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Framework

Editorial Introduction: Collins and Tacit Knowledge

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Editorial Introduction: Collins and Tacit Knowledge

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Introduction

Harry Collins is internationally recognized as a distinguished sociologist of science who writes creatively on a substantial number of varied subjects. He is acknowledged as one of the prominent specialists on the topic of tacit knowledge and has played an important role in the introduction of this topic into science studies. He has investigated the topic extensively, most famously through several case studies of physics [Collins 1974, 1984, 1985, 1990, 2001a,b, 2004], [Collins & Kusch 1995, 1998], [Collins & Pinch 1993], [Pinch, Collins & Carbone 1996]. The publication of his latest book, *Tacit and Explicit Knowledge* ([Collins 2010], hereafter TEK), provides the occasion and primary motivation for the present thematic issue of *Philosophia Scientiæ*. The aim of this issue is to discuss Collins's new ideas on tacit knowledge developed in TEK, and more generally to address issues related to the tacit dimension, especially (but not exclusively) in science.

The point of departure for this thematic issue was a conference in December 2011, entitled “Tacit Knowledge in Science: Discussions with Harry Collins”, which was organized by the PratiScienS team, in Nancy, France.¹ Harry at-

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1. PratiScienS stands for “Rethinking Sciences from the Standpoint of Scientific Practices”. The aim of the project is to develop a systematic analysis of the con-

tended the conference in person, and creatively took part in the lively exchanges about his position. Initially, Harry was ‘only’ asked to introduce the conference and to respond to the different talks, but as a result of these exchanges, he was kind enough to give a spontaneous and very stimulating extra-talk. We were, and remain, very grateful to Harry for the role he has played in making the conference a success and in participating in bringing about the present thematic issue. Although the thematic issue was inspired by the original conference, its contributions are the result of a separate call for papers.

The thematic issue begins and ends with two new contributions from Collins. In the first, Collins introduces the core elements of his characterization of tacit knowledge in TEK and reconsiders these elements in retrospect. In the second, he concludes by reviewing the articles in the issue and addresses the main questions raised by each of them.

We would also like to draw particular attention to a contribution of a special type, co-authored by Collins and Arthur Reber. Reber is Broeklundian Professor emeritus at Brooklyn College, and has conducted empirical psychological research into tacit knowledge acquisition for more than four decades. In 1993, he published a book on tacit knowledge from the experimental point of view, *Implicit Learning and Tacit Knowledge: An essay on the cognitive unconscious* [Reber 1993]. This book was the reason that the editors invited Reber to review one of the manuscripts. A by-product of the reviewing process was that Collins and Reber started a correspondence about some aspects of tacit knowledge, and came to realize they were entangled in a typical example of a long-standing clash between different frames—they came to realize that Collins’s sociological and Reber’s psychological perspectives on tacit knowledge could be thought of as “incommensurable” in a Kuhnian sense. They then conceived the idea to reconstruct their exchange, with its misunderstandings and agreements about tacit knowledge, and put it on paper. The resulting article goes beyond the scope of tacit knowledge: it has become a remarkable and entertaining ‘inside description’ of a clash of paradigms, easily recognizable to

sequences of the so-called “practice turn” in the science studies and to investigate philosophically significant issues about scientific practices. One of these issues is the role of tacit aspects in the constitution of scientific results (understood in the broad sense of result: theoretical claims and systems of claims, experimental facts, technological achievements, mathematical theorems, etc.). Other central questions are the issue of how something acquires the status of a robust result in the empirical and the formal sciences or how we should assess the contingency or inevitability of robust scientific achievements. The project started in 2007 and is pursued by a small interdisciplinary group of France-based historians, philosophers and sociologists of science (where ‘science’ must be understood here including mathematics and logic besides the empirical sciences). Beyond the core of the French-based researchers of the PratiScienS group, other researchers from many different countries are associated to the group. Besides Harry Collins, they include Hasok Chang, Karine Chemla, Peter Galison, Thomas Nickles, Andrew Pickering, Claude Rosental, Jean-Paul van Bendegem and William C. Wimsatt.

anyone who has had similar experiences with a frame-shifting discussion. It also offers some evidence that although the task is hard and success requires willful effort and perseverance, incommensurability does not preclude the possibility of mutual understanding. As editors, we wish to congratulate Collins & Reber on their success in surmounting the difficulties of the process and in providing a living exemplar of how cross-paradigm conversations go; we are delighted and grateful that Collins & Reber contributed this unexpected bonus to our thematic issue.

