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# FLECK, ANATOMICAL DRAWINGS AND EARLY MODERN HISTORY

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*SUMMARY*

*In 2003, the historian of medicine Michael Stolberg, contested the argument – developed by Thomas Laqueur and Londa Schiebinger – that in the XVIII century, anatomists shifted from a one-sex to a two-sexes model. Laqueur and Schiebinger linked the new focus on anatomical differences between the sexes to the rise of egalitarian aspirations during the Enlightenment, and a consecutive need to ground male domination in invariable "laws of nature". Stolberg claimed that the shift to the two sexes model occurred in the early modern period, and was mainly motivated by developments within medicine. This article examines the 2003 debate on the origin of "two sexes" model in the light of a 1939 controversy that opposed the historian of medicine Tadeusz Bilikiewicz, who advocated a focus on a "spirit" of an earlier epoch, and the pioneer of sociology of science Ludwik Fleck, who promoted the study of the "thought styles" of specific scientific communities.*

## *Introduction: One or two sexes: 1980s vs. 1930s.*

When studying past science, Helene Metzger, a French historian of chemistry proposed in the 1930s, one should became a contemporary of the scientists one investigates ("le contemporain des savants dont il parle")[1]. A sound advice – but how to achieve this goal? One possible way is to try to capture the "spirit of an epoch", and the

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general mood of a given period. A better understanding of economy, politics, social structure or culture of a historical era, however important, may nevertheless be insufficient to explain developments within science. This text discusses a different, and potentially more fruitful approach: a striving to reconstitute as precisely as possible concepts and practices elaborated by a given community of scientists. This approach, promoted in 2003 by Michael Stolberg in his controversy with Thomas Laqueur and Londa Schiebinger, can be linked with the views developed in the interwar period by the pioneer of sociology of science, Ludwik Fleck.

In his book of 1990, *Making Sex,* Thomas Laqueur argued that our understanding of duality of sexes is not "natural" but historical[2]. Feminists opposed in the 1970s a socio-cultural construct – gender – to a natural entity – sex. They did not contest the duality of biological sexes, only its social consequences. The possession of male of female reproductive organs should not determine social roles, rights or privileges. The perception of humanity as "naturally" composed from two distinct and mutually exclusive groups is however, Laqueur explained, a very recent invention. For two millennia there was only one sex – the male – and its inferior version – the female. The dominant view of biological sex focused on similitude between the sexes. Thus the ovary, an organ that in the XIX century became the synonym of "woman", did not have earlier a name of its own. Galen referred to it by the same name he uses for testes: "orcheis". Herophilus employed another word used to describe testes, "didymoi". He also believed that the Fallopian tubes grow from the neck of the bladder, as do the spermatic ducts in men. Galen's view was more in agreement with today's understanding of female anatomy, but he too described male and female reproductive organs as variants on an identical structure. He saw vagina as an "interior penis", and believed that uterus was similar to scrotum and ovaries to testes. Until the XVIII century, a woman was depicted as a man turned outside in, a configuration that was not

entirely irreversible. Laqueur quotes a series of cases, taken from early modern medical books, that show that in exceptional circumstances (for example, being stricken by a thunderbolt), a woman could "externalise" her reproductive organs and became a man.

The nature of "nature" changed however in the late XVIII century. From flexible and benevolent, nature became rigid and was governed by immutable, eternal laws[3]. In parallel, scientists and doctors dramatically modified their understanding of sexual differences. In the second half of the XVIII century, the relation of women to men was one of opposition and contrast, and the sexes became different in every conceivable aspect of body and soul. This "natural" difference between the sexes was grounded in anatomy and physiology. By consequence, descriptions of male and female sexual organs accentuated their dissimilarities. "La petite différence" became an ironic expression that pointed to the existence of a huge disparity. Laqueur explains the shift to two sexes hypothesis by the need to legitimate the subordination of women in the new political climate of the Enlightenment. The statement that, as everybody can see, men and women are totally different, was necessary because it justified the maintain of sexes in separated spheres[4]. In his popular book *The Evolution of Sex,* of 1889, the British zoologist and social reformer Patrick Geddes, explained thus that women who want to achieve legal and political equality between the sexes, fail to understand the absurdity of such an entreprise. To attain such an equality:

> *it would be necessary to have all the evolution again on a new basis. What was decided among the pre-historic Protozoa cannot be annulled by the act of Parliament*[5].

