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Bruno Latour – Special Issue

Bruno Latour and Peculiar Structure of the First Scientific Revolution

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Abstract:
Bruno Latour's distinctive historiographic standpoint on the origins of scientific revolutions and the multifarious accounts of their reconstructions are elicited. It is contended that, in spite of their highly iconoclastic character, Latour's views can be welcomed for their innovative approach to the inquiries of social facets of science. In particular, they can elucidate the foundations of the lucid mature theory change model proffered in our preceding writings. Correspondingly, the Copernican Revolution is envisaged in the wayward context of intense interaction and interpenetration of Aristotelean and Ptolemaic sophisticated research practices. Eventually, the Aristotle – Ptolemy pagan cosmology could not help but be exposed to repeated cogent attacks during the Middle Ages since it apparently confronted the renowned principles of monotheism, not admitting the impervious demarcation line between the celestial and mundane realms. All the opposite worlds should have one and the same Creator. Commencing with the unification, Copernicus, in effect, paved the way for the descent of mathematics from Heaven to Earth and the spread of natural philosophy from Earth to Heaven.

Keywords: Latour; Scientific revolution; Structure; Social facets; Aristotle; Ptolemy; Monotheistic *Weltanschauung*; Copernicus; Galileo; Newton

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Introduction

The Problem of the Origins of a Scientific Revolution: The Significance of Sociology of Knowledge Approach

Why did bold and abstruse Copernican research program squeeze out refined and entrenched Ptolemaic one commencing the first scientific revolution? – The basic

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epistemological approaches to broaching the subject and solving the stubbornly recalcitrant problem are commonly laid out by the following options.

(I) Guileless inductivist version; (II) conspicuous falsificationist version of Karl Popper; (III) discreet conventionalist version of Pierre Duhem; (IV) promising yet insufficiently advanced social-psychological version of Thomas S. Kuhn; (V) sophisticated falsificationist version of Imre Lakatos and Elie Zahar.

Nevertheless, the deft explanations for the ultimate reasons for Copernicus's triumph over Ptolemy seem rather dubious in the light of the following rather plain counter-arguments.

(I) Guileless i*nductivist* account famously turns out to be especially fragile since the theories from both competing research projects – that of Copernicus and Ptolemy – practically *equally* deviated from the available observational data (see, for instance, Kuhn 1977). For instance, still the notorious Buridanists, in their controversy with Aristotle, stressed that, on the unsteady ground of astronomical observations, it is impossible to assert definitely whether the Earth or the stellar sphere moves (Oresme; quoted from Kokowski 1996).

(II) Classical f*alsificationist* explanations of the substantial causes of Ptolemy's defeat are commonly reduced to the following perspicuous options.

(II. a) According to the austere one, Ptolemy's deft theory was illicitly *irrefutable* and therefore unscientific, while Copernicus's superlative theory was just the opposite. Ptolemy's ingenious heuristic was blatantly *ad hoc*. *Any* odd celestial fact could be aptly accounted for in retrospect by immense multiplying the intricate paraphernalia of heterogeneous epicycles, epicyclets, deferents, equants, and so forth.

Regrettably, the 'unrestricted proliferation' of manifold epicycles in Ptolemaic whimsical astronomy constitutes a wonted 'historical myth' (Gingerich 1997). In actual research practice, to compensate for the flagrant equant triumphal stave off, Copernicus had to insert a *new* species of no less stale epicycles. Eventually, the Ptolemaic 'antediluvian' program transpired to embrace fewer epicycles than the 'bold revolutionary' Copernican one.

(II. b) According to the second, more sophisticated version (Popper [1935], 2002), both competing theories were practically equally lame for a sufficiently long time. But eventually, the smashing blow of the 'critical experiment' relentlessly refuted Ptolemy, buttressing Copernicus at the same time. Though when did this textbook miracle happen? Alas, historians of science have not come to a consensus yet. Maybe in 1616, when lucky devil Galileo had miraculously discovered the cycles of Venus?

Unfortunately, the generally-accepted claim that Galileo had successfully predicted the unexpected phases of Venus again is a sought-after historical lapse (Ariew 1989). One can rightfully sympathize with Galileo's scathing critics among the stout Aristotelians decidedly refusing to take seriously the astonishing observational data produced by a newfangled telescope with rather dubious and murky work principles (Kuhn 1957; Feyerabend [1975] 2010; Chaunu 1984).

(III) Due to the discreet *conventionalist* approach, one cannot dare to make the final choice between the competing theories only grounded on sheer empirical considerations (Duhem [1906], 1954). Eventually, one theory surely fits better than the other since it is more 'simple', 'beautiful', 'coherent', 'economic', etc.

Yet, I. Lakatos and E. Zahar, many a time and oft retorted that the alluring 'myth of simplicity', for instance, was time and oft dispelled by the painstaking labor of the historians of science in variety of case-studies (Lakatos and Zahar 1974, 362). Furthermore, such theory-choice situations are common for the history of science, when one of the competing theories is simpler than the other indeed. However, this 'other' is in better agreement with the available experimental data at hand or better reconciles with other respectable theories (Kuhn 1977). Which theory should be *definitely* chosen? The same is true for other often misty conventionalist criteria that in common research practice, function as values only and not as definite and effective criteria of choice.

(IV) Due to T. S. Kuhn's distinctive accounts (Kuhn 1957; Kuhn 1963, 367), Ptolemy's sophisticated astronomy was going in 1543 through a depressive state of 'paradigm-crisis' that constitutes, according to the celebrated epistemological doctrine (Kuhn 1961), the indispensable 'prelude' to a scientific revolution.

Nevertheless, as Lakatos and Zahar (1974) shrewdly parried, how many scholars had perceived this horrific 'community crisis' that, withal, lasted for more than a *thousand* years? Herewith one of the celebrated historians of science persevered that in the Copernican paradigmatic case Kuhn oddly envisions 'a scandal where there was none' (Gingerich 2004). And if Kuhn's meticulous analysis of the fine 'structure of scientific revolutions' is ultimately applicable to the Copernican case, why so *few* scholars had deliberately buttressed Copernicus before Kepler, Galileo, Descartes and Newton?

Further, according to Thomas Kuhn and his partisans, a scientific revolution – in a perspicuous analogy to political revolutions, such as the 1789 French revolution or the 1917 Russian one – is taken as resolutely and completely displacing the *Ancien Régime* research traditions in science (Westman 1994). Through the course of such relentless breakthroughs, new mature research traditions are so *radicalized* that they become "incommensurable" with their mature predecessors. It leads to a bizarre standpoint that the great pundits like Newton, Maxwell, Darwin, Bohr or Einstein, being the instigators of revolutionary breakthroughs, should be pictured as convinced adversaries of the 'creative dialogue' between the 'old' and the 'new' paradigms. However, such a startling tenet seems to us rather unilateral since it apparently exaggerates the revolutionary facet of a profound scientific change. Likewise, Copernicus rather aptly *modifies* than categorically *rejects* Aristotle's and Ptolemy's stout principles. Moreover, in many important respects, he can be envisaged just as a discreet reformer of generally accepted astronomy rather than an ardent revolutionary intent on its overthrow. For instance, Copernicus discreetly modifies the famous Aristotelian principle that an object can take part only in a single natural motion. He aptly argues that a more complex principle is required to accommodate falling bodies on a rotating Earth (Goddu 2010).

