Transversal
International Journal for the Historiography of Science

Transversal: International Journal for the Historiography of Science, 1 (2016) 101-115
ISSN 2526-2270
www.historiographyofscience.org

Dossier Ludwik Fleck

Ludwik Fleck's 'active' and 'passive' elements of knowledge revisited: Circular arguments in the medical literature on inflicted head injury in the light of Fleck's epistemology

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Abstract:

A curious feature of medical literature on the evaluation of diagnostic accuracy is the frequent deployment of circular arguments. Using a case study from the medical literature on the diagnosis of child abuse, I argue that this occurs because researchers fail to distinguish what Ludwik Fleck called the 'active' and 'passive' elements of knowledge. I review the scholarly literature on this aspect of Fleck's epistemology to try to understand why it has not been put to more use in the medical literature. Scholars have admitted that Fleck's account of the active and passive elements of knowledge has confused them, and it has been read in at least three different ways: as an extreme form of relativism, as a form of realism, and as a 'middle way' in-between these poles. I argue that this 'middle way' view is both more congenial with the bulk of Fleck's work, and more palatable to medical practitioners.

Keywords:

Ludwik Fleck; active; passive; relativism; non-accidental head injury

Received: 30 August 2016. Reviewed: 23 November 2016. Accepted: 01 December 2016.

Introduction

Ludwik Fleck's account of the 'active' and 'passive' elements of knowledge is an important and under-examined aspect of his epistemology. This aspect of Fleck's work is important not only because Fleck uses it extensively throughout *Genesis and Development of a Scientific Fact* (1979 [1935], 9-10, 40, 49-50, 79, 82-83, 95, 100-101, 141, 178), but also because it is a valuable philosophical tool that can be used to describe and analyse epistemological difficulties encountered in medical practice today. In this paper I describe a commonplace problem encountered in medical research into the accuracy of diagnostic tests, and argue that this problem is the result of researchers failing to recognize that there are active elements of knowledge in addition to passive ones. I also explore some of the many different ways that Fleck's account of the active and passive elements of knowledge have been read by other scholars. These different readings

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will be considered with Fleck's account of the active and passive elements of knowledge in mind, and in the light of the medical problems discussed.

The medical problem to which I refer is the use of circular arguments in medical research into the accuracy of certain observations for the diagnosis of disease. I will illustrate the problem using a paper from the medical literature on the diagnosis of inflicted traumatic brain injury[2]: Ewing-Cobbs et al (1998). This paper examines the diagnostic value of retinal haemorrhage (RH) (bleeding at the back of the eye) and subdural haemorrhage (SDH) (bleeding under one of the membranes that cover the brain inside the skull) for the diagnosis of inflicted traumatic brain injury. Ewing-Cobbs et al (1998) argue that the presence of SDH and RH in an infant who has not been involved in a major traumatic event (like a motor vehicle accident) is highly specific for inflicted traumatic brain injury. To do so, however, they use a circular argument. Despite appearances, their conclusion is not supported by the empirical observations they make. Rather, it is assumed by these researchers in order to carry out the study. In other words, the linkage of SDH and RH to inflicted traumatic head injury is an active element of knowledge, and not the passive result of empirical observation. I will apply Fleck's account of active and passive elements of knowledge to this case study, and argue that if researchers recognised the presence of active elements of knowledge in addition to the passive ones then these difficulties could be avoided.

This failure to take account of the active element of knowledge is quite commonplace in the medical literature on the evaluation of diagnostic tests, and circular arguments are often found in this literature. As Fleck identified the active element of knowledge over eighty years ago, it is frustrating that its existence goes unrecognised today. This may be because Fleck's account has often confused philosophers. Thomas Kuhn, in the foreword to *Genesis*, said that he found Fleck's epistemology problematic, and that "Fleck's occasional attempts to develop it by distinguishing between the passive and active elements of knowledge are to me unenlightening" (Kuhn, 1979, xi). According to Stephen Toulmin "Obscurities remain, in particular, in his distinction between 'active' and 'passive' elements in knowledge, and his claim that the outcomes of science are 'inevitable'" (Toulmin, 1986, 277).

In addition to soliciting confusion, Fleck's account of the active and the passive elements of knowledge has been read in a number of different ways by other scholars. All these different readings relate to the question of whether Fleck's epistemology is an extreme form of relativism. Some readings emphasize Fleck's discussion of the active element of knowledge, and read Fleck as an extreme form of relativist. Such readings say all of the constraint experienced by researchers is the result of social and cultural pressures supplied by the researchers themselves and wider society. Others emphasize Fleck's discussion of the passive element of knowledge, and read Fleck as a form of realist. Such readings present the constraint experienced as the passive element of knowledge as being completely autonomous the active element of knowledge, and fully determine by the way that the 'world in itself' is. Others suggest a more moderate reading of Fleck, which provides a middle way between these realist and relativist poles. I argue that on this view the active element of knowledge is *necessary* but not *sufficient* for the production of the passive element of knowledge, and thus for the production of facts about the characteristics of different diseases. I refer to this reading as the 'middle way' reading, and in my view it is the optimal reading between realist and relativist poles.

After introducing Fleck's account of the active and passive elements of knowledge (section 1), I discuss the difficulties that arise when this distinction is not attended to (section 2). I present the medical case study referred to above (section 2.1), and argue that the circular argument identified in this work results from the failure to acknowledge the active element of knowledge (section 2.2). Following this, I discuss different readings of Fleck's work that have been made in scholarly literature (section 3). I discuss the problems with relativist readings of Fleck's account (section 3.1), and with realist reading of Fleck's account (section 3.2). Finally, I discuss the 'middle way' reading, which I argue is the most helpful both for understanding Fleck and for addressing the medical problem at hand (section 3.3).

[2] This condition has various names, including "abusive head trauma", "non-accidental head injury" and "shaken baby syndrome" (Moran et al, 2012).

