Doc. dr hab. Michał Kokowski

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STRESZCZENIA REFERATÓW WYGŁOSZONYCH NA KONFERENCJACH MIĘDZYNARODOWYCH:

Michal Kokowski

COPERNICUS' ASTRONOMICAL WORKS - THE REMARKABLE CASE OF APPLYING THE CORRESPONDENCE RELATIONS. IN THE DEFENCE OF COPERNICUS' SCIENTIFIC METHODOLOGY.

10th International Congress of Logic, Methodology and Philosophy of Science (19-25.08.1995, Firenze (Italy)), Section 6: Methodology

Many eminent twentieth century historians and philosophers of the so-called exact sciences, for instance, Duhem, Sarton, Butterfield, Dreyer, Koyre, Kuhn, Solla de Price, Neugebauer, and Swerdlow, appreciated Copernicus's astronomical achievements and his scientific method very critically. Therefore it seemed sound the conclusion explicated by Cohen in 1989: "If there was revolution in astronomy, that revolution was Keplerian and Newtonian, and not in any simple or valid sense Copernican."

Appreciated methodology, history of the so-called exact sciences, epistemology, philosophy of scientific discovery, theoretical physics, and mathematics very much, I see the considered issue in a completely different way.

In the first place, I hold that the creative theorists, like for instance: Bohr, Einstein, Heinsenberg, Schrodinger, who search and sometimes find the new theories of certain phenomena that preserve, in a certain region of the modeled phenomena, the numerically adequate already predictions of the old theory, use the same scientific method. I called it the hypothetico-deductive method of correspondence thinking (HDMCT). Its parts there are the hypothetico-deductive method (HDM) and the method of correspondence thinking (MCT). The core of the HDM there are the different kinds of scientific hypotheses and of deductions. The core of the MCT there is the methodological idea of correspondence (of theoretical magnitude and measurable one; of laws; of theories). Its parts there are the correspondence postulate (of laws; of theories) and its a concrete realization certain correspondence relation (of laws; of theories), among others, the real correspondence principle, and the imaginary correspondence principle. The important part in the HDMCT is played also by the limit correspondence equivalence (of laws; of theories). Furthermore HDMCT is the general method of the progress of the so-called exact sciences.

In the context of the HDMCT is defined the simple condition of scientific revolution. If certain correspondence relation of theories is realised, the scientific revolution occurs. This revolution, according to the importance of these theories, is global (the macro-revolution) or local (the micro-revolution).

Going to Copernicus issue we found on the ground of our own methodological, historical and mathematical analyses, that Copernicus, searching for the more general theory than Ptolemy's one, used not only HDM but also MCT in a systematic way. Hence he used HDMCT. Moreover, he do it in the same style as, for instance, Newton, Einstein, Bohr, Heinsenberg. Why do I think ? Since it appears that Copernicus' theory is linked with Ptolemy's one by some correspondence relations. They are the methodological heart of Copernicus' theory. Copernicus used this method considering, for example, the place of the earth in the Universe, the height of the firmament (that is the radius of the Universe) the planetary theory in the longitude and, especially, the theory of the long-period motions. In this last case, analysing, for instance, the change of the ecliptic longitude of the fixed stars (and the dependent functions) and the change of the angle created by the earth's equator and the ecliptic (and the dependent functions) he used the real correspondence principle; the main correspondence parameter there are t/T_{NUP} and $t/2T_{NUP}$ respectively (t - time, T_{NUP} - the fundamental constant equal to 1717^{ey} (Egyptian years of 365 days)).

That is why we find the clear proof that Copernican revolution was the genuine scientific revolution. But it was not the first scientific revolution and Copernicus was not the first scientist who used HDMCT at all.

Michal Kokowski

TO AVOID TRIVIALITY: SOME DIFFICULTIES IN TEACHING THE HISTORY AND PHILOSOPHY OF PHYSICS AT THE EDUCATIONAL CURRICULUM OF PHYSICS.

