

CHAPTER I

*On the Question of Discovery**Jonathan Jansen***Introduction**

Even if it were true that the Greek thinker Archimedes (ca. 287–212 BCE), stepping into a body of water, stumbled upon his theory of displacement and twice shouted “Eureka!” [I have found it!], and then excitedly ran naked through the streets of Syracuse (Addis 2019), centuries later we know that this simple model hardly begins to describe how new knowledge is “discovered” (let alone celebrated) in the social or natural sciences.

While there have been rich and long-standing debates in the philosophy of discovery, little is known empirically about the various ways in which new knowledge is produced across fields of inquiry. An entry in the Stanford *Encyclopedia of Philosophy* (2022) on the question of discovery concluded:

The goal no longer is to provide one overarching account of scientific discovery but to produce multifaceted analyses of the past and present activities of knowledge generation in all their complexity and heterogeneity that are illuminating to the non-scientist and scientific researcher alike. (Schickore 2022)

That is the purpose of this book.

I take on this challenge by lifting from a close reading of concepts and methods of inquiry across disciplines the principles that govern discovery in the doing of science. These principles of discovery, drawn from the 21 disciplines represented in the chapters that follow, are identified and discussed in the conclusion.

The scholar of antiquity Grant Parker (an author in this book) makes the interesting point that “this story is very unlikely to be true” and rather that “it represents the kind of fanciful stories Greeks made up around their cultural heroes pointing much more to the needs of the storytellers than facility” (Grant, 2024, pers. comm).

New Departures

I will not be rehearsing work on the question of scientific discovery in the philosophy of science from early theorists like Popper (1977), Lakatos (1976), and Kuhn (1962) to more recent thinkers like McArthur (2011), Schindler (2015) and Duerr and Holmes (2023). Deeply philosophical in approach, this body of work is, in the main, focused on the nature, meaning, and value of a scientific discovery.

Beyond these foundational works in the philosophy of science, there is a rich and variegated literature on social and scientific discovery in areas like the history, psychology, and sociology of science. A short sample of thinkers will illustrate how discovery is discovered, so to speak, across different fields of inquiry.

In a groundbreaking book for its time, the sociologist of science Augustine Brannigan (1981) drew attention to the *social* basis of scientific discovery by focusing on the processes by which discoveries are made and accepted as legitimate in the first place.

More than any other, Frederic Lawrence Holmes (2001), a historian of science, would trace and provide the most detailed, nuanced, and insightful accounts of the creative processes that underpinned discovery in the biomedical sciences. His use of laboratory notebooks (and interviews) to reconstruct in meticulous detail the work of Hans Krebs on the citric acid cycle in intermediary metabolism is legendary as an intimate, closeup story of how discovery happens.

Kenneth Caneva (2001) would similarly focus on *processes* of discovery and observe a very human process that shapes and reshapes knowledge where different people with different agendas and even different languages produce what at the end is regarded as acceptable scientific claims. Nancy Nersessian (2008), on the other hand, is a cognitive scientist also fascinated by how scientific concepts arise in the first place. She found that discovery is the outcome of complex cognitive operations that enable novelty, not the one-off brilliant idea that we imagine arises from a flash of inspiration.

But how does one discover the unobservable? Theodore Arabatzis (1997) takes on this difficult question by rethinking the discovery of the electron and proposes as a criterion for adjudicating discovery claims that “an entity has been discovered only when consensus has been reached [in the scientific community] with respect to its reality” (406).

Similarly, protein molecules are difficult to visualize outside of X-ray crystallography, where their three-dimensional structure was discovered. It was an “anthropologist of the senses,” Natasha Myers, who conducted

ethnographic observations of crystallographers at work to determine how they learn the intricate structures of protein molecules. She found that modelers make protein molecules visible through animation, imagination, intuition, and “embodied knowledge” (gesture, affect, movement) rather than the mechanistic and objectivist methods assumed for scientific discovery in the biological sciences (McKim & Myers 2017).

