CHAPTER 1

On the Question of Discovery

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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 *intergenerational 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

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

of my White students was taught to them through racist institutions, then that knowledge could be challenged through instruments over which I did have some say, such as the curriculum. Put differently, if racial knowledge (fraught, bitter, direct) can be learned, then it could also be unlearned.

There is an important transition I was making here – that is, discovering new knowledge to apply it in ways that improve the human condition. This is possible in professional fields like teacher education or cardiology. You can actually make tight links between the production of research knowledge and the pursuit of change in professional contexts, for example, preparing new teachers with broad and inclusive knowledge or improving survival rates in the case of myocardial infarctions (heart attacks).

Armed with this new knowledge, I knew that we could literally change the minds of students through different interventions and, in the process, produce yet another round of new insights, even knowledge through application.

Once I had moved on from being a dean at the UP to serving as vice-chancellor at the University of the Free State, I knew I had in my knapsack a powerful new knowledge for changing students' minds. With this confidence, I assembled a team that developed a core curriculum that all first-year students would have to complete in order to graduate. The core dealt with topics framed as global questions (e.g., how should we deal with our violent past?) in which students learned about ethics, history, values, time, space, and elements. This was radical by South African standards in that students were now given a broad education on some socially challenging issues rather than simply being trained to become architects, lawyers, or economists from the first day of undergraduate studies.

As expected, there was resistance from academics ("there is not enough time") and students ("I came here to study urban planning"), but we persisted in making public arguments about the value of a broader education and eventually were able to pass the core curriculum through the senate. Gradually, most students (not all) could, through the acquisition of new knowledge that had its origins in the process of discovery, now appreciate the change impacts of what they were learning. There are ample research and evaluation reports to back this up.

I taught the history unit in the core curriculum. Invariably, students would come to me after class and express surprise about a claim I made or share an insight that was troubling, to say the least. One young man eagerly informed me that his father taught him that whites and Coloreds really got along well under apartheid; he had not heard of the

1956 legislation that removed Colored people from the common voters' roll in order to preserve "White civilization."

What was evident was that for the first-time students, knowledge of a glorious past was being challenged if not disrupted and would, at the very least, give cause for reflection on what they thought they knew.

However, the curriculum was only one of many other knowledge disruptors in the lives of students. Immersing potential student leaders in overseas university placements, well-designed on-campus seminars (an extracurricular experience) were among the interventions to challenge incoming knowledge among our students.

So what does this account of discovery and its applications allow us to see about how new knowledge is generated within educational research?

First, in the described nature of the research project, observation was critical to the generation of knowledge. This was not, however, a casual observation or, for that matter, an observation from a distance. In some ways, the method in question might be what anthropologists call participant observation, which means that you are involved and inside the setting within which the research is conducted. To the experimental scientist, this is a problem; after all, the researcher is supposed to stand at a distance from the object (*sic*) of study in a context where objectivity and neutrality should be prioritized.

In education and the social sciences, and especially in a research project of this kind, knowledge is generated through intimate interaction with the subjects (*sic*) of study. This does not, of course, imply that the pursuit of new knowledge in education and the social sciences is a methodological free-for-all. It simply means that there are other standards to judge the validity of knowledge, such as resonance, credibility, authenticity, and criticality, for which there is an established literature in qualitative research.

Moreover, observation in this context is systematic in that data are constantly collected and dutifully recorded in the various spaces where I worked as a dean on and off campus. The content of choral performances on campus is observed and reveals so much of what is regarded as the cultural corpus of knowledge from which music students draw, for instance, the European classics. The ways in which students are spoken about by colleagues (children, who call adult strangers *oom en tannie* – "uncle and aunt"), the lingering symbols of education authority in campus statues, photographic memorials to past deans (White, male, Afrikaans), the ways in which labor is organized (a White man controlling scores of Black ground and maintenance workers), and of course the core texts used for instruction. All of this is observed "data" and forms the foundation on which the analysis of *Knowledge in the Blood* would proceed.

Repeat observations over a five- or six-year period, of course, deliver its own validation. Patterns begin to emerge. Exceptions become critical incidents that require explanation. The more these observations "stack up," the more comfortable one becomes in formulating and sharing knowledge claims worth testing. This is how new knowledge emerges from what initially are singular events or individual experiences that over time are recorded as systematic accounts of layered observations; new knowledge, in other words.

In sum, new knowledge is generated through iterative processes of observations made, altered, refined, tested, reformulated, and eventually made available for public scrutiny. There is no "eureka" moment; that sudden insight or thrill that something new has been discovered. Not in social research of this kind.

In my particular research, the intimacy of the relationship between the researcher and the researched, using formal language, was unexpectedly powerful in that the new insights gained were personally transformative. I certainly did not expect to be changed by the research I was undertaking. During my leadership journey with the students, there would be regular incidents that confronted my politics and challenged my emotions.