In the remainder of this editorial introduction, we first situate the subject of tacit knowledge in the landscape of the science studies; next we consider Collins's contribution to this subject; and finally, we sketch a brief overview of the contents of the present thematic issue.

1 Tacit knowledge in the landscape of the science studies

Skills and tacit aspects involved in scientific practices are a relatively recent theme in philosophical, sociological and historical studies of science, and Collins has played an important role in establishing the interest in this theme.

The origin of reflections about the nature of tacit knowledge and its modes of intervention in human activities aiming at knowledge acquisition is commonly attributed to Michael Polanyi (see especially [Polanyi 1958, 1967]). Often, Wittgenstein (in relation to rule-following) and Thomas Kuhn also have been referred to, and rightly so, as providing important insights into tacit knowledge and related epistemic issues ([Wittgenstein 1953, 89, 201]; [Kuhn 1970]; for more details see [Soler 2009, chap. IX]).

In the 1970s, oftentimes inspired by these early writings, scholars interested in science became increasingly convinced that tacit knowledge played an important role in science. How did this happen? At the time, researchers, especially in sociology of science, questioned the widespread belief that science could be adequately described only by its explicit products such as published theories and explicit justifications, and stressed the need to study “science in the making” and scientific practices rather than scientific products. They carried out detailed studies of ongoing experimental practices and claimed that such an approach led to a more profound and realistic conception of science.² As a spin-off of these practice-oriented tendencies, some researchers, among whom perhaps most importantly Harry Collins (see in particular his pioneering

2. See in particular [Collins 1974, 1975], [Garfinkel 1967], [Knorr-Cetina 1979], [Latour & Woolgar 1979], and for the early 1980s, [Garfinkel, Lynch & Livingston 1981], [Knorr-Cetina 1981], [Knorr-Cetina & Mulkay 1983], [Lynch 1982a,b]. In this context, [Bloor 1976] is also worth mentioning, since his and Barry Barnes's “strong program” has been very influential in the social studies of science in practice, although Bloor did not himself conduct detailed empirical studies.

contributions [Collins 1974, 1975]), showed that the actual process of science included many important tacit, unarticulated aspects that resisted any attempt of explication. By doing so they boosted the interest in tacit knowledge in science.

Subsequently, more and more sociologists of science, but also philosophers and historians of science, sought to explore and characterize tacit “know-how” and tacit “know-that” (a distinction first introduced by Gilbert Ryle in [Ryle 1945-1946], which later became classical), the acquisition of tacit resources, and their transmission and dissemination within larger social groups. Additionally, but more rarely, they analyzed the ways in which the attribution of tacit resources affects the constitution of scientific results and conclusions.³

Traditionally, tacit resources are almost always referred to in the literature by the term “tacit knowledge”. In order to remain consistent with this common usage, the present thematic issue is entitled “Tacit Knowledge in Science”. However, we believe that the term “tacit knowledge” should be questioned, because not every tacit resource relevant to science or knowledge production is straightforwardly well-characterized as *knowledge*.

Admittedly, conceptions of knowledge vary—as is illustrated by some of the contributions in this thematic issue. In TEK, Collins favors the “knowledge-as-stuff” metaphor, according to which knowledge can be detached from the human beings who might possess it, and can be considered “in itself”. Within this framework, we may consider, for example, the knowledge corresponding to “bike-riding” independently of the specific way in which human beings know how to ride bikes. However, other authors favor different perspectives on knowledge (see in particular Thornton’s and Reber’s articles in this issue). According to these authors, tacit knowledge can only be analyzed in reference to the nature of the process through which a task is humanly accomplished, such as, for instance, the nature of the process through which human beings successfully ride bikes. Perhaps in order to emphasize the latter perspective, Polanyi preferred the expression “tacit *knowing*” to that of tacit *knowledge*.

