

“OUTFOXING NATURE”: MATTHEW LIPMAN AND THE PROLEGOMENA TO A PEDAGOGY OF
SCIENCE

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Abstract:

This paper explores the role that the idea of science plays within Matthew Lipman’s approach to inquiry. On the one hand it seems that Lipman shares a typically modern ‘antagonist-metascientific’ view of philosophy (in a quasi Arendtian-Kantian way) in opposing the scientific undertaking and philosophical inquiry. On the other hand, he models his idea of community of philosophical inquiry on the Peircean-Deweyan theoretical construct of community of inquiry which refers exactly to the scientific undertaking. And – what is still more significant – it is just by capitalizing on the “scientific” origin of the construct that Lipman can revive the Socratic tradition of philosophy as a dialogic practice. But Lipman’s relationship with science is still more complex: he identifies science as a project of “outfoxing and outguessing nature.” By tracing the origin of such metaphors to the Heraclitean dictum “nature loves to hide” (*physis kryptesthai philei*) and to Francis Bacon’s interpretation of ancient myths, and by contrasting them with the Kuhnian idea of normal science as puzzle-solving, it becomes clear that Lipman recognizes the “thoughtful” – that is, philosophical -- dimension of science, and the need for complex thinking within science itself as a basic dimension of its development. Against the backdrop of such analyses, the paper attempts to point to the possibility of a *pedagogy of science* in a Lipmanian vein.

Key-words: Community of inquiry; pedagogy of science; Matthew Lipman; philosophical practice; Peircean-Deweyan inquiry

“Engañando la naturaleza”: Matthew Lipman y los *Prolegomena* a una pedagogía de la ciencia

Resumen:

Este trabajo explora el papel que la idea de ciencia juega dentro de la aproximación lipmaniana de investigación. Por una parte parece que Lipman comparte una visión típicamente moderna “antagonista-metascientífica” de la filosofía (de una manera casi Arendtiana y Kantiana) al oponer la tarea científica a la investigación filosófica. Por otra parte, él modela su idea de la comunidad de investigación filosófica a partir de la construcción teórica Peircean-Deweyan de la comunidad de investigación que se refiere exactamente a la empresa científica. Y - lo que es aún más significativo - sólo al capitalizar el origen “científico” de su construcción Lipman puede restablecer la tradición socrática de la filosofía como práctica dialógica. Pero la relación de Lipman con la ciencia es aún más compleja: él identifica la ciencia como el proyecto de “engañar y acertar más que la naturaleza.” Remontando el origen de tales metáforas a la sentencia Heraclítea según la cual la “naturaleza ama ocultarse” (*physis kryptesthai philei*) y a la interpretación de Francis Bacon de los mitos antiguos, y después de contrastarla con la idea Kuhniana de la ciencia normal como solución de problemas, resulta claro que Lipman reconoce el carácter “pensativo” - es decir, filosófico -- de la ciencia, y la necesidad del pensamiento complejo dentro de la propia ciencia como una dimensión básica de su desarrollo. Contra el telón de fondo de tales análisis, este trabajo intenta señalar la posibilidad de una *pedagogía de la ciencia* en una vena Lipmaniana.

Palabras clave: Comunidad de investigación; pedagogía de la ciencia; Matthew Lipman; práctica filosófica; Investigación Peirceana-Deweyana

“Enganando a natureza”: Matthew Lipman e os *Prolegomena* para uma Pedagogia da Ciência

Resumo:

Este artigo explora o papel que a idéia de ciência joga dentro da aproximação lipmaniana de investigação. De um lado, parece que Lipman compartilha uma visão tipicamente moderna de uma visão “antagonista-metacientífica” da filosofia (de uma maneira quase Arendtiana ou Kantiana), opondo o trabalho científico à investigação filosófica. Por outro lado, ele modela sua idéia de comunidade de investigação filosófica baseado na construção teórica “Peirceana-Deweyana” de comunidade de investigação, a qual se refere exatamente ao trabalho científico. E – o que é ainda mais significativo – é somente capitalizando a origem científica de sua construção que Lipman pode reestabelecer a tradição socrática da filosofia como prática dialógica. Contudo, a relação de Lipman com a ciência é ainda mais complexa: ele compreende ciência como um projeto de “enganação e superação da natureza”. Remontando a origem dessa metáfora ao dito de Heráclito “a natureza ama se esconder” (*physis kryptesthai philei*) e da interpretação de Francis Bacon dos mitos antigos, e confrontando-as à idéia kuni-ana de ciência normal como resolução de problemas, torna-se claro que Lipman reconhece o caráter “reflexivo” – isto é, o filosófico – da ciência e a necessidade de um pensamento complexo na própria ciência como uma dimensão básica para seu desenvolvimento. Contra o plano de fundo dessas análises, este artigo aponta para a possibilidade de uma *pedagogia da ciência* na vertente lipmaniana.

