Introduction

An Approach to a Branch of Logic

When I first began thinking about the issues discussed in this book, some four decades ago, one of the problems I was concerned with was the existence of God. I felt the problem to be of vital importance, as important as anything that was a matter of life and death; indeed that it was a question of *everlasting* life, of eternal salvation or damnation. Thus I tried to learn all I could about the arguments for the existence of God. I wanted to be sure that I knew them all and none escaped my attention; that I understood them properly and did not misinterpret them; and that I could evaluate or assess their correctness, worth, or strength. This concern led me to read the relevant works of classic authors such as Aristotle, St. Anselm, St. Thomas Aquinas, Blaise Pascal, and David Hume,[1] as well as those of contemporary authors like Karl Barth, Antony Flew, Alasdair MacIntyre, John Robinson, and Wallace Matson;[2] and I soon realized that another aspect of the same problem was to learn, understand, and evaluate the arguments *against* the existence of God, such as the objection from evil.

Examples of the questions I happened to think about are the following. The first of Aquinas's arguments begins with the undeniable premise that there is motion in the world and by a series of steps arrives at the conclusion that there must be a prime unmoved mover, which is called

[1] Aristotle 1952, 1: 326–27 (*Physics*, vii, 1, 241b24–243a2), 334–55 (*Physics*, viii, 250b10–267b26), 547–48 (*Metaphysics*, vi, 1, 1025b3–1026a32), 601–95 (*Metaphysics*, xii, 6–9, 1071b3–1075b10); Anselm 1958, 1–34 (*Proslogium*), 35–144 (*Monologium*); Aquinas 1952, 3–152 (*Summa Theologica*, first part, questions 1–26); Pascal 1952, 213–16 (*Pensées*, 233); Hume 1935 (*Dialogues*).

[2] Barth (1963; 1964); Flew and MacIntyre 1955; Robinson 1963; Matson 1965.

God.[3] But a second premise used by Aquinas is the claim that whatever is in motion is moved by something else. Now, whichever other flaws or merits the argument may possess, and whichever support this second premise may have had at the time of Aquinas, one difficulty is that since the seventeenth century, physics – the science of motion – has discovered that it is not motion that needs an external mover, but changes in (the direction or speed of) motion; this is the so-called law of inertia, or the first law of motion, or Newton's first law; so a key premise of Aquinas's first argument is false. I do not want to give the impression that this criticism was the end of the discussion, but rather I mention it to illustrate how this argument about the existence of God provided an occasion to distinguish between conclusion and premises.

By contrast, Aquinas's second argument was an occasion to reflect on the distinction between the acceptability of a premise and the acceptability of an inference from premise to conclusion. The second argument is similar to the first but utilizes the principle of causality, the premise that everything that exists is caused by something else, and it arrives at the conclusion that there must be a first cause, generally called God.[4] Here one issue would be the interpretive question of how exactly this argument differs from the first. Furthermore, evaluatively speaking, the principle of causality could not be questioned as easily, if at all, as the corresponding principle of motion of the first argument. However, to arrive at a first cause, the second argument depends on the idea that the series of causes and effects cannot go back *ad infinitum*. Can we then criticize the argument, as Bertrand Russell did,[5] by objecting that this idea assumes that it is impossible for a series to lack a first term, whereas mathematics tells us that this assumption is wrong because the series of negative integers ending with minus one clearly has no first term?

Or consider Anselm's ontological argument: God must exist because by God we mean a being such that nothing greater can be conceived; that is, by definition God is perfect in every way or possesses all perfections; but if God did not exist that would mean that He lacked existence, and so He would not possess the particular perfection called existence; in short, if God did not exist then He would be perfect in every way.[6] To understand this argument properly, one would have to determine whether and how

[3] Aquinas 1952, 1: 12–13 (*Summa Theologica*, first part, question 2, article 3).
[4] Aquinas 1952, 1: 13 (*Summa Theologica*, first part, question 2, article 3).
[5] Russell 1945, 462.
[6] Anselm 1958, 8–9 (*Proslogium*, chapter 3), 37–41 (*Monologium*, chapters 1–2).

it assumes that existence is a predicate; and one would also want to know how this argument is different from and how it is similar to Aquinas's fourth argument, which also involves the notion of perfection.[7] And to evaluate the ontological argument, one could object that existence is not a predicate; another question would be whether the argument really proves its stated conclusion or something else, namely that *if* God exists *then* he exists necessarily.