Laqueur's 1990 book reproduces anatomical illustrations from early modern anatomy books that present male and female genital organs as mirror images, a persuasive argument in favour of his

thesis about the omnipresence of "one sex hypothesis" [6]. These illustrations are employed today to display the historical construction of our "self-evident" and "commonsensical" view of biological sex, or to quote Laqueur, to show that "destiny is anatomy", not the other way round. Already in 1935, a Polish Jewish doctor and a pioneer of a sociological approach to the study of science, Ludwik Fleck, had shown that early modern authors depicted female sexual organs as a mirror image of the male ones. Fleck's study, *Genesis and Development of Scientific Fact,* reproduced two anatomical drawings, one by Andreas Vesalius (1642), and another by Thomas Bartholin (1673), the same images that are at the centre of Laqueur's argument. Fleck was not interested, however, in the switch from "one sex" to "two sexes" view, but in the influence of the – collectively acquired – preconceived ideas of the observer on the observation s/he makes:

> *In an Amsterdam transcription by N. Fontanus of Vesalius's Epitome, the uterus is illustrated on p.33 with the following legend on page 32: "Question: How does the seed enters the woman during ejaculation if the womb is so tightly closed that even a needle cannot enter through it according to Hippocrates, book 5, aphorisms 51 and 54? Answer: "Through a branch leading from the ejaculatory duct entering the cervix of the uterus, as this illustration shows." The idea of a fundamental analogy existing between male and female genitals, as held in antiquity, is exhibited most effectively here, and illustrated as if occurred in nature. Anatomists will notice immediately that the proportion of organs, as well as the corresponding positioning, has been restyled to conform to this theory. Truth and fiction, or perhaps better, relationships that have been retained within science and others that have disappeared from this structure appear here visibly side by side. The duct labelled S, "through which the woman became impregnated by the seed ejaculated at the time of intercourse" is typical, and is indispensable to this theory of analogy. Although unknown in modern anatomy, it is pictured in early anatomical descriptions in a style appropriate to this theory – right among other excellent data and observations*[7].

Laqueur and Fleck became intrigued by the same anatomical illustrations and interpreted them in the same way, but provided very different explanations for the shift from a worldview that stressed similarities between male and female genital organs to a one that accentuated their differences. Laqueur affirmed that this shift was grounded in political developments, and the need to contain women's demands of equality by naturalising gender hierarchy. Fleck proposed a – seemingly – more modest explanation: scientific observation always reflects the observer's "thought style", or, to put it in more recent terms, is "theory laden", a statement that we may see as trivial today, although it was surely not trivial in 1935. My text compares Laqueur's and Fleck's arguments. These two thinkers were separated by a continent and two generations: Fleck died in 1961, while Laqueur graduated from college in 1967. However, in 1939, Fleck had a lively exchange of views with a Polish historian of medicine, Tadeusz Bilikiewicz, an author of a "Laqueur-like" explanation of scientific change: the links between Enlightenment philosophy and the understanding of human fertilisation. Using this controversy I'll attempt to show that Fleck's proposal to focus on study of "thought collectives" and "thought styles" can help us to transcend broad and often vague generalisations about "style of an epoch" and uncover a precise meaning of past developments in science.