The active and passive elements of knowledge

Fleck argued that what the facts are on any matter is not fully determined by the way the 'world in itself' is. As is apparent from the title of his book, Fleck viewed facts as things that were *produced* in particular cultural contexts by groups of people working in society. As others have pointed out (Kuhn, 1979, xi; Heelan, 1986, 287), Fleck's epistemology has a Kantian flavour to it, as he argued that certain preconditions had to be adopted before observers could experience anything. Fleck called these preconditions "active linkages". Groups of observers ("the collective") had to adopt these before they could experience the facts of any matter, which he called the "passive linkages":

> Cognition therefore means, primarily, to ascertain those results which must follow, given certain preconditions. The preconditions correspond to active linkages and constitute that portion of cognition belonging to the collective. The constrained results correspond to passive linkages and constitute that which is experienced as objective reality. (Fleck, 1979 [1935], 40)

Fleck used the example of the fact that hydrogen has an atomic weight of 1.008 atomic weight units to illustrate the relationship between the active and passive elements of knowledge. In the early 1900s, the weight of individual atoms could not be measured directly, but their weight relative to the weight of other atoms could be determined by weighing equal volumes of different gases. In order to measure the weight of a hydrogen atom, it was first necessary to stipulate the weight of another sort of atom that would serve as a standard. In Fleck's day, the weight of an oxygen atom was used as this standard, and this was stipulated as exactly 16 atomic weight units, "if 16 is assumed as the atomic weight for O, oxygen, of necessity the atomic weight for H, hydrogen, will inevitably be 1.008" (Fleck, 1979 [1935], 83). Following the active association of oxygen with the atomic weight 16, it became possible to produce the passive association between hydrogen and the atomic weight 1.008. Active associations are necessary for the production of passive associations and facts.

Fleck recognised that the "origin of the number 16 for the atomic weight of oxygen is almost consciously conventional and arbitrary" (1979 [1935], 83). Most of the time, however, he thought that observers were not consciously aware that they were adopting active associations to produce passive ones. He claimed that usually researchers if asked why it was they had made a certain active association in their research, would answer "Because it is true" (1979 [1935], 102). Fleck argued that observers usually took their own activity for granted, failing to recognise that active associations were adopted due to a social consensus, and not simply as the result of empirical observation. Active associations tended to become "natural and, like breathing, almost unconscious, as a result of education as well as through [their] participation in the communication of thoughts within the collective" (Fleck, 1979 [1935], 141).

Fleck's work focused on the production of facts about syphilis, and he described this in a similar way to the production of facts about the atomic weight of hydrogen. For researchers to produce facts about syphilis, they must first agree about what the disease is. Fleck argued that, in the early modern period, all venereal disease was understood to be a manifestation of the same disease, referred to as the "*carnal scourge*" (Fleck, 1979 [1935], 10). As this was something observers had to *do* before they could make observations of patients with syphilis, Fleck referred to this association made between all patients with venereal disease as an active association: "In our history of syphilis the combination of all venereal disease under the generic concept of carnal scourge was thus an active association of the phenomena" (Fleck, 1979 [1935], 10). Having made this active association, observers could then look and see what the characteristics of patients with the carnal scourge were. Observers could, for example, see whether or not the carnal scourge was cured by treatment with mercury. According to Fleck, treatment with mercury produced mixed results, "Sometimes mercury does not cure the carnal scourge but makes it even worse" (Fleck, 1979 [1935], 10).

One way in which Fleck's epistemology is markedly different to Kant's is that Fleck did not think that all observers necessarily had to adopt the same set of active associations[3]. Different groups of observers could adopt different sets of active associations, and this had the power to change the observations that

[3] Fleck's active element of knowledge has much in common with Kant's *synthetic a priori*, excepting that this *a priori* knowledge was not transcendental, and could be different in different historical periods and for different cultures.

were subsequently made. Fleck argued that at another point in time, syphilis was defined as a disease that got better when treated with mercury. Syphilis was no longer actively associated with all cases of venereal disease, but rather was actively associated with being cured with mercury. If this definition was applied uniformly to all cases[4], the passive consequence of this would be that not all patients with venereal disease would have syphilis, as not all patients with venereal disease would be cured by treatment with mercury, "if the curative effect of mercury were alone decisive [for the diagnosis of syphilis], other venereal diseases such as gonorrhoea and soft chancre should not have become related to syphilis at all, since these remain unaffected by mercury" (Fleck, 1979 [1935], 4).

According to Fleck, active associations are necessary for the production of passive associations, and changing the active associations that are adopted can lead to a change of the passive facts produced. One final feature of the relationship between the active and passive elements of knowledge to which it is worth drawing attention is that Fleck distinguished these different elements according to whether they *obeyed the will* of the relevant group of researchers. Active associations obey the will of researchers, as they are whatever the relevant group of researchers collectively (and most likely unconsciously) decided that they are. In contrast to this, passive elements of knowledge *do not obey the collective will* of researchers:

> The work of the research scientist means that in the complex confusion and chaos which he faces, he must distinguish that which obeys his will from that which arises spontaneously and opposes it. This is the firm ground that he, as representative of the thought collective, continuously seeks. These are the passive connections, as we have called them. (Fleck, 1979 [1935], 95)

Once active associations (such as the 'atomic weight of oxygen is 16', and 'all patients with venereal disease have the carnal scourge') have been stipulated by the collective, the passive associations that then manifest (such as 'the atomic weight of hydrogen is 1.008' and 'mercury sometimes does not cure the carnal scourge but makes it even worse') are no longer for the collective to decide.

A problem from medicine, the diagnosis of inflicted traumatic brain injury in infants

Having introduced Fleck's account of the active and passive elements of knowledge, I can use it to describe the argument presented by Ewing-Cobbs et al (1998). These researchers set out to "characterize neuroimaging, physical, neurobehavioral, and developmental findings in children with inflicted and noninflicted traumatic brain injury (TBI) and to identify characteristic features of inflicted TBI" (Ewing-Cobbs et al, 1998, 300). To do this they inspected a population of children with head injuries to see if they could find characteristics that distinguished inflicted from non-inflicted traumatic brain injury.