(V) The sublime SRP (scientific research programs) methodology (Lakatos 1970) maintains that the pivotal problem of philosophy/methodology of science is to proffer a *normative* appraisal of scientific theories. A sturdy and objective *appraisal* of a scientific change is surely a *normative* problem and whereupon belongs to analytical philosophy. However, a stout *explanation* of the scientific change – of the elicited true reasons of acceptance and rejection of the theories involved – is predominantly a psychological/sociological conundrum. Certainly, the Copernican distinctive program showed itself as a 'theoretically progressive' one. Not by chance had this hallmark been gladly anticipated by one of Copernicus' faithful disciples:

> Aristotle says: 'That which causes derivative truths to be true is most true' (Metaphysics 993b 27-27). Accordingly, my teacher decided that he must assume such hypotheses as would contain causes capable of confirming the truth of the observations of previous centuries, and such as would themselves cause, we may hope, all *future* astronomical predictions of the phenomena to be found true. (Rheticus, Narratio prima; quoted from Kokowski 1996, 39)

The Copernican fine program had theoretically accounted for many important 'novel facts' not observed before – star parallax, for instance. Though *actually*, the Copernican program started to make reliable empirical progress only with Newtonian mechanics (Lakatos and Zahar 1974, 374). The 'Ptolemy-Copernicus' inextricable transition had been masterly reconstructed within the dazzling methodology of Imre Lakatos. In our view, one should not nitpick about petty lapses that are common for any pioneering treatise of this kind. Yet the crucial point is a *matter of principle*. One should never forget that the ultimate aim of the SRP methodology is to set an *objective and incontrovertible appraisal* of scientific change but not the humble *explanations* of its *actual* reasons (Lakatos and Zahar 1974, 381).

Within the shadowy frame of the Lakatos-Zahar elevated approach, it is quite easy to admit that all the subtle content of the Copernican bold program could be contrived even by Aristarchus of Samos. But why had it *not* happened? And why did these sublime designs not have any significant impact on Ptolemy and his numerous followers? In our view, the abovementioned drawbacks are connected with one and the same notorious reason – *lack of proper scrutiny of the subtle interconnections of cognitive and social aspects of scientific research*. All those sublime epistemological models (even Kuhn's), as a matter of fact, ignore to varying degrees the relentless hallmark that science is a 'community effect' (Russ Payne). Regrettably, epistemologists hold a 'great genius' vision of the progress of science. According to the romantic standpoint, the startling insights of very peculiar individuals, the 'chosen ones of the gods', are what drive science forward. Though this is an apparently distorted picture. The great luminaries like Newton, Maxwell or Einstein can only start a revolution in scientific thinking at best – but only when a broader community of researchers relentlessly prepared the field. And sedulously created the conditions for the growth of the seeds of revolution in thinking. Eventually, the history of science needs to be comprehended in new terms – in terms of *how* these broader communities progress to the point where revolutionary thinking is called for. The celebrated 'great insights and discoveries' never take place in a social vacuum. Revolutions in thinking cannot happen until the scientific community is convinced that the old paradigm (program, tradition) is broken. Only when this does really happen, appropriate alternatives to the old and entrenched paradigm are advanced.

Bruno Latour and Modern Sociology of Knowledge

Latour and Woolgar's 1979 distinctive study decidedly broke away from unilateral positivist view of advancement of science as a sheer asocial process capable of revealing universally valid truths regarding the natural world. On the contrary, they took scientific knowledge as an *artificial* product of different social, political, and economic *interactions.* Correspondingly, the pivotal tenet of modern sociology of scientific knowledge consists in the assertion that it is misleading to scrutinize the language (of science) through an analysis of words and meanings isolated from the *pragmatic* situations in which they are used (Lynch and Woolgar 1990). This applies not only to words but to methodological rules and recipes and theoretical propositions as well. Although such formulations find their particular applications in real scientific accounts, they are apparently fetishized in epistemological writings on basic scientific 'ideas' and apt experimental 'methodology'.

Forsooth, sociologists have no need to meticulously clarify everyday language, insofar as 'everyday' or 'ordinary' actions are the primary subjects of empirical study. Instead of asking, "what do we really mean, in various contexts, by 'representation'?", the studies begin by asking "What do the participants treat as representation?"

Following the trend, philosophers, historians, and sociologists of science are now questioning the privilege traditionally assigned to the verbal statement or 'proposition', devoting instead attention to multifarious forms of representation. The corresponding studies unfold a throng of ways to disclose that the particular 'representations' have little determinate meaning or logical force aside from the complex activities in which they are situated. Eventually the startling topic of 'representational practices in science' was related to the general issues in the sociology and philosophy of science (Lynch and Woolgar, 1990). Herewith a strong emphasis on the heterogeneity and discontinuity of representational formats, and on the local and contextual ground of their production, has become a common refrain in 'postmodernist' critiques of traditional accounts on science (Derrida 1970; Foucault 1970).

However, the conspicuous trend under consideration was epitomized in Barnes and Bloor's 'Strong Program' in the sociology of knowledge. A pivotal tenet of the program is to contrive sociological explanations of all scientific 'beliefs', regardless of the truth or falsity assigned to them. The 'strong program' takes the 'contents' of scientific knowledge as reified products of historical and contemporary stark controversies, sedulous partisan genealogies of scientific facts, and outrageous negotiations over credit for discoveries. On the one hand, socio-historical arguments on how scientists' theoretical commitments reflected social 'interests' were 'interesting and suggestive' (Lynch and Woolgar 1990). Though on the other hand they begged many inextricable questions on the nature of such 'interests' and how they work themselves into research settings (Woolgar 1981). Furthermore, according to Paul Tibbets, Bloor's and Barnes's constructive arguments are reflexively undermined by incongruent causal and realist assumptions (see also Laudan 1981; Woolgar 1983).

Respectively, bold

> hypotheses about changes in the mind or human consciousness, in the structure of the brain, in social relations, in 'mentalité's', or in the economic infrastructure which are posited to explain the emergence of science or its present achievements are simply *too grandiose*, not to say *hagiographic*, in most cases and plainly racist in more than a few others…The idea that a more rational mind or a more constraining scientific method emerged from darkness and chaos is too complicated a hypothesis. It seems to me that the first step toward a convincing explanation is to adopt this a priori position. (Latour 1990, 19)

The key point is that the Grand Dichotomy with its 'racist hubris' certainty should be replaced by many uncertain and unexpected divides (see also Goody 1977). According to Bruno Latour's apt analogy, the notorious divide between prescientific and scientific culture is merely a common border – like between Tijuana and San Diego. It is installed by the border guards dominated by the bureaucrats; yet it does not represent any *natural* boundary. Eventually, all these sublime Grand Dichotomies cannot provide any reliable explanation. On the contrary, they are themselves the things to be explained (Latour 1983). But in providing reliable and stout explanations one has to steer a course that can lead out of a perfunctory relativism by eliciting a number of simple, empirically verifiable causes. One needs to arrive at more *mundane* explanations than that of a great divide in human consciousness.

