Introduction

I.1 Generalized Empirical Method

Lonergan discovered the possibility of a *generalized empirical method*¹ that “envisages all data.”² As noted by Lawrence, eventually it will be known simply as adequate “Empirical Method.”³ And yet: Is generalized empirical method needed, and feasible? Might there be advantages in such a method? Will it solve problems?

Attempts to implement the method in the developing sciences reveals that it will be challenging, subtle and new. What will the new method look like in, for example, investigations into ancient geometry and physics, let alone late 19th century mathematics and physics, basic chemistry, or more recent quantum field theories and quantum chemistry? What of biology, where in embryology, for example, one investigates the emerging neurodynamics of a developing avian embryo? Or, again, there are ecology and environmental science, areas of inquiry that investigate vast aggregates of events and occurrences in ecosystems.

Here, we might recall Aristotle’s observation:

> For the things we have to learn before we can do them, we learn by doing them.⁴

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² *A Third Collection*, 140.


For, it is, in fact, too soon to be able answer questions such as those posed above. We need, first, to enter the developing modern sciences, and there make preliminary efforts with particular cases and, that way, learn by doing.

1.2 Preliminary Context of the Book

In the 20th century, philosophy of physics emerged as a major zone of scholarship. In recent decades, scholars in philosophy of physics have been grappling with sophistications of multi-variable probability theories, thermodynamics, quantum theories, special and general relativity, gauge theories, and more recently, superstring theories. And, advances are being made along various lines of thought.

A basic problem, however, is that there is little sign of an emerging consensus. There are, instead, ongoing debates and expanding ranges of views - some of which partially overlap, while others are (implicitly or explicitly) mutually incompatible. A problem here is not that there are so many views, but that philosophy of physics seems to have no way to effectively promote progress toward shared heuristics. Important insights regularly are reached by leading scholars. But, rebuttals tend to be admissible so long they are logical and have coherent terminologies. This allows for more or less endless debate wherein views need have little or no contact with scientific practice, data, or actual objects of scientific inquiry.

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Writing about present-day challenges in physics, John Earman refers to clouds on the horizon that may prove as great a threat to the continued success of twentieth century physics, as were the anomalies confronting classical physics at the end of the nineteenth century.\(^8\)

But, in contemporary philosophy of physics there is an ethos that allows the scholar to back off from taking a stand on basic questions:

As philosophers we are generalists: so we naturally find all the various foundational issues mentioned above worrisome. But, being generalists, we will of course duck out of trying to say which are closest to the solution, or which are most likely to repay being addressed. In any case, such judgments are hard to adjudicate, since intellectual temperament, and the happenstance of what one knows about or is interested in, play a large part in forming them.\(^9\)

While contemporary philosophy of physics struggles without a normative heuristics grounded in scientific practice, it is also true that contemporary experimental and theoretical physics, for their part, do not always pay much attention to the results of philosophic reflection. An extreme case is the view of expressed by cosmologist Lawrence Krauss:

(T)he worst part of philosophy is the philosophy of science; the only people, as far as I can tell, that read work by philosophers of science are other philosophers of science. It has no impact on physics whatsoever, and I doubt other philosophers read it, because it’s fairly technical. And so it’s really hard to understand what justifies it. … (S)cience progresses and philosophy doesn’t.\(^10\)

Krauss, however, distinguishes

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\(^8\) Butterfield and Earman, Part A, xx.


questions that are answerable and those that are not, and asserts that answerable questions mostly fall into the domain of empirical knowledge, aka science.

Besides the obvious performance-contradiction of Krauss’ claim, there are, in fact, complex mesh-works of subtle views regarding the importance (or not) and relevance (or not) of philosophy of physics to physics. Sometimes views are implicit, influencing work in rather hidden ways. But, some physicists have made the effort to explain and justify anti-philosophy views. So, Stenger, too, then draws attention to performance-contradiction. As in Krauss’ view, there is what anti-philosophy views say. But, what do scholars do in order to reach and defend such views?

(P)rominent critics of philosophy … think very deeply about the source of human knowledge. That is, they are all epistemologists.