## 1. *One versus two sexes: when, why?*

Lacquer's 1987 discussion of the shift from one to two sexes opens by the statement: "sometime in the late XVIII century human sexual nature changed"[8]. The view that woman is a man turn outside in was challenged, and scientists proposed a new model, the one of radical difference between the sexes. The transition to "one sex model", Laqueur argued, did not stem from new anatomical findings, because the anatomy of men and women was already extensively studied in the early modern period. Moreover, in the XIX century embry-

ology displayed common origins of male and female sexual organs. Looking from the point of view of embryogenesis, early modern anatomists were right. Developments within science are thus not the explanation for the "one sex, two sexes" switch. Scientists did not look into anatomical differences between the sexes until these differences became politically important:

> *the new biology with its search for fundamental differences between the sexes and its tortures questioning of the very existence of women's sexual pleasure, emerged precisely at the time when the foundation of the old social order were irremediably shaken, when the basis of a new order of sex and gender became a critical issue of political theory and practice*[9].

In the Enlightenment, the call for universal human rights opened the way for egalitarian claims. At the same time, a biology of hierarchy grounded in a metaphysical "great chain of being" was replaced by a biology of incommensurability. The relationship of men and women, previously defined in terms of equality or inequality, became redefined as "difference", while the precise meaning of this difference became the locus of interpretations and struggles[10]. In this process, the physician *cum* scientist replaced the priest as the moral preceptor of society. The political, economic and cultural transformations of the XVIII century, Laqueur concluded, created the context in which articulations of radical differences between the sexes became a cultural imperative[11].

Laqueur's views might have been stimulated by the publication, a year earlier (1986), of an influential paper by Londa Schiebinger on the origins of anatomical representations of female skeletons[12]. Schiebinger claimed that in the XVIII century images that stressed anatomical similarities between the sexes were replaced by ones that accentuated differences. She further developed this argument in her 1989 book, *The Mind Has No Sex? Women in the Origins of Modern Science*[13]. Schiebinger argued that until the XVIII century anatomists

drew male skeletons only, because they believed that men adequately represented female skeletons too. However, in the XVIII century, scientists started to focus on the biological differences between the sexes and found that such differences are expressed on every level of the female body. Accordingly, male and female skeletons were used to produce and reproduce contemporary ideals of masculinity and femininity. At the same time, anatomists were convinced that they did not need to take a moral stand. The body spoke for itself, and nature, and not man, created inequality between sexes and races. August Comte, among others, agreed. In his *Cours de philosophie positiviste* he argued that study of anatomy and physiology demonstrate that radical differences, at once physical and moral, profoundly separate one sex from the other[14].

In 2003, Schiebinger and Laqueur views were challenged by the historian of medicine Michael Stolberg. Stolberg accepted the claim that anatomists replaced "one sex model" with a "two sexes" view, but contested the timetable proposed by Schiebinger and Laqueur[15]. The shift to the two sexes model, he proposed, occurred much earlier, in the late sixteen and the XVII century. If exact, Stolberg analysis invalidates Schiebinger's and Laqueur' central argument, namely that the rise of the two sexes model was inseparably related to the emergence of new perception of women during the Enlightenment. Stolberg grounded his argument in a detailed analysis of early modern representations of skeletons in German speaking countries. Such skeletons already showed strong sexual dimorphism. The rise of the "early modern female skeleton", Stolberg proposed, may be related to several non-overlapping developments: the shift to religious views that focused on the purpose of each creature; the replacement of humoral perception of bodies with an approach that stressed the importance of solid structures; the abandon of the ideal that linked scholarship to celibacy and its consequence, the growing importance of the role of scholars' and doctors' wives; finally, the

rise of the medical practice of gynaecology, sustained by a belief in essential differences between the male and the female body[16].

Both Laqueur and Schiebinger dismissed Stolberg's critique. Laqueur reiterated his earlier claim that the "one sex" model was valid until late XVIII century. A few exceptions might have existed, but they were precisely that – exceptions. The two sexes model became the norm for scientists and physicians only in the second half of the XVIII century, as a consequence of a sharp increase in cultural and political pressures on the gender system. At that time, a passionate and sustained interest in the anatomical and physiological dimorphism of the sexes provided a response for the collapse of religion and metaphysics as final authority for social arrangements. A new epistemology had arisen, in which the body was the final arbiter and not an imperfect sign, and biology was expected to produce gender roles rather than merely reflect them[17].