7th Biennial Conference "History and Philosophy of Physics in Education (August 21-24, 1996, Bratislava (Slovakia)

Though there exists a really great need to incorporate the history and philosophy of physics at all levels of an education of physics, nevertheless, it is not a easy task to teach them at all.

Firstly, note, that the term "physics" has different connotations during the History. According to Aristotle, physics (theory of change, among others, of local motion) is, in principle, deeply unmathematical. Contrary, the so called mixture sciences, that is the mathematico-physical sciences as astronomy, optics and music (acoustics), are deeply mathematical.
Such mathematical level, statics (and hydrostatics) obtained thanks to Archimedes, and kinematics, theory (of local) motion, thanks to Galileo. But today, optics, acoustics, theory motion and, for instance, astrophysics and cosmology belong to the same discipline which is called physics. Moreover, today, cosmology is an exact analog of astronomy developing since ancient Greece to modern times. Both these disciplines discuss about the global structure of the Universe.

Secondly, though, it is truth, that physics step by step develop more exact, more general theories, nevertheless, it does not mean at all, that modern methodological tools and methodological conscience itself must be deeper than historical ones. It is common truth that the hypothetico-deductive method (HDM) and the correspondence principles (CP) are products of modern times. But it is an historico-philosophical mistake.

The HDM was consciously used yet by Hellenic and Hellenistic mathematicians (astronomers, opticians, theorists of music, mechanists). And the CP played very important part in the Medieval and Renaissance astronomy. A great example is given by Copernicus' works [*Commentariolus* (ca. 1508) and *De revolutionibus* (1543)]: some correspondence principles (of sort of Bohr's ones) links Copernicus's and Ptolemy's astronomical theories.

Michal Kokowski

DEFENDING COPERNICUS SCIENTIFIC METHOD

XXth International Congress of History of Sciences (20-26.07.1997, Liége (Belgium),
Section 7.2: Physics and Astronomy in the Classical Period (1543-1800)

The Copernicus scientific method was many times depreciated in the 20th century within the context of different trends of the history of science (from the history of the so-called mathematical astronomy, by the philosophico-sociologico-psychological history of science, to the recent studies on rhetoric in science).

But, from a scientific point of view, it appears that this method was a rather well, since the exactly same was used, for instance, by Bohr, Einstein, Planck and Schrödinger in their searches for regularities of certain groups of considered phenomena.

This method, called, the hypothetico-deductive method of correspondence thinking (hereafter, HDMCT), is composed of two strictly connected parts: the hypothetico-deductive method and the method of correspondence thinking (*Korrespondenzdenken*). Its essence lies in framing mathematical models of observed phenomena that "save" these phenomena. This aim is realised by: (1) an introduction an adequate mathematical language and adequate hypothetical quasi-entities; (2) an generalisation theories hitherto existing by usage: (a) an correspondence postulate and a correspondence principle (of Bohr's type) of new and old theories; (b) a squaring of a theory with phenomena by usage appropriate constants of models determined with measurements. Moreover, within the context of this method is defined a simple condition of scientific revolution: if a certain correspondence principle of theories is realised, the scientific revolution occurs.

Copernicus used the HDMCT systematically in his search for a more general astronomical theory than Ptolemy. He made it for instance in the following cases: (1) analysing the issue of the dimension of the Universe, and the related question of the horizon; (2) reversing Ptolemy's critical argumentation against the possibility of the earth's daily rotation that used the idea of natural and violent motions and the centrifugal force; (3) considering the question of the optical relativity of the local motion; (4) framing the theory of the short and medium- period phenomena as, for instance, the apparent planetary motions, especially, (as this Copernicus says) rejecting the Ptolemy's equant; (5) framing the theory of the long-period non-uniform phenomena as, for instance, precession.

