistemology of self-experimentation, subjects and objects of knowledge mutually define each other.

Shulgin was no philosopher of science, and his theory of knowledge may not be entirely coherent. On the one hand, he seemed to believe that his encounter with a new substance shaped its character; on the other, he also maintained that the substance's character was real. But if a drug's character is partly shaped by the individual taking it, how can a collective of self-experimenters ever reach consensus? Shulgin was aware of this problem but offered no clear solution. "Other researchers who taste your material will include some (most, you hope) who make separate evaluations after the fact and will agree with your evaluations, and it will then appear that you defined (developed) the properties accurately," he wrote. "Other researchers (only a few, you hope) will disagree, and they will privately tend to wonder why they failed to evaluate the material more accurately." (Shulgin and Shulgin 1991, xxi) If Shulgin was right—and the drug's character is not simply given but emerges from the encounter with its user—then the substance would not merely *appear* different to different people; it would, in a relational ontology, actually *be* different. In contemporary philosophy of science, the so-called new materialists describe such phenomena as both "constructed *and* real." (Coole and Frost 2010; Dolphijn and Tuin 2012)

I will leave it to the reader to decide whether to accept or reject the inheritance of Shulgin's ontology of drugs. What matters here is that the Shulgins' self-experiments should not be reduced to dose-finding studies, as if they and their friends merely used their own bodies for lack of better options. Their practice was not simply a crude method for determining basic pharmacological properties. It was also a way of seeking value and meaning in life—and thus touched on central questions of the humanities.

After all, there is no scientific answer to the question of what we should do, how we should live, or how we are to come to terms with our mortality. If different psychedelics truly open different doors of perception—behind which we may discover answers to such existential questions—then the Shulgins' practice of self-experimentation deserves a vivid afterlife not only in psychedelic science, but also in the psychedelic humanities. Humanists need not confine their inquiries to the armchair. Like bench scientists, they too may experiment with themselves.

References

Beringer, Kurt. 1927. *Der Meskalinrausch: Seine Geschichte Und Erscheinungsweise*. Berlin: Julius Springer.

Berning, Moritz, and Anita Hardon. 2016. "Educated Guesses and Other Ways to Address the Pharmacological Uncertainty of Designer Drugs: An Exploratory Study of Experimentation Through an Online Drug Forum." *Contemporary Drug Problems* 43 (3): 277–92. https://doi.org/10.1177/0091450916662164.

Burnett, D. Graham. 1999. "A View from the Bridge: The Two Cultures Debate, Its Legacy, and the History of Science." *Daedalus* 128 (2): 193–218.

Coole, Diana, and Samantha Frost, eds. 2010. *New Materialisms: Ontology, Agency, and Politics*. Durham: Duke University Press. http://books.google.de/books?hl=en&lr=&id=UFhBBKKTkMoC&oi=fnd&pg=PR7&dq=coole+frost+new+materialism&ots=D-XR6_NBKJ&sig=Q0eQPlUh2mkj6HU2XCky-4Nh8Bk.

Devenot, Neșe. 2013. "A Declaration of Psychedelic Studies." In *Breaking Conventions: Essays on Psychedelic Consciousness*, edited by Cameron Adams, Anna Waldstein, David P. Luke, Ben Sessa, and David King, 184–95. London: Strange Attractor Press.

Dolphijn, Rick, and Iris van der Tuin. 2012. *New Materialism: Interviews & Cartographies*. Ann Arbor: Open Humanities Press.

Doyle, Richard M. 2011. *Darwin's Pharmacy: Sex, Plants, and the Evolution of the Noösphere*. Seattle: University of Washington Press.

Dyck, Erika. 2008. *Psychedelic Psychiatry: LSD from Clinic to Campus*. Baltimore: The Johns Hopkins University Press.

