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A meta-history of science and methodology of the history of science urgently needed!

(1) The problem

In studying, researching and writing about the history of science we are forced to encounter many fundamental problems of a meta-theoretical and methodological character. However, this subject-mater is in principle neglected in literature of the branch. On the contrary, an analogous subject-matter (but not the same!) is discussed by historiography or "the methodology of history", also often called "historical methodology" (but the latter meaning is broader than the former!). A simple logic proof follows.

When we look for the terms "historiography of science" / "historiography of the sciences" and "historiography" on the Internet WWW (using Google as a browser, for example), we can find about *28,000* (but, in principle, without detailed discussions of the subject) and *7,190,000* websites (in part of them we find detailed discussions of the subject), respectively.

A similar occurrence takes place with the related terms "methodology of the history of science" / "methodology of history of science" (18 websites, including one of our Cracow conference sites, but few of them analyse the problem!), "relations between history and philosophy of science" (8), "philosophy of the history of science" (32) and "interpretation of the history of science" (96), since we can find about 21,200 websites with the term "methodology of history", 92,200 websites with a related term "historical methodology" and 570,000 websites on "philosophy of history" (the meanings of these terms are not identical to one another!).

Furthermore, when we search for the expression "how to write the history of science?", we can find 5 websites with the wording (including the website of the Cracow conference, with information on our symposium R-19, and one essay on the topic). However, when we repeat operations with the expression "how to write history?", we can find about 12,900 websites (and, in a part of them, we may find detailed discussions of the subject). Using a similar procedure, we can find 36 websites with "to understand the history of science" and about 58,800 websites with "to understand history".

Thus, we observed above that the term "historiography" is used statistically most often. But even in this case, we may come across an example which may illustrate an urgent need of discussion of the topic. An example of this, outlined on the website of the Cracow Conference, is expressed in the following question: "How should we understand the term historiography?". This term is often restricted in literature to (1) "the study of the way history has been and is written" or to (2) "the history of historical writing" or to (3) "the study of history seen in the light of ideological and philosophical systems". Among these three meanings, the third is the most interesting. We see that it does not apply to all histories written by all historians, and in this sense we cannot say that every history is always a historiography written from a theoretical or philosophical point of view. However, this notion would be incorrect. Why? Because, in fact all histories written by historians are always theoretically and philosophically laden. The only difference consists in the degree and type of this load. Of course, one may negate this thesis but, such a negation is ultimately based on an illusion that the historian is able "to research history directly" (through the use of "so-called" primary sources) as well as "to create purely descriptive re-constructions of history" (through the use of only "hard historical facts" or "pure facts", free of any theoretical or philosophical interpretation or generalisation).

Why should knowledge pertaining to such illusions be important for historians of science? Because ultimately its lack creates great obstacles in the research of and the teaching of the most subtle and crucial questions, including geneses of scientific discoveries and their receptions. To avoid

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such problems we should try to apply the history of science in a conscious way. But how can we realise this goal? Only by cultivating our research as well as teaching meta-historical and methodological considerations![1] Let us consider some of these crucial issues, below:

(2) Some crucial issues of a meta-historical and methodological nature

For many people, the history of science is a very simple or even trivial research branch which doesn't demand any special abilities from a researcher, such as, creative thinking or the use of mental energy. Therefore, the practise of the history of science seems to be limited to a passive collecting of facts.

In this sprit of thinking about the history of science, which is pleasing to all supporters of the positivistic illusion of 'pure facts' (that is facts free of any philosophical components) and of technocratism (so alive in many parts of the world), where the question "What is the history of science?" is simply trivial. In fact, it is a crucial and fundamental one. However, thought the question sounds simple, it is not easy to answer. Of course, we may state that the history of science is a specific branch of knowledge, whose nature is determined by the natures of two branches: both history and science (i.e. all scientific branches). But such a brief answer may seem to be too trivial or too brief for most people. To avoid this problem one might try to say something about the history of the historiography of science.[2] However, to formulate a more precise answer to the question mentioned above, I will deal here with matters of the meta-history of science or methodology of the history of science. While undertaking this, I also will try to answer for series of more detailed questions, such as "What is the object of the history of science?", "Who will research this object?", "What does the research consist of?, "What are the results of research?, "To whom are of the results of research addressed?" or "Who is the target audience?", and "What is the goal of the research?". Moreover, upon answering these questions, I will try to outline some of the main issues and problems necessary for an understanding of the specific character of the history of science. (Notice, that answers for distinct questions join and overlap each other.)