Considering these questions, Copernicus used systematically, among others, the correspondence postulate and the correspondence principle (of sort of Bohr's ones), and made thought experiments. For such reasons, Copernicus scientific method must be highly appreciated: especially, Copernicus's "neoplatonism", "poetics" and "rhetoric" are much more scientific than it one seemed. Moreover, since Copernicus's and Ptolemy's theories are linked by some correspondence principle of Bohr's type, contrary to famous historians of the so-called mathematical astronomy, we must state that the Copernican revolution was not only a global, conceptual, cosmological, philosophical revolution, but also a scientific one. On the other hand, Copernicus was not a father of the HDMCT, and the Copernican revolution was not the last or the first global, conceptual, cosmological, philosophical and scientific revolution. Before Copernicus, the HDMCT was used by mathematicians since at least the global Greek revolution (that discovered the idea of *cosmos*) with its sub-revolutions as: Eudoxian (4th C.B.C.), Euclidean and Archimedean (3rd C. B.C.), Ptolemean (2nd C.), Thabitean (9th C.), Alpetragian (12th C.), Maraghian (13-14th C.) etc.

Michal Kokowski

HOW, IN WHAT SENSE, AND WHY DID COPERNICUS DISCOVER THE MOTIONS OF THE EARTH?

International Congress on Discovery and Creativity (14-16.05. 1998, Gent, (Belgium)

Part.1. How?

It is, to some extent, a complicated question. To answer it properly let us differentiate five stages of the scientific development of Copernicus.

First stage: Copernicus studies at: University of Cracow (1491-1495), University of Bologna (1496-1500), and University of Padua (1500-1503); during his stay in Bologna, he assists Domenico Maria di Novara. Thanks to these opportunities, he knows very well the contemporary problem-situation in astronomy (the troubles with saving phenomena by the Ptolemy's model of the motions of the Moon; the question of rejecting the equant by usage the so-called „Tusi-device"; the question of: calendar reform or motions of the eighth sphere or model of the long-period phenomena) and philosophy of nature (Averroes's critique of Ptolemy's theory: the question of equant, and the question of existence of the epicycles in the Heavens; the Buridanistic critique of Aristotle's physics; the Pythagorean idea of the motions of the Earth together with the Buridanistic detailed discussion of the question of possibility of the Earth's motions).

Second stage: He accepts some important elements of the Buridanistic critique of Aristotle's physics including Buridanists' new physics, and similarly as Nicholas of Cusa, he interprets this new physics in a geometric way. Moreover, at the core of his research programme, he assumes the hypothesis of the mobility of the Earth and discusses motions of the Earth as „real" (in a scientific meaning of the term).

Third stage: He writes the very important page of notes in the *Alphonsine Tables*, and, (circa 1510), the *Commentariolus* - the first sketch of his theory based on the cosmology of mobile Earth. Considering here the questions of motions of the planets, of the sphere of fixed stars, and of the Moon, he focuses his attention on the question of geometricizing the short-period phenomena (and on the question of spatial relations), and only sketches the idea of proper solution for the long-period phenomena. Moreover, for short-period phenomena, he accepts, in principle, data given in the *Alphonsine Tables*. Thus, his models of short-period phenomena should save phenomena only for short interval of time when observations used in the *Alphonsine Tables* were made. However, he is not interested in getting of the exact values of parameters of his models. Just therefore, he approximates them. As a consequence, his models of short-period phenomena save approximately phenomena for data given in the *Alphonsine Tables.* Moreover, considering the question of the long-period phenomena, he assumes (together with Renaissance astronomers) that there exist very long-period changes of astronomical phenomena. So his models must be based on all known fundamental observations made from ancient to contemporary times inclusive.

Fourth stage - the years of observation: 1512-1529. He observes carefully lunar eclipses, altitudes in the meridian, oppositions, alignments, conjunctions, and occultations to find parameters of models in his own times.

Fifth stage - the years of writing the *De revolutionibus*: 1530-1543. He develops geometrical models to save short- and long-period phenomena and, in some degree, to fix spatial relations of the "new" Universe. The results of these searches are given in the *De revolutionibus*.

