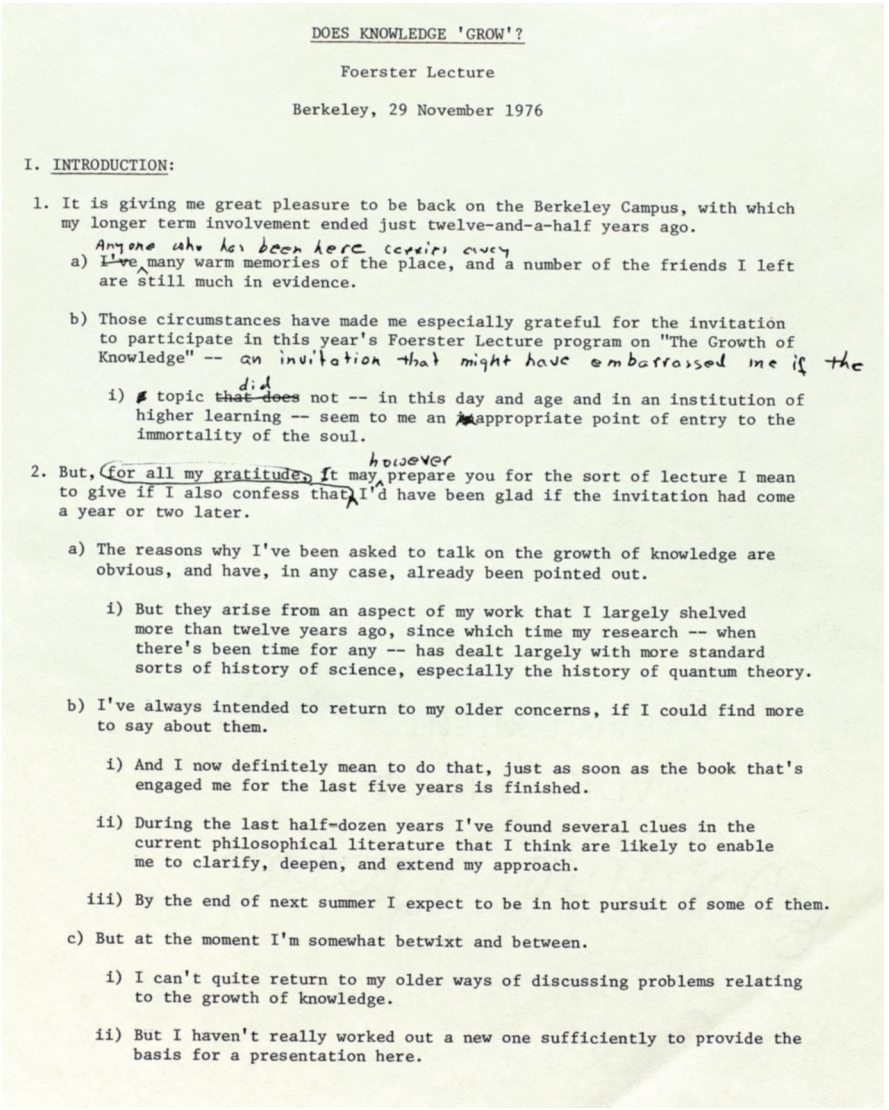
Appendix: Transcription of Thomas S. Kuhn's "Does Knowledge 'Grow'?"

Juan V. Mayoral, ed.



DOES KNOWLEDGE 'GROW'?

Foerster Lecture

Berkeley, 29 November 1976

I. INTRODUCTION:

1. It is giving me great pleasure to be back on the Berkeley Campus, with which my longer term involvement ended just twelve-and-a-half years ago.

   a) ~~I've~~ Anyone who has been here carries many warm memories of the place, and a number of the friends I left are still much in evidence.

   b) Those circumstances have made me especially grateful for the invitation to participate in this year's Foerster Lecture program on "The Growth of Knowledge" -- an invitation that might have embarrassed me if the

      i) topic ~~that does~~ did not -- in this day and age and in an institution of higher learning -- seem to me an ~~a~~appropriate point of entry to the immortality of the soul.

2. But, ~~for all my gratitude,~~ however, it may prepare you for the sort of lecture I mean to give if I also confess that I'd have been glad if the invitation had come a year or two later.

   a) The reasons why I've been asked to talk on the growth of knowledge are obvious, and have, in any case, already been pointed out.

      i) But they arise from an aspect of my work that I largely shelved more than twelve years ago, since which time my research -- when there's been time for any -- has dealt largely with more standard sorts of history of science, especially the history of quantum theory.

   b) I've always intended to return to my older concerns, if I could find more to say about them.

      i) And I now definitely mean to do that, just as soon as the book that's engaged me for the last five years is finished.

      ii) During the last half-dozen years I've found several clues in the current philosophical literature that I think are likely to enable me to clarify, deepen, and extend my approach.

      iii) By the end of next summer I expect to be in hot pursuit of some of them.

   c) But at the moment I'm somewhat betwixt and between.

      i) I can't quite return to my older ways of discussing problems relating to the growth of knowledge.

      ii) But I haven't really worked out a new one sufficiently to provide the basis for a presentation here.

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Editorial Note

In the following transcription, I have chosen not to display Kuhn's minor corrections of misspelled words, and I have corrected some misspellings that might remain. Whenever I have added a letter to a word, or even a complete word, I have put it into square brackets ([]). Kuhn's amendments of his own ideas as well as additions to the original typescript (all of them handwritten) are displayed clearly by means of curly brackets ({}). I have shown in footnotes the text that Kuhn crossed out and, therefore, discarded. Also, I have added references in footnotes whenever advisable (e.g. to Wittgenstein's and Austin's original texts). Page numbers are displayed at the end of every original page in square brackets and bold characters (**[]**). Underlining is Kuhn's, of course, and I have opted for preserving it instead of turning it into italics. In addition, I have suppressed Kuhn's alphanumerical arrangement of the lines in the text in order to make it more readable. Finally, the organization in paragraphs is mine, though I have tried to preserve Kuhn's arrangement. Original numeration helps in this regard. Yet, in some cases, I have split a paragraph in two or three when the resulting one was too long. My intention has been to provide the reader with the original content (i.e. with Kuhn's text and his revisions), though in a reader-friendly format. However, the reader should keep in mind that these are Kuhn's lecture notes, not a paper that he prepared for publication.