Palavras-chave: comunidade de investigação; pedagogia da ciência; Matthew Lipman; prática filosófica; Peirce; Dewey

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A spectre haunts Matthew Lipman’s work: the spectre of science. This haunting is manifest in two major dimensions of his thought. First, he insists on the Deweyan educational legacy, averring that his primary intellectual mentor “had no doubt that what should be happening in the classroom is thinking – and independent, imaginative, resourceful thinking, at that. The route he proposed – and here some of his followers part company with him – is that the educational process in the classroom should take as its model the process of scientific inquiry” [LIPMAN 1991: 15]. Secondly, he draws his pedagogical framework from Charles Saunders Peirce’s notion of the “community of inquiry,” which has become the architrave of the practice of philosophy in the classroom:

As far as my own history with the term community of inquiry, I attribute its beginning completely to Justus Buchler. [...] He mentioned the term and of course attributed it to Peirce, in a book of his that I read in 1959 or thereabouts. I told him that I liked it, and he said that for Peirce it was just a working phrase, it was not developed. I said to Justus, this is a term that represents something we need very much. [...] I was delighted at the recognition that [Ann Sharp] was able to give to the term, although I wasn’t as thrilled with it as she was. She was saying that this was just what we need – a working cooperative model of education that combines pragmatism with the thinking of all the people who were working to open a new approach to philosophy. [KENNEDY 2010: 15-6].

As is well known, in Peirce the phrase refers to the community of scientists who are engaged in an ever-lasting, fallibilist and experimental inquiry which – in the long run – will culminate in truth exactly by virtue of the mutual criticism and testing that scientists exert on their theories, and of the free discussion to which they are committed. It is remarkable that in shaping his educational proposal, Lipman appeals to concepts and ideas imbued by an emphasis on science.

At the same time, however, Lipman endeavours to defuse the importance of science: first, the recognition of his debt to Dewey runs parallel to a weakening of the

meaning of the scientific model in interpreting inquiry and to a criticism of the too science-oriented interpretations of Dewey's legacy:

[...] Dewey's constant encouragement of the child's engagement in independent reflection about all dimensions of experience was not maintained by his followers. Dewey's superb grasp of the possibilities of education became limited solely to the inquiry method, which was seen as a rational technique for problem-solving to be applied to the manageable areas of human life. This almost by definition excluded philosophical concerns, and metaphysical and epistemological issues were ignored. The formulation and resolution of problematic situations was proposed as the only valid paradigm for exploring and understanding the world [LIPMAN & SHARP 1994: 4-5].

By contrast, what Lipman highlights is that there is a "Deweyan way of going beyond Dewey" [STRIANO 2002], which consists in mobilizing philosophy as an educational tool. It is a Deweyan way because Dewey, who had defined philosophy as a "general theory of education" [DEWEY 1916: 338], had it "under his very nose"; it is a form of going *beyond* Dewey because Dewey, sticking to the idea of science as an exemplary kind of reflective thinking, neglected the educational potential of philosophical inquiry.

Secondly, Lipman wants to loosen and 'curb' the link between the notion of "community of inquiry" and scientific practice:

Since Peirce, however, the phrase has been broadened to include any kind of inquiry, *whether scientific or nonscientific*. Thus, we can now speak of "converting the classroom into a community of inquiry," in which students listen to one other with respect, build on one another's ideas, challenge one another to supply reasons for otherwise unsupported opinions, assist each other in drawing inferences from what has been said, and seek to identify one other's assumptions [LIPMAN 1991: 15. Italics added.].