Gumpper, Ryan H., Manish K. Jain, Kuglae Kim, Renhong Sun, Ning Sun, Zhongli Xu, Jeffrey F. DiBerto, et al. 2025. "The Structural Diversity of Psychedelic Drug Actions Revealed." *Nature Communications* 16 (1): 2734. https://doi.org/10.1038/s41467-025-57956-7.

Hadot, Pierre. 1995. Philosophy as a Way of Life: Spiritual Exercises from Socrates to Foucault. Oxford: Blackwell.

Huxley, Aldous. 1956. *Heaven and Hell*. London: Chatto & Windus.

———. 1974. *The Perennial Philosophy*. London: Chatto & Windus.

Langlitz, Nicolas. 2009. "Pharmacovigilance and Post-Black Market Surveillance." *Social Studies of Science* 39 (3): 395–420.

———. 2012. Neuropsychedelia: The Revival of Hallucinogen Research since the Decade of the Brain. Berkeley: University of California Press.

———. 2016. "Is There a Place for Psychedelics in Philosophy? Fieldwork in Neuro- and Perennial Philosophy." *Common Knowledge* 22 (3): 373–84. https://doi.org/10.1215/0961754X-3622224.

———. 2019. "Psychedelic Science as Cosmic Play, Psychedelic Humanities as Perennial Polemics? Or Why We Are Still Fighting over Max Weber's Science as a Vocation." *Journal of Classical Sociology* 19 (3): 275–89. https://doi.org/10.1177/1468795X19851405.

———. 2023. "What Good Are Psychedelic Humanities?" *Frontiers in Psychology* 14. https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1082933.

———. 2024. "Psychedelic Innovations and the Crisis of Psychopharmacology." *BioSocieties* 19 (1): 37–58. https://doi.org/10.1057/s41292-022-00294-4.

Metzinger, Thomas. 2009. The Ego Tunnel: The Science of the Mind and the Myth of the Self. New York: Basic Books.

Nietzsche, Friedrich. 1982. *Daybreak. Thoughts on the Prejudices of Morality*. Cambridge (UK): Cambridge University Press.

Noorani, Tehseen, Oliver Davis, Alex Dymock, Nicolas Langlitz, Anne K. Schlag, and Erika Dyck. 2024. "Editorial: Psychedelic Humanities." *Frontiers in Psychology* 15 (August). https://doi.org/10.3389/fpsyg.2024.1474064.

Rabinow, Paul. 1996. "Steps toward a Third Culture." In *Essays on the Anthropology of Reason*, 153–61. Princeton: Princeton University Press.

Ray, Thomas S. 2010. "Psychedelics and the Human Receptorome." *PLOS ONE* 5 (2): e9019. https://doi.org/10.1371/journal.pone.0009019.

Roberts, Thomas B. 2017. "Freudian, Jungian, Grofian – Steps Toward the Psychedelic Humanities." *The Journal of Transpersonal Psychology* 49 (2): 102–20.

Rorty, Richard. 1998. "Against Unity." *The Wilson Quarterly* 22 (1): 28–38.

Schmitt, Charles. 1966. "Perennial Philosophy: From Agostino Steuco to Leibniz." *Journal of the History of Ideas* 27 (4): 505–32.

Shulgin, Alexander, and Ann Shulgin. 1991. *PIHKAL: A Chemical Love Story*. Berkeley: Transform Press.

Shulgin, Alexander, L. Ann Shulgin, and PIII Jacob. 1986. "A Protocol for the Evaluation of New Psychoactive Drugs in Man." *Methods & Findings in Experimental & Clinical Pharmacology* 8 (5): 313–20.

Snow, C. P. 1964. *The Two Cultures*. Cambridge University Press: Cambridge.

Weber, Max. 2004. "Science as a Vocation." In *Max Weber. Vocational Lectures*, edited by David Owen and Tracy B. Strong, translated by Rodney Livingstone, 1–31. Indianapolis: Hackett Publishing Company.

Wilson, Edward O. 1998. *Consilience: The Unity of Knowledge*. New York: Alfred A. Knopf.