This book clearly builds on – but also offers new – departures from these established literatures. To begin with, this book does not spend much time on the question of what constitutes a scientific discovery. Rather, we work with a simple conception of discovery as “a rather generic term that includes quite diverse instances of the advancement of human knowledge” (Lakatos 1976) and that finds acceptance in the scientific or scholarly community.

Furthermore, none of these (and other) works in the philosophy of science deals with the discovery of new knowledge in comparative relief; that is, by studiously comparing the discovery process across many disciplines drawn from the humanities and social sciences as well as the natural sciences and engineering. To be sure, the work of Duerr and Holmes (2023) is beautifully illustrated by examples from across the natural science disciplines, while Mark Addis (2019) and his colleagues produced an insightful book on scientific discovery in the social sciences. However, neither of these works covers in one place the range of sciences and humanities in ways that lift the veil on how discovery happens.

And finally, this comparative and cross-disciplinary study of discovery in content and context emerges from the African condition. Whether it is the discovery of an African moral theory in Ubuntu, the revelations of radio astronomy from the African skies, the racialized knowledge of White Afrikaans-speaking youth, genetic studies of the prehistory of African populations, or the subaltern challenge offered by African music and architecture – all of these works bring a continental perspective to social and scientific inquiry that enriches and extends our knowledge of discovery.

In the process, we will draw contrasts with the classical model of experimental science that still captures much of the public and scientific imagination regarding the discovery of new knowledge. To this end, we have in mind the students we train in the methods of discovery.

Objectives of This Book

We typically advise our doctoral students to conduct a research project that, however modestly, adds new knowledge to the field. In the

flamboyance of the Humboldtian language, we might even encourage them to do research that “pushes back the frontiers of knowledge.” That is, to discover something new beyond what we already know.

What we spend less time on in advisement is addressing the question of how exactly new knowledge is produced beyond *procedural questions* of structured observation, hypothesis formulation, research objectives, literature review, conceptual frames, design, methods, and findings.

A meta-reflection on the generation of new knowledge means standing back from the operational and asking searching questions such as the following: What are we really doing that produces new knowledge? What kinds of thought processes guide inquiry? What is the role of human judgment in the selection of questions or the determination of methods? What is the role of error in discovery? And how is knowledge validated outside the experimental model?

In other words, for many scholars or scientists, there is little conscious “thinking about thinking” during supervision or mentoring researchers on the path to discovery in their different research pursuits.

Nor do we teach students how new knowledge is generated outside of their own field of inquiry. For example, a supervisor of engineering students is not likely to talk about comparative modes of knowledge production in disciplines like philosophy or astronomy. Nor is an advisor of students in sociology likely to discuss the processes of knowledge generation in microbiology or human genetics. A student of the philosophy of science might be fortunate to encounter such transdisciplinary conversations.

Researchers working in multidisciplinary teams would come close to seeing firsthand how ways of thinking and doing research in other fields can contribute to new knowledge production in projects that rely on combinations of people and ideas from different disciplines. Even then, the modalities of teamwork tend to be more focused on contributions from teams in different disciplines rather than deep thinking about how disciplines in conversation generate new knowledge.

This book seeks to change that with the following three objects in mind.

1. To make visible to both aspirant and established researchers the processes and pathways along which knowledge are produced in academic research. Therefore, this book is not about research procedures but research thinking that leads to new knowledge.
2. To advance knowledge about the internal reasonings or deliberations among scholars and scientists in the process of creating new

knowledge about peculiar problems. In other words, the book gives insight into the minds of accomplished researchers as they reflect on the conduct of research.

3. To offer cross-disciplinary perspectives on the modalities of knowledge production in a diverse sample of disciplines. The goal is not only educational – to broaden our knowledge of new knowledge production across fields of inquiry. It is also strategic in the sense that researchers working in one field could benefit from access to repertoires of knowledge production in other fields that might enlighten and guide their own work.