Both on the Deweyan and on the Peircean front, then, Lipman succeeds in 'desciencizing' the idea of inquiry, which, in his pragmatist forebears, is clearly interwoven with the primacy of science as the chief form of reflective and critical thinking. In this sense, science is a sort of spectre in the Lipmanian theoretical device, an element which once (in Peirce and Dewey) used to have a substantial reality, but is now reduced to mere apparition, remote echo, philological remnant (Lipman never

passed over the “scientific tenor” of Deweyan and Peircean concepts in silence). Something of such a previous reality reverberates in Lipman’s notions, but in the reframing that he gives to the idea of (community of) inquiry he tries to cancel the traces of its earlier status and to credit it with a new existence. The emergence of the community of *philosophical* inquiry is realized through an emphasis on the special status of philosophy as a way of educating thinking, and through a quite classical view of philosophy as distinct from, if not opposed to, science. While in Pierce the practice of scientific discussion is the life of a community of inquiry, and in Dewey philosophy and science, different as they are [Oliverio 2010], are two forms of reflective thinking, in Lipman philosophy seems to rank above science, as indeed above any other specific domain of culture (and in fact, there could be a philosophy of science, of religion, of art etc.). Any remnant is also a *revenant*, however--what has been repressed returns--and, as we will see, science asserts its rights as a form of thinking when Lipman focuses on science education.

After depicting what seems to be a characteristic oscillation in Lipman’s position due to the spectral dynamics briefly exposed (a dynamics of ‘cancelling’ and haunting), what I want point out is the parallelism between scientific thinking and complex thinking, between the community of scientific inquiry and the community of philosophical inquiry, to the point that we should perhaps speak of an educational philosophy of science or *pedagogy of science* instead of the *philosophy of science* that dominated epistemological discourse in the 20th century. In a way, what is here proposed is to move *with Lipman beyond Lipman*: with Lipman (that is, operating on scientific thinking in a way analogous to how he operated on philosophy) but beyond him (that is, overcoming some hesitation of Lipman as to his consideration of science, and valorizing his insights through a sort of exegetical bending).

The pillar of Lipman’s educational project is the connection between education and meaning:

The relationship between education and meaning should be considered inviolable. Wherever meaning accrues, there is education. [...] Meanings cannot be dispensed. They cannot be given or handed out to children. Meanings must be acquired; they are *capta*, not data. We have to learn how to establish the conditions and opportunities that will enable children, with their natural curiosity and appetite for meaning, to seize upon

the appropriate clues and make sense of things themselves. [...] Something must be done to enable children to acquire meaning for themselves. They will not acquire such meaning merely by learning the contents of adult knowledge. They must be taught to think and, in particular, to think for themselves. Thinking is the skill *par excellence* that enables us to acquire meanings [LIPMAN *et al.* 1980: 12-3].

Lipman distinguishes in a canonical way between literal, symbolic and philosophical interpretations. Literal interpretations are provided by science, which furnishes us with explanations. Explanations are concerned with the establishing of causal connections that link phenomena with each other. These kinds of meanings are called “literal” by Lipman because, we can surmise, they remain connected to the level of evidence, of the ascertainable facts. Philosophical interpretations are, on the contrary, beyond factuality:

Suppose you ask your children what the distance is between your home and the grocery store at which you shop. Since you have asked a very specific question, you expect a very specific answer – such as “a quarter-mile”, or “six blocks.” But to your surprise, they ask you “What is distance? Not a philosophical question – to be exact, a metaphysical question [LIPMAN *et al.* 1980: 37].

Examples like this are commonplace in the philosophical literature, and constitute the most inveterate move in modernity to defend the rights of philosophy against the assault of science. Philosophy would be the domain of a radical questioning that goes beyond the knowledge offered by science. We can call it the ‘antagonist-metascientific’ view of philosophy: risking being a loser in the struggle (*agon*) for epistemic prestige, philosophy defines itself against (*anti*) the backdrop of science as that which is beyond (*meta*) it and, in overcoming it, not only poses the questions neglected by science, but also those questions without which scientific investigation itself would make no sense (this is the fatal conceit of such a position). This view risks opening up an unbridgeable chasm between science and philosophy, severing their essential bond, which instead seemed to have been confirmed by the great revolutions in scientific theory at the beginning of the 20th century. For example, the theory of relativity is closely interrelated with the ‘philosophical’ criticism of Newtonian ab-

solite time and space by Ernst Mach. Or, again, is it possible to reflect on what being a cause means without taking into account the indeterminism introduced into physics by quantum mechanics? Issues such as time, space, cause, knowledge, the role of the subject and so on are neither only philosophical nor only scientific but they are at the crossroads of the disciplinary fields called “philosophy” and “science.” At its most speculative – and therefore innovative, creative, ‘paradigm-breaking’ – level the distinction between science and philosophy is perhaps more a matter of cultural-sociological membership than of a kind of thinking.

