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Towards a Genealogy of Thomas Kuhn's Semantics

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This paper explores Thomas Kuhn's intellectual history by examining sources that have been understudied so far: the Lowell Lectures of 1951 (The Quest for Physical Theory) and the hitherto unpublished Notre Dame Lectures of 1980. The analysis of these texts aims to reconstruct Kuhn's development of a semantics that can account for scientific progress. This analysis will show that the alleged "linguistic turn" attributed to the author is actually a renewed interest in problems that existed well before publishing The Structure of Scientific Revolutions.

1. Introduction

Beyond the perennial success of *The Structure of Scientific Revolutions* (Kuhn 1962, henceforth *SSR*), the criticisms of the incommensurability thesis and the image of theoretical change presented therein motivated Kuhn to find a characterization of meaning that adapted to the dynamics of scientific revolutions. This led to a linguistic turn that characterizes the last stage of Kuhnian philosophy. In *SSR*, Kuhn tacitly adopts some premises of descriptivist theories of meaning and formulates the thesis of incommensurability without offering a clear notion of meaning or a precise distinction between change of meaning and change of reference. The search for an alternative semantic basis led him to delve deeper into the problems of the

Sadly, Dr. Pablo Melogno (1979–2023) died while this article was in press. We will remember him not only for the quality of his academic output but also for his human qualities. His dedication to the creation and consolidation of collaborative networks has made our academic community a better place.

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change of meaning and how classification criteria operate in the delimitation of natural kinds.

This paper attempts to reconstruct Thomas Kuhn's intellectual process in search of a semantics compatible with his philosophical and historical ideas on scientific change. This reconstruction is inspired by two works that have been understudied because of their unpublished nature. The first is *The Quest for Physical Theory*, a series of eight lectures that Kuhn delivered in 1951 at the Lowell Institute in Boston. The Lowell Lectures is the first extensive piece of writing in which Kuhn sought to organize his ideas on scientific language and change. They remained unpublished until a few months ago, when they saw the light of day thanks to George Reisch's edition (2021). Our examination focuses on lectures six, "Coherence and Scientific Vision"; seven, "The Role of Formalism"; and eight, "Canons of Constructive Research" as primary references.

As Hufbauer (2012) and Mayoral (2017) have pointed out, the Lowell Lectures includes elements that anticipate the *SSR* theses and others that represent Kuhn's earlier thought that is later modified. An essential feature of the text is that Kuhn explicitly discusses several problems linked to the meaning of scientific concepts, around which he traces well-defined circuits of debate and philosophical interlocution. In this respect, Reisch (2019) states that Kuhn defined his semantic interests by reading W. V. O. Quine, Bertrand Russell, Stuart Chase, and Benjamin Lee Whorf. As we shall see, this dismantles the idea that Kuhn wrote *SSR* without adequate philosophical training. It also shows that concerns about the change of meaning were already present in Kuhn's thought before *SSR*, even if they did not appear explicitly in his main work.

Second, we deal with *The Natures of Conceptual Change*, a series of lectures that Kuhn delivered between November 17 and 21, 1980, at the University of Notre Dame, Indiana. The text of the lectures is in the Special Collections Department of the Massachusetts Institute of Technology Library and remains unpublished until now.¹ It is divided into three lectures: "What are Scientific Revolutions," "Linguistic Concomitants of Revolutionary Change," and "Language, Causal Theory and Necessary Truth." Kuhn included material from these lectures in subsequently published works (1987, 1989). He also planned to do so in *Plurality of Worlds: An Evolutionary Theory of Scientific Development*, the unfinished book he was writing at the time of his death.

This paper focuses on the second lecture. We show that Kuhn reactivates some of the semantic concerns of the Lowell Lectures, appealing to

1. The pagination we use for bibliographic citations refers to the unpublished text found in the Kuhn Archives at MIT.

cluster-concept theory as the basis of scientific change. We also show that the Lowell and the Notre Dame Lectures respond to the same agenda of semantic concerns and problems linked to the change of meaning in scientific revolutions, an agenda that Kuhn set aside in *SSR* and then reactivated to address some of the issues raised in his main work. We also show that addressing these issues led Kuhn to introduce the notion of “taxonomy” and outline the basis of the linguistic turn that characterizes the final phase of his work.

It may be questionable to attempt the intertextual comparison of two texts written thirty years apart. Nevertheless, the multiple connections between the two texts, the continuity of approach and discussion strategy, and how they shed light on Kuhn’s intellectual development justify the comparison despite their temporal distance.