(2.1) Object

The objects of the history of science are the historical sources about science (in its historically changing meaning), such as *writings*, *instruments*, *buildings* ... They are divided to three groups: (1) *primary sources* (i.e. materials that are from the time period that a researcher is discussing), (2) *secondary sources* (i.e. studies about historical sources; which were written after the time period a researcher is studying and seek to analyse the facts of that time) and (3) *auxiliary sources* (studies of auxiliary branches).

Notice, all of the types of sources mentioned are needed to properly support historical research, including *secondary and auxiliary sources* written specifically *in countries with a long tradition* of research of these problem... (These are crucial requirements for the objectivity and internationalism of research.)

(2.2) Researchers

People who are interested in researching the history science do not constitute one fixed group. Among them we may differentiate: (1) *scientists*, that would include scholars of exact and natural sciences (mainly retired), (2) *historians*, (3) *philosophers*, (4) *philosophers of science* (including supporters of internalism or externalism; recently: specialists of rhetoric and cognitive theory), (5) *historians of ideas*, (6) *sociologists of scientific knowledge*, (7) *psychologists of scientific discovery*, (8) *popularizers of science* (*science journalists*), (9) *translators* and (10) *historians of science*.

It would be idyllic for all researchers of the history of science to join all of the professional workshops mentioned above and treat them as complementary to one another. However, one cannot over exaggerate this point and should carefully distinguish the different perspectives outlined above in

[1] Note, this is in contradiction to common habit , in which the term "an introduction to the history science" is always understood in English literature as *an outline of all of the history of science* (of all events, discoveries, measurement instruments, ...).

[2] See, for example, Engelhardt (1979), Cooter (1985), Crosland (1985), Easlea (1985), Gooding (1985), Hall (1985), Hendry (1985), Pickstone (1985), Porter (1985), Schaffer (1985), Shapin (1985), Shortland, Warwick (eds.) (1989), Secord (ed.) (1993), Golinski (1998b), and Secord (2004).

one's own scientific activities. For example, it is worth noting that popularisation of the history of science (e.g. preparing texts without necessary citations: notes, appendixes, bibliography) is something very different from professional works in this field.

(2.3) Research

All research is always based on a *hermeneutics, whether* applied consciously or unconsciously by a researcher. And what is a *hermeneutics* applied by a researcher? It is:

> "all the interpretative tools used by the researcher at the stage of her / his repeated attempts to comprehend the subject under study".

A hermeneutics aims to "open" or "decode" the meanings of primarily "closed" or "coded" sources of information. Therefore a hermeneutics and 'an actual content of sources' are analogous to a well-matched key serving to open a closed lock. In other words — and speaking figuratively still — a hermeneutics is something more than only a mere type of telescope, microscope, oscilloscope or echo-sounder applied by us to comprehend searched themes, it is a rather a foresight or mental imagery in our studies. For example, when we study the history of the exact sciences, these interpretative tools may include knowledge of the exact sciences, of the methodology and philosophy of the exact sciences, of general philosophy, of the sociology of scientific knowledge, and of the psychology of scientific discovery.

All research in the history of science concerns a multitude of places and times. This concept is a determining factor in some complementary strategies of research.

Concerning the aspect of place, either a local analysis or a global analysis are applied. The former includes analyses of the scientific school (as a set of pupils), university, city, nation and country; the latter — of a group of countries, continents and all world. Making local and, especially, global analyses, we should assume an attitude of internationalism (that is free of any nationalism or centralism).

Concerning the aspect of time, a synchronic analysis or a diachronic analysis are applied. They are complementary to one another and equally important in our research. Notice, the latter may be progressive (when, starting from certain past events and ideas, we move forward in our analyses) or retrograde (when we move back in our analyses from certain events and ideas). In this point the researcher must be sensitive to the problem of anachronism (presentism, Whiggishness), its uses and abuses.[3]

A hermeneutics may also include the "so-called" historiographic methods or approaches (the latter term is much better): (1) a biographical approach, (2) prosopography (including description of research schools), (3) scientists' histories, (4) a sociological approach (social construction of scientific knowledge, together with the anthropology of the laboratory), (5) scientometric historiography, (6) the experimental history of science, (7) feminist approaches, and, (8) national styles in science.[4]

It is worth noting that this is an essential feature of a hermeneutics applied by a researcher. It predetermines one's research and the essence of their written works (their reporting of research). In consequence, the more subtle these hermeneutics are, the more detailed and precise results which are achieved by research will be.[5]

Let us give one example to better explain the problem. It is true that science, seen in a historical perspective, may be considered from various other perspectives, such as methodological, philosophical, technological, cultural, social, ... However, it is a grave misunderstanding to assume (in regards to hermeneutics applied by a researcher) that all aspects of science may be explained through the terms of sociology. (This error is often committed by social historians of science.)