Ewing-Cobbs et al (1998) looked at forty children, all under six years of age, who had been hospitalized with evidence of a traumatic brain injury, and who did not have any history of traumatic brain injuries (1998, 300). Before they could inspect these patients to find distinguishing characteristics, they needed to sort the patients in this population into two groups, those with inflicted traumatic brain injury, and those with non-inflicted traumatic brain injury. They discuss how they did this in their methods section:

> In cases of suspected child abuse, determination of whether an injury was inflicted or noninflicted was based on the assessment of the Child Protection Committee at each hospital and Harris County Children's Protective Services. Similar to the algorithm devised by Duhaime et al to detect probable inflicted injury, injuries incompatible with the stated method of injury (eg, bilateral subdural hematomas and retinal hemorrhages with a history of falling from the couch; multiple skull fractures, multiple intracranial hemorrhages, and bilateral cephalohematomas with a history of falling four feet)

[4] Fleck highlights that this definition was not applied uniformly to all cases, as it was only applied to cases in which the disease had spread beyond the genitals, to affect the body more generally: "The mercury idea really concerned the diagnosis only of so-called constitutional syphilis, that is, the stage of generalized disease. The primary stage, properly venereal because of it is localized in the genitals, remained untouched by that idea and was characterized by the idea of the carnal scourge" (Fleck, 1979 [1935], 5). Nevertheless, this change in definition illustrates the effect of changing active associations.

> and unexplained injuries (eg, no history of trauma in conjunction with intracranial injuries and old skeletal fractures) were presumed to indicate assault. (Ewing-Cobbs et al, 1998, 301)

So, in their own words, Ewing-Cobbs et al (1998) *presumed* that the presence of SDH and RH in the absence of a history of a serious traumatic event was strong evidence of assault. Patients presenting with SDH and RH would only be considered as non-inflicted TBI if they also presented with a history of a serious traumatic event. The sort of traumatic event that Ewing-Cobbs et al (1998, 305) considered to be sufficiently serious to cause SDH and RH was a motor vehicle accident. Falls from the couch, falls from four feet, and no history of a traumatic event were not considered serious enough to warrant the diagnosis of non-inflicted TBI. Ewing-Cobbs et al (1998) presumed that they already knew the sorts of events that could cause SDH and RH, and they used these presumptions to sort patients into diseased and non-diseased groups. *In Fleckian terms, the linkage between inflicted traumatic brain injury and the presence of SDH and RH in patients with no history of a serious traumatic event (such as a motor vehicle accident) is an active element of knowledge*.

The argument used by Ewing-Cobbs et al (1998) to distinguish inflicted TBI from non-inflicted TBI can be presented as a simple syllogism. Referring to the patients who were sorted into the abused group as patients 1, 2, 3…etc., this argument can be written out formally as follows:

Argument 1

1. Patients with SDH and RH in the absence of a history of a serious traumatic event have been abused.
2. Patients 1, 2, 3…etc. have SDH and RH in the absence of a history of a serious traumatic event. Therefore (by deduction)
3. Patients 1, 2, 3…etc. have been abused.

Having sorted the patients from the population under investigation into abused and not abused groups, Ewing-Cobbs et al (1998) could then look and see which characteristics could be used to distinguish patients with abusive head trauma from those without abusive head trauma. They found that a number of physical, neurobehavioural, and developmental characteristics could be used in this way:

> Characteristic features of inflicted TBI include acute computed tomography/magnetic resonance imaging findings of pre-existing brain injury, extraaxial hemorrhages, seizures, retinal hemorrhages, and significantly impaired cognitive function without prolonged impairment of consciousness. (Ewing-Cobbs et al, 1998, 300)

Acknowledging that "extraaxial hemorrhages" (i.e. bleeding outside the brain but inside the skull) include SDH, we can see that Ewing-Cobbs et al (1998) concluded that SDH and RH can be used to distinguish inflicted TBI from non-inflicted TBI. They go on to clarify exactly how this can be done in the discussion section of their paper (1998, 305):

> Although retinal hemorrhage was not a variable independently considered, the fact that 70% of the inflicted group and none of the children in the noninflicted group were noted to have retinal hemorrhages supports the selection criteria. Subdural and subarachnoid hemorrhages, which occurred in both groups, did not independently indicate the presence or absence of assault. However, in noninflicted TBI [traumatic brain injury], subdural hematomas were most common in motor vehicle accidents and were not associated with either falls or crush injuries. (Ewing-Cobbs et al, 1998, 305)

Ewing-Cobbs et al (1998) argue that because none of the children in the non-inflicted group had RH, the presence of RH should be taken as strong evidence of assault. They also argue that their results support the conclusion that the presence of SDH can be used as diagnostic for inflicted TBI, so long as patients involved in serious traumatic events (like motor vehicle accidents) are excluded. Ewing-Cobbs et al (1998) argue that this finding is a passive element of knowledge.

Ewing-Cobbs et al's (1998) argument to support the conclusion that SDH and RH can be used to characterize inflicted TBI can be presented as follows:

Argument 2

1. Patients 1, 2, 3…etc. have been abused.
2. Only patients 1, 2, 3… have SDH and RH in the absence of a history of a serious traumatic incident. Therefore (by simple enumerative induction)
3. Patients with SDH and RH in the absence of a history of a serious traumatic event have been abused.