We have to move, however, on the razor’s edge and to avoid a double mistake: first, that of sinking into the Hegelian night where all cows are black, that is, into the in-difference of philosophy and science. Indeed, close as their bonds are, philosophy and science may manifest a different “intentionality.” That is clear at the extremes: in scientific investigations addressing more empirical issues, the level of philosophical reflection is of course reduced. In philosophical inquiries concerning, for instance, the role of science within the totality of human culture or the ethical dimensions of scientific activity, reflection is more *about* scientific investigation per se than intertwined with it. But the recognition of this different intentionality of science and philosophy should not plunge us into the second mistake--that of building walls between them. The latter can take various forms: let us pick out the “positivist” and the “Kantian-Arendtian” as emblematic instances of two opposed kinds.

In positivist theory, meaningfulness belongs exclusively to scientific discourses, whereas philosophy is a sort of monster that tries to combine the epistemic impulse of science with the meaningless (i.e. destitute of any empirical testability) language of arts. In Lipmanian terms, we can say that on the positivist account there are only two legitimate forms of discourse: the scientific one, which aims at knowledge and is concerned with literal explanations, and the artistic one, which expresses the feeling of life through symbolic interpretations but does not aim at producing knowledge. Philosophy is that chimera which pretends to know reality but – as it uses meaningless terms – confines itself to expressing life-feelings, which are better conveyed by the symbolic interpretations of art. As a consequence, in the memorable words of Carnap [1932: 241], philosophers are “musicians without musical talent.”

The separating line is no less strict in the Kantian-Arendtian approach, although here full appreciation is awarded to philosophy, which in a way is a nobler activity. For Hannah Arendt [1978] (scientific) knowledge, which uses thinking as a means in view of an end, is distinguished from the activity of thinking *stricto sensu*, which arises, in Kant's words, from the nature of our reason, and is an end in itself. Knowledge, as Arendt-in-the-wake-of-Kant puts it, is concerned with truth (and therefore with mistakes and deception); thinking, on the contrary, is concerned with meaning and meaninglessness. Knowledge deals with what Arendt calls the world of appearances, of things known by perception; by contrast, thinking withdraws from the world of phenomena and of common sense. The consequence is that within this approach, thinking is a solitary activity occurring in the mind of the individual. If we accept this view and draw all the consequences, it follows that a community of philosophical inquiry is not possible. The idea of a process of co-thinking in space (the setting in the circle of the CoPI) and time is possible for knowledge (science) but not for "pure," "philosophical" thinking. As such, the very possibility of the CoPI is connected with an idea of philosophy that is distinct from the Kantian-Arendtian view, and which the "scientific"-Peircean origin keeps on inhabiting in the CoPI. Science as a spectre continues to haunt the CoPI and makes it possible, whereas philosophical thinking as an end in itself and as the unfolding of the nature of our reason would condemn us to perpetuate philosophy as the private practice of thinkers sunk in their own minds.

Lipman had the genius to revive the Socratic tradition of philosophy as a dialogic practice:

Nevertheless, *applying* philosophy and *doing* it are not identical. The paradigm of doing philosophy is the towering, solitary figure of Socrates, for whom philosophy was neither an acquisition nor a profession but a way of life. What Socrates models for us is not philosophy known or philosophy applied but philosophy *practiced*. He challenges us to acknowledge that philosophy as deed, as form of life, is something that any of us can emulate [LIPMAN 1988: 12].

He did it, however, not as the coeval works of Pierre Hadot did, in a scholarly way, but with an educational aim, and by devising together with Ann Sharp an educational procedure designed to actually realize that practice in the classroom. Now,

that has been possible – this is the first hypothesis I want to advance – not despite the scientific background of the notion of community of inquiry but thanks to it. In other words, although Lipman seems not to share the view of Peirce and Dewey as to the exemplarity of scientific thinking as a form of second-order, reflective and critical thinking, and seems rather to draw a line between philosophical inquiry and scientific investigation, he can realize philosophy as a communal and distributed practice of inquiry exactly by trading on the possibilities offered by the (science-oriented) notion of community of inquiry.

Indeed, it has been modern science – as Dewey [1929] made clear – that broke with the spectator attitude typical of western philosophy; that is, with what we can define as the “academization” of philosophizing. I mean “academization” in a quite literal sense: I am referring not so much to the process of the transformation of philosophy into an academic discipline during the Middle Ages [HADOT 1995] as to the epoch-making transfiguration to which Plato exposes the Socratic legacy by founding the Academy. As Peter Sloterdijk has recently pointed out, Plato’s great insight was that “the absences of his teacher, Socrates, did not have to take place in the hallways and in the public squares any more, where every passer-by might poke fun at him.” For this reason, Plato set out to invent a place appropriate for

the precarious condition of the complete devotion to thought. [...] the original Academy is nothing else than a space-creative innovation: it represents a brand new institution for the lodging of those absences which can arise upon the quest for the – still widely unknown – connection of the ideas between each other, and – why not – upon the study of the connection of words and things, which can only be problematic, if one thinks of it. The Academy is the architectural equivalent for what Husserl characterized as *epoché* – an abode for neutralizing the world and for bracketing cares, a shelter for those enigmatic guests, which we call ideas or theorems [SLOTERDIJK 2011: 56].