Even if we put aside differences between conceptions of knowledge, however, some tacit elements commonly referred to as “tacit knowledge” still do not straightforwardly qualify as *knowledge*—at least not without further discussion. Take for example the tacit presuppositions an analyst attributes to a given scientist from the past in order to explain the behavior and position of this scientist, when these presuppositions are *false* according to the present-day science of the analyst: are these presuppositions tacit *knowledge*? Or take

3. Beside Collins’s publications mentioned in note 1 and the references given note 2, here is a selection of works that deal with the tacit dimension of human knowledge (human knowledge broadly understood: from basic, everyday cognitive activities like linguistic or mnemonic tasks, to very specialized theoretical and technical scientific practices): [Chomsky 1990], [Davies 1989], [Dreyfus 2004], [Ferguson 1992], [Lynch 1985, 1993, 2007], [MacKenzie & Spinardi 1995], [Pinch, Collins & Carbone 1996], [Reber 1993, 2002], [Searle 1995, 2001], [Soler 2009, chap. IX], [Soler 2011a,b], [Stich 1978], [Turner 1994].

some ordinarily-tacit values and norms that were once constitutive of past scientific practices, such as the requirement “reject any force-at-a-distance and throw it out of science”: are these norms tacit *knowledge*? Even if the answer is affirmative for *some* conceptions of knowledge, the knowledge’s status surely cannot be taken for granted from the outset. Consequently, the currently standard expression “tacit knowledge” is potentially misleading and confusing. It would be preferable to start from an agnostic position, and adopt a more neutral vocabulary that does not already commit us to a position on the epistemic status of the elements that we treat as tacit.

From such a perspective, we could replace “tacit knowledge” with “tacit resources”, “tacit aspects” or “tacit dimension”. As far as Collins’s three central categories in TEK are concerned—Relational, Somatic and Collective Tacit Knowledge—we could substitute the “*K*”, which stands for Knowledge in RTK, STK and CTK, with an “*X*”, and remain agnostic about the relation between *X* and knowledge.

2 Collins’s contributions to the topic of tacit knowledge

Collins creatively and critically exploited the contributions of Polanyi, Wittgenstein, Kuhn and others, and put them to work in his research on science. He is one of those scholars who have helped us to improve our understanding of both the *nature* of tacit knowledge, and the *epistemological consequences* of the involvement of tacit resources in scientific and technological practices.

From his first publication devoted to the tacit dimension (his now classical paper on the TEA-laser [Collins 1974]) onwards, via his famous book *Changing Order* [Collins 1985], and many other publications, culminating in TEK [Collins 2010], Collins has developed diverse and helpful *analytical tools*, as well as insightful, although often controversial, *theses* related to tacit knowledge. Let us briefly review a selection of these tools and theses.

2.1 Analytical tools for a finer grasp of tacit knowledge

2.1.1 Types of tacit knowledge

Collins introduced multiple categories that help to distinguish *various types* of tacit knowledge and to understand the relations among them.

In [Collins 2001a], nearly a decade before the publication of TEK, Collins proposed his first useful classification of tacit knowledge, which was composed of five categories: (i) “concealed knowledge” (such as knowledge that

is kept secret); (ii) “ostensive knowledge” (such as knowledge that is transmitted by pointing); (iii) “mismatched saliences” (such as knowledge that is not expressed because the knower does not realize that it needs to be revealed to a recipient); (iv) “unrecognized knowledge” (knowledge that is actually used but not expressed and even not known to be possessed by the user); (v) “unrecognized/uncognizable knowledge” (knowledge that is not articulated and not explicable in a given stage of human history, and that is perhaps humanly impossible to explicate).

In TEK, Collins introduces three new categories of higher-order, RTK, STK, and CTK, and explains their relations to the five older 2001 categories. In particular, the first four types of tacit knowledge he introduced in 2001 become different sub-types of *Relational Tacit Knowledge* in TEK.