Part.2. In what sense?

The answer is easy: Copernicus discovered the motions of the Earth in the same sophisticated way as, for instance, Albert Einstein discovered that the curvature of the space-time depends of the matter distribution.

Part.3. Why?

The answer is clear: Copernicus used the hypothetico-deductive method of *Korrespondenzdenken* (correspondence-oriented thinking), and made it in the same methodological style as the greatest theoretical physicists, for instance Einstein.

To clarify this answer let us add what follows. The method mentioned above is a combination of the hypothetico-deductive method (with modified, broad understanding of the term „deduction" that, for some methodological reasons, links the terms „induction", „abduction", „analogy", and classically and narrowly understood the term „deduction") and the method of *Korrespondenzdenken* that uses the conceptions of the correspondence postulate and the correspondence principle. This combination enables both effective mathematicizing the regularities of phenomena (that are observed and measured in certain ways) and also explaining them.

Michal Kokowski

IN DEFENCE OF THE METHOD OF PHYSICS: THE HYPOTHETICO-DEDUCTIVE METHOD OF *KORRESPONDENZDENKEN*

11th International Congress of Logic, Methodology and Philosophy
of Science (20-26.08.1999, Cracow (Poland)), 10. Philosophy of Physical Sciences

Under the influence of T.S. Kuhn (1962) and P.K. Feyerabend (1975)[1] a number of contemporary thinkers - as they say - in advocating the interests of history of science, have became adherents of the trends of thought named: *Strong Programme of Sociology of Knowledge*, *Destructivism, Rhetoric of Science*, and *Science in Context.* All these currents assert unanimously that there is nothing such as a scientific method and a solid scientific truth.

The scientific method and all scientific truths are historically changed and determined not by the Nature but by social and cultural contexts: group interests, agreements and commitments. Thus scientific activity itself and its outcomes have only a conventional character.

But careful research in the field of the so-called exact sciences [i.e. all disciplines that create mathematical models of (observed and measured in a certain way) phenomena] which is focused on the issue of the scientific practise and scientific discoveries, both historical and contemporary ones', falsifies the views mentioned above. Thus, agreeing with an opinion of physicists such as S.Weinberg, A.Sokal, J.Bricmon, and P.Anderson[2], I say there does exist the scientific method.

Furthermore, my own philosophical thesis is that the **H**ypothetico-**D**eductive **M**ethod of ***K****orrespondenz****D****enken* (correspondence-oriented thinking) - HDMKD is the method of the so-called exact sciences.[3] This method is composed of two penetrating parts: the **H**ypothetico-**D**eductive **M**ethod - HDM and the **M**ethod of ***K****orrespondenz****D****enken* - MKD.

The former is a general introduction to the scientific method. It considers, among other things, the issue of a scientific hypothesis and a scientific realism, the question of scientific reasoning and argumentation like the idea of deduction (as it is understood commonly), induction and abduction, (after Kant and Planck) the idea of the absolute truth and the Nature as regulative ideas showing the aim of researches, the idea of pictures of the Nature - unfinal theories of phenomena, the idea of reductionism, correspondence and emergency, the issue of theoretical change, the principle o undetermination by data, the issue of theory-ladenness of facts, and the question of a scientific revolution.

The later specifies the scientific method of the so-called exact sciences. It concentrates on more quantitative aspects and ponders, among other things, over the issue of a correspondence principle and a correspondence postulate of Bohr's type, and the question of measurement instruments.

On this ground I say for instance. HDMKD determines the progress of physics (understood in a broad sense as the synonym of the so-called exact sciences).

Within the context of this method, the simple condition of a scientific revolution is defined. If a certain correspondence relation of theories is realised, a scientific revolution occurs. This revolution, according to the importance of these theories, is global (a macro-revolution) or local (a micro-revolution).