The Academy is the “objective correlative,” to use T.S. Eliot’s formula in another way, not of Socrates engaging in dialogues in the streets and squares of Athens, but of Socrates absorbed in meditation; not of Socrates as an educator, therefore, but of Socrates as the paradigm of the autarchic *sophós*; not of the cooperatively inquiring [DEWEY 1929/1930: 155] Socrates, but of Socrates as the quintessence and embodiment of wisdom. The former Socrates is really the philosopher, the one who is be-

tween wisdom/knowledge and ignorance and occupies therefore the middle-mediating-daimonic place of Eros [Hadot 1995; Garrison 1997]; the latter Socrates is the anticipation of the philosopher as a Truth-dispenser, who is enabled to do that because he views the ideas as eternal paradigms in a movement of spectatorial, theoretical (after *theorein*, to gaze upon, to behold) withdrawal from the world and from existence with others, a movement that culminates in dwelling in the sphere of Meanings.

What is at stake is not so much the difference between applying and doing philosophy as (see the passage from Lipman, above) a way of *practicing* philosophy. The academic way of doing philosophy occurs in the thinker's mind, is a private "experience," is what Plato describes in his Seventh Letter [341b-341c]: the thinker is alone with his *pragma*, with the object of his theorizing--he lives and is with it [*all'ek pollês sunousías gignoménes perì to prâgma autò kai toû suzên*] not with his fellow inquirers, and his mind feeds on itself [*autò heautò éde trépheî*]; doing philosophy in the CoPI is a cooperative inquiry and in this sense a matter of critically discussing, of producing arguments to support one's own views, of assessing exhibited reasons etc, which characterizes science as a collective enterprise and not as a lone activity. Philosophizing within a CoPI is a contextualized practice, which does not appeal to the spectator attitude but to the capacity for deconstructing and reconstructing concepts as they are produced in a critical dialogue committed to pursuing an inquiry. This is the Peircean-Deweyan (and therefore "scientific") element that Lipman keeps in his educational apparatus, and through which he can revive the Socratic tradition apart from any "academization."

To be sure, in Lipman's rejection of any purely spectator attitude the emphasis is not laid, (as it is in Dewey) on the actual transformation of reality as it occurs in scientific experimentation, where ideas are plans of action. But thinking in a CoPI is not just playing with ideas either, away from the world of appearances and of co-existence with others: in the CoPI, thinking is constantly connected to and rooted in the experience of subjects. Thinking in a CoPI is not staying *nowhere* (as in Arendt) or *elsewhere* (as in Sloterdijk) – rather, it is staying with others in a space and in a time

devoted to cooperative inquiry: that is the legacy – unaware as Lipman may be of it – of the Peircean-Deweyan stress on science as a model of inquiry.

The first point I wanted to make is that the CoPI is possible as far as the spectre of science (as a collaborative enterprise) haunts it and that, therefore, the link between science and philosophy is more structural than Lipman’s distinction between the literal meanings of scientific explanation and the metaphysical meanings of philosophical investigation might lead us to believe. As such, there is something “unthought-of” in Lipman that goes beyond what at first sight might appear as a quite canonical “antagonistic-metascientific” view of philosophy (of course in the Kantian-Arendtian version, not in the Carnapian-positivist one).

Sed contra: is not presenting Lipman as opening up a chasm between science and philosophy a caricature of his theories? It is true that in distinguishing between literal and metaphysical interpretations Lipman seems to join in the modern ‘antagonistic-metascientific’ view of philosophy. Many affinities can be detected between his and the Arendtian approach, according to which science concerns *truth* (that is, the adequate description of how the world is and of the causes that link phenomena with each other) and philosophy concerns *meaning*, with the danger of relegating science to a sort of a-philosophical status. However, when Lipman tackles issues regarding science education, a different pattern emerges. I quote at length:

In recent years, the notion has become familiar in educational circles that for students merely to learn the outcomes of classical scientific inquires does not ensure that their scientific education has been successful. Success would occur only if students had been taught to *think scientifically*. But what does this mean, *to think scientifically*? In its most essential aspect, it means to ask oneself the kinds of questions scientists ask themselves, to be alert to the problematic aspects of one's experience the way scientists are, to reflect self-critically about one's own procedures the way scientists do, and to find it of value not just to one's thinking but to one's life that if a distinction needs to be drawn, it becomes urgent that one draw it, and if a connection needs to be drawn, it becomes urgent that one make it. On the other hand, one is not thinking scientifically when one encounters a discrepant case and is not perplexed by it, or when one fails to realize how one's own reflections as a scientist are in fact internalizations of the conversations one has had and might have with one's colleagues in the scientific community [LIPMAN 1988: 88-9].