Londa Schiebinger similarly argued that the early modern female skeleton was an exception rather than a rule. Some anatomists did produce such skeletons but the early female skeletons were a rarity, while they became the norm in the XVIII century. Or, it is wrong to judge fundamental shifts in scientific culture merely by "firsts". Moreover, these early female skeletons had a different meaning. They were a description of the diversity of human bodies rather than a statement on the nature of human society. Sexual dimorphism was recognized in earlier periods, but only in the XVIII century male and female bodies were resexualized along profoundly different lines from those of the Galenic word. Accordingly, the XVIII century anatomists who produced "typical" female skeletons were convinced that they are doing something entirely new[18]. New ways of looking at bodies, Schiebinger and Laqueur insisted, were the result of radical shift in politics and in culture, that is, something that happened on a macro-level and that induced a global change in the world view of Enlightenment scholars.

Tadeusz Bilikiewicz held similar views. Major shifts in scientific views of earlier periods reflect global changes in the epoch's world view. Fleck disagreed. He did not contest that such global shifts in world view shifts may occur and that they may affect the ways scientists observe natural and phenomena. He argued, however, that change in science cannot be explained solely by such sweeping developments. In order to understand specific development in science, one should above all study carefully concepts and practices of well defined communities of scientists – or, in his terms, the "thought styles" of specific scientific "thought collectives".

2. *Fleck, Bilikiewicz, and the debate on nature of scientific observations*

Ludwik Fleck (1896-1961), a Polish Jewish physician, immunologist, and pioneer of sociology of science, was rediscovered thanks to an image of an early modern skeleton in his book. In his preface to the English translation of *Genesis and Development of a Scientific Fact*, Thomas Kuhn explained that he discovered the existence of Fleck's quasi-forgotten monograph, while reading Hans Reichenbach's *Experience and Prediction*, a book that reproduced two illustrations from *Genesis and Development of a Scientific Fact*[19]. Reichenbach's view of reality was, Kuhn added, the very opposite of Fleck's one, and he borrowed the images of human skeletons published in *Genesis and Development* to make a very different point. Nevertheless, Kuhn was intrigued by the title of Fleck's monograph and looked it up in the Harvard Library. In the preface to the second edition of his *Structure of Scientific Revolutions*, Kuhn named Fleck as one of the thinkers that had inspired his book, thereby attracting attention to Fleck's study[20].

Fleck uses multiple examples, mainly taken from his own branch of scientific investigation, in order to demonstrate that observation cannot be separated from the "thought style" of the observer, while the latter is shaped by a given community of scientists ("thought

collective"). The term "thought style", one should add, is misleading. In Fleck's text this term includes all the elements that shape perception and cognition: knowledge taken for granted and mental habits, but also specific training of scientists and their material practices: experimental models used, instruments and reagents, and the collectively accepted way to evaluate new evidence.

The idea that observations, and, more specifically anatomical observations, are shaped by the observer's preconceived ideas was already expressed by Zygmunt Kramsztyk (1848-1920), a Polish physician and philosopher of medicine whose writings, in all probability, informed Fleck's views[21]. Observations, Kramsztyk explained, depend on the observer's aims. Even an everyday observation is a highly selective process:

> *walking through the woods, a botanist will focus his attention on moss and mushrooms, a forester will estimate the diameter and height of trees, and possible profits that could be obtained from them, a painter will take an interest in form, colours, light and shadow, a hunter will search for game, and a child will only look for berries*[22].