The comparison of this original 1976 version of the lecture with a revision of 1980 located in the same folder of Kuhn's papers at the MIT's Distinctive Collections (MC 240) might be of interest for researchers. In my chapter, I have used some of Kuhn's new passages in the 1980 version for my own commentary. Clearly, not every change in that version is worth attention. For instance, some handwritten additions to the typed text—here introduced by curly brackets—were omitted in the 1980 version, and some others were preserved. I shall only mention cases like these if, in my view, they are relevant. I will do the same with the new sentences Kuhn introduced: whenever they are merely stylistic variations, I do not point them out. In these cases, I shall leave for the researchers to compare the original documents. In short, in my footnotes to Kuhn's text—all footnotes are mine—I have only pointed out those changes that, in my view, are relevant for the interpretation of the text.

Finally, references at the end of this text are mine. The full reference for this text in Kuhn's unpublished papers at the MIT Archives is as follows:

Kuhn, T. S. (1976): "Does Knowledge 'Grow'?" Foerster Lecture, University of California, Berkeley, 29 November 1976. Thomas S. Kuhn's Papers, 1922–1996. MC 240. Distinctive Collections, Massachusetts Institute of Technology, Cambridge, Mass. Box 5, Folder: "Berkeley: Foerster Lecture, 1976."

Thomas S. Kuhn's Foerster Lecture: The Transcription

DOES KNOWLEDGE 'GROW'?
[Thomas S. Kuhn]
Foerster Lecture
Berkeley, 29 November 1976

Introduction

It is giving me great pleasure to be back on the Berkeley campus, with which my longer-term involvement ended just twelve-and-a-half years ago. {Anyone who has been here carries away}[1] many warm memories of the place, and a number of the friends I left are still much in evidence. Those circumstances have made me especially grateful for the invitation to participate in this year's Foerster Lecture program on "The Growth of Knowledge"—{an invitation that might have embarrassed me if the} topic {did} not[2]—in this day and age and in an institution of higher learning—seem to me an appropriate[3] point of entry to the immortality of the soul.

But it may {however} prepare you for the sort of lecture I mean to give if I also confess that{, for all my gratitude,}[4] I'd have been glad if the invitation had come a year or two later. The reasons why I've been asked to talk on the growth of knowledge are obvious, and have, in any case, already been pointed out. But they arise from an aspect of my work that I largely shelved more than twelve years ago, since which my research—when there's been time for any—has dealt largely with more standard sorts of history of science, especially the history of quantum theory. I've always intended to return to my older concerns, if I could find more to say about them. And I now definitely mean to do that, just as the book that's engaged me for the last five years is finished.[5] During the last half-dozen years I've found several clues in the current philosophical literature that I think are likely to enable me to clarify, deepen, and extend my approach. By the end of next summer, I expect to be in hot pursuit of some of them. But at the moment I'm somewhat betwixt and between. I can't quite return to my older ways of discussing problems relating to the growth of knowledge. But I haven't really worked out a new one sufficiently to provide the basis for a presentation here.[6] **[1]**

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[1] Up to this point, the statement is a handwritten substitution of "I've," which Kuhn crossed out.

[2] This part of the phrase originally read: "a topic that does not."

[3] This word was originally "inappropriate."

[4] The phrase "for all my gratitude" was originally after the initial "But," and between commas. A circle around it, excluding the first comma, and an indicative arrow moved it to this new place.

[5] Kuhn is evidently referring to *Black-Body Theory and the Quantum Discontinuity, 1894–1912*, which was published in 1978 by Oxford University Press.

[6] Understandably, the first two paragraphs are different in the 1980 version (the third one is more or less the same). After all, both the context and the moment in which Kuhn delivered this lecture

Under these circumstances, I'm going to try for a compromise. In the first part of my lecture—roughly half {to two-thirds}—I'm going to go over points that I think of myself has having made before. But in a somewhat different way, one that will enable me to underscore an aspect of what I've said that's often been misunderstood. Then, I'm going to seem to reverse my field entirely. Most of the rest of my lecture will be devoted, inevitably in a preliminary way, to pursuit of one of the clues I've recently referred to. At that point I'm going to be speaking in a somewhat heretical fashion about a standard philosophical problem, the relation of knowledge and belief. And for some time most of you are likely to be wondering what on earth the two parts of my talk have to do with each other. Hopefully, the closing parts of [the] lecture will resolve that perplexity, and simultaneously provide you with the most refined version I've yet got of an answer to the question posed by my title. The question is: Does knowledge grow? And what I shall be trying throughout my remarks to prepare you for is the realization that it's got no yes or no answer. If I'm right, then both my title and the {theme}[7] announced for this year's Foerster Lecture program are somehow misphrased, though I think in interesting and I hope fruitful ways.

My Aristotle Exposure

{Now to my topic which I am going to approach}[8] by retailing a bit of my autobiography. For me it's a significant bit, for it's the episode that persuaded me to leave theoretical physics for history of science, and to do so in hope of drawing philosophical lessons from my new field. That is not, however, my reason for choosing it here. I've had numerous similar experiences since. Many of them could be used to make the same points, a fact which—lacking time to multiply examples—I ask you from here on to take for granted. I choose this one, not for its personal significance to me, but because the others are likely to prove too technical for an audience with little knowledge of science or its history. **[2]**

{For the example, I now}[9] take you back almost thirty years to a time when I was asked to suspend work on my physics doctoral thesis to prepare a set of lectures on the history of seventeenth-century mechanics. They were intended to constitute one of several case studies for an undergraduate science course directed to non-scientists, and it took me very little time to {realize}[10] that I'd better stay away from Newton, since his work was too technical for my audience. The case would, I concluded, have to center on Galileo. And to treat his work I'd have first to find out what people

had changed. I shall not include here the 1980 version of this introduction, but I briefly commented on the difference in Section 2.2 of Chapter 15.

[7] "Theme" appears here handwritten over the word "topic," which is crossed out.

[8] Up to this point, this part of the sentence substitutes "I think I can best approach my topic."

[9] From the beginning of the sentence, this part substitutes "So, I now."

[10] "Realize" is a handwritten replacement for "conclude," which is, of course, crossed out.

had {known}[11] in the years before his work was done. What there'd been for him to add.