As a final example, consider the fact that the existence of God is still a controversial issue, that is, there is no consensus among scholars that the existence of God can be proved by means of conclusive arguments; can one use this very fact as a reason why God does not exist?[8] That is, can one formulate the meta-argument that if God exists, then by now mankind would have discovered the relevant evidence and arguments, because God is supposed to be the creator of the universe and of the human mind, and the human mind is supposed to be rational, and its inability to prove the existence of its creator must be a sign of something? Is this meta-argument an instance of the fallacy of ignorance, or can it escape that criticism?

The arguments for and against the existence of God thus provided my first introduction to an activity which I would now call argument analysis. But these arguments and this activity were not the only things that were leading me into the direction of a cluster of fields represented in this book. For at about the same time, during my college years, I also became interested in the problem of the logical analysis of scientific knowledge. Having started my undergraduate education with the intention of majoring in theoretical physics, I found that besides being interested in the drill and exercise questions and problems that appeared in class discussions, homework assignments, and examinations, I also was asking myself questions that did not seem to have the same kind of straightforward answers and that my professors were not as ready or willing to answer. They were questions like the following.

What is the relationship between the first and the second law of motion? The first, also called the law of inertia, states that every body persists in its state of rest or uniform motion in a straight line unless it is compelled to change that state by an external force; and the second, also called the law of force, asserts that force equals the time rate of change of momentum, or in cases where the mass is constant, force equals mass

[7] Aquinas 1952, 1: 13 (*Summa Theologica*, first part, question 2, article 3).
[8] Cf. Scriven 1966, 152–58.

times acceleration.[9] Is the law of inertia just a special case of the law of force, that is the case when the acceleration and force are zero, or does the first law contain information above and beyond that conveyed by the second law? Or is their relationship such that the first law says that if there is no external force acting, then the body will remain at rest or in uniform rectilinear motion, whereas the second law claims that if there is an external force, then the body will undergo an acceleration proportional to it? Such a relationship would amount to their being essentially the converse of one another. Or is the second law a special case of the first insofar as the first is really the biconditional[10] that if there is no force, then there is rest or uniform motion (i.e., no acceleration), *and* if there is a force, then there is acceleration; whereas the second law is just a quantitative reformulation of the same biconditional, to the effect that if there is acceleration, then there is a force proportional to it, and if there is a force, then there is an acceleration proportional to it?

Another problem stems from the fact that physicists often regard the proposition "force equals the time rate of change of momentum" as the definition of force.[11] Now if a definition is an explanation of the meaning of a word or of a concept, how can such a definition be a law of nature, the second law of motion? And if a definition is not an explanation of a meaning, what is it? What is the definition of a definition, or the meaning of meaning?[12] Furthermore, if the second law is a definition, note what happens when it is used to replace the term "force" in the statement of the law of inertia; the latter then reads that every body persists in its state of rest or uniform motion unless it is compelled to change that state by a change in its velocity, namely unless it does not persist in that state;[13] and this sounds like a tautology. But how can a tautology be a law of nature?

Should such problems be solved by interpreting these two laws in a different and less obvious manner? That is, the first law could perhaps be interpreted to mean that the natural state of a physical body is rest or uniform motion, and such a state is natural in the sense that it requires no explanation. The second law could be construed as saying that what

[9] Cf. Feynman et al. 1963, pp. 9–1 to 9–2; Kittel et al. 1962, 55–56; Ingard and Kraushaar 1960, 59; Lindsay and Margenau 1957, 85–86; Newton 1934, 13.

[10] The question whether the first law is really a conditional or a biconditional may be regarded as equivalent to the question of the meaning of the connective unless, i.e., whether "p unless q" means "p if and only if not-q" or merely "p if not-q."

[11] See, for example, Ingard and Kraushaar 1960, 59; Lindsay and Margenau 1957, 86.

[12] At the time I consulted Ogden and Richards 1946; and "The Problem of Meaning in Linguistics," in Quine 1961, 47–64.

[13] Cf. Lindsay and Margenau 1957, 86–87; Eddington 1930, 124.

requires explanation is deviations from the natural state, i.e. accelerations; and such explanations should be sought in terms of forces, i.e., by saying that accelerations are the effects of the action of external forces. The two laws would then be two methodological principles of explanation whose roles would be complementary.