There are three complementary approaches in developing physics: reductionism, correspondence and emergency. Scientists who are dreaming on a final theory - on a theory of the Nature always frame limited, non-perfect and non-final theories - only non-perfect, mean pictures of Nature. But, along with the progress of physics, step by step, these theories become deeper, more unified, and by that they better seize the Nature itself.

While using this method as a hermeneutics of a scientific text of broadly understood physics we may precisely show, for instance, how N. Copernicus discovered the motions of the Earth[4], how S. Weinberg unified weak and electromagnetic forces, and even how theoretical biologists framed mathematical models of biological phenomena[5].

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[2]S.Weiberg, *Dreams of a Final Theory* (1992)*;* A. Sokal, J. Bricmon, *Impostures intelectuelles* (1997); P.Anderson, 'Historical overview of the twentieth century physics', in: L. M. Brown, A. Pais, B. Pippard (eds.) *Twentieth century physics*, (1995), vol. III p.2017 - 2032.

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Michal Kokowski

NICOLAUS COPERNICUS AND THE INTERDISCIPLINARY PROBLEM OF INTEGRATION…

Science in Europe–Europe in Science: 1500–2000 (Maastricht, 4-6 November 2004)

NICOLAUS COPERNICUS (1473–1543), a Renaissance man, with no exaggeration may be regarded as a leading figure in European integration understood in all possible contexts and aspects (scientific, philosophical, political, economical, sociological, linguistic…).

He was born and lived nearly all his life in Royal Prussia, including Varmia (in those times the remote parts of the Polish Kingdom). But, from 1490 to 1494, he studied philosophy (liberal arts, natural philosophy, ethics, and metaphysics) in Cracow University (in those times Cracow was the capital of the Polish Kingdom). Then, he continued his studies in Italy: from 1496 to 1499, he learned canonical law in Bologna University. In 1500 (the jubilee year proclaimed by the pope), he was in Rome (serving his apprenticeship in canon law at the Roman Curia). From 1501 to 1503 he studied medicine in Padua University, and on 31 May 1503 he received his doctor degree in law in Ferrara University. Then, after his arrival to Prussia, as a canon of the Varmia Chapter, he performed various duties: he was a physician, secretary of a bishop, administrator, economist, commander of the defense of Olsztyn in the war 1520-1521 against the Tautonic Order... . Meanwhile, he wrote some astronomical works that rendered famous his name.

The questions sketched above are very well known, and it is easy to comprehend them properly. In contrast, an appreciation of Copernicus's originality—a crucial problem in contemporary Copernican studies—is more complicated and subtile. Nevertheless, the issue needn't be reserved only to experts.

Two main motifs exist in this research. First are general considerations regarding the rationality or irrationality of Copernicus's discovery of the motion of the Earth. Second are detailed analyses of mathematical models of astronomical phenomena provided by Copernicus in the *Commentariolus* and *De revolutionibus*, and their comparison with analogous models invented by medieval Islamic astronomers. The first commanded the attention of philosophers and historians of science interested in the philosophy of scientific discovery and other scholars interested in rhetoric and dialectics. The second drew the attention of historians of mathematical astronomy. These two groups of researchers differed on many questions. Nevertheless, it was virtually dogma for both of them, and also for many 20th-century scientists as well as the 16th- and 17th-century Aristotelians, that Copernicus did not formulate any (conclusive) proof for the motion of the Earth. (This is a crucial thesis, since it makes Copernicus's originality very dubious). In my opinion, however, this fundamental thesis is the result of a great historical, methodological and terminological misunderstanding. The source of the error stems from (a) an oversight of important historical currents in the history of the ancient, medieval and Renaissance philosophy, especially theories of knowledge, and (b) an insufficient coherence between the philosophical and mathematical considerations mentioned above. I have a similar objection to another important thesis (that completely deprives Copernicus of originality), namely, that the Copernican revolution was not a genuine revolution in science, but only a simple conservative repetition and revival of old ideas.