Of course, not many physicists attempt to work out explicit views of knowledge, objectivity and reality. It may never be necessary that a majority of physicists do so. But, as alluded to in the previous paragraph, whether one adverts to what one does or not, we each have our views; and, at any time, we each have our openness (or not), to types of question that we deem worth asking (or not). All of this shapes ongoing inquiries, discoveries, developments, plans and strategies. So, while not in the sense necessarily of spelling out explicit views, at least in the sense of what

12 Julian Baggini and Lawrence Krauss, “Philosophy v science.”
13 Stenger, last paragraph.
physicists do, the claim of the title of Stenger’s article (self-) evidently holds: “Physicists are philosophers, Too.”

Other examples reveal further aspects of progress in physics not adverted to by anti-philosophy views. Krauss and others speak of “empirical knowledge.” But, what is empirical knowledge? Even in a so-called “hard-science” like physics, it is not only experimental data that contributes to progress. Are not Einstein’s writings (old and more recently discovered) empirical? In the ongoing effort to make new progress, Einstein’s works are studied partly in the hopes of improving understanding of what Einstein meant, and what he didn’t mean. The emergence of gauge theories, and eventually the Standard Model in particle physics, was a slow and tortuous journey. Theoreticians such as Weyl, Einstein, Klein, Pauli, Feynman and others appealed to up-to-date experimental results. But, they also read, struggled with, argued with, and learned from each other’s writings - the meanings and significance of which were not, and still are not, immediate. Obviously, then, progress in physics depends on ongoing efforts to obtain and interpret not just particle tracks on computer screens, but screen-tracks, print-tracks and write-tracks that are expressions of physicists working in diverse areas of the field. Whether adverted to or not, in every area of physics, expressions of physicists are empirical; and interpreting them is part of progress. And no area in modern physics can escape the challenges of progress in hermeneutics, epistemology and ontology.

Regarding struggles in physics of the last thirty years, Rovelli comments:

Of course there are ideas. These ideas might turn out to be right. Loop quantum gravity might turn out to be right, or not. String theory might turn out to be right, or not. But we don’t know, and for the moment, nature has not said yes in any sense. … I suspect that this might be in part because of the wrong ideas we have about

\(^{14}\) Stenger.


invitation to generalized empirical method

science, and because methodologically we are doing something wrong, at least in theoretical physics, and perhaps also in other sciences.17

For other sciences, we can, for example, look to biology. There too, we find numerous fundamentally opposed views, openly at odds with each other, clashing within and across areas. There are, for example, “dueling discourses in interdisciplinary biology.”18 As in physics, this too is not merely philosophical. For here too, ranges of different views guide experimental work, shape questions and interpretations, and are part of pedagogies that lead to the next generation of investigators and educators with similarly opposed views.

In the biological sciences, problems are especially evident in the groupings of views generally known as “systems biology.”19 Systems

biology seeks to understand organisms in terms of “systems,” “levels of systems” and “biological information.” One of the potential advantages of the approach is that it embraces interdisciplinarity from the start. This has led to developments in understanding complex combinations of layerings of time-dependent probability distributions in organisms and ecosystems, and is contributing to ongoing progress in the medical sciences and environmental sciences.

But, there are foundational problems in premises, conclusions and goals of systems biology. A main focus in contemporary systems biology is numerical computation and computer simulation of: information, control, levels, systems and subsystems. However, as will be revealed in the chapters below, these conceptual constructs are not verified in actual organisms (even in one-celled organisms, let alone multi-cellular plants, animals, and ecosystems). In the meantime, some of the main hypotheses of systems biology have contributed to the rise of horrific models wherein organisms allegedly are accounted for in terms of codes, molecular information tapes, genomic computer programs and other fictions.20

Commenting on the diversity of competing views in the academy as a whole, Rovelli offers hope:

Somehow cultures reach, enlarge. I’m throwing down an open door if I say it here, but restricting our vision of reality today on just the core content of science or the core content of humanities is just being blind to the complexity of reality that we can grasp from a number of points of view, which talk to one another enormously, and which I believe can teach one another enormously.”21

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20 For example: “There is no concept more intrinsic to systems developmental biology than that of process control by a preformed genomic program, in exactly the same sense as the term ‘program’ is used for the code directing a complex stepwise computational program” (Isabelle S. Peter and Eric H. Davidson, “Transcriptional Network Logic: The Systems Biology of Development,” ch. 11 in, A. J. Marian Walhout, Marc Vidal and Job Dekker, eds., Handbook of Systems Biology, Concepts and Insights (Amsterdam: Academic Press, 2013), 213). See Chapter 2 for discussion.