The new three-fold mapping of tacit knowledge constitutes the core of the analytical tools provided by Collins in TEK—even if, as we will see below, at the end of section 3.2., Collins does not conceive the mapping *only* as a set of useful tools, but also as an *ontological* division of the realm of tacit knowledge into three altogether exhaustive kinds. In TEK, each of the three kinds of tacit knowledge is classified according to the reason why the knowledge *K* involved resists explication, and the three kinds are ordered according to the force of the resistance to explication offered by the corresponding kind of *K*. *Relational* or *weak* tacit knowledge (RTK) is knowledge that: (i) is explicable today (i.e., could be explicated without fundamental problem, offers no essential resistance to explication: hence the “weak”); and (ii) remains however tacit in some particular situations, for contingent reasons that have to do with the relations between people or groups of people (hence the “Relational”). *Collective* or *strong* tacit knowledge (CTK) corresponds to knowledge that possesses the three following features: (i) it is required to act relevantly and creatively in a certain collective (hence the “Collective”); (ii) it is presently inexplicable *because of its collective character*; (iii) we cannot see today how it could be explicated in any foreseeable future (hence the “strong”). *Somatic* or *medium* tacit knowledge (STK) is positioned in between. It corresponds to somatic skills defined by the three following features: (i) they are difficult to explicate *because they involve the body*; (ii) as a consequence of this particular kind of difficulty, they remain, as a matter of fact in the present stage of scientific development, inexplicable; (iii) they could nevertheless, assuming further developments in scientific knowledge and technology, be explicated (hence the “medium”), but only in *certain* ways—ways corresponding to what Collins calls senses (3) and (4) of explication.

Mentioning Collins’s senses (3) and (4) of explication leads us to another distinction developed in TEK, which plays an important role in several papers of this thematic issue: the distinction between four different possible meanings of “explicable” [TEK, 81]. This distinction proves to be a source of difficulties for some of Collins’s readers. Or so is the conclusion of the editors, based on their interpretation of several articles submitted to the call for papers for this thematic issue.

2.1.2 Four different meanings of “explicable”

According to Collins, tacit knowledge becomes explicit by the mediation of “strings”. Strings are physical patterns without intrinsic meaning, like the material side of a written word or of an uttered sentence. More broadly put, strings may be the physical substrate of any meaningful human interpretation—that is, almost any material thing.

There are four ways in which the manipulation of strings can lead to the explication of some knowledge K , which is not explicated. This gives four senses of “explicable”: (1) “explicable by elaboration”: “a longer string affords meaning when a short one does not”; (2) “explicable by transformation”: “a physical transformation of strings enhances their causal effect and affordance”; (3) “explicable by mechanization”: “a string is transformed into mechanical causes and effects that mimic human action”; and (4) “explicable by explanation”: “mechanical causes and effects are transformed into strings called scientific explanations” [TEK, 81]. Senses (1) and (2) are related to the most widespread uses of “explicable” and “explicit”. Roughly speaking, to explicate in these senses is to capture, in ordinary language, what is tacit for an interlocutor, by saying more or saying it differently. By contrast, senses (3) and (4) depart from common usages. To explicate in sense (4) is to develop a scientific explanation of some performance or knowledge K . It might be, for example, a scientific explanation of “riding a bike” in terms of the curve that should be taken to compensate for a given angle of imbalance [TEK, 101]. To explicate in sense (3) is to succeed in building a machine that is able to realize some K , such as, for example, a robot able to ride a bike as well as humans do—that is, able to go from a point A to a point B without falling—even though for the same performance, the underlying robotic processes differ from those of humans. We think it is important to examine the counterintuitive implications related to Collins’s senses (3) and (4) of explication. Some of these implications are considered in the contributions to the present thematic issue (see notably those by Thornton and Soler-Zwart).

Other interesting conceptual distinctions are introduced in TEK in relation to RTK, STK and CTK. To close our selection, we would like to mention the analysis proposed by Collins of eight different “types of cannot” [TEK, 90]. Differentiations of these types were urgently needed, and are considerably clarifying, when compared to crude classical definitions of tacit knowledge as knowledge that *cannot* be explicated.

Let us turn to the epistemological consequences of the inevitable involvement of tacit resources in scientific and technological practices.

2.2 Epistemological implications related to tacit knowledge

2.2.1 Delays, failures and losses in knowledge transmission

A first, no longer very controversial but still important implication of Collins's earlier case studies, is that tacit knowledge can be responsible for impediments, delays or even failures, in the transmission of the experimental or technical protocols. When a scientist S_2 attempts to follow protocols set out by another scientist S_1 for *re*-producing experimental facts or technical objects that S_1 claims to have successfully produced, S_2 might fail because S_2 does not succeed in acquiring the tacit knowledge possessed by S_1 . A successful replication is not guaranteed by the conservation of written protocols and public reports, because the tacit knowledge (especially the tacit know-*how*) is never completely captured by such explicit means. This raises the risk of irreversible losses of knowledge. Limiting such risk requires timely and costly maintenance policies and activities—such as uninterrupted transmission of the specific human know-how from experts to apprentices, or the development, where possible, of mechanical or ‘turnkey’ methods for bypassing human tacit knowledge.