While the arguments about God's existence had provided me with an introduction to that type of critical thinking that may be called argument analysis, such questions about the logical structure and status and the methodological import of the laws of physics provided my first introduction to other aspects of critical thinking, such as self-reflective argumentation, critical reasoning, and metacognitive reflection.

A third intellectual source of this book lies in the influence exerted on me in graduate school by the ideas of one of my professors in philosophy of science. Paul Feyerabend introduced me to an appreciation of the history of science and the historical approach to scientific methodology, to the analysis of scientific reasoning from the point of view of rhetoric and persuasion, and to Karl Popper's philosophy of science and the critical approach to science and philosophy (labeled "critical rationalism").[14] To be sure, I did not follow Feyerabend into his epistemological anarchism of "anything goes," which I regard as an iconoclastic excess. Nor did I follow the Popperians too closely into their emphasis on falsificationism, anti-justificationism, and anti-inductivism. Instead, my exposure to the history of science, rhetorical persuasion, and Popperian critical rationalism soon converged to make me focus on the arguments and reasoning that played a crucial role in the Copernican Revolution, especially the arguments for and against the earth's motion around the sun, as recorded and reported in Galileo Galilei's *Dialogue on the Two Chief World Systems, Ptolemaic and Copernican* (1632). Here was a collection of arguments and reasoning comparable to the arguments about the existence of God for their number, variety, accessibility, relevance, and importance.

A fourth source brought me a lot closer to the material in this book. At a slightly later stage of graduate school in philosophy, I was deeply influenced by the ideas of another one of my professors.[15] Through Michael Scriven I became exposed to the philosophy of the social sciences and the problem of their epistemological relationship to the natural sciences; to

[14] At the time the relevant works were Feyerabend (1962a; 1962b; 1963; 1965; 1970a; 1970b; 1970c); later such ideas were systematized and elaborated in Feyerabend 1975.

[15] At the time the relevant works were Scriven (1956a; 1956b; 1958; 1959; 1962a; 1962b; 1966; 1968).

the metascientific concept of explanation and its relationship to deduction, covering laws, inference, and understanding; and to another topic that brings us to the heart of the matter and deserves special attention.

That topic was treated in a seminar entitled "Elementary Reasoning from an Advanced Standpoint," given in the winter quarter of 1967. Scriven's description of the course is sufficiently eloquent, emblematic, and informative as to deserve extended quotation:

> The logical structure of actual arguments is still strikingly obscure, a fact which is concealed behind the internal precision, the intricacy and the intrinsic interest of the various formal systems which have been spawned in the attempt to clarify that logical structure. The classical formal accounts, from the syllogism through extensional sentential calculi to the systems S1–S6, are either notoriously or notably deficient, especially with respect to (i) the encoding procedure, (ii) the identification of assumptions and presuppositions, (iii) the circularity of certain definitions of the connectives in terms of the stroke function (or of numbers in terms of iterated quantifiers), (iv) the analysis of implication, (v) the distinction between deductive and inductive arguments and (vi) that between use and mention, (vii) the "paradox of analysis," (viii) the "Achilles and the tortoise" regress, (ix) the nature of argument by analogy and (x) of induction by simple enumeration, (xi) the analysis of "internal" and "external" probability, (xii) general statements, (xiii) "classical" and "criterial" definitions, (xiv) evaluation, etc.
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> This seminar will examine some well-known proposed treatments of these difficulties, including suggestions by philosophers such as Lewis, Reichenbach, Carnap, Strawson, Ryle, Toulmin, Anderson and Belnap. To provide a basis for such discussions, the seminar will be substantially concerned with the "workshop" task of analyzing elementary arguments with more than usual care. This analysis will be used not only to evaluate the suggestions mentioned, but also to develop a more accurate account of reasoning and a more effective method of teaching the skills involved in it. This will involve some study of relevant psychological data, of innovative elementary texts, and of the relation between psychology and logic. Prerequisite: the capacity to identify 80% of the topics and people mentioned or unusually high motivation and reasoning capacity. Texts: Toulmin, *Uses of Argument* and Strawson, *Introduction to Logical Theory*[16]

Here was a manifesto which I would now reconstruct as follows. The overarching issue may be defined as that of the methodological and epistemological status of the science of logic or logical theory and the status of the science or theory of reasoning and argument. For example, is logic an abstract science that studies entailment, truth functions, the calculus of propositions, predicates, relations, identity, etc.; or is it a special social science that studies the mental activities of reasoning and