As for Barnes and Bloor, worst of all in order to explain science one has to kneel before one peculiar science, that of economics. Thus, ironically, many 'materialist' studies of the profound origins of science are in no way material. They defiantly ignore the precise practices and subtle craftmanship of knowing. Hence

> it seems to me that the only way to escape the simplistic relativist position is to avoid both 'materialist' and 'mentalist' explanations at all costs and to look instead for more parsimonious accounts, which are empirical through and through, and yet able to explain the vast effects of science and technology. (Latour 1990, 21)

In sum, Latour finds all the explanations in terms of social groups, interests or economic trends convincing only when they proffer a specific *mechanism* to sum up 'groups', 'interests', 'money' and 'trends'.

Turning to the thrilling case of the first scientific revolution, one can conclude that the rationalization that took place was not of the mind, of the eye, of philosophy but of the sight. For instance, why was perspective such an important invention? "Because of its logical recognition of internal invariances through all the transformations produced in spatial location" (Ivins 1973, 9). Hence in the West, even if the subject of the printed text were guilelessly unscientific, "the printed picture always presented a rational image based on the universal laws of geometry. Hence the Scientific Revolution all appearance owes more to Albrecht Dürer than to Leonardo da Vinci" (Edgerton 1980, 190). In this sense

> Antonello's St. Jerome is an apt paradigm of a new consciousness of the physical world attained by Western European intellectuals by the late XVth century. This consciousness was exhibited by such artists as Leonardo da Vinci, Albrecht Dürer, Hans Holbein and others who "developed a sophisticated grammar and syntax for *quantifying* natural phenomena in pictures". (Edgerton 1980, 189)

That is why Latour resolutely rejected the so-called 'materialist' explanations that apply 'infrastructures', or 'markets' or 'consumer needs' to account for the advancement of science. On the contrary, it is the visual construction of something like a 'market' or an 'economy' that cries for explanation. Moreover, one commonly takes for granted that there exist, somewhere in society, powerful macro-actors that naturally dominate the social scene: Corporation, State, Material Productive Forces, Cultures, Imperialism, etc. But the problem is that these conspicuous entities could not exist at all. A 'state', a 'corporation', a 'culture', an 'economy' et al. are the result of a punctualization process that obtains a few indicators out of many traces. In order to exist, these entities, have to be summed up once upon a time and somewhere. Far from being the key to comprehension of science, the abovementioned entities are the very things the new comprehension of science should explain. The large – scale actors to which the partisans of the Strong Program are keen to attach 'interests' are immaterial in practice as long as precise and empirically verified mechanisms to explain their origin or extraction and their changes of scale have not been proposed. "To take the existence of macro-actors for granted without studying the material that makes them 'macro', is to make both science and society *mysterious*'" (Latour 1990, 56).

Furthermore, many accounts were proffered to hack up the history of science with the history of capitalism. For instance, many efforts have been made to display the scientist as capitalist. According to 1990 Bruno Latour, these startling efforts (even including Latour and Woolgar 1979, chapter V) were 'doomed from the start', since they took for granted the notorious division between mental and material factors. Correspondingly, there is not a history of engineers, then a history of capitalists, then one of physicists, chemists and mathematicians, then one of economists and accountants. On the contrary, there is a single history of these important centers of calculation. "It is because all these inscriptions can be *superimposed, reshuffled, recombined,* and summarized, and that totally new phenomena emerge, hidden from the other people from whom all these inscriptions have been exacted" (Latour 1990, 60).

Finally, two tempting attempts have been made to relate the structure of cognitive abilities to social structure. The first one applies Kuhn's celebrated paradigms (Barnes 1982), while the second adheres to Wittgenstein's thought-provoking 'language games' (Bloor 1983). The conspicuous attempts are interesting but they still try to answer a question which Latour strongly recommends to reject: how cognitive subtle abilities are related to our societies. The key point is that the inextricable question (and the various answers) accept the idea that the stuff our society is made off is somehow *different* from that of our sciences, our images, and our information. Yet

> we are dealing with a single ethnographic puzzle: some societies – very few indeed – are made by capitalizing on a larger scale. The obsession with rapid displacement and stable invariance, for powerful and safe linkages, is not a part of our culture, or 'influenced' by social interests: *it is our culture.* Too often sociologists look for *indirect* relations between 'interests' and 'technical' details. The reason of their blindness is simple: they limit the meaning of 'social' to society without realizing that the mobilizing of allies and, in general, the transformation of weak into strong associations, is what 'social' also means. Why look for far-fetched relations when technical details of science talk directly of invariance, association, displacement, immutability, and so on? (Latour 1990, 64)

A Blunt Origin of the Copernicus-Ptolemy Transition: In the Wake of Bruno Latour

The near-by goal of the present paper is to strengthen efforts in landing the sky-high Lakatos-Zahar account in the wake of the abovementioned Latour's sociology of knowledge approach by taking a further step on the thorny path of reasonable explanation for the mundane reasons for the incipience and triumph of the Copernican breakthrough program. In our humble opinion, the renowned accounts (I) - (V) unfortunately miss an important point of the Ptolemy-Copernicus transition. Viz., *Copernican and Ptolemaic congenial programs were realizing the radically different from each other ways of astronomy and physics stout reconciliation.*

Withal, let us recall how Paul Feyerabend, who devoted many years to the meticulous study of the first scientific revolution, concluded that *not one* reason *and not one method, but different* reasons, withal assessed from *diverse* positions, *is what had made up the intricate Copernican revolution*. We would like to add that these sober reasons and vantage points were relentlessly *intertwined*. Regrettably, this interweaving was substantially random, whereupon one should *not* try to explain the *whole* medley only by the blunt influence of simplified methodological rules.

Consequently, the ultimate aim of the present account is to propose merely a *more stout* (but not the ultimate!) answer to the stale question "*Why did the Copernican bold program eventually supersede the entrenched Ptolemaic one?*" To proffer a more apt and sober explanation one has to provide a substantial 'theoretically progressive problem shift' relative to other rival reconstructions taking the social-cultural facets into account to a greater extent. And to exhibit that the Copernican Revolution, alas, is a more inextricable phenomenon than seems from the spellbinding epistemic conceptions of scientific revolutions (Kuhn 1977; Lakatos 1978).

In good sooth, the previous alluring yet scant accounts have intensely oscillated between *two alternative extremes*. On the one hand, in the taken for granted blunt vein, the apparent differences between research traditions were hastily taken to be insignificant and fruitful communication (and even deep interpenetration) unproblematic. On the other hand, in the new-fangled, post-Kuhnian distinctive disquisitions, really significant differences between the research traditions are commonly exhibited to be so radical that their actual communication is regarded almost impossible.