Directed and goal-oriented scientific observations depend even more on the goal of a given study and on the observers' preconceived ideas[23]. Thus, the "simple clinical facts" observed by doctors are strongly affected by their pre-existing views:

> *Last year, two scholars, Bitzos and Abadie, published two new but entirely different theories of glaucoma in Archives d'Ophtalmologie. Today, every theory of glaucoma must also cover iridectomy, and must explain why this operation removes the symptoms of the disease. One of the theories claimed that iridectomy can be effective due to the cutting of the iris plexus nerve, while the other conditioned the positive effect on the removal of the major part of the secretory area. Consequently, one author affirmed that iridectomy will be successful only when it has covered the middle part of the iris, in which the plexus nerve is present, and that a positive effect*

> *would be obtained even if we limited our action to cutting through the iris. This was presented as an unquestionable clinical fact. For the other author, the observation that iridectomy is conditioned by the total area affected, and that it is more effective the greater the section of the iris that is removed, whether at the infra iris region or in the circumferential area, is a clinical fact. At least one of the authors must be wrong, although both of them express their opinions in perfectly good faith. However iridectomy has been performed so frequently and for so many years, that in all probability all its variants and effects are already well-known. It may be concluded that clinical facts are difficult to interpret, they can be easily misinterpreted, and they are perceived by us through the prism of theories*[24].

There is no such a thing as a truly neutral clinical observation, Kramsztyk explained, because:

> *the observer's mind is not a blank sheet, but contains many general ideas and many pieces of information that are unconsciously transferred to the observed facts. The observer, who views nature with his "mind's eye" notices above all those phenomena which are consistent with his previous knowledge and overlooks all the others. He may even observe non-existent phenomena if they are necessary to confirm his views*[25].

Drawings in atlases of pathology illustrate the central role played by pre-existing knowledge in shaping perception. Such drawings are usually presented as a faithful record of a doctor's visual impressions. In fact, however, they always incorporate the observer's presuppositions about the observed phenomena. Preconceived ideas led to the selection of certain specific visual elements and the rejection of others. For this reason, one cannot dissociate observation from understanding and interpretation. Illustrations in atlases of pathology are always shaped by physicians' views of a given disease at the time the picture is drawn, and they tend to become quickly outdated for precisely this reason. Occasionally, one can even accurately deduce the publication date of an atlas from the way its depicts

a given pathology[26]. Medical observations, Kramsztyk concluded, are always molded by the observers' view:

> *the physician's attention is usually directed towards the phenomena that he has been trained to see, those with which he is familiar, and those which are the most frequent*[27].

Fleck consolidated and extended Kramsztyk's insights on the ways the observer's preconceived ideas and "readiness of mind" shape the – supposedly neutral – scientific and medical observations. However, on one crucial point Fleck took a very different direction than Kramsztyk did. While Kramsztyk's thoughts on science and medicine were centred on individual practitioners, Fleck promoted a view of science as a collective endeavour and a social institution. Observations and interpretations made by scientists are shaped by the use of shared language, instruments, techniques and experimental systems, by the division of labour in laboratories, by the hierarchical structure of science, by rules that govern scientific publications, and by the systems of professional rewards for scientists. The popular image of the "solitary genius", Fleck argued, is a myth, and a view of science focused exclusively on the analysis of individual efforts, *epistemologia imaginabilis*. Accordingly, the only way to study science is to focus on specific "thought collectives" and to follow their endeavours.

Fleck published his opus magnum, *Genesis and Development of Scientific Fact*, in 1935 (it was published in German in Basel). The book had a lukewarm reception in Poland. Professional philosophers, but also professional historians of medicine, criticized Fleck's – (supposed) relativist stance and his unorthodox style of argumentation. Nevertheless, some fond his approach stimulating. In the 1930s, Fleck was able to diffuse his ideas in Polish medical and philosophical journals. His debate with Tadeusz Bilikiewicz was printed in a maga-

zine destined to a general cultivated public, *Tygodnik Wspolczsny* (The Modern Weekly). Flecks published there in 1939 a paper "Science and social context". Bilikiewicz wrote a detailed comment on that paper. Fleck provided a lengthy answer to this comment, and Bilikiewicz reacted briefly to Fleck's reply. Their exchange allowed Fleck to clarify his view of scientific "thought styles" [28].