Ewing-Cobbs et al (1998) first distinguish the patients in the population they study with inflicted TBI and non-inflicted TBI (argument 1), and then inspect these groups to see if they can find characteristics that can be used to distinguish patients with inflicted TBI from those with non-inflicted TBI (argument 2). Thus, they use argument 1 and argument 2 in sequence to support their conclusion. It should be immediately apparent that there is a serious problem with the overall argument so produced. In argument 1, Ewing-Cobbs et al (1998) presume that the presence of SDH and RH in the absence of a serious traumatic event is strong evidence of assault, and in argument 2 they claim that they have observed that this is the case. The conclusion of argument 2 is the same as the first premise from argument 1 – the overall argument presented by Ewing-Cobbs et al (1998) is circular. What Ewing-Cobbs et al (1998) claimed as an empirical finding of their study is actually an assumption they made to carry out their study. *They have assumed what they claim to have shown.*

Ewing-Cobbs et al (1998) is not the only study in the medical literature on the diagnosis of abusive head trauma that deploys circular arguments like this one. There are numerous examples of just this sort of circular argument being deployed in this literature (Moran et al, 2012; Högberg et al, 2016). The use of circular argumentation in this literature on the diagnosis of inflicted traumatic brain injury has not gone unnoticed. Researchers drew attention to the problem of circular argumentation in this literature more than a decade ago (Moran et al, 2012, 235-236). Since then, however, dozens of papers on this topic have been produced that deploy circular arguments. According to one recent review "The primary defect is that virtually all the SBS/AHT [shaken baby syndrome/abusive head trauma] literature is circular" (Moran et al, 2012, 274). According to another review "Circularity bias renders the diagnostic value of clinical triad findings and diagnostic algorithms very low" (Högberg et al, 2016). The problem of circular argumentation is widely recognised in the medical literature on the diagnosis of inflicted TBI (Vinchon et al, 2010; Moran et al, 2012)[5]. An incorrect diagnosis can lead to the mismanagement of the patient, to the decision to remove a child from good parents, to the decision to leave a child with abusive parents, and to miscarriages of justice in murder trials. As the allegedly empirical conclusions of circular arguments are not informed by empirical observation, they have nothing to contribute to the question under investigation. Arguments like the one deployed by Ewing-Cobbs et al (1998) do not inform the discussion about how to accurately diagnose child abuse. Attention paid to these arguments by other doctors simply wastes time and effort, and distracts doctors from paying attention to other arguments that might actually inform the question at hand. Even though the circular nature of the arguments presented in much of the research into the diagnosis of inflicted head injury has been identified, this research is still used to support conclusions about how to make a diagnosis of this condition (Högberg et al, 2016). Failure to take account of the circular nature of these arguments means that they can still be used to close down legitimate discussion about how to diagnose child abuse, and this is deeply concerning. Given this, it is appropriate to think more closely about why these circular arguments are produced.

[5] Circular arguments are actually quite commonly deployed in medical literature on the diagnosis of many diseases. Instances of circular arguments can be found in medical literature on rickets (Slovis and Chapman, 2008), fibromyalgia (Yunus et al, 1981; Wolfe et al, 1990), thyroid disease (Gøtzsche, 2007, 80-81), and Cushing's disease (Elamin et al, 2008). Peter Gøtzsche has identified that many studies of diagnostic accuracy exhibit circular logic, and argues that "It is important that the consumer of medical literature is not deceived when medical writers use circular arguments" (2007, 81, 84). This paper goes beyond this descriptive claim by exploring why such arguments are deployed, and suggesting that a more widespread appreciation for Fleck's work can help address this problem.

Forgetting about the active element of knowledge is at the root of this problem

The production of circular arguments can be described and explained in Fleckian terms. As discussed in the particular case of Ewing-Cobbs et al (1998), there are two such stages to all such research. The goal of this sort of research is to compare groups of diseased and not-diseased patients, in order to identify the characteristics that distinguish these two groups of patients. However, not all of these distinguishing characteristics are associated with the diseased patients by empirical observations made during this study – they are not all part of the passive element of knowledge. Before it is possible to inspect these two groups, it is first necessary to divide the population of patients into these two groups. This means that researchers must have some way to distinguish patients with and without disease *before* they carry out their study. The association of some distinguishing features with the diseased group of patients is not the result of observations made during the study, but rather are *pre-conditions* for the study to be carried out at all. These characteristics, that are used to sort patients into diseased and not diseased groups in the first place, are not part of the passive element of knowledge. Rather *they are part of the active element of knowledge*.

If researchers forget that some of the characteristics that distinguish diseased from not-diseased patients are pre-conditions for their work, and thus part of the active element of knowledge, they may then claim to have *observed* that these are distinguishing characteristics when they have done no such thing. This is what Ewing-Cobbs et al (1998) have done. As discussed above, the linkage between inflicted traumatic brain injury and the presence of SDH and RH in patients with no history of a serious traumatic event was an active element of knowledge in this study, which they later claim as a passive element of knowledge. The trouble is that these researchers seem to believe that all distinguishing characteristics of disease are identified by directly inspecting a population of patients. That is, they believe that all knowledge of disease is passive. Fleck's arguments that some knowledge must be active has not been widely accepted. So active associations get treated like passive ones. Consequently, pre-conditions are treated as results, and circular arguments are produced.

If Fleck's account of the requirement to adopt active associations before passive associations could be produced were more widely known and accepted, then the difficulties described above might be avoided. Researchers, armed with knowledge of Fleck's epistemology, might be more inclined to ask 'what is an active element of knowledge in this study?', and thus might confuse the active with the passive less often. This raises the question of why it is that Fleck's discussion of the active and passive elements of knowledge is not more widely known and employed[6]. It is possible this it because Fleck's discussion of this topic has confused readers, as discussed in the introduction. A number of different readings of Fleck's account of the active and passive elements of knowledge have been made, and many of these either have relativist implications that should be unacceptable to practising medics, or fail to address the problem at hand. I now review several readings of this aspect of Fleck's epistemology with the medical problems discussed in this paper in mind.