I won't trace my route further, but its outcome was that I spent a large part of a hot Cambridge summer trying to read my way through Aristotle's Physics. For weeks and weeks, I found the experience intensely frustrating, and I can't any longer figure out quite why I persisted. At least in translation I could read the words and understand, or think I was understanding, what Aristotle was trying to say. But I couldn't at all understand why anyone should ever have said such implausible and inaccurate things. Yes, Aristotle gave arguments, but in this area, physics, it was easy to fault either their logic or the premises to which logic was applied.

Under these circumstances I was ready to join the large group that thought Aristotle had been a dreadfully bad physicist, but two considerations held me back. First, I didn't think anyone could have been quite that bad, especially a person who in other areas, including the life sciences, had done absolutely first-class work. Second, if others had read Aristotle the way I was reading him, it became impossible to understand how his Physics could have been taken quite as seriously as it doubtless had been by a great many people during a very long period of time after his death. Though I couldn't make sense of the text, I therefore continued to think that somehow or other the fault might be mine rather than Aristotle's.

Well, it turned out that the fault was mine, and I still remember the moment of discovery, the moment when I broke into Aristotle's text. **[3]** I was sitting at the desk in my living room with a four-color pencil in my hand and the heavily marked up book in front of me. I looked up and {stared abstractedly}[12] out the window—that's the visual imprint I still retain. And suddenly a lot of pieces I'd had at hand for some time sorted themselves out and came together in a new order. My jaw dropped, because all at once Aristotle looked like a very good physicist, but of a kind that I'd not imagined possible. Now I did understand why he'd said what he said and also the nature of the authority of the arguments which had previously seemed to me so nearly vacuous. Of course, the job was not all over. There were later moments of more moderate illumination. And even when they stopped, there was lots of work to be done on matters of significant detail—though it was of a sort that I felt then and since should be left to people who know Greek. But what made this later work possible was the initial moment of reordering. And it came, not piece by piece, sentence by sentence, but all at once after a long period of preliminary frustration had provided the pieces from which my new way of reading Aristotle's text was forged.

That, as I've already indicated, is a sort of experience I've had again and again since, and it's always dramatic, though not in the same degree. First comes a period of malaise: I can't be reading this right; no one in his right mind would have said that. Then, if I'm lucky, follows the discovery of a new way to read the same passages, one that suddenly permits the sentences to make more than merely

[11] Kuhn adds "known" right at the end of the line, and crosses out "believed," which was originally the first word of the next line.

[12] "Stared abstractedly" substitutes "gazed."

grammatical sense. And sometimes when this occurs, there's another dividend.[13] Sometimes a new way of reading permits prediction or retrodiction. If that's the way my subject thought, then he ought to have believed this and this and this. And he is likely to have recorded it in that place. And you go an[d] look, and it's there, and you're reasonably persuaded you've got things right. My most recent experiences of that sort have come while reading and puzzling over Max Planck. One need not go back to antiquity or even the seventeenth century for them.[14] **[4]**

The Aristotle example illustrates {in a concrete form} what's gone wrong in each of these cases. I'd been trying to read Aristotle with a vocabulary and a set of associated concepts that worked very well for Newton and that could be used, though with somewhat deceptive results, for Galileo. Deploying those concepts, that way of talking, there were certain discoveries to be made on the way to Newtonian mechanics. I'd been looking to see which of them were to be found in Aristotle, what was left for Galileo and Newton to do. And I'd found substantially none of them at all. On that way of reading, the growth of knowledge of mechanics from Aristotle to Galileo had been tremendous.

But once I broke into Aristotle's text and he began to seem a good physicist, the whole notion of growth began to seem problematic. Aristotle hadn't been working on mechanics. Until perhaps the mid-sixteenth century there hadn't been a field with an identity at all like that of mechanics. More important, within the field on which Aristotle was working a number of terms—like motion, matter, space, and speed—functioned rather differently {from the way they would when}[15] they later recurred within Newtonian mechanics. By and large, the problem wasn't translation. After Newton there were no better English terms into which to render Aristotle's Greek. But somehow the terms related to each other and also to the phenomenal world in different ways when they occurred in Aristotle than they did when encountered in Newton.

That, of course, is what made the term "growth" problematic, and more generally posed a problem of comparison. It was and is very easy to point to a number of things that could be done with Newtonian physics but not with Aristotelian. But since it wasn't quite possible to state one theory in the language of the other, it was by no means clear how to compare what practitioners of the two might reasonably said to have known. These are the problems that Professor Feyerabend and I have

[13] At this point, before the full stop, Kuhn had written "—one I did not encounter with Aristotle." He crossed out this part. Kuhn preserved this part in his 1980 version.

[14] There are parallelisms between the last two paragraphs and Kuhn's description of his "Aristotle experience" in "What Are Scientific Revolutions?" (Kuhn 1987, 15–17). Actually, as Pablo Melogno properly points out (Melogno 2023), that paper (Kuhn 1987) describes Kuhn's "Aristotle experience" as he already did in his Perspective Lectures at the University of Notre Dame (Kuhn 1980, I, 4–7). Therefore, these paragraphs in the Foerster Lecture were probably an earlier version of the same description.

[15] "From the way they would when" substitutes "than they would when," though only "than" appears crossed out. Clearly, "they would when" is common to both versions.

{described}[16] as resulting from the "incommensurability" of successive theories—though we don't always mean the same thing by that term. I've no intention of pursuing them further here. But I might mention parenthetically that they're the most likely focus for the next round of my own work. Quine on radical translation and Kripke and Putnam on reference do provide clues that may permit more sense to be made of the notion. **[5]**

Now let me illustrate, as briefly as I can, some of what was involved in my breaking into Aristotle's text. Obviously I can't do the whole or even do any parts with full responsibility to the texts. But I hope I can do enough to make plausible {a few}[17] generalizations about what I found there, generalizations which will tie this part of my lecture back to my older work and simultaneously supply elements needed in the last part of my lecture. A first illustration is easy, and will be familiar to many of you.[18] When the term "motion" occurs in Aristotelian physics, it refers to change in general, not just to the change of position of a physical body. Change of position, the exclusive subject of mechanics for Galileo and Newton, is one of a number of sub-categories of motion for Aristotle. Others include growth—the transformation of an acorn to an oak—or change of state—the heating of an iron bar or the transition from sickness to health. As a result, though Aristotle recognizes that the various sub-categories are not in all respects alike, the basic categories relevant to the recognition and analysis of motion must apply to changes of all sorts. In some sense that is not merely metaphorical, all varieties of change are seen like each other, as constituting a single natural family.