The present account humbly stems discreetly from a more common and mundane 'unhagiographic' *intermediate picture*. Respectively, we readily admit that the substantial differences between the research traditions exist at the various levels, ranging from entrenched ontological commitments and inextricable epistemological beliefs similar to Ptolemy's notorious instrumentalism up to subtle mathematical technique.

However, these often antagonistic traditions were able to *communicate* fruitfully in the creative acts of such pundits as Ptolemy, the Moslem celebrated astronomers, Copernicus, Galileo, Descartes, Kepler, and Newton. Owing to the *intersubjective* nature of human communications, the research practices had vigorously communicated by the various ways that permitted comparisons, adaptations, and even fruitful *cross-fertilizations*.

The intermediate humble approach first and foremost originates from the principled criticism of the narrowness of advanced epistemological models: they as a matter of fact (yet due to the different philosophical reasons) lack the subtle mechanisms of the paradigms' (or SRP's, or research traditions/practices) intense *interactions* (Nugayev 1985 a, b). To meet the sound critical arguments, a lucid 'mellow theory-change' epistemic model had to be advanced (Nugayev 1999). Respectively, the profound origins of scientific revolutions are being fathomed not so much in the stale discrepancies of entrenched mellow theories with the 'hard facts' (common to all SRPs or 'paradigms'), as in the multifarious collisions of 'old' pivotal research practices with each other. The latter transpire first and foremost in relentless contradictions that *can* be most effectively (yet not always!) excluded in a more general ('global') research tradition. Whereupon, the leading parts in mature theory change are played by the intense 'trade' of the proponents of the old paradigms' that may lead to mutual accommodation and even profound interpenetration of the participants' s views.

Withal, impugning Alan Sokal's legal critique, Bruno Latour had stressed that what Sokal failed to grasp is that hard "facts remain robust only when they are supported by a common culture, by institutions that can be trusted, by more or less decent public life, by more or less reliable media". Hence with the rise of alternative 'hard facts' whether or not a proposition is believed depends far less on its veracity than on the *conditions* of its 'construction'. Viz., *who* is making it, to *whom* it is being addressed, and *from which* social institutions it emerges.

Yet the inevitable encounter of the stout programs, traditions or 'practices', their deep interpenetration, and strong twisting provide the erection of a vast *hybrid* realm at first with a haphazard throng of crossbred theoretical models. Though gradually, on consecutive soothing and eliminating the various contradictions between the hybrid models, the crossbred solid system is sedulously set up.

Up to a point, the lucid epistemic model can be taken as proffering a reliable *mechanism* of practically simultaneous drastic transformation of the 'old' paradigms. The hallmark of the sophisticated mechanism consists in the contrivance of the crossbred systems from all the basic theoretical objects of 'old' mellow theories. The crossbred systems constitute cohesive channels through which the accommodation of the 'old' traditions encountered inevitably commences. The accommodation gradually leads to the installation of a throng of *crossbred* theoretical schemes. The hotchpotch will probably be ultimately processed and subsequently generalized to set up a conspicuous *structure* of a novel global theory. Incidentally, a mellow scientific theory may be empirically successful if it constitutes a kind of a Kantian' draft' that can be furnished and explicated by the results of new bold experiments that increase its empirical content significantly. The global theory may become such an effective vehicle for the production of new testable statements. For this purpose, it should merge and intertwine the 'old' classical research traditions in such a subtle way that they once and for all cease to contradict each other, so that the newly-constructed unification can successfully explain and anticipate novel experimental evidence.

Hence the crux of the present account is to provide further reliable sociology of knowledge and historical backing to the lucid epistemological theory-change model (see also Nugayev 2020). We contend that *profound breakthroughs in science were first and foremost not due to ingenious contrivances of brave novel paradigms or bold invention of startling new ideas* '*ex* nihilo'. (The gist of the Copernican program was known even to Aristarchus!). On the contrary, *the profound breakthroughs were caused, among other important things, by the harrowing humble processes of piecemeal accommodation, gradual interpenetration, and* *discreet intertwinement of the 'old' pivotal research traditions preceding such radical breaks.*[3]

For instance, in contriving his startling 1905 masterpieces (the daring theory of light quanta plus the whimsical special relativity) Einstein was inspired by a stout belief in the necessity for *unity* in science (Nugayev 2018) - the faith he inexorably carried through his whole life. Whereupon, sagacious identifying and dexterous resolving the relentless paradoxes revealing the profound clashes between the entrenched research practices turn out an indispensable part of the Scientific Method as such. A case of diverse programs' inevitable encounter leads to a wonted situation when a domain of *hybrid* models emerges formed by plain conjunctions of the models of different research programs (Ptolemy, Tycho Brahe, Lorentz, Abraham, Klein). However, commonly the hybrid models transpire to be self-contradictory; and when this is properly realized (by Copernicus, Maxwell, Einstein, Dirac), the crossbreeds are deftly constructed from the basic objects of *all* the cross-theories. *The successful contrivance of new mellow theory commences owing to the crossbred domain's gradual growth.*

The present account strives to expound that the Copernican breakthrough turns out as an artificial result of elucidation and (partial) resolution of the profound dualism, of the 'deep abyss' (A. Koyré) between Ptolemy's deft mathematical astronomy and Aristotelian descriptive qualitative physics. Forsooth, the basic interpretation of the opposition between astronomy and physics that is necessary to situate Copernicus historically is that of Alexandre Koyré. Hence, it is in the wake of his brilliant writings to demonstrate that it is not accidental that the dazzling writings of Copernicus, Galileo, Kepler, Descartes, Newton, and their exalted disciples were all the indispensable levels of mathematics descendance from Divine heavens to sinful Earth and the reverse conquest of the Sky by Earthly mature physics. It is important that this process had inevitable socio-cultural roots. Rationalization that took place during the first scientific revolution was first and foremost of the sight, when the Renaissance artists had advanced a subtle grammar and syntax for *quantifying* natural phenomena in pictures (Latour, Edgerton, Ivins).

The Rise and Advancement of Ptolemaic Ingenious Research Program

Lakatos and Zahar carefully exposed how Ptolemy and Copernicus had invented and coherently advanced the diverse *research programs*. Both rival designs had branched off from the same Pythagorean – Platonic 'protoprogram'. Its basic principle consisted in that, since heavenly bodies are immaculate, all the astronomical appearances should be masterfully 'saved' by the artful combinations of *as few uniform circular motions as possible.* The stout principle was installed as the firm cornerstone of the powerful *heuristic* of both rivals; wherein the '*heuristic*' was principal, while the '*hard core*' only subordinate. The hard core of Ptolemy's ingenious program was made up from the geocentric solid hypothesis in conjunction with the Aristotelian natural philosophy, with its notorious paraphernalia of natural and violent motions and the impenetrable and stiff demarcation line between the shabby terrestrial (sublunary) and sublime celestial realms. It should be pointed out that Aristotelian physics was an empirical science *par excellence* that imbibed common experience much more naturally and fully than the rigid, strict, elevated, and abstract science of Galileo, Descartes, and especially Newton. Everyone knows that all the hard bodies quite naturally fall down, while fire soars up.