Section 2 analyzes the semantic proposal Kuhn presented in the Lowell Lectures, which prefigures an alternative to the linguistic foundations of logical positivism and Percy Bridgman’s operationalism. Section 3 states that Kuhn takes up this program adhering to a version of the cluster theory in the second Notre Dame Lecture and extends it with nuances until the Thalheimer Lectures of 1984. Section 4 shows that as part of this program, taxonomies appear in the second Notre Dame Lecture as a unit of analysis of theoretical change for the first time, thus initiating the linguistic orientation that characterizes the late Kuhn. We conclude that the introduction of taxonomic incommensurability and the linguistic frame of the late Kuhn results from abandoning cluster theory and the need to understand scientific change in a new semantic context. Therefore, we propose that Kuhn’s linguistic turn in his late work should be understood as renewing an interest that existed before *SSR* was published and not as venturing into an unexplored field.

2. In Search of the Roots of Kuhnian Semantics

Attempting to construct a genealogy of Kuhnian semantics implies challenging the idea that Kuhn underwent a linguistic turn in his maturity. In agreement with Reisch, it implies asserting that such a milestone in Kuhn’s intellectual development entails a return to his philosophical roots, which can be found in his Lowell Lectures:

It is sometimes remarked that in the wake of *Structure* Kuhn’s thinking took a “linguistic turn” toward semantics and away from the sociological and psychological themes within *Structure*. In light of *Quest*, however, this development appears more as a linguistic return to early theorizing about the semantics of “meaning systems” that Kuhn debuted here. (Reisch 2021, pp. ix–xx)

The idea we challenge arises because Kuhn's semantic intuitions are insufficiently developed in *SSR*, as is well known. This led several critics (e.g., Shapere 1964; Scheffler 1967; Davidson 1973; Sankey 1994; Bird 2000) to claim that Kuhn's concerns with semantic problems only arise from the repercussions of his major work. In these terms, *SSR* would have been written without a systematic framework on the issues of meaning, a framework that Kuhn only began to develop because of the subsequent difficulties. However, we argue that this diagnosis is incorrect since examination of the Lowell Lectures reveals that several debates about the meaning of scientific terms were part of Kuhn's working horizon well before *SSR*.

SSR does not provide a systematic notion of meaning and meaning change. As we point out below, Kuhn's concerns about the meaning of scientific terms in the Lowell Lectures and Notre Dame Lectures are much more explicit and systematic than in his main work. However, this does not imply that semantic considerations are utterly absent from *SSR*². This section provides an overview of the lectures, emphasizing some features in favor of this reading. In *The Quest for Physical Theory*, the seed that gave rise to *SSR* can be glimpsed since the young Kuhn overturns a series of ideas and intuitions that will follow him for the rest of his career. However, Kuhn's intellectual process during the 1950s modified some conceptions and postponed his addressing others. Moreover, the lectures were aimed at an educated audience—the Boston elite—but they did not necessarily have a background in the philosophy of science.

A significant point of interest is the presence of certain semantic intuitions that are taken up again in “Second Thoughts on Paradigms” (Kuhn 1974) and are not fully developed until the Notre Dame Lectures. Such intuitions primarily encouraged Kuhn's reactive attitude towards the idea of a purified language of the logical positivists and Percy William Bridgman's operationalism. Both were contaminated with a descriptivist theory of meaning that Kuhn categorically rejected.

Roughly speaking, operationalism is a doctrine that establishes the need to operate with scientific terms unequivocally associated with the

2. In chapter V, Kuhn discusses learning the basic terms of Newton's physics, anticipating the holistic view of meaning he adopts in later writings (1974, 1983a, 1987). Moreover, chapter IX includes a lengthy attempt to elucidate the change in the meaning of terms like “mass” in the transition from Newton to Einstein. It would be of great interest to clarify the connections between the somewhat latent semantic framework of *SSR* and the more systematic developments found in the Lowell Lectures and the Notre Dame Lecture. We have decided to clarify the connections between these two lectures and defer their connections to *SSR* for future analysis.

corresponding result of an experimental measurement. Thus, the very definition of terms is proposed as a function of a measurement procedure.

In general, we mean by any concept nothing more than a set of operations; the concept is synonymous with the corresponding set of operations. If the concept is physical, as of length, the operations are actual physical operations, namely, those by which length is measured; or if the concept is mental, as of mathematical continuity, the operations are mental operations, namely those by which we determine whether a given aggregate of magnitudes is continuous. (Bridgman [1927] 1958, p. 5)

The compatibility of this view with neopositivist physicalism is evident. In Kuhn's notes, he states that he became acquainted with Bridgman's work on the French front during World War II. Although some elements included in his later thought seem to have been inspired by Bridgman (cf. Mayoral 2017), Kuhn criticizes the operationalist doctrine in virtue of two difficulties.