A second aspect of Aristotle's physics—harder to spot and even more important—is that it's a physics of qualities. By that I don't mean simply that it aims to explain quality and change of quality, for other sorts of physics have done that. Rather I have in mind that Aristotelian physics reverses the priorities of matter, on the one hand, and qualities, on the other, that have been standard since the middle of the seventeenth century {when giving sci. exp.}[19] In Newtonian physics a body is constituted of particles of matter, and its qualities are a consequence of the way those particles are arranged, move, and interact. {Matter is thus primary.} In Aristotle's physics (unlike his metaphysics) matter is very nearly dispensible. It's a neutral substrate, present wherever a body could be—which means wherever there's space. **[6]** A particular body exists at whatever place this neutral substrate, a sort of sponge, is sufficiently impregnated with qualities to give it individual identity. Change occurs by changing qualities, not matter, by lifting some qualities off and

[16] "Described" substitutes "labelled."

[17] "A few" substitutes "two."

[18] Kuhn's description of Aristotelian physics from this paragraph to the first one on p. 9 closely parallels those in both his first Perspective Lecture (Kuhn 1980, I, 7–10) and "What Are Scientific Revolutions?" (Kuhn 1987, 17–20). Accordingly, I have divided the text of this part of the Foerster Lecture into paragraphs on the basis of the published version.

[19] This abbreviation can be expanded to "scientific explanation." I thank Yafeng Shan for suggesting this interpretation.

replacing them with others. There are even some implicit conservation laws which the qualities must apparently obey.

There are other similarly general aspects to Aristotle's physics, but I shall try to get at the points I'm after from these two, picking up one other well known one in passing. What I want now to begin to suggest is that, as one recognizes these and other aspects of Aristotle's viewpoint, they begin to fit together, to lend each other mutual {support,} and thus to make a sort of sense collectively that they individually lack.

Begin from the notion of a qualitative physics I've just sketched. When one analyses a particular object by specifying the qualities that have been imposed on omnipresent neutral matter, one of the qualities that must be specified is its position, or, in Aristotle's terminology, its place. Position thus becomes a quality of the object, one which changes as the object moves or is moved. Thus, local motion (motion tout court in Newton's sense) is change-of-quality or change-of-state for Aristotle, rather than being itself a state as it is for Newton. {and for anyone who can enunciate the principle of inertia.}[20] And it's precisely seeing motion as change-of-quality that permits its assimilation to all other sorts of change—acorn to oak or sickness to health. That's the aspect of Aristotle's physics from which I began, and I could equally well have travelled the route in the other direction.[21]

But if that much is clear, then another aspect of Aristotle's physics—one which regularly seems ridiculous in isolation—begins to make sense. Most changes of quality, especially in the organic realm are asymmetric, at least when left to themselves. An acorn naturally develops into an oak, not vice versa. A sick man will often grow healthy by himself, but an external agent is needed, or believed to be needed, to make him sick. One set of qualities represents a body's natural state, the one which it realizes voluntarily. **[7]** Clearly, then, the same should be true for local motion, change of position, and indeed it is {in Aristotelian physics.} The quality which a stone or other heavy body strives to realize is position at the center of the universe; the natural position of fire is at the periphery. That's why stones fall towards the center until blocked by an obstacle and why fire flies to the heavens. They are realizing their natural properties just as the acorn does through its growth. Another part of [the] initially strange Aristotelian doctrine fall[s] into place.

Well, one can go on for some time in this manner, locking individual bits of Aristotelian physics into place in the whole. But I want instead to conclude this aspect of my talk with one last example, Aristotle's doctrine about the vacuum or void, for it illustrates with particular clarity the way in which a number of doctrines, individually dubious, lend each other mutual support. Aristotle states that a void is impossible, and his basic argument is that it's a contradiction in terms. By now you should be able to see that. If bodies are {neutral} matter individuated by qualities,

[20] This addition was suppressed in the 1980 version.

[21] In the 1980 version, Kuhn adds: "That's my first example of the fitting or the locking together of parts" (DKG-1980, 7).

then there must be matter wherever there could be a body, that is, everywhere in space. But a void would be space without matter, thus a contradiction in terms.

Alright, one understands the argument, but surely Aristotle could have adopted another view of the relation between space and matter. Yes he could, but look what would have happened to other central aspects of his physics. If there could be a void, then the Aristotelian universe of cosmos could not be finite. It's just because matter and space are coextensive, that space can end where matter ends, at the outmost sphere, beyond which there's nothing at all, neither space nor matter. Well, that doctrine also seems dispensible, though getting rid of the finite universe would make trouble for astronomy since the stars are thought to move about the earth. But trouble comes earlier and more directly, for in an infinite universe there is no center—any point is as much the center as any other—and thus no natural position at which stones and other heavy bodies realize their natural quality. **[8]** Or, to put the point in another way, one which Aristotle actually uses, in a void a body couldn't be aware where its natural place was. It's just by being in contact with all positions in the universe through a chain of intervening matter that a body is able to find its way to the place where its natural qualities are fully realized. Thus, the Aristotelian theory of natural local motion as well as ancient geocentric astronomy are threatened by an attack on Aristotle's doctrine of the void. {Now, what I mean by the interlocking of parts should be clear.}

That ends what I want to say about Aristotle's physics, and I'll therefore draw this first portion of my talk to a rapid close with two sets of remarks about the ground so far covered. First set grows out of what's been said about the way in which a number of the central pieces of Aristotelian physics lock together, lending each other mutual support. Remember that the[22] pieces {I've just been displaying} are ones I could not have[23] {picked out as elementary parts} until after I'd broken into Aristotle's text{, seen its structure as a whole. They were not the parts picked out by} my earlier Newtonian vocabulary.[24] That, I think, is why the experience of breaking into the text had to be a relatively sudden and unstructured experience after

[22] "The" replaces "these," whose two final letters are crossed out.

[23] This part replaces "described to you."