To illustrate how discovery unfolds in one particular field of inquiry, education, I will present my quest to understand the intergenerational transfer of troubled knowledge among White South African youth.

Discovering the Knowledge in the Blood

As in most fields, the path to new knowledge starts with a hunch, a puzzle, a sense of intellectual unease, and ultimately a research question. Questions such as the following are:

Why is it that my White Afrikaans students, who were children at the end of apartheid, hold such strongly beliefs about a past they were not part of?

In those years, as the first Black dean of education (2000–2009) of a then almost all-White Afrikaans student body at the University of Pretoria (UP), I observed through daily interactions that my charges held a glowing account of the (apartheid) past, a bitter sense of the present, and a pessimistic view of the future. Their future was dark, so to speak. I spent many nights tossing and turning as I tried to solve this riddle in my head. After all, they did not experience apartheid and they were in primary school when Nelson Mandela was released from prison.

I arrived at this conundrum through observation. I had an “open-door” policy for first-year students – that is, they could come and see me for any reason without an appointment, and they came. I had regular lunches with those who signed up for a 10- to 12-person meal with the dean. I observed them in teaching practice, sometimes on invitation, as they learned how to teach under the supervision of an expert mentor at a selected school. I met with the principals of the local schools from which they came. On occasion, I visited some of their homes and sat down for coffee with the parents and, at times, grandparents.

My second language (Afrikaans) came in handy for these engagements with people, many of whom had very strong emotions about the language. I even attended their churches from time to time and was sometimes asked to speak at a “men’s breakfast” or a women’s outreach at a local gathering of believers. Among the eye-opening invitations was to speak to youth cultural groups like the Voortrekkers (Afrikaans youth movement that promotes citizenship; Stanhope 2012) whose very name brought to mind memories of White Afrikaans conservative ideology. Still, I accepted invitations and at one stage I was mildly concerned about my safety when the group of White men asked me to speak at an evening meeting of an Afrikaner Bond (a nationalist movement to promote cohesion and Afrikaner culture, politics, and economic power; Uys 1988) chapter in Pretoria North where on the table in front of us in a dimly lit room was the largest Bible I had ever seen. I sent up a silent prayer just in case things went awry.

To borrow a metaphor from the sciences, these events served as my social petri dish for microscopic investigations of the people I served and the knowledge they treasured. Except that this was not a science lab but a form of social inquiry in which the fieldwork was carried out at my workplace on the dedicated campus of UP’s faculty of education.

To be clear, I did not initially start off with a well-articulated research question in mind or even understand my social interactions as research at all. It was in the process of engagement with my students and the institutions that shaped them that I saw the opportunity to record critical incidents as they happened and try to make sense of them. After every visit to my office or to a social event, I would write down the things that stood out from those interactions before retiring to bed.

I knew from my work as a researcher that the author of the book of Ecclesiastes probably was right: “There is nothing new under the sun.” Others must have written about this problem in other contexts and in different ways. My instincts as a comparativist lured me into literature about national socialism during the Second World War. What do we know about Jewish children whose parents and grandparents suffered and died during the Holocaust? How did German children respond and behave when they realized that their parents served Hitler’s cause? This excursion into the literature of postwar Germany was a minefield. I had to keep two things in mind at the same time. One, not to impute moral equivalence to the children of apartheid and those of the Nazis. Two, to nevertheless look for learnings from writings about the children of two different cataclysms.

In the process of searching for comparative sources, I stumbled upon a treasure trove of creative work that spanned novels, films, biographies, and, of course, scholarly publications in the form of academic books and learned journals. One film changed me deeply. Florian Henckel von Donnersmarck's (2006) *Das Leben der Anderen* [The Lives of Others] gave me unique insights into the troubled lives of the perpetrators (the Stasi, in this case) and the possibilities of redemption. More than any other source, that film changed my approach to the research underway and to the very process of finding new knowledge.