First, Kuhn argues that it is impossible to capture the complexity of scientific language through formal mechanisms. The pragmatic commitment of language is inalienable. And despite their potential usefulness on certain occasions, the formalist reconstructions of the logical empiricists or operational analysis à la Bridgman do not capture this commitment. Confidence in the fertility of the formal examination of scientific concepts was a premise shared by Bridgman and the logical empiricists, and it went well with downplaying the historical and sociological components of science. Under James B. Conant's aegis, Kuhn's reluctance to operationalism reaffirms the distance between the formal reconstructions of philosophers and the actual workings of science:

No existing body of scientific knowledge has as yet been reduced to a formalism paralleling in its completeness or abstractness the formalism to which we have reduced most of mathematics. Nevertheless, it appears likely in principle that such formalization can be achieved. But whether the meaning system for such a formalism could be adequately described is less clear. The modern philosophy of science known as operationalism bases much of its program upon the supposition that it can be. But no adequate illustrations of such a scientific meaning system have yet been provided. (Kuhn [1951] 2021, p. 132)

Second, Kuhn attributes an idealized description of scientific activity to operationalism: in practice, no one uses the terms with the rigidity of the definitional conception. Even if realized, the consequence would be that

several synonymous terms would be taken as distinct and dependent on the measurement experience. In operationalism, the distance measured with an instrument x cannot be defined as equivalent to the distance measured with an instrument y , regardless of whether the measured values coincide numerically or whether both instruments were calibrated with the same standard:

The failure to prescribe some such unique operation for the determination of distance makes synonyms of various different operations used to define the single term distance. And this is equivalent to making certain sorts of synonymy depend upon previous scientific experience which is surely not a satisfactory characteristic of a meaning system. But the alternative provided by the unique definition is too narrow for practical application. Certainly our texts do not even attempt to approximate such an ideal. ([1951] 2021, p. 133)

In the young Kuhn's view, scientists are educated in a mode of work that involves a language that makes up their world. The scientific world is an "orientation" of the ordinary behavioral world. In it, language is much more specific than in regular speech, although such specification "... should not be carried to the extreme of completely eliminating the pragmatic background of its application" (Mayoral 2017, p. 274). Although some of these pragmatic application criteria violate the dictum of providing explicit definitions of the components of the theoretical vocabulary, they ultimately facilitate a common framework of communication that, according to Kuhn, would enhance the virtues of theory. Among such virtues, it facilitates

... the degree to which a theory is confirmed, although its particular application depends on the orientation to the unified vision that the theory, based on this orientation, communicates about the phenomena, which is reflected in its explanatory capacity; and we must not forget, the manageability of the theory, the fact that its theoretical and conceptual structure is sufficiently clear so that there is a generalized practice on the same problems. ([1951] 2021, p. 275)

These orientations (or points of view) are related to the paradigms of *SSR*, the disciplinary matrices of the "Postscript" (1970b), and the lexicons of Kuhn's mature work. Although the unit of analysis in the first case is cognitive, in *SSR*, it is predominantly sociological and in the later Kuhn, linguistic. Nevertheless, a common intuition survives in these different formulations: scientists have shared commitments that make their practice

possible. In the Lowell Lectures, this premise gives rise to a particular consideration of scientific language, for although it is more precise than ordinary language, it is not radically different from it. The use of language does not depend on rigid and organized rules but on consistent learning that allows individuals to communicate and adapt to the environment. It is not true that individuals learn through strict memorized definitions; instead, we do so because violating some rules is an adaptive risk. This does not mean that it is useless to formalize certain parts of scientific language, but formalizing everything can be counterproductive because

its results would be to freeze scientific attention upon just those aspects of nature which are embraced by contemporary science. It would provide a place in its meaning system for aspects of nature now considered technically relevant and no place for others. As a result it would not be a language adequate to embrace new conceptual developments in science. ([1951] 2021, p. 134)