[24] This part, from "Remember that" to this point, was transformed almost entirely. The original reads: "I couldn't, that is, locate the parts in my earlier Newtonian vocabulary until I'd seen the whole, but neither could I see the whole until I'd got a number of the parts." Kuhn then added (handwritten): "To break into the text, I had to juxtapose hypothetical parts with corresponding [?] parts, until things fell together." He crossed it out together with the rest of the original point, except for the words "my earlier Newtonian vocabulary," which remain in the text. In the 1980 version, this passage was once again transformed and extended. The new one reads:

Remember that, though I've been calling these elements "pieces" or "parts," they are ones I could not have picked out until I'd broken into Aristotle's text. Used in the Newtonian sense from which I'd started, my vocabulary cut the world of phenomena up differently from the way it did after my breakthrough. For example, all fundamental Newtonian events were motions of matter, whereas for Aristotle they had been changes of quality. As a result, I couldn't even locate the pieces interlocked within Aristotelian physics until I'd caught at least a glimpse of the whole structure. Nor could I see the whole until I'd begun to glimpse the parts. (DKG-1980, 9.)

a considerable period of frustration during which I'd been trying to isolate parts that would make a whole and vice versa. Many of you will recognize this gibberish about parts and wholes as a familiar way of speaking. Though I knew neither the term nor the literature that now accompanies it until quite recently, what I'd been up to in reading Aristotle was hermeneutic interpretation, and what I've been calling "breaking into" his text was the discovery of a point of entry to the hermeneutic circle.[25]

The second point is that, in illustrating the interlocking of parts, I've been highly selective. I have been choosing parts that lie in what I'm henceforth going to call the CORE of Aristotelian physics or of the Aristotelian world view. It's not clear to me just how precise this notion can be made. At this time, we lack apparatus for exploring it, and even with apparatus we're likely to have to settle for a continuum from the center out. Still, I think I've showed you what I have in mind. Roughly speaking, the core of a theory is the group of its parts that can't be removed or changed individually without creating havoc in a large part of the surrounding territory. **[9]** The elements in a theory-core stand or fall pretty much together.[26]

My third point, then, follows directly from this one. Though a theory has a core, the core does not exhaust its content. There's also a periphery, and the elements in it are only constrained, not determined by, the core. To determine these peripheral elements requires additional thought and argument, often accompanied by observation and experiment as well. Aristotle, for example, proposes a particular semi-quantitative relation between the speed of a motion, the force causing it, and the resistance to it. That relationship turns out to result in an internal contradiction, and finding a replacement for it produces a vast amount of consequential medieval research.{—conducted without threatening the core.} Or again, Aristotle asks what keeps a projectile in motion after it leave[s] the hand or the sling. He suggests two possibilities, neither of which satisfies many of his successors. They evolve another which, from the fourteenth century becomes standard until Galileo. These and many other problems {in the periphery} are the subjects for an Aristotelian research tradition—conducted in an area where choices and alternatives are available without doing violence to the core.

All of which brings me to the final set of remarks in this part of my lecture, and they can be very short for they're by now obvious. I have at this point gotten back, by a different and I hope unexpected route to a set of themes that I've presented repeatedly before. What I, starting with Newtonian concepts, had to do to break into Aristotle's text is in a number of respects what Aristotelian physicists had to do {in reverse} to make the transition to a Newtonian world-view. That transition required a change of core and was thus the sort of episode I've labelled scientific revolution. {—Sort of change that makes "growth" problematic.} By the same token, what I've

[25] The lines from "Many of you" up to this point were suppressed in the 1980 version.

[26] In the 1980 version, the first line on p. 10 reads: "I've emphasized motion as change of state, the concept of a qualitative physics, and the doctrine of the void, and there are others" (DKG-1980, 10). After that, the first line in the 1976 version follows, slightly altered at the beginning: "These elements, the ones in a theory-core stand or fall pretty much together" (DKG-1980, 10).

here been calling the core—a term I seem to have taken over from Joseph Sneed—points to the aspect of a scientific theory that I previously tried to cover with the better known of two distinct uses of the term paradigm. And the term periphery then points to the area in which people with a given core or paradigm conduct what I've for some years called normal or puzzle-solving research.{—Sort of change where growth clearly does occur.} We're thus back where I started some years ago, with one possible exception. **[10]** I'm not sure whether it should be described as a novelty or as a source of clarification, but this way of putting my points does indicate, far better than my old one, what I take the source of a paradigm's authority to be.{—Why people seem to get so locked into them.} It's not just the conservatism, the force of habit, a clinging to old idea—though those things go on. Nor is it the existence of a special authoritarian Establishment the members of which can determine and enforce the beliefs to which less prestigious members of the profession must adhere—though again phenomena of somewhat that sort can be observed. Nor is it even that the beliefs work, that they yield correct predictions—though that's obviously of tremendous importance to science, especially to bringing order in the periphery. Instead, what I want to point to is the manner in which the parts interlock and thus to the absence of options with respect to the individual elements in the core. To change a component of the core, one must change many others at the same time, produce a new and different core. If one does not see how to do that—and it isn't easy—one is stuck where one is, for to abandon a core or paradigm entirely is to abandon the conceptual underpinning required to do research at all. {For all of which there's a corollary. What must usually precede a change of core is not doubt about one or another particular component. Instead, it's a global sense that the whole system has gone wrong. CRISIS.}

Knowledge and Belief

Now, at last, I do come to the point where, as I warned you at the start, I'm going to reverse my field. Though I've risked giving the show away by distributing a bit of scripture in advance, I'm likely for some time to be heard as having embarked on a quite different lecture. Furthermore, given the limits of time usual on such occasions, I'm going to have to begin abruptly and move fast. That being the case, let me try to help by dropping a couple of clues in advance. Though I've recently used the term "belief" when speaking of the core, I'm persuaded that, in some sense I can't yet entirely make out, I've been speaking of knowledge. Trying to unpack that conviction, furthermore, is going to bring me back at the end to the question of my title: Does Knowledge 'Grow'? **[11]**.