2.2.2 Tacit knowledge and the experimenter's regress

A second, crucial and highly controversial thesis is Collins's famous thesis of the experimenter's regress. In Collins's words:

To know whether you have built a good gravitational wave detector, you should try it and see if it works properly. But to know what “works properly” means you have to know what it should see. But to know what it should see, you have to know what gravitational waves look like. But to know what gravitational waves look like, you have to build a good gravitational wave detector and look at them. But to know whether you have built a good gravitational wave detector, you should try it and see if it works properly. And so on! [Collins 2004, 126]

The experimenter's regress locates tacit knowledge at the level of the proper working of the instrumental device (in the above quotation, the gravitational-wave detector). When an experimental controversy arises, any experimental conclusion advocated by a given team can be contested by claiming that the competing experimenters lacked the crucial tacit knowledge needed to carry out the experiment successfully.

2.2.3 Under-determinations in tacit knowledge attribution and variable ideas about success

The problems with replication and the experimenter's regress might be considered to be a pragmatic and elaborated version of the Duhem-Quine thesis

about the under-determination of theories by empirical evidence. Accordingly, tacit aspects introduce an additional source of indeterminacy in science [Soler 2011b]. In a given historical scientific controversy, in principle, at least two interpretations are possible, and alternative interpretations actually are sometimes endorsed by rival teams: either the experimenters do indeed possess some tacit knowledge and their experimental conclusions are well-grounded; or they do not possess the required tacit knowledge and their experimental conclusions must be dismissed as methodologically faulty. But how do we know if some subjects indeed possess tacit knowledge, and who decides in case of disagreements between the actors?

The experimenters' regress thesis draws our attention to the empirical conditions through which we usually attribute tacit knowledge to actors, whether or not they are scientists. Namely: we notice that some people or groups of people, ourselves possibly included, are able to perform valued tasks repeatedly whereas others are not able to do so; we notice that they are able to perform these tasks without telling how they do so, and that many aspects of their successful actions are hard or even impossible to express (when we ask the actors to explicate them or when we try to articulate them ourselves); we conclude that these people have resources at their disposal that others lack and, if we are ready to identify the result of their actions as a *true* success, we are ready to consider the possessed resources as tacit *knowledge*.

Such an attribution of tacit knowledge is not too problematic when we are dealing with already institutionalized and socially stabilized kinds of action, such as bike riding, normal science and the like. In these cases, what "success" means is relatively clear; individuals or groups by and large agree about what counts as a success and what counts as a failure. But the more we deal with pioneering, creative, open, non-stabilized and non-consensual practices—such as when scientists attempt to investigate new phenomena by means of poorly-mastered experimental devices, or during periods of scientific revolution, or when avant-gardist artists challenge established conventions, and so forth—the more the meaning of success becomes an open-ended and controversial matter. In such pioneering situations, the people involved entertain different (often tacit) intuitions about success and how to recognize it; the parties compete to impose their own (often tacit) values and to have them recognized as the appropriate ones. Two competing groups of people operating with heterogeneous intuitions about success are unlikely to attribute the status of *knowledge* to the same tacit resources. A tacit resource valued as knowledge by some, is likely to be dismissed by others as a tacit prejudice.

In short, tacit knowledge identification and attribution is strongly related to ideas about success, and ideas about success might vary between societies, among individuals, and from one context to another. Among other sources of under-determination, 'subjective' and 'social' sources can be suspected to play a role in attributions of tacit knowledge. Examples of such attributions are the tendency of parents to overvalue the capacities of their children, and hence to attribute tacit knowledge to them all too easily; or the hegemonic

tendencies of a given community to claim that they are the sole possessors of the inexpressible knowledge required to achieve certain socially valued aims. Trevor Pinch and Michael Lynch give examples in their contributions.

2.2.4 The ontological status of tacit knowledge

Reflections such as those we have just discussed lead us to ask questions about the *ontological status* of tacit knowledge. Is tacit knowledge *real*? Or, is tacit knowledge *relative and inextricably attached* to some (collective or individual) subject?