Bilikiewicz (1901-1987), studied medicine and philosophy, and in 1926-28, travelled to Leipzig to specialize in psychiatry. He met there Henry Siegerist, one of the leading historians of medicine in the interwar era and the head (from 1928 to 1932) of the Institute of History of medicine in Leipzig (other important scholars in that institute were Karl Sudhoff and Owsei Temkin), and decided to write a thesis in history of medicine[29]. Thanks to Siegerist's help, Bilikiewicz obtained a Rockefeller fellowship that allowed him to stay three years at the institute and to write a thesis (directed by Sigerist) on "Embryology in the Baroque and Rococo Periods". The main argument of this study was that scientific views of the XVIII century reflected broad socio-cultural developments. Thus, the description of spermatozoids as autonomous, freely moving entities was related to the decline of absolutism, and the position of ovists, who attributed the principal role in embryogenesis to the egg, was related to the growing role of women in the French court society[30]. Upon his return to Poland, in 1933, Bilikiewicz was unable to obtain a full-time position as historian of medicine. He participated in teaching of this discipline at Krakow University, and published historical articles in the main journal of the Polish community of historians of medicine, *Archives of the History and Philosophy of Medicine,* but his main source of income was his work as psychiatrist (after World War II, he was appointed to the chair of history of medicine at Gdansk University). His later historical studies were less innovative than his thesis. He mainly wrote biographies of XVII and XVIII century Polish doctors.

The controversy between Fleck and Bilikiewicz is organized along two axes. One is a more "classical" debate on relativism. Bilikiewicz believed that there is an absolute, unique scientific truth, while Fleck claimed that the term "scientific truth" is valid only within the framework of a given "thought collective". The second, and probably more original axis of their debate is methodological: both Fleck and Bilikiewicz agreed that development within science are affected by "external elements", but each pointed out to different elements that need to be studied in order to understand scientific change.

Let's look at the controversy about scientific truth first. Bilikiewicz argued that social context influences the content of science, but only when scientists are unable to conduct a "methodologically correct" scientific investigation, that is, one that can answer specific questions through the application of an appropriate scientific method. His doctoral thesis displayed the role of the board social and cultural context on the understanding of fertilisation and embryogenesis in the XVII and the XVIII century. Such influence existed, however, only because the human mind had limited cognitive ability. When humans move from cognitive objects that are relatively easy and simple to more complex and difficult ones, they are obliged to use less accurate and more creative methods. As they advance towards the unknown, their mind are exposed more and more to the action of numerous external factors. At this point cognition is strongly affected by patterns created in the researcher's mind by his social and cultural environment. Such patterns can predetermine the form, style and direction of a cognitive process. This is, however, a necessary evil, not a structural necessity. The goal of science is to gradually eliminate social and cultural influences. In this respect, scientific creativity is very different from artistic creativity. While the latter gives free rein to imagination, the ultimate aim of science is to free itself from external influences and to uncover truth about laws that govern natural world. Historians of science should therefore strive

to separate what is proved to be scientifically true from what is proven to be false. Studies of thought styles, Bilikiewicz concludes, are especially useful for the understanding the origins of erroneous scientific ideas.

Fleck rejected the assumption that an "objective scientific truth" is independent of external factors. He opened his text "Science and social context" with the statement that the problem of the relationships between the two,

> *is not only the dependence of the conditions of scientific work on the social context, but, above all, the dependence of the very substance of science, its problems, views and factual data*[31].