What then is the difference between knowledge and belief?—under what circumstances may one properly claim to know something rather than simply to believe

it?[27] The question is not easy, and I can best indicate the difficulties involved by briefly presenting what's been the standard—though by no means the only—philosophical account of knowledge. On this view, knowledge is justified true belief. {Here,} "justified" {means that there must be evidence or good reasons behind a knowledge claim.}[28] {T}hough you may believe something that, in fact, happens to be true, you shouldn't claim to know it if you've acquired the belief by chance or for reasons that would not ordinarily supply any basis for conviction.[29] And "true" because of the following very important distinction between what one must say when a belief claim and a knowledge claim are defeated.[30] When something you once believed turns out to be false you say, "I used to believe that such and such, but I was wrong." But if you properly claimed to know something and it proved false, you have to say something like "I used to think I knew that, but I did not." In one case your mistake has been about "such and such", the object of belief; in the other it's been about what I'll gloss over as your relation to the object of belief.—You didn't really know it at all.[31]

Both those phenomena seem to me indubitable, and also very important. One must not claim to know something in the absence of good reasons. Also, one may not resort to phrase[s] like "I used to know, but…." Furthermore, the very strength of those criteria lends great plausibility to the definition of knowledge as justified true belief, plausibility to which I can't here even begin to do justice. In particular, there's no way in which I can here confront a series of recent elaborations of the doctrine, one by my much admired Princeton colleague Gilbert Harman.[32] Instead, I shall try briefly to suggest the area in which I think this standard doctrine confronts difficulties. And then, without even asking how those difficulties might be met

[27] In the 1980 version, the latter question reads as follows: "What extra am I trying to communicate if I say, 'I know such-and-such,' rather than saying simply that 'I believe it'?" (DKG-1980, 12).

[28] Except for "justified," the rest of the sentence is a handwritten addition. Initially, this part started with "'justified' because, though […]."

[29] In the margins, Kuhn annotated "Chinese fortune cookie … Flipped a coin, pulled petals from daisy." It was intended to be read here. In the 1980 version I am also considering here, Kuhn's paragraph at this point was, in full: "Here, 'justified' means backed by adequate evidence. You may, that is, believe something for any reason at all: by chance, a dream, the message in a Chinese fortune cookie, or the number of petals on a daisy." He also added a new paragraph below, which completes the previous one similarly to the one in the 1976 version: "But if one of these was the source of your belief, then you may not properly claim knowledge. Knowledge claims must be backed by evidence that would normally supply basis for conviction." See DKG-1980, 12.

[30] The sentences from "{Here}" up to this point were slightly different in the 1980 version, though Kuhn expounded the same ideas.

[31] The end of this paragraph is different in the 1980 version. Kuhn wrote: "in the other it was about your state of mind; you did not really know 'such-and-such' at all" (DKG-1980, 12).

[32] In the 1980 version, Kuhn was much briefer; from "Furthermore" up to this point, he only wrote: "The doctrine that takes knowledge to be justified true belief seems to me entirely right as far as it goes." And goes on: "What follows is not criticism, much less rejection" (DKG-1980, 12). The reference to Harman is avoided.

within the standard view, provide you with a sketch of an alternate approach suggested by the work of Austin and Wittgenstein.[33] **[12]**

My difficulty with the standard doctrine has been that it's ultimately unilluminating, or too little illuminating, with respect to the difference between the circumstances under which one may properly make a belief and a knowledge claim. {That is: we do make both belief and knowledge statements. In childhood we sometimes make mistakes, get corrected, thereafter get it right. What have we learned?} The trouble appears clearly in a standard example used to show that knowledge and belief claims can attach to the same object or situation. Half an hour ago I believed I had left my raincoat in the garage; now I know that I did. Presumably the situation which creates that remark was somewhat as follows. Half an hour ago I missed my raincoat and wracked my brain to think where I'd left it. I remembered that I'd had it on when I entered the garage, and that I'd taken it off before checking the air in my tires. [I c]an't remember that I put it on again before driving off. So I believe I left it there. On the basis of that belief I go to the garage, and there's my coat. Now I know I left it there.

Here the difference between the two claims seems to hinge on the amount of evidence or on the nature of the evidence: Incomplete recollections of my previous itinerary vs. finding my coat with my gloves in the pocket, and so on. But where along the continuum of degree[s] of evidential support does the transition from knowledge to belief occur[?] Could more secure memories have justified a knowledge claim? Or, for that matter, was I really right to say "now I know that I did" when I walked into the garage and found my coat? Perhaps it's just an imitation of my coat. Or perhaps someone stole my coat and then replaced it in the garage after hearing me say I was going to look there. {Should I have looked for evidence about these points[?]}[34]

Those difficulties seem to me real, and they'd probably be more apparent if they weren't disguised by the criterion which demands that, for a knowledge claim to stand, its object must be true. Truth may appear to provide the missing distinction between knowledge and belief. But since we can't ever tell—except perhaps in mathematics and direct reports of subjective observations—whether the object of a knowledge claim is in fact true, we're left as puzzled as ever about the nature of the circumstances under which we may appropriately claim knowledge. {We clearly do

[33] In the 1980 version there is no trace of the sentences since the last "Instead." The contents of the next few lines in that version are very similar—though differently written—to the beginning of the next paragraph in our text, including those that, in 1976, were handwritten (see the next sentences into curly brackets). The paragraph from the 1980 version that I quoted at length at the beginning of Section 4.1 of Chapter 15, above (i.e. the one that begins "Be clear […]"), was also part of those lines.

[34] In the 1980 version, Kuhn says something more: "I don't know how to answer, but that is not the primary difficulty. More fundamental is the strong intuition that people, all of whom use the knowledge/belief distinction in the same way, would give different answers to questions about the requisite amount of evidence. Somehow questions about strength of evidence seem almost besides the point" (DKG-1980, 13).

use the distinction without absolute assurance about truth.}[35] The notion of truth is being asked to bear inappropriate weight. It can't, that is, be the cue that tells us whether to say "know" or "believe."[36] **[13]**

A first clue to the route out of this still insufficiently examined morass is provided, I think, by a remark due to Ludwig Wittgenstein. He'd been considering a number of examples of knowledge claims, most of them provided by the philosopher G. E. Moore. And one of them {is} of particular utility since it strengthens the problems I've just been examining. Moore, emulating Sam Johnson with the stone, has said "I KNOW THAT'S A HAND.["] Surely the evidence is overwhelming, but still it could go wrong. Perhaps Moore is dreaming, or perhaps it's a laser picture that he sees.[37] One begins to suspect that maybe evidence isn't quite the right word to use when what's involved is just looking and seeing, where there's no weighing of the basis for claims and counter-claims{, no act of judgment.}

What Wittgenstein says is: "The propositions presenting what Moore '<u>knows</u>' are all of such a kind that it is difficult to imagine <u>why</u> anyone should believe the contrary."[38] Note that what's here invoked is simply the difficulty, not the impossibility of imagining reasons for believing the contrary. {Also, more important, that difficulty is in picking a motive [or] a reason for trying to imagine.} And, in fact, even "difficulty" seems to me not quite the right word, for it's not always at all difficult to imagine reasons. I think one comes even closer if one substitu[t]es the term "perverse" so that the statement becomes: "The propositions presenting what Moore '<u>knows</u>' are all of such a kind that it would be perverse to try to imagine <u>why</u> anyone should believe the contrary."