There was the White student from low-income family whose father came pleading for a bursary to enable his daughter to study to become a teacher. In an instant, I saw my own father when I first asked him if he had money for me to start university studies. That experience, in which I was the funding authority, so to speak, who held in my hands the future of this young student's future, shook me to the core. I could no longer view my student through the simplistic lens of White privilege/Black disadvantage. Race had collapsed into class in front of my very eyes. More importantly, I started to feel a deep sense of empathy because we were, in fact, very similar as human beings who wanted to improve our lives through a study in resource-poor families.

Here was the discovery of knowledge I was not prepared to talk about, and that was self-knowledge. My arrogance took a knock, the leadership assumption that I was there to set White people straight. I now realized that my own knowledge of the past was itself fraught to the extent that I thought I was better, more informed, and much more capable than those I led. That confident sense of self-knowledge was gradually eroded as I came to the realization that I had not only led these young people but that I had come to love them too. It was a new and unexpected experience, and wonderfully liberating.

This is perhaps the most important aspect of conducting research and pursuing its object: the generation of new knowledge. You have to

constantly leave open the possibility that you might be wrong. As explained, my starting hypothesis about racist White students was too simple. I sensed that there must be something more to how they know what they know about the past, present, and future. It was the commitment to reading and reading widely that then brought to my attention the problem and paradox of indirect knowledge.

Which raises something fundamental to discovery in all fields of inquiry. You have to know what else exists on the topic under investigation. And in this context, there is simply no substitute for reading everything that was ever published or that exists in the gray literature or perhaps even in the literature in other languages in order to know that what you are researching has the potential to say something new.

The problem, of course, is that students often read the literature in order to confirm their own direction or to indicate that their research is in good company by citing the authorities repeatedly but hiding their own voice. That capacity to not only read the relevant literature but also evaluate it critically at the same time is clearly something that can be learned over time with the necessary application. It is not easy.

With the experience of doing advanced research, I tried to show in this essay, the acts of reading and rereading happens throughout the research process. You stumble across new literature and reframe your questions or redirect the entire study if necessary. But throughout you are committed to wanting to say something new, to discover new knowledge, in other words, however modest your contribution to the body of literature in your field.

In much of the research in education and the social sciences, however, most of the new knowledge is generated in a mist; there is not the straightforward causality of the sciences where confident claims are made about the effects of X on Y under conditions of Z. There are far too many moving parts in qualitative research to make such confident knowledge claims, which is both the challenge and the excitement of studying human knowledge, beliefs, and values.

At the same time, I have only discussed one particular modality of discovery in educational research. There are of course many others, such as experimental research in educational psychology or conceptual analysis in the philosophy of education or case study inquiry in education policy studies. The example that I used to illustrate processes of discovery in curriculum theory draws on a particular strand of inquiry, referred to as the politics of knowledge.

In this way of doing discovery (the politics of knowledge), there are always background questions that guide the process of inquiry, such as the nature and purposes of knowledge, the ownership and contestation over

knowledge, the transmission mechanisms for knowledge transfer, and the powers that authorize knowledge as official or otherwise. This means that in my head, as a researcher in the politics of knowledge, I am always alert to questions about knowledge, identity, conflict, and power.

Finally, there is something to be said about the character, personality, or orientation of a researcher to problems that is so important in the quest for discovering new knowledge. You need to be open to learning the scholarly habits of the mind such as being incessantly curious about the world around you. My recent education books and articles all came about because of an intellectual restlessness that propels one toward discovery. Two examples must suffice.

First, I wondered out loud among fellow researchers in higher education why the same set of universities, despite repeated government interventions, would regularly fall back into their states of dysfunction. There were no clear answers in the global literature on higher education. So, I decided to do a deep dive into these institutions, conducting more than 100 interviews with university leaders and scouring hundreds of institutional documents.

A critically important finding would emerge that what kept these universities in states of chronic dysfunction was two interrelated problems: low capacity and low integrity. My book *Corrupted* (2023) explains in finer detail how those two elements of capacity and integrity maintain dysfunction.

Second, I was deeply puzzled by the ease with which the language of decolonization spread across South African campuses in the mid-2000s. That description of our historical woes was foreign, never appearing in the political literature or policy positions of any of the liberation movements, except for a brief moment when communists referred to South Africa as an instance of "colonialism of a special type" – but that did not gain traction in national politics. What was going on? So, with a colleague, we conducted intensive interviews with academic teachers in 10 universities and found something alarming: Everyone made up their own meanings for decolonization so that it was easy for institutions to defang this potentially radical idea before it gained a strong foothold in the formal curriculum.

Our book *The Decolonization of Knowledge* (Jansen & Walter 2022) offered the first detailed empirical work still not available anywhere in the academic world where the necessary activism of students and teachers would remain blunted because they lacked a theory of institutions.

In summation, without learning and honing the scholarly habits of the mind, it will be very difficult to ask the quality of questions that are the sine qua non for the discovery of new knowledge in any field of inquiry. With this commitment in mind, I reached out to colleagues in other disciplines.