Collins was one of the first scholars to draw our attention to the problematic character of the epistemic status of tacit knowledge, when he identified the experimenters' regress and the under-determinations that go with it. In TEK, however, Collins does not take experimenter's regress into account and leaves aside its implications. Let us recap Collins's ontological position in TEK: in that book Collins offers a systematic conceptual analysis of tacit and explicit knowledge, from which follows a new three-fold classification of tacit knowledge, which Collins endows with an empirical and ontological status. RTK, STK and CTK are not just three useful tools to order a 'hypothetical something' called "tacit knowledge". No, for Collins tacit knowledge is real knowledge, and RTK, STK and CTK name three different existing kinds of tacit knowledge. In brief, RTK, STK and CTK cut the realm of tacit knowledge at its joints. Thus in TEK, Collins treats tacit knowledge as if it is unproblematically real; he reasons as though the success, failure, or relevancy of human actions—which work as criteria for tacit knowledge attributions—are uncontroversial and taken for granted; as though knowledge is some sort of real "stuff", isolable as such and independent of any specified subject.

The different attitude that Collins takes toward tacit knowledge in TEK, as compared with his earlier work, has puzzled some readers (see notably Pinch's and Lynch's contributions to this thematic issue). In response to his critics, Collins attempts to clarify the relation between the stance adopted in TEK and that adopted in his earlier works, and explains the position endorsed in TEK as a shift of attention.

3 Fundamental background features of Collins's worldview

Collins's recent realist approach and three-fold ontological mapping of tacit knowledge operates within a particular worldview. To conclude our presentation of Collins's perspective on tacit knowledge, we shall introduce some core elements of this worldview.

According to Collins, reality is made of two radically different kinds of beings and processes. On one side, there are interpretative beings and processes,

that is, beings that possess language, produce meaning, have culture, use symbolic entities and make translations between them. On the other side, we have beings and processes that do not interpret—in Collins’s terminology they are determined by strings and transformations of strings: cause-effect processes, mechanical transformations, nature as opposed to culture, inert things as opposed to meaningful entities. This dual perspective is at the heart of Collins’s crucial and pivotal “transformation-translation” thesis [TEK, 25ff.].

Only human beings are interpretative beings—or more exactly human-like beings, since, as Collins insists, where to draw the dividing line exactly is unimportant: the essential point is the existence of the ontological divide. Human-like beings are unique in their interpretative activities. Moreover, human beings are *social* beings in an essential sense [TEK, 116]. Consequently, all aspects that are on the side of interpretative realities, such as language, meaning, culture, translation and so on, are *social* realities. They would not exist in the absence of a collectivity—a collectivity whose members present certain kinds of somatic and non-somatic affordances that enable interpretative activities. As a true collectivist, Collins claims that all aspects of interpretative realities are properties of collectives, and that they cannot be reduced to individuals or to interactions between individuals. Individuals acquire language, meaning, and culture, as well as the ability to translate and interpret creatively and relevantly, by means of their immersion in society through a mysterious “socialization process”.

Human-social beings and human societies are characterized by variability, flexibility, openness and unpredictable processes, or in Collins’s concepts, by “polimorphic actions” [Collins & Kusch 1995, 1998]: different members of a given society, as well as one and the same individual at different moments, act flexibly, creatively and relevantly according to the social contexts; societies themselves, and the tacit social rules that characterize them, differ from place to place and change rapidly through time.

In contrast, non-human, or non-human-like beings and groups of such beings—animal species, inert “natural kinds”, etc.—are characterized by relatively uniform, fixed, rigid, predetermined (i.e., mechanical) behaviors. Such behaviors do not vary from one member of the species to the others—neither in a given period of history, nor through time: dogs or stones do not behave today in an essentially different way than they behaved yesterday and will behave tomorrow. In Collins’s terminology, such behaviors correspond to “mimeomorphic actions”. Non-human-like beings do not adapt their way of behaving flexibly throughout the process of their immersion into the group they belong to.

This ontological duality between interpretative-translational and non-interpretative-mechanical realities is highly controversial, and far from being an easy matter. It is reminiscent of Descartes’ dualism, which still preoccupies contemporary debates on the relations between the natural and the social

sciences. In spite of its intricacies, Collins manages to propose his dualist position in a clear and bold way.