Kuhn understands that we need a language broader than the language of science to contemplate aspects that could be relevant tomorrow even if they are not relevant today. Since our perceptions fluctuate constantly, a formal language that can account for novelties would have to know future possibilities in advance, which is impossible. The linguistic aspects of science are advantageous for its study because they are publicly accessible, while the orientations, qua psychological structures are not, which seriously hinders their study. Kuhn gradually eliminates any psychologicistic component from his post-SSR work (including the appeals to Gestalt psychology) but not the semantic intuitions about the need to discard the projects of analysis of scientific theories based on definitions of necessary and sufficient conditions. When explaining the limitations of this position, Kuhn provides the following example:

Certainly if we want to know whether a given entity should be called a dog, we do not look first to see whether the claws are retractile [like in cats]. We are far more likely to look first at certain of the characteristics predicated of dogs by our general laws. Roughly we may describe our concept according to the following diagram. At its center is what we may call our hard core of meaning, the attributes of which we are relatively certain. Dogs bark, they bite, they have four legs and nonretractile claws. In a ring outside of this center come the attributes of which we are relatively certain: dogs are fur-bearing for the most part, dogs are normally tameable. You notice that I include here as part of the meaning of dog “fur-bearing,” which I know is occasionally violated. But it is still usually a useful way of judging

whether what I see is a dog. I simply must be prepared to be mistaken in using this criterion alone, and I won't use it alone. In still a third and larger circle we include a number of attributes about which we are even less certain. For example, our expectations that dogs are actually tame, that they can be trained, that they have a name to which they will respond. ([1951] 2021, p. 143)

A descriptivist position would try to set a clear definition of "dog" that avoids the vagueness raised by the concentric scheme of proposed features (a strategy that will later constitute the notion of feature space; see Kuhn [1984] 2017). However, such a "clear" definition does not capture that different dogs have different characteristics. Then, a definition that only includes the common attributes of all that is called "dog" will necessarily be conceptually poor and therefore useless:

(...) in our discussion of the precise definition of a word like "dog." in making it precise we emasculated it. We deprived it of those components of its meaning which determined our reactions toward the entities with respect to which we employ it. These former components of meaning then had to reappear as generalizations about the entity dog now precisely defined, and as soon as we tried to state these generalizations, the vagueness which had formerly been inherent in the meaning of the word appeared in our generalization. We had therefore gained nothing by making our definition precise. To get rid of this vagueness, we should have had to reject all the generalizations except those about which we were absolutely certain. But to reject these somewhat uncertain generalizations would have been to deprive ourselves of a set of heuristic rules which, however inadequate they may be, do determine our activities ([1951] 2021, p. 146).

This way of schematizing the methodology for defining the entity "dog" through concentric spheres of characteristics shares many features with the cluster theory of meaning.³ Such a theory has been popularized mainly by Wittgenstein's ([1953] 1986) proposal of language games. The core of Wittgenstein's view is that proper language analysis involves observing the current ways in which language is used. People (and scientists are people) communicate using terms that do not require dictionary definitions but only the context and a few formal rules that are mostly implicit. The emblematic example is that of "game," a cumulative concept

3. Developed by Ludwig Wittgenstein, P. F. Strawson, and John Searle, among others.

that includes—by extension—multiple activities that bear only a family resemblance. Nevertheless, when two people communicate and use such a concept, they quickly understand what the other speaker refers to within a given language game. As we saw in Kuhn’s example, “dog” is an unproblematic term in everyday language games. Though the various dogs we know of bear only a family resemblance to each other, the concept itself ends up “emasculated” if we try to use such a term through definitions based on necessary and sufficient conditions. Including prominent dog features in such a definition (like having fur or even a tail) will necessarily leave out many actual dogs. We shall see in the next section the analogy between this scheme and the presentation of Johnny’s fable that Kuhn includes in the second Notre Dame Lecture.

Although Kuhn did not take up these problems again in *SSR*, a look at *The Quest for Physical Theory* ([1951] 2021) reveals that Kuhn’s semantic concerns are the same, despite the change of approach that crosses his intellectual path. The roots of Kuhnian semantics manifest here for the first time. As Kuhn himself pointed out, he put some of these intuitions aside during the pre-*SSR*⁴ era, and as we shall see in the next section, they returned in the Notre Dame Lectures. We then proceed to the second Notre Dame Lecture: the nodal point where Kuhn consolidates his linguistic analysis of science.