[3] On *anachronism* see Jardine (2000a), (2000b), (2003).

[4] See Kragh (1987).

[5] For more details see Kokowski (2001), p. 6–8.

(2.4) Results of research

The results of such research are all the effects caused by the use of the hermeneutics of research. They include (1) *understanding* (expressed or not expressed in a written form), (2) *written works* (published or unpublished), (3) *reconstruction of instruments*, (4) *measurements using archaic instruments or their modern re-constructions*.

To *written works* (unpublished or published) we include: (1) *professional works* (written by experts in the field), (2) *didactic works*, and (3) *popularising works*. They may have different forms, for example: (1) *a monograph* (i.e. a academic treatise on a finite area of study), (2) *a book consisting of a collection of papers* (on a small or larger area of study), (3*) a paper*, (4) *a review*, (5) *a research report*, (6) *a letter to editors of magazines* (with, among others, a polemic on statements made by other researchers, on any topic).

Note, each text (such as scientific, historical or literary text) consists of four key elements. It includes: (1) *the literary form of the text* (*genre and type*), (2) *the information stratum of the text* (base information) — data, names, titles of works, ..., (3) *the hermeneutics of text (explanation)* — all means applied explicitly or implicitly in text to interpret the subject under study, (4) *the rhetoric of the text (persuasion)* — all means serving to convince the reader of the expounded theses.

In this context some problems appear, such as: the difference between a literary narrative and a historical one, the issue of constructivism and narrativism of a historical narrative, the issue of general terms and periodisations, and the narrative substances (such a "revolution", "evolution" or "progress") in a historical narrative, the myth of "hard historical facts" or "pure facts" (free of any theoretical or philosophical interpretation or generalisation) of a historical narrative; the truth of so-called "historical sentences" and historical narrative. Such matters are considered with great care by specialists of general historiography, for example, Topolski (1968), (1978), (1998). Nevertheless, these matters have a very specific character when they are considered in the field of the history of exact sciences. It is caused by an existence of the (real) methods of these sciences.[6]

Furthermore, the construction of a historical narrative based on certain episodes of the history of science is contingent on whether its author's educational background was, for example, as: a historian or/and a historian of science, or/and a sociologist, or / and a philosopher, or / and philosopher of science, or/and a scientist. (Note, it is not a problem of anachronism.) In consequence, if, for example, we are only historians and sociologists of science we may only write sociological history of science in a professional way. Then, if such interpretations of the history of science have more ambitious aims, they are one-sided at best or even entirely wrong (as, e.g., the Strong Programme of sociology of knowledge).[7]

It is worth noting here, yet another point of a great importance: popularising works are often mistaken for professional works. It seems that the literary form we call 'an essay' is responsible for this. Let us read the following three quotations:

> What is a history paper? A history paper is an essay. As such, it shares many characteristics with essays on other topics. Essays come in various shapes and sizes, and no two of them are alike. Each, though, expresses an opinion. A piece of writing merely describing something or explaining how something works, is not an essay. An essay always conveys its writers viewpoint. In an essay, a writer never simply explains or describes. Instead, she makes an argument, and provides a reasoned array of evidence to back up her opinions. (Todd F. Carney, *Guide to Writing History Papers* (1996), (2004), see the web site: http://www.sou.edu/history/carney/writing.htm).

> [Essay —] a short prose composition on a subject; an attempt (*The Oxford Reference Dictionary* [Oxford: Clarendon Press, 1991], p. 279).

> [Essay —] a study on a subject touching this subject in a subjective way and joining elements of artistic, scientific and journalistic prose (*Encyklopedia PWN w trzech tomach* [Warszawa: PWN, 1999], vol. I p. 578; the quotation translated by M.K.).

[6] Since the times of Thomas S. Kuhn's and Paul Feyerabend's criticisms of scientific methods, many historians and philosophers of science and sociologists of scientific knowledge treat this issue as a mere myth, Which is a great oversight. See Kokowski (1999c).