Reception of the active and passive elements of knowledge
Fleck the relativist

Fleck is commonly read as an extreme sort of relativist, who argued that the facts of any matter are whatever researchers and wider society collectively agree that it is (Harwood, 1986; Shapin, 1986; van den Belt and Gremmen, 1990; Wettersten, 1991; Fagan, 2009, 279-280; Seidel, 2011). Such readings of Fleck's epistemology often appeal to an interpretation of his account of the active and passive element of knowledge. Jonathan Harwood, for example, gives this summary of the active and passive elements of knowledge:

[6] Discussion of the active and passive elements of knowledge is not entirely absent from medical literature. For instance, G.P Pena (2011) has skilfully used this aspect of Fleck's epistemology to describe and reflect upon the development of knowledge of renal allograph pathology. Even so, I argue here that there is much medical research that would benefit from paying closer attention to Fleck's work.

> Active connections are properties of the system under study which are assumed within a thought-style. On the basis of these assumptions, other properties of the system appear obvious or inescapable, 'imposing' themselves upon the observer; these are what Fleck terms passive connections. Active connections have an arbitrary character; passive ones seem necessary. (Harwood, 1986, 184)

As an abstract summary of Fleck's account, this has much in common with the discussion of Fleck's views that I have presented. However, as Harwood fleshes out his interpretation of Fleck, important differences emerge. Harwood dismisses this aspect of Fleck's epistemology as unoriginal and of limited value to scholars in the present day:

> Possibly novel in their day, active and passive are little more than a sociological reformulation of the concepts 'subjective' and 'objective'. That is, active or subjective connections are characteristic of narrowly institutionalized (thus contentious) knowledge-claims. Broadly institutionalized (thus unexceptionable) knowledge-claims embody passive or objective connections. (Harwood, 1986, 184)

Notice that Harwood here reduces the passive element of knowledge to that which is "broadly institutionalized", and thus to that which is agreed upon by all. On this view, objectivity is reduced to universal agreement. The active elements of knowledge, by contrast, are supposedly different to the passive elements because they do not command universal agreement, are more controversial, and seem more subjective. Harwood thus reads Fleck as an extreme form of relativist, for whom knowledge is either obviously arbitrary or is reduced to that which is uncontroversially accepted by the collective. Even "objective" knowledge, on this view, is fully determined by historical, social and cultural decisions about what groups of people believe to be the case.

In a similar vein, Sofia Siwecka (2011, 38-39) has argued that Fleck's distinction between the active and the passive has to do with the perceived strength of the association between concepts. Siwecka (2011, 39) says that the particularly strong connections are the passive ones, and have the status of facts, whereas the active connections are weaker, and are merely considered as hypotheses. She says that the weaker active associations are first to be made, and over time as more and more are made, some grow stronger and stronger. Eventually the passive associations are so strong that they are "transmitted to posterity becoming "certain knowledge" no longer requiring scientific validation" (Siwecka, 2011, 39). Here, passive associations are treated as those that researchers do not (and never think to) challenge.

These readings of Fleck are problematic. As discussed above, it is true that the active element of knowledge sometimes has an arbitrary character (as was the case for the claim 'the atomic weight of oxygen is 16') (Fleck, 1979 [1935], 83). Nevertheless, I showed that Fleck thought that as a general rule, it is the active element of knowledge, not the passive, that researchers see as beyond doubt (Fleck, 1979 [1935], 141). It is the passive element of knowledge, not the active, that researchers see as the result of empirical observation. Nevertheless, aspects of these readings do chime with Fleck's work; specifically Siwecka's suggestion that passive associations can be produced purely by the build-up of active associations over time. Fleck did say that "As any poet knows, a web of fantasy spun for long enough always produces inevitable, spontaneous and formal connections" (Fleck, 1979 [1935], 101). For Fleck, *any* sufficiently complex work of fiction would produce passive associations like those found in science[7]. By drawing such a parallel between science and fiction Fleck does slip into extreme relativism.

John Wettersten, however, has read Fleck's account of the active and passive elements of knowledge as Fleck's attempt to *distance* himself from such extreme forms of relativism:

> A central problem which arises for Fleck's view is how science can be objective. He studies science as a sociological and anthropological phenomenon. But he also sees the need to avoid being carried too far by his approach into a merely relativist point of view. He rejects the view, however, that there are distinguishable subjective and objective aspects of science. He introduces instead the notion of

[7] The main difference between science and myth, according to Fleck, was that myth contained relatively fewer passive linkages: "Myth differs from science in this respect only in style. Science seeks to include in its system a maximum of those passive elements irrespective of inherent lucidity. Myth contains only a few such passive elements, but they are artistically composed" (Fleck, 1979 [1935], 95).

> active and passive aspects. Active aspects are those traits of a theoretical system which are agreed upon but not forced. We explain these aspects with sociological and anthropological laws. They include psychological, emotional, and social elements. The passive elements are those demanded by the framework in which one finds oneself in some society. (Wettersten, 1991, 478)

If this is indeed what Fleck is doing, it provides little to no defence against the charge of extreme relativism, as Wettersten himself argues (1991, 493). If this is Fleck's position, he has merely swapped an epistemology that reduces truth to whatever an individual researcher believes, for one that reduces truth to the necessary consequences of the beliefs of the collective (Seidel, 2011, 236). In both cases, truth is fully determined by what people believe and by nothing else.

Relativist readings of Fleck's epistemology such as these have been very influential. Many scholars have appealed to Fleck's work to support their own extreme relativist positions (Shapin, 1986; Engelhardt, 1996; Cunningham, 2002). Medical facts are not fully determined by what people individually or collectively believe. If they were, then the medical-legal diagnosis of child abuse would always be correct because a court believes that this is the case. It would be impossible for the court to make a misdiagnosis, and there would be no point doing research into what the characteristics of inflicted traumatic brain injury are. Even if everybody (or nobody) believes that a particular medical-legal decision is correct, the consensus view may be mistaken. Something other than consensus opinion must govern what the facts of any medical matter are.