There is in this passage more than the mere repetition of the idea that science education should deal more with the process of scientific inquiry than with the mere products of it. In other words, it is limiting to read it only as the re-proposition of the general suggestion (in this case applied to science) according to which in order to attain educational goals it is advisable for teachers to encourage thinking in students, to introduce them to the theoretical devices of a discipline, to provide them with the epistemological keys for entering a sector of knowledge, and not just to dish up ready-made results, formulae, terms, theorems etc.. Something more seems to echo in the passage; in fact the description of what thinking scientifically means is coextensive with what might be a good depiction of (most of the features of) philosophical thinking. And the reference to reflection as a form of the internalization of conversations might be used as an adequate representation of what happens in the CoPI. As a consequence, at least implicitly, scientific thinking parallels philosophical thinking. So a question can be raised: what does it mean “to think” in science, and what relationship does this kind of thinking have with philosophical thinking? The continuation of Lipman’s passage is revealing:

Just as the most successful hunters are those who can surmise the ways of their quarry and, when the quarry hides, have a hunch where it hides, so the most successful scientists are those who can outfox, outguess nature, and have a hunch where it hides when it does so. They learn to think how nature works [...]. Likewise, the student must think how the scientist works and must think how the scientist thinks [LIPMAN 1988: 88-9].

Many themes are interwoven here. It is interesting to note how the recognition of scientific thinking by Lipman occurs in a text dominated by the ancient-Heraclitean idea that *nature has the tendency to hide* [*physis kryptesthai philei*]. Indeed, there is a plexus of suggestions in the few quoted words. As Hadot [2004] has pointed out, the Heraclitus sentence did not originally carry the meaning it acquired only after the death of the thinker from Ephesus--first with the process of the generalization and abstraction of the concept of *physis* (nature) carried out by the Sophists, Plato and Aristotle, and later with the creation in the Hellenistic and Roman world of the idea of the “secrets of Nature.” This notion assumes, Hadot notes, an opposition between the visible--that is, what appears, the phenomenon--and the invisible, what

is hidden behind this appearance. Nature itself becomes the big mystery because, on the one hand, it manifests itself in a rich and multiform display of visible qualities but on the other hand it withdraws from the appearances, and has to be investigated in order to find its secrets [HADOT 2004, ch. III, §§ 3-4]. Modern scientific thinking is elaborated on this idea of the secrets of Nature, and all experimental science can be interpreted as a way of drawing them out. One of the champions of early modernity, Francis Bacon, explicitly connects the “secrets of Nature” theme to that of hunting. In interpreting the myth of Pan in his treatise *On the Wisdom of the Ancients* he writes:

This, if any be, is a noble tale, being laid out and big bellied with the secrets and mysteries of nature. Pan, as the name imports, represents and lays open all the things or nature. [...] The office of Pan can be by nothing so lively conceived and expressed, as by feigning him to be the god of hunters: for every natural action [...] is nothing else but a hunting. Arts and sciences have their work, and human counsels their ends, which they earnestly hunt after. [...] But forasmuch as it was Pan’s good fortune to find out Ceres as he was hunting, and thought little of it, which none of the other gods could do, though they did nothing else but seek her, and that very seriously, it gives us this true and grave admonition, that we expect not to receive things necessary for life and manners from philosophical abstraction, as from the greater gods, albeit they applied themselves to no other study, but from Pan: that is, from the discreet observation and experience, and the universal knowledge of the things of this world; whereby, oftentimes even by chance, and as it were going a hunting, such inventions are lighted upon [BACON 1842: 290-292].