3. The Semantics of the Second Notre Dame Lecture

In the second Notre Dame lecture, Kuhn dwells on the problems of meaning change that had been dragging since *SSR*. He points out that the very notion of “meaning” became problematic after Quine’s (1951) critique of the analytic/synthetic distinction and takes up the critique of traditional conceptions of meaning in a very similar structure to the one he had developed in the Lowell Lectures. According to the traditional view, knowing the meaning of a word implies knowing its definition (Hempel 1964). A definition consists of a set of necessary and sufficient characteristics for applying a term so that whoever knows these characteristics is in a position to apply the term correctly. But this is problematic if we consider the limited role that definitional features play in language use: “One

4. Regarding the period after the Lowell lectures, Kuhn stated that “... the primary result of that venture was to convince me that I did not yet know either enough history or enough about my ideas to proceed toward publication. For a period that I expected to be short but that lasted seven years, I set my more philosophical interests aside and worked straightforwardly at history. Only in the late 50’s, after finishing a book on the Copernican Revolution and receiving a tenure university appointment, did I consciously return to them” (Kuhn 1977, p. xvi). For a detailed review of this process, cf. Hufbauer (2012).

obvious argument against this view is that many of us use lots and lots of words unproblematically—without hesitation or communication problems—even though we are totally unable to provide a list of their defining features” (Kuhn 1980, p. 23).

One possible response is that we have learned the defining characteristics of the terms we use correctly, even if we cannot enumerate them consciously. Kuhn combats this idea through the statement “all swans are white.” We suppose that a subject has obtained the statement by generalizing, and he finds an apparent black swan. The problem arises here whether or not whiteness counts as a defining characteristic of the concept “swan.” If it does, the black bird is not a swan, and the initial statement holds; if not, it is a swan, and “swans are white” no longer holds. This disjunction reveals a second problematic aspect of the traditional conception linked to learning the characteristics that define a term:

- e) So in this case, access to the list of defining features—whether conscious or unconscious—affects behavior, determines how one reacts when brought to Australia.
 - i) And, in practice, in circumstances like this people tend to disagree, which suggests that nothing quite like a shared list of defining features is acquired when learning the language. (1980, p. 23)

Kuhn understands that these limitations merit the search for a substitute, a notion of meaning that is not committed to necessary features. According to this, Kuhn takes up the Lowell line and activates his adherence to the cluster theory. This conception makes it possible to preserve the idea that we acquire meaning through a set of features, but without assuming them as necessary. Concepts are applied using familiar or prevalent characteristics that make it possible to establish the membership relations of a kind, depending on whether or not the new specimens have sufficient features of the cluster that defines the kind. Kuhn draws a balance of the advantages of this position:

- i) People clearly do have access to the required lists.
- ii) Anyone who can make normal use of the word *swan* can tell you a lot of features that most of them share.
- iii) Problems would arise if one still had to pick the defining features from this list, and one is no longer required to do anything of that sort. (1980, p. 24)

Despite these advantages, the cluster theory still presents the problem of specifying which characteristics are sufficient to introduce a specimen

within the field of application of a concept. This problem places the proposal at a point similar to the traditional conception:

- f) If you try to answer those questions, you will encounter exactly the same problems that were encountered before in trying to decide whether a particular feature belonged to an object by definition or by empirical law.
 - i) It's not hard to imagine cases in which the answer to this question ought to influence behavior—is that fowl a swan or not?
 - ii) But there's no reason to suppose that uniform evidence about how-much-is-enough can be found, that knowing a language includes knowing an answer to the question "how much?".
 - iii) Apparently, we're back where we started. (1980, p. 25)

However, Kuhn finds this difficulty salvageable. It is inspired by an erroneous conception of the relation between language and the world under which it is justified to ask how many characteristics are sufficient. Kuhn's strategy does not consist in providing an answer to this question but in questioning the conditions that allow its formulation:

- b) The answer, I think, is that we expect language to be neutral, applicable in all possible worlds.
 - i) We suppose that a person who has learned the term "swan" will know, under all conceivable circumstances, whether it applies or not.
 - ii) Or, to put the point another way, we suppose that, if only we knew what the word "swan" meant, we would be able to say of any creature, imagined or real, that it was or was not a swan.
- c) But, why should we be able to do anything of the sort?
 - i) Why should a language that has evolved from experience in dealing with a particular environment function unproblematically when transferred to another one? (1980, p. 25)

It is not surprising that the search for a semantic basis for his theory of science led Kuhn to reject this way of understanding the nature of meaning. For Kuhn, language is a product of the knowledge practices and strategies that each community of speakers develop when interacting with the environment. Hence, we must pose the question of how kind relations and meaning criteria operate regarding the actual practices of the speakers of a language, not logically possible conditions. It is possible to preserve the

fundamental intuitions of cluster theory if we conceive the nature of language as follows:

- a) That in learning a language one acquires knowledge of nature that is prior to and independent of descriptive generalizations couched in that language.
 - i) If anything of that sort is the case, however, then one may begin to see how cluster concepts might function even in the absence of any answer to the question how much is enough? (1980, p. 26)

To strengthen this view, Kuhn points to a second assumption of the discussions of meaning, namely the idea that meanings are learned and fixed one by one, independently of the linguistic networks to which they belong.