Such dependence is inseparable from the very structure of science. Fleck strongly disagreed with Bilikiewicz's statement that scientific creativity is very different from artistic one. For him both scientists and artists depend on their specific "thought collective", and the main difference between them is the density of interactions in their relative "thought collectives". This is a difference of degree, not of essence:

> *the artist translates his experience into certain conventional material by certain conventional methods. His individual freedom is in fact limited. By exceeding these limits, the work of art becomes non-existent. The scientist also translates his experience, but his methods and materials are closer to a specific (scientific) tradition. The signs (i.e., concepts, words, sentences) and the ways in which he uses these signs are more directly defined and are more subject to the influence of the collective; they are of more social and traditional character than those used by the artist. If we call the number of interrelations between the members of a collective "social density", then the difference between a collective of men of science and a collective of men of art will be simply the difference of their densities: the collective of science is much more dense than the collective of art. The obstacles hindering the scientists in his free creation, the so called 'hard core of reality' with which he is confronted in his work, results from this very density*[32].

The notions of truth and falsehood, Fleck adds, cannot exist outside thought styles that generated them:

> *I'm not claiming that "one and the same statement" can be both true and untrue for "A" and "B", respectively. Provided that "A" and "B" participate in the same thought style, the statement will be either true or untrue. But when they have different thought-styles, there will be no such a thing as "the same statement", for one of them will either interpret the other's statement in a different way, or will be unable to understand it at all*[33].

An approach grounded in the study of thought collectives, Fleck proposes, eschews the fruitless search for the "thing in itself". Such a search is totally meaningless when dealing with contemporary science (or, to use Latour's expression, technoscience) that heavily relies on the use of increasingly complicated instruments and techniques. Scientists who penetrate ever deeper into objects, find themselves more distant from the "things", and closer to "methods", because it is not possible to disentangle "scientific fact" from instruments and practices that shaped it[34]. The complex process of genesis of such facts can only be grasped through a study of the thought styles of specific scientific thought collectives.

The second axis of the Fleck-Bilikiewicz controversy is the debate on the role of "style of an epoch" in studying science. Bilikiewicz claimed that Fleck is not familiar with methods used by historians: "Fleck frequently employs historical material, but not for a moment he ceases to be a natural scientist". A true historian, according to Bilikiewicz, strives to remain attuned to the elements in the style of a given period that create specific sensibilities, as well as to correspondences between sciences, philosophy and arts. He pays attention to broad cultural issues such as sensibility, customs and trends. The personal style of people who live in a given period often reflects the style of an epoch and the one of their social and cultural milieu. Historian's task is to

uncover the general elements that affect a period's style, but also to the multiple ways individuals react to that style.

Fleck did not deny the existence of general cultural trends and admits the possibility that such trends affect scientists, but argued that the term "style of a period" is much too vague to be useful for a historian of science. It is important to investigate links between society and science, but "the approach employed by the majority of authors is artistic and literary rather than scientific; it consists of intuitive feelings of similarities". Bilikiewicz viewed performationism and mechanism in biology as analogous to contemporary absolutism, and linked the development of individualism with the discovery of spermatozoa. Now, for Fleck an approach that attempts to uncover the "spirit" of a given epoch is much too vague and indeterminate, and is not sufficient to explain specific developments in sciences.

If one wants to avoid the pitfalls of vague associations and excessive generalisations one should, Fleck proposes, focus on specific thought communities and on their development, interrelations, counter actions and co-operation in different periods. Through the study of scientific thought styles, that is, for Fleck, studies of well defined patterns of production and validation of knowledge in specific disciplinary communities,

> *we may come closer to the problems of a given field and their solutions…we avoid being pushed into dry ideological doctrine and we attain a science of cognition rich in details and capable of cultural growth. It seems to me that it is less important to study entire concepts and theories, such as, for example, the embryological evolutionism of the XVIII century, than to analyse individual sentences of a text or to analyse an unknown code*[35].