Fortunately, Fleck's lapses into extreme forms of relativism are not representative of the bulk of his epistemological work. Many scholars point to passages where Fleck says explicitly that the facts of any matter are not fully determined by what researchers individually or collectively take them to be. These scholars emphasize that Fleck himself rejected relativism, and often read Fleck as a form of realist.

Fleck the realist

Fleck explicitly rejected the view that matters of fact are fully determined by the social, historical and cultural choices that determine the active element of knowledge. In these two passages Fleck says clearly that what the facts are is not simply a matter of collective psychology:

> These last statements must not, however, be taken to mean that the Wasserman reaction can be reconstructed in his objective entirety simply from historical factors along with those of individual and collective psychology. Something inevitable, steadfast, and inexplicable by historical development is left out of such attempts. (Fleck, 1979 [1935], 79)

> [T]here are always other connections which are also to be found in the content of knowledge that are not explicable in terms either of psychology (both individual and collective) or history. (Fleck, 1979 [1935], 10)

Feeding off Fleck's view that "Something inevitable, steadfast, and inexplicable by historical development" has a role in determining what the facts of any matter are, Steven Toulmin (1986) and Ilana Löwy (1988; 2004) have both argued that Fleck's relativism only applied to the active element of knowledge, and did not extend to the passive element of knowledge. "Fleck did not believe that observations are radically theory-laden and he considered science capable of cumulative improvement" (Löwy, 1988, 135). Löwy does not explain what she means by "radically theory-laden" or by "cumulative improvement", but does cite Toulmin (1986) to substantiate this claim. Toulmin (1986, 279, 281) takes a radically theory-laden fact to be one that is accepted as beyond dispute "because it expresses a conceptual relation actively built into the theories that shape the Denkstil [thought-style] current in the professional thought community concerned". This is a fair description of an active element of knowledge. If this is what Löwy means by "radically theory-laden" facts, then she is quite correct to claim that Fleck did not believe all facts were of this kind, as he argued that there were passive associations in addition to active ones.

However, Toulmin then argues that Fleck saved himself from the absurdities of radical theory-ladenness by arguing that some facts may be accepted as beyond dispute because they "express an empirical relationship that demands passive acceptance from all scientists working in that science

regardless of their current theoretical views" (Toulmin, 1986, 279). This interpretation of Fleck is incorrect. As we have seen, Fleck argued that there was "no firm ground of facts" (Fleck, 1979 [1935], 92). Consequently, scientists were never simply passive when it came to the production of facts. "Not a single statement can be formulated from passive links alone" (Fleck, 1979 [1935], 49). Fleck held that there were no facts of any kind that had to be accepted simply because of the way the world is.

Closer to the present day, Löwy (2004, 438-439, 441) makes a similar claim again. Löwy correctly identifies that, for Fleck, certain elements of our knowledge arise spontaneously and oppose our will – we cannot have things any way we want. But, according to Löwy, Fleck held that "the intrinsic properties of the material world" act independently of any social, historical and cultural factors, to constrain the production of knowledge (2004, 439). She argues that knowledge of syphilis was shaped by the given nature of the human body and of the spirochete that actually causes the disease, quite independently of any social, cultural or historical constraints placed on our knowledge:

> In parallel, the entity syphilis was also shaped by the 'passive resistance' of the material world. There were and are many competing perceptions of the disease 'syphilis', but these perceptions are constrained by intrinsic properties of human beings and of the bacillus Treponema pallidum. (Löwy, 2004, 441)

So for Löwy, the fact that syphilis was caused by *Treponema pallidum* placed an inevitable and ahistorical constraint on our knowledge of syphilis. Löwy equates the passive elements of knowledge with the "*hard residue of material reality*" (2004, 439). Löwy says that Fleck held that scientific knowledge was a "*mixture* [my emphasis] of 'active' and 'passive' elements" (2004, 439). According to Löwy, the active elements provide sociological forces that constrain knowledge. These are therefore historical in nature and change over time. The passive elements, by contrast, are ahistorical in nature and do not change over time (Löwy, 2004, 439).

This, again, deviates from Fleck's own position. For Fleck, even the existence of this spirochete was not an inevitable or ahistorical fact. According to Fleck, our historically contingent understanding of syphilis was not dependent on this spirochete. Rather, Fleck argued that our knowledge of this spirochete was dependent on our historically contingent understanding of syphilis:

> It has already been demonstrated here that Spirochaeta pallida alone cannot define the disease. Syphilis is not to be formulated as the "the disease caused by Spirochaeta pallida." On the contrary, Spirochaeta Pallida must be designated the "micro-organism related to syphilis". Any other definition of this microbe is hopeless, and further, because of the question of germ carriers, cannot serve to define the disease unambiguously. (Fleck, 1979 [1935], 21)

According to Fleck, the passive associations only arise because certain active associations are made. "Every act of cognition means that we can first of all determine which passive connections follow of necessity from a certain set of active assumptions" (Fleck, 1979 [1935], 64). Passive associations are produced by accepting certain active associations, which means that the passive associations will change as the active associations change. This is why Fleck thought that "changes in thinking manifest themselves in changed fact" (Fleck, 1979 [1935], 50). So if the active associations are historical, then so are the passive associations. Active and passive associations are not distinct and autonomous elements that are 'mixed' or 'tangled' together in natural science, as Löwy says they are (2004, 439). Rather, their relationship is a constitutive one; the passive associations are produced as a result of adopting certain active associations.
Löwy (1988) also does not expand on how Fleck's work was supposed to be "cumulative", but Toulmin (1986) uses this term to mean "progressive improvement" (Toulmin, 1986, 282-284). Löwy (2004) does indeed seem to suggest that Fleck's held that scientific knowledge (despite many contingent twists and turns) was heading inevitably towards some ultimate truth. Invoking Fleck's metaphor of a river on its way to the sea, Löwy here argues that the inexorable pull of the physical properties of water and the force of gravity (representing the "intrinsic properties of the material world") will inevitably lead all rivers on disparate courses (representing the knowledge of different historical actors) to the same final location – the sea (representing ultimate truth):