21 See note 17, last paragraph.
How, though, might we actually change how we are doing things so that methodologically we are doing what is right? How, actually, might it be possible to “grasp from a number of points of view, which talk to one another enormously, and which … can teach one another enormously”? Whatever we do, we should not undermine progress that science and philosophy of science already are making. Yet, whatever change is possible, it also will need to help us get beyond present-day confusions and conflicts within and between sciences and philosophy of science.

Part of what is needed is a transitioning to a balanced empirical method, that is, generalized empirical method. Generalized empirical method is not yet operative in the sciences and philosophy of science. No doubt, emergence of the balanced method will be difficult, and may well require a prolonged transition period. However, once normalized, generalized empirical method will be key not only to resolving old problems, but also to opening up new growth trajectories in science and philosophy of science. Among other things, the new method will be generative of new standards of competence and a control of meaning that as much as possible will be “at the level of the times.”

1.3 Structuring of the Book

Some topics mentioned in earlier chapters ultimately depend on future progress discussed in later chapters. But, all topics are introduced for future follow-up in the academy. The book is not a treatise reaching conclusions but, as mentioned in the Preface, is an invitation to a development in empirical method.

Readers may be of various academic backgrounds. While the chapters climb in difficulty, I have attempted to make the main body of the text generally accessible. Footnotes include pointings to more advanced issues,

22 See note 17.
23 See note 17, last paragraph.
24 See note 1.
as well as references to up-to-date literature. All of this added to the complexity of the book structure. But, in the spirit of the main purpose of the book, it seemed important to provide references for the larger context.27

Regularly, there are quotations from the book *Insight*. This is not to invoke *Insight* as an authority on, say, correct terminology, or as a way to settle debates. However, as mentioned in the Preface, the book *Insight* can be helpful in providing precise (doctrinally compact) description that points to future developments. I sometimes write *self-attention*; and also sometimes refer to the possibility of being *luminous* in one’s work. The term *self-attention* does not appear in the book *Insight*. However, generalized empirical method will depend on appealing to all data, all experience. That broadened focus of attention includes what can be called *self-attention*.28 What begins to emerge is the need and possibility of a developing *control of meaning*29 in the sciences and philosophy of science. It is convenient to have a name for this: *self-luminous*, or (within a later adequate Empirical Method30) *luminous*. While the possibility and need of being luminous begins to emerge, the normalized achievement will be something for future sciences and philosophy of science.

It will be noticed that much of the discussion draws on topics from biology. This is not to give priority to biology, or to suggest that biology is more accessible than, say, physics or chemistry. The emphasis on biology partly is because biology is an inviting context. But, as the book brings out, biology also provides a convenient context from which to enter many aspects of what, in fact, is an omnidisciplinary challenge.

Choices had to be made about which topics to include. As indicated in the Preface, the book reveals the need of suites of transitional works to be written by teams of authors. For instance, graduated series of pedagogical works will be needed on our “notion of a thing.”31 Note that the present book also moves past challenging foundational problems in chemistry. For

27 All of this can be navigated according to one’s interests and background.
28 See, for example, *CWL3*, 3, 4, 5, 13, 14, 95-96, 422-423.
29 See note 25.
30 See note 3.
31 *CWL3*, ch. 8, 270-295.
the future philosopher working within the new method, however, it eventually will be normal to reach a control of meaning in representative examples from up-to-date chemistry. Otherwise, talk of “chemical equations,” “atomic weights,” “molecules,” “compounds” and “biomolecules” will be out-of-date or will lack control of meaning in images, descriptions, names and techniques. Implicitly, therefore, the book also is an invitation to learn something of modern chemistry, self-attentively. Similar remarks apply to physics and all of the developing sciences and technologies. I am, though, referring to future foundational progress in the community. In the meantime, the present book invites interest in, and beginnings in, the new method, through discussion, reflection and preliminary self-attention in a range of contexts outlined below.