Das Leben der Anderen put my mind in the position of trying to understand the other side without losing the criticality that this kind of research required. I would restart my inquiry with a sense of empathy rather than outright condemnation. I now had a procedural challenge with different methodological consequences: What could I know about the world around me, and how would I know it if, as a child, my parents were from the class of perpetrators? I would have to listen differently from what my emergent research design suggested.

However, it was a biography that gave me the conceptual tools with which to make sense of the stories of my students. Eva Hoffman's (2005) *After Such Knowledge: Memory, History, and the Legacy of the Holocaust* is still one of the most exquisite forms of biographical writing I had ever encountered; but it also offered the most insightful contribution to second-generation studies. I was so excited by the richness of her work that I searched for contact details (she was a writer for the *New York Times*, so I wrote to the paper for contact details) and traveled to London for dinner with this extraordinary thinker and writer.

The first concept of value for my work was Hoffman's reference to the intergenerational transfer of trauma. This was a powerful idea in that it offered evidence of how a traumatic experience could pass from one generation to the next. This way, you did not have to be there (in a nearby or distant past) to experience what happened to earlier generations.

What I found equally fascinating were the mechanisms for the transfer of trauma across generations. It was seldom direct; in fact, survivors of the Shoah hardly spoke about their traumas. What the children and grandchildren did pick up on was body language, veiled references, awkward responses, and intense reactions when references were made to traumatic pasts. For this, Hoffman (2005) left us with the illuminating concept of indirect knowledge, which for me as a curriculum theorist was much more accessible for analysis than trauma, and so I coined the phrase, the *inter-generational transfer of knowledge*.

Now I felt I was onto something. I had no skills or training to investigate trauma; that task fell within the domain of the work of my colleagues, such as Professor Pumla Gobodo-Madikizela, who studies transgenerational trauma. What I could investigate were the mechanisms for the transfer of knowledge from one generation of White Afrikaans citizens to their children, whom I was now tasked with leading and teaching. The research question loomed large in my imagination as I crisscrossed the campus every day: How exactly did my students learn to be optimistic about the past, bitter about the present, and downcast about the future?

An important departure I made in comparison to Hoffman's (2005) work came from the observation that the transfer of knowledge to my students was direct, not indirect. White parents spoke openly about how things were better under apartheid, how the Black government had run the country into the ground, and that in the future, jobs would be for those from designated groups only. Students repeatedly heard these direct messages from all the social institutions that formed them. This direct rather than indirect learning was for me a point of discovery, new knowledge.

Children would hear these messages from teachers in the schools who taught the formal curriculum but through the lens of their Whiteness; the curriculum might have been the same in the postapartheid era as far as topics are concerned, but the interpretation of the content was vastly different depending on whether you were in a Black school or White school. They would be exposed to the same refrain from their churches; the sinking ship narrative of a country in decline could even be heard through prayers of distress and supplication. They would be exhorted in cultural clubs (quasi-religious organizations in many ways) to put on the whole armor of God against the evil one, the identity of the latter leaving little to the imagination. And, of course, they would hear from the parents at home and relatives and friends who came for a *braai* (Afrikaans colloquial, loosely translated as a *barbeque*) after the rugby match; those "quota players" in the rugby game had lowered the standards of times past when all the boys were White.

By the time 17- or 18-year-olds arrived at university, they had a firm knowledge of South Africa's past, present, and future. This is what Hoffman (2005) called the paradox of indirect knowledge – not having been there (in the past), you nevertheless lived as if you were.

All of this evidence has been laid out in my 2009 book *Knowledge in the Blood: Confronting Race and the Apartheid Past* and related publications. This was how I came upon new knowledge, which, as described, built on what was already known (the comparative literature) and then expanded

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that knowledge into an unfamiliar context, which then delivered fresh insights into how students came to know a past they were not part of.