[16] From a class handout distributed on 31 January 1967 at the University of California, Berkeley.

argument? If the former is the case, how does logic relate to mathematics? Is it just a branch of mathematics? Or does it provide the foundations of mathematics? If logic is a social science, how does it relate to experimental cognitive psychology? In any case, aside from the issue of the meaning to be attached to "logic," there is a thriving enterprise called formal or symbolic logic, and there exists an important human activity consisting of reasoning and argumentation; so we may ask, what is or ought to be the relationship between formal or symbolic logic and reasoning or argument? Moreover, even if we take the point of view of the (empirical) science of reasoning, there is also the question of how such a science would relate to the practical *art* of reasoning. Finally, even if we take the point of view of symbolic logic, there is the nontrivial question of how its principles are to be applied to the analysis of arguments in natural language.

Scriven's recommendation of Stephen Toulmin's book *The Uses of Argument* was a consequential one. However, the primary lesson I derived from Toulmin was not a particular theory of the layout or arguments, which however novel and interesting I did not find especially viable and congenial. Nor did I derive from it a special theory of argument assessment to the effect that principles of evaluation are field-dependent and that there are no universally correct such principles. Rather I adopted from Toulmin what seemed to be his solution to the problem of the epistemology of the science of logic and argument. He seemed to be suggesting a critique of formal or symbolic logic as being insufficiently concerned with actual human reasoning, with nondeductive arguments such as are common in law, with argumentation in natural language, and with practical applications; and he seemed to be making a plea for a logical theory that was more empirical, more general, more natural, more practical, and more historical.[17]

[17] Here is one of the most emblematic passages: "Logic conceived in this manner may have to become less of an *a priori* subject than it has recently been. . . . Accepting the need to begin by collecting for study the actual forms of argument current in any field, . . . we shall use ray-tracing techniques because they are used to make optical inferences, presumptive conclusions and 'defeasibility' as an essential feature of many legal arguments, axiomatic systems because they reflect the pattern of our arguments in geometry. . . . But not only will logic have to become more empirical; it will inevitably tend to become more historical. To think up new and better methods of arguing in any field is to make a major advance, not just in logic, but in the substantive field itself: great logical innovations are part and parcel of great scientific, moral, political or legal innovations. In the natural sciences, for instance, men such as Kepler, Newton, Lavoisier, Darwin and Freud have transformed not only our beliefs, but also our way of arguing and our standards of relevance and proof" (Toulmin 1958, 257–58).

The four sources I have elaborated did not immediately and directly lead me to the investigations presented in this book. For about a decade I studied the arguments for and against the existence of God primarily to seek enlightenment about God and religion and not to master argument analysis. Similarly I studied the logical structure and status of the laws of physics to learn primarily about the nature of science and scientific reasoning and not about human reasoning in general. I studied the persuasive force and critical-rationalist aspects of scientific reasoning in the history of science to learn first and foremost about the role of persuasion, criticism, and history in scientific inquiry, and only secondarily to learn about the role of these things in general human reasoning. And I studied the problem of the epistemological and methodological status of the science of logic and reasoning not in order actually to build or develop a viable logical theory or theory of argument, but mostly as a special problem in the philosophy of science, special in three senses: (1) it is a particular one out of many such problems; (2) the science or discipline in question – logic – is especially important; and (3) it encompasses an overarching issue, namely whether logic is or ought to be a mathematical or a social science, and if the latter whether the social sciences are *sui generis* or like the natural sciences.

Thus, in line with the second strand mentioned above, in my undergraduate thesis I examined the problem of the relationship between the laws of quantum mechanics and of classical thermodynamics, by analyzing some of Werner Heisenberg's arguments that the former are essentially similar to the latter; my key aim was a better understanding of quantum physics.[18] And combining the third and fourth strands, my doctoral dissertation and first book examined the methodological and epistemological status of the historiography of science from the point of view of the concept of explanation; I analyzed the logical structure of explanations advanced by historians of science to determine whether they are more like scientific explanations or more like historical explanations, or whether they are special and if so what their special characteristics are; my two-fold aim was to understand better the concept of explanation on the one hand and to understand and improve the discipline of history of science on the other.[19]

In both cases, however, most of my discussion consisted of interpretations and evaluations of arguments, in the former case arguments