In my new book *Copernicus's Originality: Towards Integration of Contemporary Copernic-an Studies* (Warsaw–Cracow, 2004), I review the debate in the literature over Copernicus's orginality, and try to show some fundamental beliefs that earlier studies shared both explicitly and implicitly. Then, my defense of his originality is presented that is based on an integral approach to contemporary Copernican studies.

Michal Kokowski

NICHOLAS COPERNICUS IN FOCUS OF INTERDISCIPLINARY RESEARCH

Symposium “Nicholas Copernicus in Focus”. 2nd International Conference of the European Society for the History of Science (Cracow, 6-9 September, 2006).

To understand well a genesis, essence and reception of Copernicus's scientific works we must apply an interdisciplinary approach in our research of the issue. And it is a good familiarity with the history of Copernican studies that should be chosen as the basis of such inquiries. What is more, we should be critically open to all possible aspects of the Copernican studies. We must analyse with very rapt attention the issues belonged to astronomy, physics, mathematics, methodology, philosophy of science, logic, rhetoric, theology, general philosophy, arts (with literature, painting, ...), linguistic, politics (including the question of German-Polish quarrel about Copernicus), ... as well as the question of patronage. And we must consider all these matters in historically changing contexts.

Such a broad strategy was applied by the author in his own Copernican studies in last twelve years. This strategy - at least at the author conviction and of some his careful readers - appeared to be very fruitful. Among others, it appears that the crucial thesis of the Copernican studies of the last 30 years - which states "the Copernican revolution is a kind of myth" - is simply wrong and caused by a lack of integration of research.

For details of the author's approach see among others:

Michal Kokowski, "Copernicus and the Hypothetico-Deductive Method of Correspondence Thinking. An Introduction", Theoria et Historia Scientiarum 5 (1996): 7-101.

-------, Thomas S. Kuhn (1922-1996) and the Issue of the Copernican Revolution (in Polish, with an extensive English abstract). In Studia Copernicana, vol. 39. Warszawa: Instytut Historii Nauki Polskiej Akademii Nauk, 2001.

-------, "The Glitters and (Semi-)Shadows of Galileo by Annibale Fantoli" (review essay; in Polish), Zagadnienia Filozoficzne w Nauce XXXII (2003), p. 26-44.

-------, Copernicus's Originality: Towards Integration of Contemporary Copernican Studies (Warsaw-Cracow: Wydawnictwa IHN PAN, 2004), pp. xvi + 340).

-------, "The current quests of Copernicus's grave. Reflection of advocatus diaboli" Part I-II, (in Polish), members.chello/m.kokowski/index.pl.

-------, "Review essay and errata of best-seller 'Book that nobody read' by Owen Gingerich" (in Polish; 28 pp.; Kwartalnik Historii Nauki i Techniki, in press).

-------, The Various Faces of Nicholas Copernicus. The Meetings with the History of Interpretations (600-page, in Polish; in progress).

Michal Kokowski

A META-HISTORY OF SCIENCE AND METHODOLOGY OF THE HISTORY OF SCIENCE URGENTLY NEEDED!

Symposium “How to Understand and Write the History of Science? or Methodology of the History of Science”. 2nd International Conference of the European Society for the History of Science (Cracow, 6-9 September, 2006).

In studying, researching and writing the history of science we are forced to meet many important problems of 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", called also often "historical methodology" (but the latter meaning is broader than the former!).

There are many examples that may illustrate an urgent need of discussion on the theme, including the one sketched at the website of Cracow Conference: "How to understand the term historiography?". This term is often restricted only to "the study of the way history has been and is written" or to "the history of historical writing" or to "the study of history seen in the light of ideological and philosophical systems". However, from a methodological point of view, this is a regrettable limitation based finally on an illusion that the historian is able "to research history directly" (by using of the so-called primary sources) as well as "to create purely descriptive re-constructions of history" (by using of only "hard historical facts" or "pure facts", free of any theoretical or philosophical interpretation or generalisation).

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