I take Wittgenstein's point (or perhaps by now it's mine) to be somewhat as follows. Of course, any of the things Moore claims to know could be false. But only under quite extraordinary, rather mind-boggling circumstances. In the absence of some reasons to suspect such circumstances, the weighing of evidence is simply not at issue—one can simply look and see. Indeed, if one couldn't ordinarily just look and see—if one had always to be thinking of other possibilities, weighing the evidence pro and con—then one would spend one's life in a perpetual state of paralysis, wondering whether one knew anything at all, and what sort of world one had been born into. One in which THAT'S not a hand and my raincoat isn't my raincoat. **[14]**

That step, suggested by Wittgenstein, seems to [me[39]] a first one. A second one, of rather greater importance, is made available, I think, by a remark of Austin's in his essay "Other Minds." It's familiar, but I think has seldom been taken sufficiently seriously. Autobiographically, it's the one that first opened this area to me,

[35] Originally, in the handwritten addition, after "without" there was "knowing…," but the word was crossed out and replaced by the new sentence ending.

[36] In the 1980 version, the lines since the last handwritten addition were replaced simply with: "But nevertheless we do make such claims correctly time after time" (DKG-1980, 14).

[37] There is a side handwritten annotation: "hologram". It's on the left margin, near this point.

[38] *OC*, §93.

[39] As in the 1980 version considered here.

persuading me very suddenly that the difference between knowledge and belief must be very deep and serious indeed. In his essay Austin emphasizes that in asking about a statement of belief we always say, "Why do you believe?", while in querying a knowledge claim we say "How do you know?"—Why do you believe?, vs., How do you know? Austin goes on to point out that the first question, {Why do you believe?},[40] is regularly answered {by} giving evidence or reasons, good or bad, to justify the belief. The question How do you know?, he continues, may be answered in the same way, by giving evidence, but it may also be answered, and often is, by giving what he calls credentials.[41] "My father was a well-known ornithologist, and he used to take his children on long weekend walks, teaching us to recognize the birds."

This second answer—the one in terms of credentials—is likely, I think, to prove the more basic. Though I'm by no means sure, the one in terms of evidence or reasons is likely to have been called forth by memories of how the speaker's father instructed him. Those are not inappropriate instructions to repeat when speaking to a non-bird watcher.[42] But whether that's right or not, the credentials answer is a standard and, under appropriate circumstances, a fully satisfactory one. When it is, then the answer in terms of credentials simply specifies a special sort of training, a special sort of initiation procedure, after which one is a member of a group which, under ordinary circumstances can simply recognize the standard birds on sight.

Two things about that point of view seem to me of special interest. The first—which is going to be of importance to my conclusion—is that it bridges the gap opened by the standard distinction between knowing that and knowing how. Knowing {how}[43] regularly refers to special skills: I know how to ride a bicycle, play the piano, make a duck à l'orange. {These questions are}[44] always answered in terms of credentials. My father taught me. I took lessons as a child. I've worked with a copy of Julia Childs. **[15]** Emphasis on the special nature of that answer has, in recent years, made it harder and harder to see why one should even use the same verb "to know," when answering questions about skills as one does when asked how one knows that the bird is a goldfinch. Austin brings the two uses of the term back together by pointing out that the answer to a question about "knowing that" is often simply the specification of the credentials, the special training, that permits one to know. {—to know on sight. Without judging, weighing evidence.}

The second thing that interests me about Austin's view is that {it} leads him quickly back to two p[oin]ts. I've just made in interpreting Wittgenstein. There are circumstances under which even the trained bird watcher will not know. The bird moved by too fast, or it was half hidden in the leaves. {There are reasons for doubt.}

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[40] Kuhn deletes here "How do you know?", which he had originally written here instead of the correct (first) question.

[41] Kuhn inserts an arrow signaling this point, which comes from the note: "Austin's example, 'There's a goldfinch.'"

[42] The last two sentences were erased in the 1980 version.

[43] Kuhn deletes "that" and overwrites "how".

[44] These words replace "It's."

Then he'll have to look at color, shape, whatever else he can see, and reach a judgment from the evidence about what the bird is likely to be. In which case, of course, he won't claim to know, but only to believe that it's a goldfinch. {On the other hand,} where knowledge is appropriately claimed, then matters of evidence and contemplation, and judgment are not quite what's involved. {One doesn't go through the requisite steps. It would be perverse to do so.}[45] But also notice, as Austin does, that knowing something doesn't make it so. Things can still go wrong.[46] But only in extraordinary ways. {Under circumstances it's hard to imagine.} Austin says: "If we have made sure it's a goldfinch, [...] and then in the future it does something outrageous (explodes, quotes Mrs. Woolf, or what not), we don't say we were wrong to say it was a goldfinch, we don't know what to say. Words literally fail us."[47]

Well, I think by now many of you will have seen where I'm heading, and I'm at last ready to take the step back to Aristotle myself, using as a bridge the passage from Wittgenstein that's been distributed to you in advance.[48] In fact, I've already used one bit of it, the lead sentence from the middle numbered paragraph, the one that points out the common characteristic of those things which Moore claims to know. Context is the one I gave before—a discussion of Moore's knowledge claims. But the claim at issue is not the hand before the face but Moore's knowledge that the earth had existed before his birth. I'm going to read the first and third paragraphs, and suggest that many of you will want to follow along. **[16]** The question being raised, as you'll rapidly see, is the following: What happens when two people from different cultures, with different backgrounds and therefore different credentials, meet?