- i) We have, that is, ordinarily supposed that meanings are learned piecemeal, one-by-one;
- ii) That if we know what the word "swan" means, then we must know what the meaning of "swan" is;
- iii) Where the meaning of "swan" is something that characterizes the word by itself, independent of the meaning of terms like "duck" and "goose." (1980, p. 27)

To counter this assumption, Kuhn develops a holistic position, according to which the distinction of the kind "swan," "goose," and "duck" conforms to the notion of local holism in that each of the three terms cannot be learned without reference to the other two. Likewise, any change in the relevant characteristics of one of the species affects its relationships with the others:

- i) One need only suppose that the list of features shared by swans is enlarged to include those useful in distinguishing swans from ducks and geese.
- ii) In the space whose dimensions are provided by that expanded list of features, ducks, and geese and swans will form separate clusters.
- iii) And the condition that the only creatures like swans must be swans can then be replaced by the condition that all creatures lie significantly nearer to some of the three clusters than to either of the other two. (1980, p. 27)

The change of language that is characteristic of scientific revolutions implies that different languages entail different modes of cognitive access

to nature. This means that learning the meaning of words cannot be separated from identifying the objects that populate the world and their division into kinds:

- iii) In this way of learning, by ostension, by pointing and uttering or, more generally, by learning words and phrases there is no taking the two components apart.
- iv) One simply cannot separate the process of learning words from the process of learning about the objects and activities to which the words refer.
- v) Without recourse to a single generalization like “All swans are white” knowledge-of-nature is acquired together with language. (1980, p. 32)

This image of the language-world relation leads Kuhn to affirm that learning names is simultaneous to acquiring clusters of features, allowing individuals to be grouped as members of a kind based on certain common traits. In terms of the cluster theory, these traits have different weights in establishing kind relations, although none is necessary for kind membership.

The Notre Dame Lectures are a landmark in the evolution of Kuhn’s ideas on the meaning of scientific terms and in the project of providing a semantic basis for the incommensurability thesis. Kuhn recovered some of the coordinates that he had outlined in the Lowell Lectures and left aside in *SSR*: the critique of traditional conceptions of meaning and the constitutive role of language for knowledge.

The comparison between Johnny’s fable as presented in the Notre Dame Lectures and the Lowell Lectures reveals that Kuhn’s understanding of meaning is essentially the same at both points in his life. In 1980 he had a name (cluster theory) for such a theory of meaning and used it explicitly. Nevertheless, it is clear that how Johnny assimilates the meaning of “swan” is analogous to how the young Kuhn analyzed the meaning of “dog.” The conception of the nature of language that underlies both sets of lectures is thus similar. Some features of this basic conception are the importance of pragmatic components in determining meaning, the limitation of attempts to formalize language, and the dynamic and evolutionary character of scientific language.

The history of cluster theory after the Notre Dame Lectures sheds further light on this question. Kuhn returns to these problems in later texts (1983a, 1984, 1987), but he does not adhere to cluster theory, which does not play any relevant role after 1980. It is last mentioned in the third Thalheimer lecture (1984, p. 107), where he expressly states that he has already abandoned this conception. Much of what the second Notre Dame lecture offers is a roadmap that Kuhn did not follow, probably because the

inadequacies of the cluster theory made it unattractive to account for the change of language effected in a scientific revolution. As we shall see below, the notion of "taxonomy" became a substitute for cluster theory, providing a new basis for the problems Kuhn addressed.

4. The Irruption of Taxonomic Incommensurability

The notion of a taxonomy appears in the Notre Dame Lectures when Kuhn attempts to specify the type of linguistic change during a scientific revolution, bringing up the possibility of an anomalous case in the classification geese-ducks-swans. Kuhn reviews three possible anomaly outcomes, the first two corresponding to regular change and the third to revolutionary change.

First, we may assume the appearance of an apparent goose with duck-like features, but close examination may show that it was a duck and not a goose. In that case, the anomaly is absorbed by adjustments in the classification criteria that remove the initial ambiguity but do not require changes in kind divisions. A second examination may show that the new creature is neither a duck nor a goose but a new bird. Here, too, modifying the classification requires introducing a new type of bird, but again the old divisions remain unaltered.