William Eamon makes Bacon’s link between hunting and science clearer:

As a scientific methodology, Pan’s hunt proceeds from one experiment to another [...] in the same way a hunter tracks his prey deliberately, step by step, guided by footprints and signs. Bacon called this method “a sagacity and a kind of hunting by scent, rather than a science.” The experimental scientist is a hunter of the secrets of nature (*venator naturae*, according to Gassendi) whose “sagacity” and vast experience enables him to see things others cannot see. Instead of “groping in the dark,” he patiently reads the minute signs and clues that will lead him to his prey hiding in the dense thicket of experience. The advent of the hunt metaphor in the scientific discourse of the early modern period testifies to the emergence of a new conception of the aims and methods of science. Instead of viewing natural philosophy as a sort of hermeneutics, or textual analysis—“natural philosophy without nature,” as the late John Murdoch

aply characterized late-medieval physics—intellectuals of the early modern period tended to think of science as a search for new and unknown facts, or of causes concealed beneath nature’s outer appearances. [...]The repeated references to the hunt for the “secrets of nature” in the scientific literature of the seventeenth century should not be dismissed as mere rhetoric. Far from being a mere hackneyed metaphor, the continual appearance of that well-worn phrase indicates a subtle shift in the direction of natural philosophy [EAMON 1996: 283-4, 297].

It is significant that while in Bacon the hunt metaphor is chiefly related to the role of an active intervention in natural processes, Lipman refers it to scientific *thinking*. His stress is on “reasoning” rather than on the mere observation and experimentation. On the one hand, with the semantic constellation dominated by the hunt/secrets of Nature theme, Lipman establishes a connection with the dawning of modern science; on the other, with his stress on thinking, he avoids any inductivist or banally empiricist view of the hunt. Science is a cooperative enterprise of critical thinking in which a community of inquirers are reflectively involved in a confrontation with Nature, trying to trump it in terms of cunning and sagacity by building theories and explicative constructs. If Nature has the tendency to hide, thinking scientifically is a form of “decrypting nature”: the explanations are not, however, the mere deploying of literal interpretations but the sometimes highly speculative and creative invention of (empirically testable) explanatory conjectures.

In this sense, I do not think we have to interpret this “decrypting of nature,” the Lipmanian “outfoxing and outguessing”, as corresponding to a sort of Kuhnian puzzle-solving. On the contrary, the puzzle metaphor seems to go the opposite way in comparison with the hunt theme in Lipman, as I propose reading him. In Thomas Kuhn’s analysis, two major features of puzzles are highlighted:

1. Puzzles are, in the entirely standard meaning here employed, that special category of problems that can serve to test ingenuity or skill in solution. [...] It is no criterion of goodness in a puzzle that its outcome be intrinsically interesting or important. [...] Though intrinsic value is no criterion for a puzzle, the assured existence of a solution is [KUHN 1970/1996: 36-7].
2. If it is to classify as a puzzle, a problem must be characterized by more than an assured solution, There must also be rules that limit both the nature of acceptable solutions and the steps by which they are to be obtained [KUHN 1970/1996: 38].

The activity of puzzle-solving is not an “outguessing” or an “outfoxing” of nature, it is just the articulation of the paradigm--that is, of the “dogmatic framework” [KUHN 1963] within which normal science, as Kuhn calls it, happens. It is not a hunt (in the Lipmanian sense) and a confrontation with nature, but it is what J.J. Schwab defines as “stable research,” during which the community of scientists confines itself to the taken-for-granted domain of investigation and “to fill[ing] a particular blank in a growing body of language” [SCHWAB 1962, p. 15] and therefore does not behave in the self-critical and reflective way that Lipman indicates as exemplary of how scientists think (and that students should in their wake). In these phases of stable research the scientist *does not think*, does not reflect upon the principles which define and “sketch out” (to use a Heideggerian term) his field, but “[h]e receives them from the others and treats them as matters of fact. He uses them as means of enquiry and not as objects to be enquired into. The principles define his problem for him and guide the pattern of experiment which will solve it, but the principles are not treated as problems in themselves” [SCHWAB 1962: 16].

But stable research is not science *tout court* and it is not science as inquiry. In fact, Schwab points out that science is inquiry as far as “conceptions – principles – must be invented or adapted by the investigator in order to determine his subject matter and his data” [SCHWAB 1978: 133]. Scientific subject matters are not already there, they are “carved,” to use Feyerabend’s [2001] expression, from the “abundance of being” with the help of a set of concepts that identify an object to be investigated and so establish a domain of knowledge. At the same time and through the same move, methods and the perspective with which to conduct the investigation are devised:

Not only the *what* but the *what-about* are determined by inquiry. When our matter is made a subject by tearing it from context and forcing on it some conception of self-supporting unity and completeness, there is also a restriction of what to investigate about it. The effect of principles which make a material investigable at all by impressing on it an appearance of unity and completeness is complemented by further effects which determine the form our knowledge will take [SCHWAB 1978: 134-135].