Moreover, inertial motion is not an experimental fact: common experience contradicts it. Furthermore, everyone knows for sure that in Nature 'there is no void existing

[3] See Nugayev (2018, 2020) for multifarious rational reconstructions of the Maxwellian and the Planck-Einstein breakthroughs, as well as Nugayev 2002 for more thorough study of the sociological facets of this tenet.

separately' (Aristotle 2007a). The Sun and the Moon rise and set, while the thrown bodies do not uphold their rectilinear motion.

Due to common experience, masterly fixed by the flexible notions of Aristotelian natural philosophy, the distinctive '*Lebenswelt*' (Edmund Husserl) in which one lives and acts mercifully is not a mathematical one nor can it be properly 'mathematized'. This volatile kind of reality is the wonted realm of uncertainty, unsteadiness, inaccuracy, etc. exhibited by the vague terms 'almost', 'a kind of', 'more or less', etc.

Whereupon the Greek dazzling thought could hardly concede that exactness can successfully survive in the wry world around us and that the ponderous matter of stale sublunary world with its inextricable hotchpotch of four basic elements (earth, water, air, and fire) can adequately 'represent mathematical entities' (Koyré 1957) similar to the ideal objects of Euclidean geometry. According to Stagiritul, 'the [immaculate] mathematical exactness should be demanded only for the [peculiar] objects lacking matter' (Aristotle 2007b).

On the contrary, the heavens are created from an entirely different, odd, and immutable substance, the celebrated 'aether' (or the so-called 'fifth element'). Heavenly bodies are the components of ether spherical shells that fit tightly around each other in a strict order that commences with the Moon, and extends to the sphere of distant fixed stars. A heavenly shell is characterized by its specific rotation, which accounts for the peculiar motion of the heavenly body contained in it. Though outside the utmost sphere of the fixed stars, the powerful *prime mover* is solidly situated. It diligently imports motion from the outside sphere inward. And the natural motions of all the heavenly bodies are unforced, perfectly circular, and neither speeding nor slowing down.

Consequently, the perfect motions of the stars take their place in accordance with strict geometrical laws. Thus, according to Stagiritul's discreet doctrine, *mathematical astronomy is possible while mathematical physics is not.* Whereupon the Greek astronomers not only masterfully applied sophisticated mathematics but with amazing patience and magnificent skill observed the skies. However, they had not even dared to mathematize inextricable terrestrial motions.

The celebrated Claudius Ptolemy (87-150) reached the acme of ancient pre-science not least because he was a *Hellenistic* polymath: an astronomer, astrologer, mathematician, geographer, and even poet rolled into one. His masterpiece – the '*Almagest*' – dominated the European thought for more than fourteen centuries. The socio-cultural context of the Ptolemaic research tradition is transpired by the eloquent fact that the author of '*Almagest*' was a successful resident of Alexandria, the splendid capital of Hellenized Egypt. Hellenistic distinctive civilization was a blend of stunning Greek culture with discreet civilizations of Egypt and Babylon and a substantial departure from the earlier arrogant Greek attitudes towards the dubious 'barbarian' cultures. The extent to which genuinely hybrid Greco-Asian cultures emerged is rather contentious, but the encounter of the three pivotal cultures captured even the elevated domain of theoretical astronomy (Neugebauer 1975).

Unlike the 'antediluvian' Babylonians and Egyptians, who had sedulously examined the heavens merely to keep track of their shabby seasons, the 'sophisticated' Greeks had apprehended astronomy from a sublime theoretical standpoint: they strived to comprehend the basic nature and makeup of the whole Universe.

Claudius Ptolemy, as a typical Hellenist, *craved* (not without success) *for balancing himself discreetly between the three pivotal cultures* in all the basic domains of research activity but first and foremost in ontology and epistemology. In natural philosophy, he deftly oscillated between sophisticated mathematical models and blunt, empirically-grounded qualitative physics, while in epistemology – between the blunt realism and crude instrumentalism.

On the one hand, he was certainly aware yet decidedly skeptical of Aristarchus' heliocentric hypothesis due to rational arguments based on the stout and well-grounded empirically principles *of Aristotelian physics.*

On the other hand, since Aristotle, all appearance, turned to be the only philosopher to whom Ptolemy referred explicitly, the author of the '*Almagest*' was many times and oft accused of slavish adherence to the blunt principles of Aristotelian natural philosophy. However, the trite dictum is an obvious oversimplification. One should recall that, according to Aristotle, the rest is nobler than the motion, and the Sky is much more perfect and nobler than the Earth. Hence, the '*Almagest*' subtle model of the solar system did *substantially* deviate from orthodox Aristotelianism at least in the two crucial respects.

(i) Aristotle persistently maintained that heavenly bodies should move around the Earth in *single* uniform circles. Yet, in the Ptolemaic complicated models, the odd motion of the planets is an intricate *combination* of *two* circular motions; moreover, at least one of them is *non-uniform*.

(ii) Aristotle also maintained – alas, again from the elevated and abstract ontological grounds – that the Earth should be located at the *exact* center of the Universe. Yet in the Ptolemaic feasible distinctive system, the Earth is decidedly *displaced* from the center of the Universe. Furthermore, in Ptolemy's inextricable cosmology there is no unique center of the Universe; the central orbit of the Sun and the planetary local deferents all have slightly *different* geometric centers, none of which coincides with the Earth. In the '*Almagest*' and in other writings as well, Ptolemy had frequently demonstrated that the non-orthodox (concerning the Aristotelian natural philosophy) aspects of his subtle models all were directly dictated by stubborn facts of observations.

As is well-known, Ptolemy's most controversial contrivance was the notorious '*equant*': a planet revolves around the Sun at a significantly non-uniform rate. However, it can facilely be exhibited that the non-uniform rotation of the radius-vector connecting the planet to the Sun implies a uniform rotation of the radius-vector connecting the planet to the so-called 'equant'. The latter is the subtle point directly opposite the Sun relative to the geometric center of the orbit (Fitzpatrick 2010).

It is merely from the modern historically unilateral standpoint that Ptolemy's equant turns out a precursor of the celebrated Kepler ellipses. Yet for such caustic yet objective critics as the Islamic /Arabic astronomers and subsequently Copernicus (since the works of the Maragha school might be known to the author of '*De Revolutionibus*' – see, for instance, Swerdlow & Neugebauer 1985) and his associates, the compelled insertion of the equant was a typical Lakatosian 'ad hoc$_3$ hypothesis'. It obviously contradicted the distinctive spirit of the Aristotle - Ptolemy program – the pivotal tenet of uniformity of motion in respect to the center of the Universe. However, according to Lakatos & Zahar's alluring stance, the 'ad-hocness' should be taken, within the flexible frames of the SRP methodology, not as a narrow property of an isolated hypothesis but as a multilateral *relation* between two consecutive theories. Incidentally, even Ibn al-Haytham (965-1040) initiated the first sober critique of Ptolemy's physics for the violation of the basic principle of uniform circular motion.