> Thus, each river has a unique trajectory defined by its specific geographic, geological and climatic conditions, but given the physical properties of water and the existence of the force of gravity, 'all rivers end up in the sea'. (Löwy, 2004, 439)

I am afraid that Löwy has misread Fleck's metaphor of rivers ending in the sea (Löwy 2004, 439; Fleck 1979 [1935], 78). For Löwy, the physical characteristics of water and the existence of the force of gravity represent the "intrinsic properties of the material world" (2004, 439). But for Fleck, "the field of gravity corresponds to the dominant and directing disposition, and the water to the work of the entire thought collective" (1979 [1935], 78). The disposition to which Fleck was referring was the will of these researchers to develop a blood test for syphilis. The purpose of this metaphor was to illustrate how it was this will that directed research towards an ultimate destination, and not some pressure exerted by an autonomous "residue of material reality". Indeed, Fleck used this metaphor to illustrate his view that there was no such thing as an ultimate truth for the "intrinsic properties of the material world" to guide researchers toward. "There is no such thing as the sea as such. The area at the lowest level, the area where the waters actually collect, is merely called the sea!" (Fleck, 1979 [1935], 78). For Fleck, there was no such thing as ultimate truth as such. What researchers called the truth was merely where their knowledge ended up after much thought-style directed research and struggling. In order to save him from "radical theory-ladenness" and extreme relativism, Toulmin (1986) and Löwy (1988; 2004) attribute to Fleck a belief in brute facts and absolute truth which Fleck explicitly rejected.

In a similar vein, David Stump has argued that the passive element of knowledge corresponds to the 'world as it is in itself':

> Fleck claims that some elements of science are not creations of a thought collective, and he calls these the "passive element of knowledge"… Therefore, Fleck's dependence on a passive element to account for the objectivity of scientific theory is no better than the view that correspondence with an inaccessible noumena makes our theories true. (Stump, 1988, 305)

If this were true it would make Fleck's epistemology unsuitable for addressing the problems encountered in medical practice described above. If the passive element of knowledge corresponds to knowledge of the 'world as it is in itself', then there would be no need to attend to the active element of knowledge that was adopted to produce it. As discussed above, it is the belief that facts about the characteristics of disease are not "creations of a thought collective" that leads to the production of circular arguments, as this belief leads researchers to forget the active element of knowledge in their work. Fleck, however, argued that no element of knowledge corresponds to the 'world as it is in itself'; and that the notion that we could find that our knowledge corresponds with the inaccessible noumena is incoherent (Fleck, 1979 [1935], 28). "All insistence on the 'essences and things', like all search for the 'thing in itself', would not be natural science at all" (Fleck, 1986, 56).

Fleck's appeal to "Something inevitable, steadfast, and inexplicable by historical development" in his account of the passive element of knowledge has led several scholars to argue that Fleck's views on the epistemic status of facts was self-contradictory. According to Stump, "Fleck wavers back and forth between relativistic language and objective language, but it is not possible for him to define the objective element of knowledge as a passive element because his own position is that it is impossible to separate passive and active elements of our knowledge" (Stump, 1988, 305). Harwood argues that it is contradictory of Fleck to try to explain what researchers see and think by appealing to an active element of knowledge that "'dictates' and 'coerces' how and what a scientist sees and thinks", whilst at the same time appealing to "constraints imposed by the real world" to do the same thing (Harwood, 1986, 182). Henk van den Belt and Bart Gremmen have chastised Fleck for arguing that knowledge is relative to the active element of knowledge whilst at the same time arguing that some of the researchers he studied were wrong to hold the beliefs they did, and argue that Fleck makes a mockery of his relativist aspirations as he does so (1990, 467, 478). Thomas Schnelle argues that "against his own postulates, Fleck, too, ultimately assigns an empirical reality the task of deciding, independently of the presuppositions of the thought-style, what is to be ascertained and recognized as a style-adequate solution, as a style-adequate passive linkage, and as a 'fact'", and therefore that "Fleck must contradict himself" (1986, 253). Despite these concerns, Fleck's account of the active and passive elements of knowledge is not self-contradictory. Rather, it is a coherent and useful epistemology that finds a middle way between less appealing realist and relativist extremes.

The 'middle way'

As discussed above, several scholars have argued that Fleck's work has a Kantian flavour. It is useful to consider the Fleck's discussion of the active and passive elements of knowledge with the Kantian metaphor of the judge and the witness in mind. According to Kant:

> Reason, holding in one hand its principles, according to which alone concordant appearances can be admitted to count as laws of nature, and in the other hand experiments which it has devised according to these principles, must approach nature in order to be taught by it. It must not, however, do so in the manner of a pupil who agrees with everything the teacher says, but of an appointed judge, who compels the witnesses to answer the questions which he himself has phrased. (Kant, 2007 [1787], 16)

In this metaphor, the 'world as it is in itself' is represented by the witness. The experiences of the witness are not directly available to the court. The witness does not simply volunteer testimony to the court. Rather, the judge, representing researchers investigating the world, must ask the witness questions in order to produce testimony. Therefore, the activity of the judge is necessary to produce testimony, which represent the results of empirical investigation. Furthermore, how the judge frames the questions affects the testimony that is produced. The activity of the judge affects the answers provided by the witness. Notice, however, that how the questions are framed does not fully determine the testimony produced. Although the activity of the judge is *necessary* for the production of testimony, it is not *sufficient* for testimony to be produced. How the questions are framed is entirely for the judge to decide, but the testimony that is then produced is not. The judge may even be surprised by the answers the witness gives. Even though the testimony is shaped by the judge's choices about how to frame questions, the testimony still resists the judge's will.