I.4 Chapters of the Book

For the convenience of readers making use of online search engines, each chapter begins with a detailed abstract. Here, I provide a broad outline of the book chapters and Epilogue.

The first chapter, "Space and Time," is “a bridge"\(^\text{32}\) into the book. The chapter draws attention to the concreteness and historicity of the Space and Time problem. Lonergan’s two main theorems on, respectively, the abstract intelligibility and the concrete intelligibility of Space and Time are discussed in Chapter 5 of the present book. Chapter 1 keeps a focus on introductory problems and ends with a pointer to the fact that part of what is needed are additional elementary examples.

The second chapter, “A Foundations Lift from the Adult Columbidae,” enters avian science.\(^\text{33}\) The chapter makes some progress toward intimating the possibility of a verifiable explanatory heuristics of the adult pigeon. Keeping discussion to the adult pigeon makes it possible to temporarily defer more challenging questions about organic development.

\(^{32}\text{CWL3, 163.}\)

\(^{33}\text{See, for example: Lewis Stevens, Avian Biochemistry and Molecular Biology. Cambridge University Press, Cambridge, 1996.}\)
A heuristics reached in Chapter 2 leads to fundamental questions about living organisms, reflections about which follow in later chapters.

The third chapter, “Growing to Flight Mastery: The Whole Storeyed Story,” looks to the problem of organic development. Special attention is given to avian development, one of the most studied in 20th century embryology and developmental biology. A main objective is to do for avian development what Chapter 2 did for the adult bird. That is, Chapter 3 makes some progress toward intimating the possibility of explanatory heuristics for avian development; and then of organic development more generally.

The fourth chapter, “Biological Entities,” includes a question posed by, among others, Erwin Schrödinger: What is Life? In his effort to account for what has sometimes been called a reverse entropy in organisms, Schrödinger initially suggested that the numerical quantity negative entropy might be helpful. Soon after, he abandoned that approach. Later, in 1953, entropy with a negative sign was introduced into information theory, and was named negentropy. The fourth chapter of the present book does not enter into information theory. Instead, preliminary reflections suggest that, once suitably transposed, Schrödinger’s more basic suggestions about entropy and negentropy refer to real aspects of both organic and non-organic entities. The fourth chapter also makes progress toward a heuristics of living and non-living entities, autonomic forms and synnomic forms, respectively.

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35 “The remarks on negative entropy have met with doubt and opposition from physicist colleagues. ‘… entropy taken with a negative sign,’ which by the way is not my invention. It happens to be precisely the thing on which Boltzmann’s original argument turned. But F. Simon has very pertinently pointed out to me that my simple thermodynamical considerations cannot account for our having to feed on matter ‘in the extremely well ordered state of more or less complicated organic compounds’ rather than on charcoal or diamond pulp. He is right” (Erwin Schrödinger, “Note to Chapter 6,” in What is Life?).
The fifth chapter, “The Concrete Intelligibility of Space and Time,” lifts previous chapters into a larger context. Chapter 5 includes questions about the universe and what Lonergan called emergent probability. The chapter ends by raising the problem of implementation. This also serves as segue to the Epilogue.

The Epilogue, “What is Science?”, picks up on the problem of implementation raised at the end of Chapter 5. The discussion draws attention to a later (1965) discovery of Lonergan, the discovery of an omnidisciplinary methodology (pre-) emergent in history that he called functional specialization. Probabilities of emergence and survival of generalized empirical method will increase within the supporting context of an emerging “specialized auxiliary,” that is, beginnings toward functional specialization. And, mature empirical method will be functional. Of course, the Epilogue can only lightly touch on these large and complex issues. However, references to the literature are given. Also, it was important to draw attention to the fact that implementation of the solution to the problem of cultural progress and decline will be intrinsic to adequate empirical method in the sciences.

37 See Epilogue.
38 CWL3, 747.
39 See, for example, CWL3, “General Bias,” sec. 7.8, 250-269, and discussion there of cycles of decline in culture.