It is no coincidence that after Eudoxus' primeordial model (made up of the system of concentric rotating spheres) was resolutely abandoned, actual progress in the realization of geostatic program ran *counter* to the powerful heuristic of Platonic protoprogram (Zahar 1973). The eccentric resolutely displaced the Earth from the center of the circle; the Apollonian and Hipparchan deft epicycles provided that the actual path of the planets about the Earth was not circular; and, eventually, the Ptolemaic notorious equants entailed that even the motion of the epicycle's empty center was not simultaneously uniform and circular. The perfidious insertion of the equant was the strongest blow upon the stale heuristic of the Platonic protoprogram: it was almost equal to its full wreck. So, within the Ptolemaic intricate program *mathematical exactness that insisted on the insertion of noncircular orbits and the* *centers of rotation not coinciding with the earth center began to diverge increasingly and irreversibly from the stout and empirically sound principles of Aristotelian physics.* Hence eventually one can take *Ptolemaic inextricable cosmology as a substantially **dual** fundamental theoretical scheme waywardly mixing the basic principles of 'Platonic immaculate mathematics' with those of 'Aristotelian sober physics'.*

To retain the indubitable advances of the Aristotelian dazzling doctrine and the conspicuous achievements of the mathematical astronomy, Ptolemy in the '*Planetary Hypotheses*' had to advance further and at the same time attenuate the blatant rupture between the mundane and celestial phenomena. Since the '*Almagest*' confined itself to subtle mathematical models, Ptolemy had to propose preliminary physical models for the same constructions, yet in vain. An apparent example of his numerous failures is represented by the attempt to construct the ingenious 'tambourine-like', 'sawn-off' mechanism able to transform motion from outer spheres of his cosmos to inner ones (Murschel 1985).

However, *after the 'Planetary Hypotheses' the profound abyss between the physical and mathematical facets became even deeper* (Jones 2005). So, Ptolemy's inextricable cosmology could not help but be exposed to stout repeated attacks during the European Middle Ages (Linton 2010). It apparently confronted the strict principles of monotheism not admitting the stiff demarcation line between the celestial and mundane worlds; *all seemingly different worlds nevertheless should have one and the same Creator.*

The Copernican Farsighted Breakthrough: An Origin and Advancement

All appearance, the ultimate motive of contrivance of the heliocentric program consisted not at all in sedulous elimination of the wonted discrepancies between the Ptolemaic 'wry' cosmology and stout observational 'hard facts'. In our humble opinion, Copernicus was invigorated predominantly by aesthetic and metaphysical (*essentially theological*) considerations. They aimed at effectively eliminating the profound rupture between refined mathematical astronomy and Aristotelian blunt qualitative physics so eloquently depicted by A. Koyré (1957).

However, it did not prevent him from applying standard Aristotelian 'argumentative technique' to posit the greater probability of his assumptions over those of his geocentric opponents.

> "All these arguments make it *more likely* that the earth moves than that it is at rest. This is especially true of the daily rotation, as particularly appropriate to the earth" (Copernicus [1543], 1972, *De Revolutionibus*, book I, ch.8, 17).

But certainly, it was his Christian Weltanschauung that made the rupture between physics and astronomy especially bigoted. Namely this monotheistic standpoint moulded the staff provided by the three pivotal sources: the cosmological views of Pythagoreans, Aristotle's fine cosmology (Goddu 2010) and (last but not least!) its inexorable critique provided by the' Buridan school' (embracing John Buridan, Nicole Oresme, and Albert of Saxony):

> "Copernicus developed a critical approach to natural philosophy but one that enabled him to modify Aristotelianism while remaining a participant in a broadly conceived Aristotelean tradition [...] He developed his own version of Aristotelianism, very much influenced by Renaissance Platonism, Neoplatonism, Stoicism [...] It was also a version of Aristotelianism that was anti-Averroistic and more flexible in its approach to mathematics" (Goddu 2010, xxii, xxiv).

In that respect Copernicus can be taken as a scholar which belonged to a respectable ancient tradition of reconciling Ptolemy's mathematical models with the concentric cosmology of Aristotle (Barker & Vesel 2012) though now in favorable socio-cultural context of Christian Weltanschauung enforcement.

It is no coincidence that the celebrated introduction to his opus Magnus - '*De revolutionibus orbium coelestium*' (1543) - was by right dedicated to 'his holiness Pope Paul III'. The respectable canon at Frombork Cathedral, Doctor of Theology, whose maternal uncle (and powerful promoter) was Lucas Watzenrode, the honorable bishop of Warnia, openly admits that he have been inevitably

> "impelled to consider a different [from Ptolemy] system of deducing the motions of the universe's spheres for no other reason than the realization that *astronomers do not agree among themselves in their investigations of this subject".*

Furthermore,

> "those who devised the eccentrics seem thereby in large measure to have solved the problem of the apparent motions with appropriate calculations. But meanwhile, they introduced a good many idea which *contradict the first principles of uniform motion.* Nor could they elicit or deduce from the eccentrics the *principal consideration*, that is, the structure of the universe and the true symmetry of its parts".

On the contrary,

> "we discover a marvelous symmetry of the universe, and an established harmonious linkage between the motion of the spheres and their size, such as can be found in *no other* way" (Copernicus, [1543], 1972, I, 22).

It was Copernicus' Christian Weltanschauung that determined his discreet attitude towards the sober arguments of the pagan Aristotle. Therefore, he is not limited to referring to the authority of Stagiritul to justify the unacceptability of uneven movement. Instead, he proffers a stout metaphysical argument of *his own*: variable speed can only be caused by variable force. Yet God, as the Primordial Cause of all the movements, is Always Constant. Consequently,

> "I began to be annoyed that the movements of the *world machine*, *created for our sake by the best and most systematic Artisan of all,* were not understood with greater certainty by the [pagan] philosophers, who otherwise examined so precisely the most insignificant trifles of this world" (Copernicus [1543], 1972; my italics).

Secondly, while for Aristotle gravitation constitutes the tendency of heavier bodies to long to the center of Universe, for Copernicus it is merely the tendency of heavier bodies to get to the centers of any spherical masses of matter.

The true origin of the inextricable paradoxes, due to Copernicus's distinctive standpoint, consists in the non-ideal odd movement of the planets. However, according to the Aristotle - Ptolemy sober doctrine, resolutely elevated to dogma by the Christian faith, the planets necessarily belong to ideal spheres and *should* be engaged in uniform motions along with the perfect circles or along with their artful combinations.

Following not so much Aristotle as his own stout theological arguments, Copernicus was convinced that the supposed perfection of the heavens requires celestial bodies to execute *uniform* circular motion only. Whereupon he was spurred to decisively stave off first and foremost the dubious equant model.