Wittgenstein takes it up as follows:

> However, we can ask: May someone have telling ground[s] for believing that the earth has only existed for a short time, say since his own birth?—Suppose he has always been told that,—would he have any good reason to doubt it? Men have believed that they could make rain; why should not a king be brought up in the belief that the world began with him? And if Moore and this king were to meet and discuss, could Moore really prove his belief to be the right one? I do not say that Moore could not convert the king to his view, but it would be a conversion of a special kind; the king would be brought to look at the world in a different way.
>
> Remember that one is sometimes convinced of the correctness of a view by its simplicity or symmetry, i.e., these are what induce one to go over to this point of view. One then simply says something like: "That's how it must be."[49]

The next paragraph is the one I've already excerpted for you. It begins by pointing to the difficulty in imagining reasons to doubt knowledge claims, and closes:

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[45] This handwritten addition was preserved in the 1980 version, though "requisite" was replaced with "relevant." (See DKG-1980, 16.)

[46] In the 1980 version, Kuhn writes here: "Even when one knows, things can still go wrong" (DKG-1980, 16).

[47] Austin (1961, 88). In his quotation (in both the 1976 and the 1980 version), Kuhn does not include "and a real goldfinch," which is part of Austin's original text. I have signaled this omission with "[...]."

[48] Kuhn refers to a sheet with §§92–94 of *OC* extracted.

[49] *OC*, §92. This quotation is not a separate indented paragraph in Kuhn's original text.

"Everything that I have seen or heard gives me the conviction that no man has ever been far from the earth. [remember that this was written before the space program].[50] Nothing in my picture of the world speaks in favo[u]r of the opposite."[51] Then Wittgenstein continues: "But I did not get my picture of the world by satisfying myself of its correctness; nor do I have it because I am satisfied of its correctness. No: it is the inherited background against which I distinguish between true and false."[52]

Those passages seem to me to contain everything required to bring this long lecture to a close. When Wittgenstein {refers to}[53] "the inherited background against which I distinguish between true and false," he's speaking of what, following Austin, I've recently been calling "credentials{,}" {products of special initiation.} For Moore's example, "This is hand," the credentials are simply, I'm a human being and a native speaker of English. For Austin's birdwatcher, they're childhood walks with his ornithologist father. For a solid state physicist, they're another special sort of initiation and training. **[17]** But the processes which supply such credentials seem to me very similar—and in their results almost identical—with those that initiate someone into the worldview of the Aristotelian physicist or into any later worldview, including the partial worldviews of groups of specialists. Here one has what I called the core, a set of parts constituting a whole which is acquired altogether, not built up piecemeal out of parts each of which one inspects for its correctness. It is just this core which, by virtue of the way its pieces interlock, become difficult to imagine reasons to doubt.[54] And it is also this core which provides the background essential for the discussion of problems in the periphery, for the evaluation of arguments and of evidence for particular beliefs in the region where the core allows choice, room for growth, a variety of possible alternatives.

Thus, very roughly speaking—this part I'm sure is not yet quite right—I'd describe the core as the region of knowledge claims, those it's difficult to doubt, those to which evidence and its evaluation are not quite relevant. The periphery then becomes the region of beliefs, the area in which sound opinion demands the consideration of alternatives and of the weight of evidence favoring each. In Wittgenstein's phrase, the core is "the inherited background against which I distinguish between true and false"[55] by the evaluation of evidence.

But if this way of linking the second part of my lecture to the first has any appeal at all, then Wittgenstein's first paragraph will carry us further. There his issue is the transition from one sort of inherited background, one set of credentials, one core to

[50] Square brackets are Kuhn's. They are part of the original typewritten text. I have left that sentence as it was originally written.

[51] *OC*, §93.

[52] *OC*, §94.

[53] The full beginning of the sentence was originally: "What Wittgenstein calls," instead of "When Wittgenstein refers to." The former one was modified: the first and third word were replaced.

[54] In 1980, Kuhn inserts here: "It's part of the background with respect to which reasons are specified" (DKG-1980, 18).

[55] *OC*, §94.

another. And many of you will already have recognized that the points Wittgenstein makes about {it} are—as near as makes any difference—identical with those I've tried to make, against much resistance, about paradigm change. Moore cannot hope to prove his point to the king, but he may be able to persuade him. If he succeeds what results will be a conversion of a special sort. What may help to bring it about is not so much sensory evidence as aesthetic factors like symmetry and simplicity. And when conversion occurs, if it does, it will happen all at once. The king will suddenly say, "That's how it must be," after which he "will look at the world in a different way."[56] Even the terms are identical, and the translation is not mine but Anscombe's and von Wright's.[57] **[18]**

Does Knowledge 'Grow'?

And now at last I am ready to conclude, and I shall do so by reverting to the question raised in my title: "Does knowledge 'grow'?" That's a question I've spoken to before, so I would like to be brief. And fortunately, the distinctions developed in this lecture will permit me to be so. If by "knowledge" we mean knowing how—if, that is, we take a purely instrumental view of knowledge—then knowledge clearly does grow. We know how to do many things that Newton and his contemporaries could not do, and they knew how to do many things that the Greeks could not. On the other hand, if we mean by "knowledge" the more usual "knowledge that": That stones fall because their natural qualities are fully realized at the center, or instead that they fall because of gravitational attraction to the earth, or, still instead, that they fall because their path is a geodesic in {4-d} curved space{time.} If that's the sense of "knowledge" that we have in mind, then I think the answer must be that it does not grow. Surely there is a change. But I see no evidence at all of growth or even of some asymptotic approach to a final state.

One can therefore argue for either a yes or a no answer to the question: Does knowledge 'grow'? Some of you will, I suspect, find one more appealing, others the other. But if you do choose either one, I think you'll be making a mistake. I've already suggested that "knowing how" and "knowing that" are inextricably connected. That being so, I would myself conclude that the question is badly formed. Or, perhaps, to use a currently fashionable term from hermeneutics, that we have here an aporia.[58] **[19]**

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[56] *OC*, §92. Kuhn's second quotation is not exact, as is evident. The "will" is not in Wittgenstein's text.

[57] This latter sentence was deleted in 1980.

[58] This last sentence was deleted in the 1980 version.

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