Science as inquiry, as *fluid research*, is/includes, therefore, a kind of philosophical thinking. All the dimensions of Lipmanian complex thinking are involved: as

we have seen above, Lipman himself, describing how scientists think, recognizes that it is a form of self-critical reflection occurring in a continuous communication between the members of a community. Furthermore, it requires creativity and inventiveness: it is an old view of science that confines it to establishing causal connections and to providing literal interpretations. Much more is at stake: as Gerald Holton [1996] emphasized, art and science do not belong to far apart worlds, and logic, experimental ability and mathematics do not exhaust the scientific enterprise; if this were the case, a computer or a robot could realize original scientific research. Imagination is at work in science, metaphors and themes [Holton 1988] play a crucial role, and the stress on the solely evidence-based meaningfulness is a positivist heritage to be delivered to the “epistemological junk shop.” Finally, Michael Polanyi [1958] has drawn our attention to the scientific enterprise as a form of personal knowledge, animated by intellectual passions and by the need to perform acts of appreciation—for example, of the beauty and elegance of a theory, which are the criteria used by scientists to assess the value of conjecture in explaining some facts. As a consequence, not even caring thinking is alien to science [OLIVERIO 2009]. For all these reasons, scientific thinking as it occurs in science as inquiry/fluid research, is a form of complex thinking indeed, and science education in this sense is co-extensive with the education of complex thinking. It is understandable, therefore, why in the long passage quoted above Lipman describes the community of scientists in words transferable to his own notion community of philosophical inquiry.

When Lipman writes that the student must think in the way the scientist works and must think the way the scientist thinks, he shows that he has a much more refined understanding of what science is like than the reference to the mere “literal explanations” could induce us to believe. Lipman does not say that the student must *work* how the scientist works—he does not lay the stress solely on the phase of experimentation. Indeed, such a stress would risk offering an image of science as merely manipulative, “practical-empirical” in the derogatory sense of the word: classes in the laboratory are useless if they confine themselves to making students *tinker around*, as Richard Feynman puts it. For instance,

[t]o expect students to learn anything Newtonian by playing around with objects is to underestimate the epistemological

revolution inaugurated by Galileo and Newton; and also to underestimate the pedagogical problems in getting children to comprehend the classical scientific worldview. Galileo's conceptual scheme does not emerge by playing around with objects, it emerges by intellectual production using borrowed concepts, and learnt logical and mathematical techniques. There is an important educational role for “messing about”, as Hawkings has described it, for being acquainted with the phenomena, as Mach demanded, or for tinkering around, as Feynman has suggested, but this role is not that of producing in itself contemporary scientific concepts and understanding [MATTHEWS 1994: 133].

Even when scientists *work* (unless in the phases of stable research), (complex) thinking is appealed to and therefore if we, as educators, want to usher students into the world of science as inquiry we have to teach them to *think* scientifically. The recognition of this “thoughtful” dimension of scientific work corresponds to (and explains) the re-framing of the hunt theme which Lipman, as I suggest reading him, realizes: hunting not just as experimenting but as outfoxing, an exercise of thinking comparable to that required by philosophical inquiry.

A final hypothesis may be raised: could not the argument be led a step further (toward a utopia?) and the sentence “the student must think how the scientist works and must think how the scientist thinks” be read as a two-way statement to mean, not only from the scientist to the student, but also from the student to the scientist? In other words, not only should how the scientist works and thinks be a model for how students think, but also how students think in classrooms transformed into communities of philosophical-scientific inquiry could represent a model for scientists. As Karl Popper repeatedly insisted at the end of his intellectual career, one of the most momentous challenges to the contemporary scientific enterprise is to re-discover the courage to dare to conjecture, to practice “great science” (i.e. creative, innovative, paradigm-breaking) and not only “big science” (i.e. over-specialized, lingering over the study--thorough but ultimately sterile--of aspects increasingly remote from the great questions). In order to reach this goal, new generations of scientists should not be trained within the framework of knowledge supplied by manuals, as happens in “normal” science, but should be educated to *think* scientifically and therefore philosophically. That cannot happen through courses in philosophy of science that

tackle epistemological questions from without, in ways alien to real practice. What should be promoted is the (thinking) skill to recognize in scientific work a thoughtful dimension, which gets lost in training for operating in over-specialized contexts. In this sense, and by analogy, the classroom turned into a CoPI can be a model of science education for scientists, and a Lipmanian pedagogy of science could constitute a horizon of meaning for the scientific enterprise.

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