A third and more problematic scenario occurs with a creature that shares some characteristics with geese and others with ducks so that its recognition requires an alteration of the previous classification:

- ii) The new creature may turn out to be a goose—it may, that is, resemble geese far more than it does ducks when closely examined.
- iii) But it turns out to resemble only some of the geese, and, when the required adjustment of feature space has been completed, the rest of the geese have been moved out of the goose cluster entirely and have joined up with the swans.
- iv) Now things which were geese before are geese no longer.
- v) Some of the ones that move will be creatures from which we learned the term goose.
- vi) Language itself will therefore be violated by the change. (1980, p. 35)

This passage offers the most remote antecedent of the no-overlap principle that Kuhn developed in later texts (1987, 1991), which is one of the main concepts of his late period. The idea that scientific revolutions involve a change in the categorization systems is central to the image of taxonomic change that Kuhn offers in the last years of his work. This change is caused by the appearance of a specimen that belongs to two

kinds that do not have a genus-species relationship at the same time. This passage allows us to establish that the notion of taxonomic change and the no-overlap principle are inspired by intuitions that Kuhn had already formulated in the Notre Dame Lectures.

It is worth inquiring further into what led Kuhn to this point. He states that in the botanical taxonomy of the nineteenth century, the plants discovered in the Pacific Ocean did not fit the two criteria—opposition and alternation—used to classify the distribution of leaves on a stem until then. The difficulties in assimilating the new specimens into the available taxonomies were such that the classification criteria had to be modified, causing morphological traits to displace functional characteristics as a criterion for kind membership:

- d) That change grew out of pressure from New Pacific specimens, but the result was significant cross-category switching in the higher levels of classification of European and American plants.
 - i) As that switch occurred, furthermore—as morphological features supplanted functional ones in determining likeness—a quasi-evolutionary metaphor began occasionally to appear in botanical writing. (1980, p. 36)

This allows Kuhn to introduce an explicit formulation of the taxonomic structure of scientific language for the first time:

- c) Every scientific theory presupposes a taxonomy, whether the one that groups the falling stone with the growing oak, or the one that groups an atom with a solar system for the purpose of writing an appropriate Schrödinger equation.
 - i) Traditionally it has been supposed that all these taxonomies could be reduced to single, neutral, observational base—simple ideas, a sense-datum language, or something else in the sort.
 - ii) Now, however, most philosophers would concede that no such neutral taxonomic base exists.
 - iii) Its place is taken by whatever language, both everyday and specialized, is in fact acquired and used unproblematically by the scientific community under study.
 - iv) What philosophers use to call the observation vocabulary of a science—the firm foundation on which its theoretical constructs were erected—is now increasingly seen to be the simply antecedently available vocabulary—antecedent, that is, to the invention or assimilation of some particular theory with its accompanying vocabulary and concepts. (1980, p. 38)

Kuhn had used the notion of taxonomy in earlier texts (1970a, 1971, 1974, 1976), but he had used the term in a non-philosophical sense, linked to the work of naturalists and other developers of animal and plant taxonomies. We should not underestimate the heuristic value of these forays, which played a fundamental role in identifying taxonomies as a unit of analysis of scientific change. This is the exact moment when Kuhn begins to use the notion of taxonomy with systematic philosophical pretensions, marking the emergence of an orientation well known in later texts (1983a, 1987, 1991). We have enough textual evidence to mark the Notre Dame lectures as the birthplace of taxonomies as a unit of analysis in Kuhn's thought and a conception based on the no-overlap principle and taxonomic incommensurability. These and other associated concepts marked the main orientations of the last decade of Kuhnian philosophy.

We must dwell on the subsequent fate of the notion of taxonomy to specify how Kuhn assembled the new elements of his stance. In *Commensurability, Comparability, Communicability* (1983a), he argues that taxonomic categories provide criteria for establishing relations of similarity and dissimilarity between the members of a kind. He introduces this thesis within a discussion of the role of metaphor in science, which suggests that by defining taxonomy as a unit of analysis of scientific change, Kuhn rewrote part of his ideas about a revolutionary change in taxonomic terms. *Rationality and Theory Choice* (1983b) reaffirms this direction by connecting the process of categorization operated by taxonomic categories with the locally holistic learning of kind terms.