[7] I am not alone in expressing this view. See Heilbron (2002).

In my opinion, a history paper (including a paper on the history of science) that is written as an essay may be a very good popularising paper but, surely, it is not a professional paper (compare the last quotation, above). Similarly, one of the best-sellers among books on the history of science, that being *The Copernican Revolution: Planetary Astronomy in the Development of Western Thought* by Thomas S. Kuhn (1st ed. 1956, 8th ed. 1984; and many reprints) is a popular book on the level of laymen, not a professional monograph on the topic.[8]

(2.5) Addressees of results (target audience)

Works on the history of science have different target audiences, such as (1) finite group of experts, (2) students, (3) secondary and primary pupils, and (4) educated laymen. In consequence, works directed to different audiences should be written in different ways, with a different degree of attention to detail, and use of a different critical apparatus (such as notes, appendixes, bibliography, illustrations, indexes of names, terms, and places).

However, in these times subject to the rule of the popular culture, this natural and justifiable division is often neglected and works on the history of science are written for mass media audiences. In consequence, they are written on a very popular level and lacking the necessary amount of detail.[9] It is a wrong approach. One must remember that the history of science — as an analysis of the process of development of science (including scientific discoveries, etc) — is always a very complicated matter. Therefore, it should first be analysed in detail on the level of the expert.

(2.6) Aim of research

The aim of research is to show science in a historical perspective, and this perspective must be based on historical sources.

Though this answer sounds very simple, its realisation is very complicated. It is caused by the fact that science analysed through the use of historical contents is always very complex. (It is only a delusion of amateurs that science was simple in the past.) To have a good understanding of science researchers must examine all of it different minute aspects (such as its essence, its genesis, and its reception; its social organisation); and its various relationships with other parts of culture (such as philosophy, religion, the arts, politics and society, and technology).

(3) Conclusion

In studying, researching and writing about the history of science we encounter many important historiographic problems, that are both meta-theoretical and methodological in character. Together they constitute a distinct field of study, a branch called the historiography of science. One must stress that this branch of knowledge should be the basis of every introduction to the history science. The cultivation of a good foundation in the historiography of science is a good way to avoid various naiveties (in the spirit of the "Science Wars") which have come to reign in the history of science in recent years.

In this context it is still worth of remembering the New Humanism of George Sarton, which unified the humanities and the sciences (in the spirit of the third Culture of Snow) constituted a foundation for introducing the history of science as a university discipline in the United States.

> As opposed to the old humanists who deliberately increase the gap between science and the humanities, the main purpose of that new education would be to bridge the gap and to close it as much as possible. The solid literary and artistic basis and the insistence on the historical point of view even in the scientific courses would oblige the more scientifically minded to consider more carefully the non-scientific aspects of life; on the other hand the frequent explanations of the scientific method by men familiar with the history of science and with all the vicissitudes of human progress, would enable the more literary minded to

[8] I analysed Thomas S. Kuhn's views on the Copernican revolution (with their genesis and reception) in my doctoral dissertation in detail. See my monograph on the theme: Kokowski (2001) (it is an extended version of my doctoral thesis), and http://www.cyfronet.pl/~n1kokows/kuhn_en.html with information on this book. It is the only monograph on this topic in world literature.

[9] This is the case with many works today, for example, on Copernicus and the Copernican revolution.

understand the spirit of modern civilisation. To be sure such results could not be attained at once, nor even to-morrow, for they would necessitate the existence of instructions able to unite the scientific and the historic points of view, and such instructors cannot be produced on short notice. However, I can imagine a time when no one will be allowed to teach history whose scientific ignorance has disqualified him to understand its inwardness (Sarton (1956), p. 135–6).[10]

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[10] Note, ideas formulated on the basis of English language: the dichotomy of the "two cultures" ("science" – "the humanities and social studies"), and the "third culture" (that surmounts this dichotomy) were the cornerstones even of Sarton's first works on the *New Humanism* [see Sarton (1918), ..., (1956)]. The same terms "two cultures" and "the third culture" were introduced many years later by Charles Percy Snow [see Snow (1956), (1959)], but without mention of the existence of Sarton's works, already known at that time. Thus, in Kokowski (2001), p. 54–5 fn. 47, and p. 318–319, I proposed the use of "the two Sarton – Snow cultures" and "the third Sarton – Snow culture" instead of the primary terms "the two cultures of Snow" and "the third culture of Snow".

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