Writing on early modern anatomical illustrations, Fleck failed to apply his own prescription. His explanations are grounded in broad assumptions about the way doctors of that period viewed human bodies. His descriptions of images of skeletons and sexual organs are limited to

general statements, such as the importance of the observers' preconceived ideas, or the proposal that one needs to pay attention to the precise meaning of words in an ancient text, and they did not attempt to uncover the conditions that led to production of specific images or texts. Bilikiewicz's critique was not groundless: Fleck indeed lacked the skills of a professional historian. By contrast, when writing about his scientific own scientific disciplines, bacteriology and immunology, Fleck provides detailed and insightful analyses of specific disciplinary practices. The third chapter of *Genesis and Development of a Scientific Fact* develops such a fine grained analysis of circumstances that led to the elaboration of the Wassermann reaction for the diagnosis of syphilis and to the rise of a new scientific community – the one of serologists. In another work, Fleck described how differences between the "style of practice" of biochemists and epidemiologists create different definitions of a pathological bacillus, and thus different and incommensurable "scientific truths"[36]. Only such detailed case studies, Fleck proposed, can elucidate the relationships between "science" and "social context".

3. *Investigating early modern "thought styles"*

This text compares Fleck's criticism of Bilikiewicz's approach to Stoller's criticism of Schiebinger's and Laqueur's views. Fleck recognized that Bilikiewicz's hypothesis that linked the search for individual freedom and changes in women's status with new understanding of human reproduction, was interesting and stimulating. He criticized it however for being too imprecise, grounded in literary analogies rather than in a precise demonstration. When extracted from rhetorical formulations and considered soberly, Bilikiewicz's statements fail to convince. His study did not explain why XVIII century scientists made specific cognitive choices and rejected other, equally plausible, solutions. Moreover, Fleck added, sweeping generalizations grounded in a belief that a "style" of a given period

directly shapes scientific cognition may legitimate the subordination of scientific investigations to ideological imperatives, alas a very concrete danger in 1939:

> *clever politicians process as rapidly as possible the newly-acquired information into demagogic slogans. The sociological, collective nature of knowledge was first turned into a political slogan involving the social and class conditioning of science, and then the competing political trends created the spirit of nation and race to provide a mythical world-view, propagated through ages. Now, since all science depends on the environment, the process should be reversed and a suitable science should be developed to fit the artificially modified environment. There is no objective science anyway. Consequently, left wing or right wing, proletarian or national physics, chemistry, etc., should be "made" as soon as possible; we will fabricate evidence to obtain politically necessary and predicted results*[37].

Historians, anthropologists and sociologists of science attempt today to uncover as many specific links as possible between "science" and "social context". The latter, as defined by Fleck, includes not only a broad world view – or "style" – of a given period, but also, or rather above all, the specific material and social conditions that shape scientific concepts and practices. These elements may be – relatively – easy to retrieve when one deals with recent science, characterized by a high density of interactions between researchers, multiplication of publications and other written traces, and abundance of material artefacts[38]. This task is much more difficult, however, when dealing with the early modern period. Historians who study the science of that period are obliged to rely on a relatively small corpus of documents that often can yield partial information only. Nevertheless some experts on early modern science also adhere to a "Fleckian" point of view, and privilege, as much as possible, detailed case studies over sweeping generalisations.

In his controversy with Laqueur and Schiebinger, Stollberg strived to take into consideration elements that might have shaped practices

of doctors that produced anatomic drawings. He attempted to link early drawings of female skeletons to changes in the ways clerics, naturalists and doctors described human bodies, the growing role of physicians' wives, and the rise of a new medical specialization – gynaecology (or rather women's medicine). His arguments is, however, still grounded in general assumptions about developments within medicine, not in a precise demonstration that linked biographies of authors of specific anatomical illustrations to their scholarly production. Such a demonstration is perhaps impossible. The existing sources may be insufficient to fully understand the precise circumstances that led to the production of the first drawings of "female skeletons". In other cases, however, historians may be able to uncover biographic and prosographic details that can illuminate the practice of early modern scientists and doctors, but also shed light on the process of scientific change. Fleck's call to study "science as it is, not as it ought to be"[39] – that is to investigate practices developed in a specific site and historical moment, by a well-defined group of scientists outlines a methodological principle that may be of interest for scholars of early modern science too.

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