4 Contents of the special issue

Beyond a common interest in tacit knowledge, the authors of articles in this thematic issue have different backgrounds, stemming from various research traditions, and displaying a variety of professional interests. Three of them, Trevor Pinch, Michael Lynch and Stephen Turner are well-established sociologists of science and technology. The other contributing scholars, Tim Thornton, Léna Soler and Sjoerd Zwart, have backgrounds in philosophy. Tim Thornton is a Wittgenstein specialist; Léna Soler has been trained in the tradition of historical philosophy of science (more specifically philosophy of physics); and Sjoerd Zwart's main area of interest is the analytical philosophy of technology. As has already been mentioned in section 1, the author of the final critical article, Arthur Reber, won his spurs in empirical psychology. The differences in background of the authors guarantee contrasting ways of framing on Collins's analyses of tacit knowledge, and this alone already enhances the interest of the present thematic issue.

Let us turn to the structure of this issue. The first critical contribution is written by Trevor Pinch, who once was a student of Collins and has collaborated with him for decades [Collins & Pinch 1979, 1982, 1993, 1998], [Pinch, Collins & Carbone 1996]. Pinch is therefore very well suited to place the treatment of tacit knowledge in TEK in the context of the rest of Collins's work. By so doing, he discusses a tension “between the realism underlying his [Collins's] notion of ‘tacit knowledge’ and the constructivism underlying his [...] ‘experimenters’ regress’”. In relation to this challenge, Pinch addresses—as Lynch and Turner also do—the question of the ontological status of tacit knowledge and the empirical criteria according to which we may decide that someone has the tacit knowledge in question.

While Pinch focuses on *Collective* Tacit Knowledge, and Lynch concentrates on *Relational* Tacit Knowledge, both authors ask the same kind of question: should we take literally Collins's “knowledge-as-stuff” metaphor and conclude that some subject possesses tacit knowledge as though it is some kind of “stuff”? Or should we treat tacit knowledge as an “actors’ category” used in relation to various aims, for example, to reinforce a cultural identity, secure the autonomy of science, enhance the status of a profession, or protect labor practices from managerial surveillance and control? Note that if, as the editors claim (see section 3.2), the attribution of tacit knowledge is under-determined, the two options are always possible with respect to the interpretation of a given situation (i.e., the analyst can either conclude that some real tacit knowledge is indeed possessed by the actors, or that the possession of tacit knowledge is claimed by the actors in order to achieve certain

aims); moreover, the two interpretations are not necessarily mutually exclusive. Both Pinch and Lynch seem more sympathetic to the second option. In particular Lynch, as a student of Harold Garfinkel's ethnomethodology in sociology, and as a well-known ethnographer of laboratory practices [Lynch & Sharrock 2010], pursues the second interpretation and suggests

that an empirical sociological alternative [to developing a typology of tacit knowledge] is to investigate pragmatic and polemical uses of the tacit/explicit distinction in particular circumstances of action and conflict.

The next article is written by Stephen Turner. In his 1994 book, *The Social Theory of Practices: Tradition, Tacit Knowledge, and Presuppositions* [Turner 1994], Turner argues that the notion of practice conceived as a tacit stuff "shared" by a group, is beset by difficulties and fails to serve its purpose. In the present thematic issue, Turner criticizes Collins's notions of "collectivity" and "collective" along the lines he set out in his 1994 book and in his 2011 review of TEK [Turner 2011]. Like Pinch, Turner concentrates on *Collective Tacit Knowledge*, but his aim is different. It is to examine the crucial idea behind the notion underlying Collins's treatment of tacit knowledge, namely, the notion of "collective" upon which Collins has built his category of Collective Tacit Knowledge. Turner distinguishes between the social and the collective. Whereas the former explains society using bottom-up explanations in terms of processes occurring between individuals, so that the social is reducible to relations among individuals, past and present, the latter is more ontologically laden. Like "Durkheim's sociologization of Kant" it implies "collective, shared, psychological" irreducible contents, that are "necessary to account for social life." Turner offers an analysis of the specific assets and difficulties of each approach, which he calls a "Scorecard". The resulting "score" should, according to Turner, leave us unconvinced that "Collective Tacit Knowledge fills an explanatory need in a simple, or single cause, and in this sense 'parsimonious' way". Turner arrives at this conclusion following an interesting line of thought. He starts with transcendental arguments of the kind "conditions for the possibility of" used by Kant and the neo-Kantians, and subsequently focuses on the long tradition of transcendental reasoning in which causal claims are deduced from transcendental arguments. He judges the latter to be vague and elaborates on two reasons for this vagueness: the problems of transmission and under-determination. This brings him to question—like Pinch and Lynch but via a different route—the 'realist status' of tacit knowledge. When one reconstructs a position like 'endorsing some tacit presupposition', is this presupposition actually there, 'in the head' of some individuals or somewhere in the collective? Turner's answer is negative, and he proposes an alternative interpretation.