The Organization of This Book Project

I initially approached 30 leading scientists and scholars across South Africa to write about 10 pages of their response to a deceptively simple discovery question: How is new knowledge produced in your field?

I sampled authors based primarily on their reputations as leading scholars and intellectuals in a range of disciplines; the specific disciplines chosen were secondary considerations, provided they bridged the social and natural sciences, the humanities, and the biomedical sciences. It is conceivable that confirming, but also new, insights on discovery could have emerged had this book included fields like anthropology, mathematics, and ophthalmology, to mention singular examples, but there are inevitable limits of space and range in a book of this kind.

Most of the contributors were known to me from a vantage point that I enjoyed as president of the Academy of Science of South Africa. I had worked with them before, and those who signed up were eager to participate.

The responses of these senior researchers were intriguing. They all felt excited and, more than a few, a little anxious about the assignment. They were excited because they sensed something novel in the making; most had not encountered, let alone written about, such a question before. Their response comports with the starting rationale for the book that we train procedurally rather than devote time to thinking about the processes of thinking in the fast-moving world of academic research.

These accomplished academics were somewhat anxious. While they were among the leading researchers in the world, this novel task could result in some uncomfortable exposure. Several offered, "I'll send you what I wrote so far, and you tell me whether I am on the right track." I was humbled by the enthusiasm for the task and grateful for the willingness of my colleagues to allow themselves to be vulnerable while taking on this novel book project.

I was also excited because I knew that these were outstanding researchers who through their chapter contributions could markedly shift our understanding of how new knowledge is generated. This would be, as far as I could read, the first book-length treatment of the subject that happens to come from a Southern/African context involving more than 20 different fields of study.

Twenty-one of the invitees eventually delivered on the commitment to participate in the project. The goal was to obtain the maximum variation in the final list of disciplines so that one could gauge the subject of discovery from a range of research contexts that stretched from surgery to the classics. Accordingly, I approached researchers across disciplines and

Palaeontology	Law	Genetics
Physics	Archaeology	Education
Theology	Astronomy	Psychology
Philosophy	Dentistry	Architecture
Linguistics	Music	Engineering
Microbiology	History	Biochemistry
Surgery	Classics	Public health

Figure 1.1 Overview of the sampled disciplines.

institutions to ensure optimal diversity in the disciplinary mix of contributing authors.

In addition, I sought out experienced researchers, most of whom were still active researchers and who enjoyed international reputations for their accomplishments. Put differently, I wanted contributors who were highly knowledgeable about research in their respective fields and could therefore speak with authority on the questions posed to them. With this intention, the sampled disciplines are listed in Figure 1.1.

Three caveats are important in reading each chapter.

First, the broad field descriptor such as "engineering" does not reflect the specific area of research discussed by each contributor, which, in this example, is a subfield called "process engineering."

Second, within each discipline, there is a range of alternative methods that could be pursued in the conduct of research. In this book, each contributor reflects in some depth on their familiar method/s of research in a particular subfield of their larger discipline.

Third, in several of the disciplinary explorations presented, there is teamwork involved where the contributing researchers come from two or more fields. For example, in Chapter 5 on applied biochemistry, basic sciences and engineering are combined in the search for catalytic enzymes with industrial applications. What these chapters mostly reflect is the main or starting discipline in which the author of that chapter works.

I asked contributors to write about 10 pages for two reasons. To make the task of writing about an unusual subject (a meta-reflection on discovery within the discipline) manageable rather than overwhelming and to get the authors to the essence of how knowledge is produced within their primary area of work.

In addition, I invited each author to write their chapter in a biographical style; that is, to describe the processes of discovery in the discipline as a life story rendered in the first person. Such an approach, I surmised, would not only make the stories "real" in the reading imagination of others but also would encourage accessibility in the mode of writing. Readers would therefore be able to read about discovery through the working lives of researchers and gain a qualitative sense of who the scholar or scientist is through the narration of their work.

However, the accessibility question was not easily resolved in the composition of this book. It is often very difficult for researchers to write about complex issues within the discipline in ways that nonspecialists can understand. In the everyday conduct of one's research, especially in the bench sciences, there is seldom a need for broader public communication except, perhaps in fields like infectious diseases during a pandemic. Those working in professional fields such as education and psychology are much more likely to be drawn into public conversation on pressing issues such as the efficacy of different reading methods in primary school or the impact of social media on self-esteem among teenagers.

I spent many hours reading, commenting on, and rereading several of the chapters to ensure that a reasonably educated person without specialist knowledge of vertebrate paleontology or continental philosophy could follow the main arguments about discovery in the disciplines. At the same time, I did not want to dilute the cogency and coherence of the arguments made, given that this is also a specialist text for those interested in the problems and politics of knowledge within the disciplines. Whether that balance between accessibility and high-level argument has been achieved will be up to the readers of this monograph to judge.

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