It is helpful to think of the relationship of the active and passive elements of knowledge in this way. The active element of knowledge is equivalent to the judge's decisions about how to frame questions, and the passive element of knowledge is equivalent to the testimony produced. It is only after researchers adopts active associations (such as the 'atomic weight of oxygen is exactly 16', and 'all patients with venereal disease have the carnal scourge') that it becomes possible to produce passive associations (such as 'the atomic weight of hydrogen is 1.008' and 'mercury sometimes does not cure the carnal scourge but makes it even worse'). Active associations are necessary for passive associations to be made, like the activity of the judge is necessary to produce testimony. As discussed in section 1, changes to the active associations adopted produces changes to the passive associations that then manifest; like changes to how the judge frames questions affects the testimony then produced. Even so, the active associations adopted are also not sufficient to determine the passive associations that are produced. Nothing about claiming that 'the atomic weight of oxygen is exactly 16' entails that the atomic weight of hydrogen must be 1.008. The atomic weight of hydrogen might be exactly 1, or 2, or 1.5. Indeed, many researchers in the past expected that this value for hydrogen would be exactly 1, in accordance with Prout's hypothesis. Nevertheless, once the atomic weight of hydrogen is stipulated as 16, the atomic weight of hydrogen does not obey the will of researchers and turns out to be 1.008. Similarly, it might be the case that all patients with venereal disease are cured by treatment with mercury. Stipulating that patients with venereal disease have the carnal scourge does not entail that this should not be the case. Early modern medics may well have expected that mercury would cure these patients. Regardless of the wishes of these medics, mercury turned out not to cure all cases of the carnal scourge. In a manner analogous to the Kantian metaphor above, active associations are necessary but not sufficient for the production of passive associations.

The Kantian metaphor of the judge and the witness is not perfectly analogous to Fleck's account of the active and passive elements of knowledge. One important dis-analogy is that Fleck's account has nothing equivalent to the witness. The witness represents the unknowable 'world as it is in itself', and Fleck rejected all talk of such a thing, and chastised Kant for making use of such this notion (Fleck, 1979 [1935], 28). Happily, researchers do not need such a notion to fend off accusations of extreme relativism. Following Fleck, it is possible to see that once researchers adopt active associations, they can talk about things that are not up to them, without having to talk about the 'world as it is in itself'. It is possible for researchers to find that their will is resisted, without having to worry about what is doing the resisting.

Another important dis-analogy is that Fleck did not believe active associations to be historically transcendent, as Kant believed that synthetic *a priori* judgements were. As discussed in section 1, the active element of knowledge could change over time. This produces something similar to the conventionalist epistemology of Henri Poincaré, and several scholars have read Fleck's work in this way (Giedymin, 1986, 186; Schnelle 1986, 248-253; Sady 2016). It is beyond the scope of this paper to make a detailed comparison between Fleck and Poincaré's epistemologies, but in my view there are enough similarities[8] to claim that this conventionalist reading of Fleck is optimal, and is the 'middle way' view to which I have referred.

Despite the concerns of many scholars raised above, this conventionalist reading of Fleck is not self-contradictory. As the active element of knowledge is necessary for the production of the passive element, no matters of fact are independent of the activity and choices of researchers. Nevertheless, as the active element of knowledge is not sufficient for the production of the passive element, the facts of any matter need not obey the will of researchers. There is no contradiction in saying that there is no truth apart from the decisions made by us as knowers and saying that what is true is not fully determined by what we as knowers wish was the case.

Conclusion

I have argued that circular arguments found in the medical literature on child abuse result from researchers forgetting about the active element of knowledge in their work, and believing that all facts about the characteristics of disease are passive elements of knowledge. To explore why Fleck's arguments that facts are never made up of passive elements alone has not been taken up by medical practitioners, I have reviewed a number of different readings of his epistemology. I found that Fleck's account of the active and passive elements of knowledge has been read in several different ways, and has produced confusion amongst scholars. I have argued that extreme relativist and realist readings of Fleck's account are both unpalatable to a medical audience and less congenial to Fleck's work than a third 'middle way' view. On this view, the active element of knowledge is *necessary*, but not *sufficient* to produce the passive element of knowledge. As the active element is necessary for the production of facts, the facts of any matter are always relative to the active linkages made, and researchers always need to make sure they are aware of the preconditions they adopt in their work. As the active element is *not sufficient* to produce facts, what the facts of any mater are is not fully determined by the social, historical and cultural decisions that fully determine the active element of knowledge. The passive element of knowledge resists the researcher's will. Consequently, factual knowledge does not reduce to what researchers believe to be true, and the pitfalls of extreme forms of relativism are avoided. On this view, Ewing-Cobbs et al (1998) really did produce facts about what they take to be inflicted traumatic brain injury. For instance, they found that "*seizures*" and "*significantly impaired cognitive function without prolonged impairment of consciousness*" were passively associated with this condition. Nevertheless, all parties need to remember that these facts could only be produced by adopting the active association between inflicted traumatic brain injury and SDH and RH.

Acknowledgements

I am very grateful to the organizing committee for the international conference on Ludwik Fleck's theory of thought styles and thought collectives – translations and receptions (Wrocław 2016), particularly Paweł Jarnicki, for their work organizing the conference at which this paper was presented. I am grateful to the Project Science Foundation for their financial support.

[8] Conventionalism is sometimes understood to be a view on which all scientific laws are arbitrarily chosen, but is not Poincaré's view. Like Fleck, Poincaré argued that following the adoption of conventions (which function like the active element of knowledge) allowed researchers to have experiences that are not up to them: "*This convention being given, if I am asked: Is such a fact true? I shall always know what to answer, and my reply will be imposed upon me by the witness of my senses*" (Poincaré, 2001, 324). One important difference between Fleck and Poincaré is that Poincaré appealed to crude facts that are forced on all observers in his epistemology, whereas Fleck argued against the existence of such things. In my view this gives Fleck's epistemology an advantage over Poincaré's.

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