The next two contributions come from scholars who were trained as philosophers, but in different traditions. In his paper, Thornton—who is himself the co-author of a recent book entitled *Tacit Knowledge* [Gascoigne &

Thornton 2012]—criticizes Collins’s notion of “string” in relation to the issue of tacit knowledge. The culprit of Collins’s problematic use of strings is, according to Thornton, the way Collins has responded to (and misunderstood) Wittgenstein’s rules regress. Both Thornton’s and Soler-Zwart’s papers consider Collins’s four senses of “explicable” and ask the question of the relation between explicable in senses (1) or (2) on the one hand, and explicable in senses (3) or (4) on the other hand (see section 3.1 above). Thornton describes the success of the explication in senses (3) and (4) at a given time as an “action at a distance” with respect to explication in senses (1) and (2). According to his account, mechanization and scientific explanation of some knowledge K by some engineer or scientist, for example the construction of a robot able to ride a bike, would make the knowledge of people who know how to ride bike explicit “at a distance”. Yet, the people in question need not know anything about what the scientist or engineer has achieved, and remain as incapable as before of explicating how they ride a bike. Soler & Zwart in their article instead urge that we should always specify the sense in which some knowledge K has been explicated instead of just saying that K has been explicated ‘*tout court*’. The attributions “explicit” and “explicable” should always carry an index that specifies which of Collins’s four senses is meant. This would be sufficient to avoid confusion and the impression of counterintuitive consequences such as the one put forward by Thornton under the telling expression of “action-at-a-distance”.⁴

The main aim of Soler & Zwart is to elaborate and expand upon Collins’s tacit knowledge framework. The authors first argue that the identity of the RTK category and, as a corollary, what unifies its sub-cases, and makes them pertain to one and the same category, is not well-characterized in TEK. They suggest that a better characterization of RTK would be knowledge ‘not explicated *for reasons that are contingent with respect to the nature of K* ’, rather than ‘not explicated *for relational reasons*’. According to this suggestion, RTK is knowledge that is explicated or not for contingent reasons; thus in particular, it can be explicated or not by one and the same subject depending on the circumstances; or it can be explicable for one subject and not the other. Taking these possibilities into account, Soler & Zwart recommend that the terms “explicit”, “tacit” or “explicable” should always be accompanied by the specification *for whom and when*. This would help to avoid confusions or misunderstandings when using Collins’s distinctions. Moreover, the authors identify an ambiguity in the interpretation of RTK, STK, and CTK, and indicate how to avoid the related possible confusion. Using some new notations, they explicitly formulate a profound asymmetry between RTK on the one hand, and STK/CTK on the other, and introduce some possible sub-types of RTK. Finally, they consider dynamical aspects of Collins’s framework, and discuss

4. Collins (private communication, 30 April 2013) agrees with Soler & Zwart but also thinks that the idea of explication at a distance is illuminating.

the possibility—not considered by Collins—of transformations over time of STK to RTK and CTK to RTK.

The penultimate contribution of the thematic issue, preceding Collins's response to the articles, is the 'Collins-Reber piece', the specific character and originality of which have already been stressed in section 1. To some extent, this piece is a report of a journey in which two well-established scholars who have studied tacit knowledge for decades, discuss that topic from their different disciplines and individual perspectives. It beautifully illustrates the difficulties scientists encounter when they try to understand each other's intentions, use of terms, meaning of concepts, and main research questions on by and large the same subject. Aside from the particular topic of tacit knowledge, we recommend this article to anyone who is interested in framing, paradigms and incommensurability. Combining imagery from two articles of this thematic issue, we can say that Collins and Reber, after having passed for decades like "ships in the night", finally came to see each other at the horizon, found a way to come closer without crashing, and finally navigated side by side, on the "wide river of tacit knowledge with islands of explicit knowledge popping up here and there and slowly developing into more extensive territories".⁵

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5. The first expression is borrowed from the Collins-Reber's article, and the second from Collins's response to the contributions.

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