A year later, the second Thalheimer lecture, "Breaking into the Past," reworks the point by placing the notions of "lexicon" and "taxonomy" as the basis for postulating that language learning is simultaneous with the recognition of the objects that make up the world.⁵ At that lecture, Kuhn claims that relations of similarity and dissimilarity are organized into taxonomies. Later, in *What Are Scientific Revolutions* (1987), he argues that taxonomies organize the relations of similarity/dissimilarity and that these are transformed as a result of the change of metaphors that accompanies a scientific revolution.

As the 1980s progressed, Kuhn organized his ideas on language learning and the meaning of scientific terms around the notion of taxonomy

5. "To acquire a lexicon is thus to acquire a taxonomy, a knowledge of the sorts of objects and situations that do and do not populate the corresponding world. In addition, it is to acquire knowledge of features (not all of them, nor the same ones for all learners) that permit the members of the various categories to be distinguished and identified. Members of a single category must be like each other and unlike those of other categories." ([1984] 2017, p. 77)

while leaving behind the cluster theory and the concept of feature space. In short, we can claim that Kuhn took up again, in the 1980s, a significant trend of the Lowell Lectures seeking answers to questions made explicit by the provocative theses of *SSR*. The development of this proposal led first to adopt the cluster theory and then abandon it, paving the way for the introduction of taxonomies. However, all these tools are increasingly refined approaches to a set of philosophical problems that were already budding in young Kuhn's thinking.

5. Final Remarks

We have analyzed Kuhn's intellectual process, taking as reference two crucial moments in Kuhn's thought that have been insufficiently explored. Our tour shows that in the Lowell Lectures of 1951, Kuhn addresses a fairly definite set of problems concerning the nature of language and the determination of meaning. This program was left aside in *SSR*, leaving a gap in semantic issues that critics of the Kuhnian proposal quickly pointed out. To remedy this difficulty, Kuhn reactivated his semantic interests in the Notre Dame Lectures, seeking to assemble the cluster theory with the image of science derived from *SSR*. This project does not crystallize, and the inadequacies of the cluster theories give rise in the Notre Dame Lectures to the introduction of the notion of "taxonomy," the pillar of the linguistic approach that characterizes the last stage of Kuhnian thought.

These findings show that the linguistic turn in Kuhn's mature work did not arise spontaneously in the 1980s. Nor, as Shan (2020) asserts, can it be established that it was the consequence of a strategy resulting from articulating the thesis of incommensurability focusing only on semantic aspects (such an aprioristic turn being the infamous "wrong turn" proclaimed by Bird 2002). The semantic focus has its genesis in Kuhn's youthful efforts to offer an alternative to logical positivism and Bridgman's operationalism. These intuitions do not appear in *SSR* but remain dormant until their recovery in the second Notre Dame lecture. In that sense, the "wrong turn" should perhaps be renamed "wrong return."

This lecture is a historic milestone: the moment when Kuhn takes up his semantic concerns and where taxonomy appears for the first time as a unit of analysis of theoretical change. Such a unit would soon become the locus of Kuhn's philosophical and historical investigations, as the Wittgensteinian cluster theory is abandoned in the 1984 Thalheimer Lectures. From this and other recent findings in unpublished materials, we understand that it is necessary to revise the predominant periodizations of Kuhn's intellectual evolution, as well as the very image of "the late Kuhn." The examination of the unpublished writings—still in progress—shows that a good part of the proposals and formulations of the so-called "last

Kuhn” do not take shape in the last years of his work but date back to the early 1980s. There would be no such thing as a “linguistic turn” but a return to the semantic roots.

This tour allows us to see the Lowell and Notre Dame Lectures as expressions of the same philosophical agenda, which Kuhn dealt with in diverse ways in 1951 and 1980, but which maintains shared references both in the spectrum of problems he posed and in the theoretical tools he used to solve them. For reasons we cannot establish here, but which are gradually being explored (Hufbauer 2012; Melogno and Courtoisie 2019), in *SSR*, Kuhn set aside this agenda of problems about the nature of meaning, the language-world relation, and the learning of kind terms. Beyond this, connections between the Lowell and Notre Dame Lectures show that the concerns about meaning were not an unforeseen consequence with which Kuhn began to grapple after 1962. Conversely, they are part of a research program that took shape in the earliest stages of his intellectual journey.

We hope to have shed light on the genealogy of Kuhnian semantics as it appears in his more mature works by examining two insufficiently studied lectures. The effort of reviewing and publishing Kuhn's unpublished texts is still fruitful and relevant for a community nourished by his intellectual journey as much as ours. This work aims to be another example of this.

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