The resolute rejection of the equant was connected with that Copernicus not only employed a great deal of observational data from Arabic astronomical sources, but also many subtle theoretical components as well. The latter first and foremost included the famous 'Tusi couple', applied by Copernicus to exchange Ptolemy's clumsy geometrical equant construction. Thus he willingly agreed with the blunt criticism of Ptolemy's model by Ibn al-Haytham, Ibn Rushd, Nur as-Din al-Betrugi and other Moslem conspicuous astronomers (Kokowski 2012).

In his '*De Revolutionibus*' Copernicus realizes the task targeted first in the '*Commentariolus*'. The motivation for contriving the heliocentric system consisted in the assertion, that if the planetary orbs are ordered around a single center according to a strict principle, then the Earth cannot be that center. Invigorated by the '*best intentions to layout the Divine Order of the Heavens*' Copernicus craves to return to Aristarchus's queer proposal to place the center of the Universe on the Sun. But this attempt generated the profound paradoxes within the Aristotelian physics inextricably connected with the stale notions of 'natural' and 'violent' movements. As a result, Copernicus had gradually invented merely a sophisticated *crossbred* theory. It incepted to pave the way to divine immaculate mathematics and mundane qualitative physics significant *interpenetration*. As outstanding French historian punctuated, "Copernicus in an insinuating manner and probably unconsciously had inserted into the stout Aristotelian fortress two innocent premises through which Kepler, Galileo, and Descartes vigorously blew it up" (Chaunu 1984, 430).

In the eminent Introduction to '*De Revolutionibus*', Copernicus passionately appeals to a highly influential *coterie* of respectable clergy including Pope Paul III (to whom the Opus Magnus was dedicated), Pope Clement VII (who not only adopted the '*De Revolutionibus*' but even strongly insisted on its publication), Nicholas Schonberg, cardinal of Capua, Lucas Watzenrode, bishop of Warmia, Tiedemann Giese, bishop of Chelmno, et al. Throughout the whole '*De Revolutionibus*' its author consistently condemns the author of '*Almagest*' for inherent *paganism*. Copernicus's scathing criticism of Ptolemy's stale system is grounded on the weighty argument, according to which the Pagan's inextricable medley system (deftly embracing tens and hundreds of epicycles, abstruse epicyclets, and quirk equants) is nevertheless lacking strict, monotheistic Order, pre-established by the Lord, 'the best and *most systematic* Artisan'. Incidentally, sometimes the instrumentalism of the notorious '*Almagest*' went so far that one and the same movement of the same planet was displayed by two *substantially different* mathematical models. (Recall, for instance, Ptolemy's queer math models of Mars's odd motion). All appearence, the multifarious components of the Ptolemaic motley system vividly epitomize the various plans of different pagan 'artisans', of warring Hellenistic gods, densely inhabiting both dazzling Olympus and the dismal tombs of the pharaohs as well.

Not by chance,

> "their [the Ptolemy partisans'] experience was just like someone taking from various places hands, feet, a head, and other pieces, very well depicted, it may be, but not for the representation of a single person; since these fragments would not belong to one another at all, a monster rather than a man would be put together from them" (Copernicus [1543], 1972).

Likewise, Copernicus probably paved the broad way for Galileo's and Newton's mighty mathematical physics. If the stringent and robust demarcation line between divine and mundane worlds is lacking since the Earth is just an ordinary planet of the Solar system, the mathematical subtle notions and elevated principles will apply both to its rotations around its axis and the Sun, as well as to all the bodies moving along its surface. Moreover, in subsequent Galileo's works, the graphical Aristotelian 'natural' movements had to be decidedly transformed into abstract and sublime 'inertial' ones. It should be specially pointed out, in the wake of Latour's path-breaking writings, that this rationalization, this 'geometrization' of space took place within 'simultaneous transformation of science, art, theory of vision, organization of craft and economic powers' (Latour 1990,30).

Likewise, Galileo commenced with descending mathematics from the Skies to the Earth, being inspired not so much by '*De Revolutionibus*' as, in the all-pervading spirit of the Renaissance, by Plato's '*Timaeus*' (and the corresponding renowned yet highly controversial discoveries provided by the new-fangled telescope). As a true Copernican, Salviati famously points out in the '*Dialogues*' in his dispute with the stubborn Aristotelian Simplicio, "and [as] to the Earth, we try to ennoble it and make it more *immaculate,* striving to *liken it to celestial bodies* and, in a sense, to place it in heaven, from where your philosophers expelled it".

In path-breaking '*The Assayer*' ([1623], 1957) Galileo famously maintains that "philosophy is written in that great book which ever lies before our eyes — I mean the universe — but we cannot understand it if we do not first learn the language and grasp the symbols, in which it is written**.** This book is written in the mathematical language, and the symbols are triangles, circles, and other geometrical figures, without whose help it is impossible to comprehend a single word of it" (Galilei [1632], 2001, quoted from Burtt 2003, 75; see also Stillman Drake's distinctive translation, 1957, 237-238).

And to calm down the reader by whom the magnificent Book was written, in his renowned introduction to the '*Dialogue Concerning the Two Chief Systems – Ptolemaic and Copernican*' Galileo punctuates that

> "he who looks the higher is the more highly distinguished, and turning over the Great Book of Nature (which is the proper object of philosophy) is the way to elevate one's gaze. And though whatever we read in that book is the creation of the omnipotent Craftsman, and is accordingly excellently proportioned, nevertheless that part is most suitable and most worthy which makes His work and His craftsmanship most evident to our view" (Galilei [1632], 2001) . Eventually (for faithful Galileo) immaculate "*mathematics is the language with which God has written the Universe* "(quoted from Lial et al.,1995,2).

Alexander Koyré famously insisted that Galileo's alluring interpretation of Christian theology was inspired by Plato's '*Timaeus*'; specially by the whimsical myth of the creation of the Universe. The pivotal figure of the renowned dialogue – the almighty Demiurge, a divine Craftsman – punctiliously constructs the stout mathematical order out of the preexistent chaos to put up the Universe (the 'cosmos'). For that grand purpose he punctiliously cuts out small triangles to erect four regular solids; and then he artfully applies them to construct real bodies, plants, and even animals out of them (Plato [386 BC], 2000). Moreover, in '*Timaeus*' the notion of a divine Craftsman was enriched by the notion of pre-established harmony devised by Him.

Thus, Nature becomes empty and ordered: in the process of its creation God discreetly put strict mathematical necessity in it. And mathematical knowledge is not merely true but is substantially *sacred* even more than the Holy Bible. Forsooth, while there are plenty of interpretations of the Bible, the mathematical truths are unique and should be resolutely kept out of discussions.

At the sake of mathematization, Galileo had decidedly transformed the subtle methodology of natural science and had relentlessly elevated mathematization, as well as (real and thought) experimenting up to the highest ranks of leading scientific methods (Husserl [1936], 1970). Eventually, it made it possible for the Florentine to contrive the 'principle of inertia' before Newton.