[18] Finocchiaro 1964.
[19] Finocchiaro 1969; 1973c.

advanced by physicist Heisenberg; in the latter case arguments propounded by philosophers Joseph Agassi (who had pioneered the critical examination of the historiography of science), Carl Hempel, and Michael Scriven (both of whom had elaborated the theory of explanation), and by historians of science Alexandre Koyré (when explaining aspects of Galileo's physics) and Henry Guerlac (when explaining aspects of Lavoisier's chemistry).[20] Thus both theses consisted largely of exercises in argument analysis. The rest amounted to what I would now call self-reflective argumentation and methodological reflection; that is, in the constructive parts of those investigations I advanced and defended some appropriately nuanced claims about the relationship between quantum mechanics and classical thermodynamics, about the nature of the concept of explanation, and about the status and prospects of the discipline of history of science. In short, although these earlier works were not yet explicit contributions of the type found in this book, they were sustained exercises in argument analysis, self-reflective argumentation, and methodological reflection, and so they were significant experiences in preparing the ground for those contributions. One other experience was also crucial; it regards teaching, to which I now turn.

My experience as a teaching assistant in graduate school consisted largely of assisting in symbolic logic courses, and to a less extent in introductory philosophy courses of both the historical and the problem-oriented variety. But after I obtained a tenure-track position in logic and philosophy of science, for several years my teaching experience consisted mostly of teaching a course in introductory logic that was meant to be distinct from an introduction to symbolic logic; the course was supposed to be an introduction to reasoning and critical thinking that would focus on actual arguments in natural language and on the development and improvement of students' logical skills. The teaching of such a course turned out to be a very challenging task. For one thing, at that time (early 1970s), there were not many appropriate textbooks. Three exceptions were Max Black's *Critical Thinking* (1952), Monroe Beardsley's *Thinking Straight* (1966), and Howard Kahane's *Logic and Contemporary Rhetoric* (1971); but after adopting them, I found them not completely satisfactory for one reason or another. The difficulty was compounded by what I had learned from Scriven's "Elementary Reasoning from an Advanced Standpoint" and Toulmin's *Uses of Argument*; for the appreciation

[20] See Agassi 1963; Guerlac 1961; Heisenberg 1955; Hempel 1965; Koyré 1939; Scriven (1958; 1959; 1962a); cf. Finocchiaro (1964; 1969; 1973c).

of the epistemological problem of the status of the science of logic or reasoning suggested that the material taught in my introductory logic could and should be not some second-class substitute for introductory symbolic logic, not some sloppy version of a more rigorous course, but merely a simplified account of a subject with its own distinctive and high standards, aims, and criteria.

Fortunately I was not the only scholar struggling with this problem. Soon more appropriate textbooks began to appear, for example, Scriven's *Reasoning* (1976) and Robert Fogelin's *Understanding Arguments: An Introduction to Informal Logic* (1978). Moreover, the field of "informal logic" began to take root in 1978 in Canada with the first international symposium on the subject; the "critical-thinking movement" began to organize itself at its first conference in 1981 in California; and the same happened to "argumentation theory" in The Netherlands in the early 1980s.[21]

In my own case, my exposure to the pedagogical problem of teaching introductory logic and critical thinking had two important effects. One involved the realization that many problems with the introductory logic course were the result of its being introductory rather than of my wanting to focus on actual reasoning and practical skills; for example, all introductory courses face the problems of the necessity of simplification, the distinction between simplification and oversimplification, and the relationship between introductory and more advanced courses. This realization led me to conceive and teach a more advanced course. Entitled "Logical Theory," the course description read: "General study of the nature of argument; how it relates to reasoning, criticism, deduction, logical form, induction, and persuasion. Emphasizes both the systematic development of logical concepts and their application to actual arguments."[22] And in turn, the preparation for this course and the attempt to create material suitable for it resulted directly in researching and writing many of the essays that are reprinted in this book.

The second effect was that my teaching introductory logic provided not only serious pedagogical challenges, but also rich and fruitful material and motivation to undertake the studies collected in this book. Although all pedagogical experience has, or should have, some such synergistic interaction with research, the case of introductory logic and critical thinking is special in this regard. Its special character is due to the fact that if

[21] Cf., respectively, Blair and Johnson 1980; Paul (1982; 1984; 1985); Barth and Martens 1982; Eemeren et al. 1987.
[22] For more details, see Finocchiaro 2002.