I knew as a researcher that for this emerging knowledge to have validity, I needed to test it further by searching for disconfirming evidence. Is it reasonable to assume that all social institutions that produced this fraught knowledge among White Afrikaans youth could, in fact, work in one direction? It sounded too good (too bad, actually) to be true.

So I visited a historian of education friend from my student days at Stanford who actually studied the problem of historical knowledge transfer from the perspective of American students. Sam Wineburg found that the children's memory of the Vietnam War came from two very different institutions. Their parents might have told them that the war was necessary in the fight against communism and that the USA was "the good guy" in this long and deadly struggle. But when they went to the movies, those same students would gain a very different knowledge about that war in which Americans were betrayed as imperialists and whose government would lie about the deaths and atrocities meted out against civilian populations. At least there was some measure of doubt among US students about the official narrative of that war.

It then struck me that apartheid's success with the indoctrination of young White students was to ensure, even enforce measures that required all institutions to tell the same story about Black people as incompetent and the liberation movements as nothing more than a front for godless communism. That knowledge was settled in the minds of the children through primary school and high school, in church and community, and so in their first year of university studies, they already had a settled narrative in their heads about Black and White, good and evil, and so on.

Through these daily interactions, I became aware of the fact that not all White Afrikaans students were victims of the bitter knowledge transmitted across generations. There were always individuals among the students (and staff) who were clearly different in that something or someone had interrupted the circuitry of knowledge that produced those singular narratives of pasts, presents, and futures.

Sometimes it was a progressive-thinking parent who voted with the White liberals in the apartheid years, instantly alienating the family from conservative friends. Sometimes it was an Afrikaner man who married an English woman (or vice versa), an association that also carried heavy costs given the abiding memories of the Anglo-Boer War a century ago. Occasionally, a White Afrikaans child was placed in an English school, or an open-minded relative or teacher had planted the seeds of doubt

about troubled narratives of White supremacy. These were rare events – exceptions, actually – but required that I report the new findings with the necessary caution, context, and complexity. Sweeping statements or gross generalizations about some discovery would clearly diminish the credibility of what I found.

Still, throughout this research I was conscious of the fact that I was doing something highly unusual – a Black scholar studying White people. For generations, research was done the other way round, where White researchers studied Black people, from the missionary anthropologists to the apartheid sociologists. Similarly, Black scholars in education tend to study Black issues and concerns.

There was something satisfying about turning the lens of the Black researcher on White subjects in order to gain knowledge about a historical enemy. But that positionality came at a risk, even as I made the familiar strange, as anthropologists like to put it. White lives were certainly familiar from our everyday interactions in the marketplace (buying and selling), White homes (domestic servants), White farms (laborers), and White employment (lower-level functionaries, such as drivers), generally. At the same time, there were limits to what a Black person could know about the interior lives of the subjects under study.

Fortunately, by this time I had made good friends among those with a critical bent in the White Afrikaans community at the UP, and so I would send them drafts of my writings and ask these scholars and friends to comment on and assess the validity of the knowledge claims being made. Their feedback proved to be invaluable, sometimes leading me to conduct another round of data collection on a problem I had only partly understood or revise some of my theses in the light of added evidence.

In short, the discovery process was far from linear. New knowledge was generated, tested, revised, tested again, and then put out into the public sphere for the purposes of external review. Here it might be useful to distinguish between two forms of peer review of new knowledge claims. That which would be done formally once a manuscript (article or book) is sent out for double-blind peer review and that which is done informally with critical friends and, in this case, institutional natives, namely, those who understand intimately and directly the meaning of White, Afrikaans identities (yes, plural), forms of socialization, and beliefs.

In making these closeup observations of my subjects over a period of five to six years before starting serious writing, I concluded that what I had discovered was a knowledge problem, not simply a story about socialization or indoctrination. This was good news. For if the troubled knowledge