Yet the very opportunity of implementation of mathematical methods in natural science turned out to be grounded on the elevated procedure of *idealization*. Thus, the exact science of modernity commenced with taking all natural phenomena as more or less adequate approximations of some Platonic 'ideal essences'. The latter lack, contrary to Aristotle, profound existence *within* the natural phenomena. They exist *alongside* them as the 'certain limits of infinitely small sensory becoming'; hence they can be freely invented by the ingenious human mind. And they are the stiff relations between the ideal 'quasi-essences' that are immaculately depicted by the exact Laws of Nature. At the same time, relations between the real objects (e.g. rods and clocks / tables and chairs) are fixed merely by the *approximations* to the strict laws. Just as Galileo himself had humbly put it, 'the search for essences, in my judgment, is a vain and hopeless kind of pursuit". Just to quote Hermann Weyl's exposition of Husserl's 1913 "*Ideen zu einer reinen Phanomenologischen Philosophie*" in stupendous "*Raum-Zeit-Materie*":

> "It is the nature of a real thing to be inexhaustible in content; we can get an ever deeper insight into this content by the continual addition of new experiences, partly in apparent contradiction, by bringing them into harmony with one another. In this interpretation, *things of the real world are approximate ideas.* From this arises the empirical character of all our knowledge of reality" (Weyl 1922, 5).

Consimilar platonic (and neo-platonic) motives that found their guileless expression in the alluring tenet of '*delightful accordance between the [base] Cosmos and the Holy Trinity*' induced Johann Kepler to the strenuous search for the stout mathematical laws stiffly governing the planet motions. Properly educated in strict Lutheran faith, Kepler had passionately devoted himself to delving into the sacred '*Book of Nature*'. "We astronomers are *priests of the highest God* concerning the book of Nature" (quoted from Barker & Goldstein 2001).

Nevertheless, the brave views of Kepler and Copernicus differed significantly. In Copernicus's blunt theory, the planetary motions were impeccably circular. They demanded no causes and took part due to the inertia of the bodies. Consequently, the Sun was not the actual center of force. Only Kepler's profound reflections on the true source of planetary motion revealed the leading role of the Sun and buttressed him in unfolding the subtle mechanics of planetary motion.

On the relentless grounds of Trinitarian thoroughgoing doctrine, Kepler decidedly took the Sun as the geometric and dynamical center of the cosmos. The startling coequality of Father, Son, and Spirit implied the continuity of the Center, Periphery, and space of the Cosmos. The gorgeous Sun epitomized God the Father, the Stars respectively referred to God the Son, while the wonted planets humbly incarnated the Holy Ghost. Furthermore, Kepler plied to reveal an immaculate universal law that would meticulously picture the motion of both the Earth and the planets. His assiduous quest was invigorated by the alluring analogy between the base Cosmos and the Holy Trinity.

Kepler took the second resolute step towards the deep interpenetration of mathematical astronomy and qualitative physics and elicited the laws roughly breaking the Aristotelian stiff principle of uniform rotation of divine bodies. His perspicuous laws were famously the first scientific laws taking math form. The Skies relentlessly started ruining the qualitative physics of Aristotle. Masterful reconciliation of the divine and sublunary realms masterly moved Aristotelian physics aside (Kepler [1609], 2005).

The epistemological import of the Copernican-Galilean scientific revolution (unification of the celestial and terrestrial physics) found its fine expression in the title of Kepler's masterpiece: '*Astronomia Nova seu Physica Coelestis*' (The New Astronomy of Physics of the Heavens). Kepler was not alone in rejecting Aristotle's natural philosophy from the stringent standpoint of Christian theology. In 1644 Rene Descartes had published '*Principia Philosophiae*' where he proffered a theory of motion *directly* grounded on heliocentric model. Eventually, Descartes' epoch-making writings epitomized the final elimination of the Aristotelean stale system. According to modern historians, it was Cartesianism which turned the handy heliocentric surmise into a dominant paradigm (Chaunu 1984).

Isaac Newton's main purpose was to reveal the stringent laws that firmly dictate the motion of *both* terrestrial and divine bodies. He had pioneered in exhibiting, - thanks to powerful heuristic of Copernicus and Galileo, - that it was the same force that attracted all the bodies to the Earth that compelled the Moon to obediently orbit the Earth.

Sir Isaac deftly amended the 'hard core' of the Copernican celebrated program by efficaciously unifying and generalizing the partial theoretical schemes of Copernicus, Kepler, Hook, Descartes, and Galileo and coming up to the whimsical conjunction of three laws of dynamics altogether with the mysterious gravitation law. Eventually, in the ingenious science of modernity Aristotelian qualitative 'essences' had been ingeniously replaced with immaculate mathematical abstract objects. Look at "*Principia*".

> "Since the ancients (as we are told by Pappus) made great account of the Science of Mechanics in the investigation of natural things; and the moderns, laying aside substantial forms and occult qualities, have endeavoured to subject the phenomena of nature to the laws of mathematics; I have in this treatise cultivated Mathematics, so far as it regards Philosophy" (Newton [1687], 1846, 1).

In Newton's stiff methodology the relentless dictum 'to subject the phenomena of nature to the laws of mathematics' constitutes the most robust one. A man of science should while sedulously examining the intricate phenomena of nature, force his sense data in such a dry and suitable for experimental purposes way as to proffer them for stringent analytical treatment.

Conclusion

The drawbacks of well-known epistemological models of scientific revolutions are connected with one and the same reason – lack of proper scrutiny of the subtle interconnections of cognitive and social aspects of scientific research. The epistemological models, as a matter of fact, ignore to varying degrees the relentless hallmark that science is a 'community effect'. Regrettably, epistemologists hold a 'great genius' vision of the progress of science. According to the romantic standpoint, the startling insights of very peculiar individuals, the 'chosen ones of the gods', are what drive science forward. Though this is an apparently distorted picture. The great luminaries like Newton, Maxwell or Einstein can only start a revolution in scientific thinking at best – but only when a broader community of researchers relentlessly prepared the field.

The goal of the present paper is to strengthen efforts in landing the sky-high epistemological models of scientific revolutions in the wake of Bruno Latour's sociology of knowledge approach by taking a further step on the path of reasonable explanation for the mundane reasons for the incipience and triumph of the Copernican breakthrough program. In our humble opinion, the renowned accounts of the Ptolemy-Copernicus breakthrough unfortunately miss a substantial point. Viz., Copernican and Ptolemaic congenial programs were realizing the radically different from each other ways of astronomy and physics stout reconciliation.

Correspondingly, the Copernican Revolution is envisaged in the context of intense interaction and interpenetration of Aristotelean and Ptolemaic sophisticated research practices. Eventually, the Aristotle – Ptolemy pagan cosmology could not help but be exposed to repeated cogent attacks during the Middle Ages since it apparently confronted the renowned principles of monotheism, not admitting the impervious demarcation line between the celestial and mundane realms. All the opposite worlds should have one and the same Creator. Commencing with the unification, Copernicus, in effect, paved the way for the descent of mathematics from Heaven to Earth and the spread of natural philosophy from Earth to Heaven.

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