

New Interpretative Categories for Natural and Social Sciences

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Abstract

By interpreting and joining together the historiographic categories suggested by Bogdanov, Sohn-Rethel and Koyré I obtained two dichotomies as the foundations of both natural science and social science, providing that they are conveniently interpreted according to each of these two cases. In particular, a new characterization of Marx' theory of society is obtained.

Keywords

History of Physical Science, History of Social Sciences, Bernal, Bogdanov, Sohn-Rethel, Koyré, Kuhn, Marx

1. An Alternative in Natural Science?

Let us recall the exciting episode of the Second International Conference on History of Science in London in 1931.¹ Bukharin and some Soviet scientists have presented a sketchily yet very promising alternative interpretation of science and its history according to a Marxian viewpoint. This presentation was so impressive for many British scientists that later some of the most authoritative among them started an active search for developing an alternative view on history of science.²

Actually, London proclamation of Russian historians of science represented the protraction of the cultural programme of a large Russian movement, i.e. Proletkult, searching an alternative not only in history of science, but also in the entire culture. This movement, born during Russian Revolution, originated from both Alexander Bogdanov's

¹(Bukharin, 1971). In the “Introduction”, xi-xxix, P.G. Wersky reports the details of Russian delegation's attending this Conference.

²Other scientists were L. Hogben, Needham, Lilley, Farrington, etc.

popular works on scientific and humanistic disciplines³ and the charismatic figure of the poet Anatoly Lunacharsky. At the end of WW1 the number of adherents to this movement was around 500 thousand. It applied Bogdanov's program to develop a "cultural revolution" that proletarian class had to pursue before or at the same time of eliciting its political revolution (Bogdanov, 1911). Proletkult's influence on Russian political life was at the top when Lunacharsky was nominated Minister of Education and Bogdanov was asked to suggest an economic plan for the new communist society.

Yet, after the period of time called "war communism", in 1922 Vladimir Lenin has edited again his philosophical book⁴ in order to renew his political attack to Bogdanov's thinking; moreover he forced Proletkult to obey the Communist Party. As a consequence, the movement lost its original momentum. In the 30's—i.e. some years after Lenin's and then Bogdanov's deaths—, Bucharin reiterated in mildly terms the Bogdanov's program for a proletarian alternative in natural science.⁵ But in that time the great problem of the new society was the failure of the economic planning. In the hopes of Stalin's regime, the participation of a prestigious delegation to London International Congress on History of Science had to answer the expectations of the world Marxist movement for the manifestation of the new historical age started by Soviet revolution; the contributions by Soviet delegation to London Conference had to represent worldwide that the proletarian revolution had already achieved its main cultural goal, i.e. an alternative appraisal on science and technology.

Yet, some years after, the scientists have been charged of betrayal owing to their pursuing the "bourgeois science". Nicholai Bucharin (1888-1938) was tried and executed; some other scientists (for ex. the mathematician Ernst Kolman (1882-1979)) have been sent in gulags. Afterwards, the search for an alternative in natural science was pursued in Russia through a State's plan for promoting an alternative genetic in Siberian agriculture, under the scientific direction of an agronomist, Trofim Lysenko (1898-1976). The disastrous conclusion of the planned experiment left free SSSR's scientists to pursue in the 50's the "bourgeois science".

2. Bernal's New History of Natural Science

In this story, the English group of scientists that in London has been fascinated by the contributions coming from Russian delegation, has ideally received the torch of the

³About Bogdanov see (Jensen, 1978). Let us recall that first Bogdanov (1873-1928) introduced Marxism in Russian socialist milieu. His specific book (Bogdanov, 1897) had 10 editions. In the Bolshevik group he was the most relevant intellectual Marxist, the only one capable to contrast the authority of Plechanov, the intellectual leader of Menshevik group. His numerous works range from economy to philosophy, from work organization in factories to history of science, from science to science fiction (he was the first Russian writer on the latter subject). He did not share the program to "construct a proletarian God" which some others of his group followed (for ex. (Lunacharsky, 1908); see a historical appraisal on this program in (Scherrer, 1980). Bogdanov's political and cultural life is illustrated by (Grille, 1966); his philosophy by (Jensen, 1978), (Biggart, 1989) and (Gare, 2000).

⁴(Lenin, 1927); it was first edited in 1910, one year after Lenin's visit to Capri school for revolutionary social-democrats; this school was promoted by Bogdanov, Lunacharskii and Gorkii. On the polemics following Lenin's book, see (Bogdanov et al., 1982) and (Sochor, 1988).

⁵See for ex. (Biggart, 1987).

program for the revolutionary program in history of science.⁶ Among this group of English scientists, John Desmond Bernal (1901-1971) has represented the most authoritative figure.⁷ He produced a history of natural science according to a viewpoint which cleverly connects science to society. Surely, his vision of the general history of mankind is of a Marxian nature; the ancient age left room in modern times to capitalistic society, where natural science originated; the latter age is developing in anticipation to a new age:

We are now in the midst of a struggle which is evidently a major turning-point in the history of mankind (Bernal, 1953: p. 177).

Inside this framework, science's development is viewed by Bernal as broadly interacting with history of economics:

Interrelation between economic and social factors on one side, and scientific and technological ones on the other side does not admit dispute. [However,] Which should have the priority is not so easy to see (Bernal, 1953: pp. 172-173)

According to him, what a historian can at best do, is to list all factors (both the progressive ones and the retarding ones), describing this interaction between science and society. Wisely, he never reduced history of science to a list of events determined in a mechanistic way by economic forces:

... the vigour of science depends not so much on the level of techniques as on its rate. Not only that, but science is internally a very explosive enterprise. Scientific progress tends to come in bursts because it depends so much on the interaction of many minds. In any period when there are a substantial number of workers in the field and there is an atmosphere of optimism, ideas and applications come thick and faster—kind of chain reaction is set on foot. Contrariwise, if effort in any field falls below a certain level, if workers are isolated or overspecialized, pedantry takes the place of enterprise and the process of discovery comes to a full stop. (Bernal, 1953: p. 135)

Similar ideas can be recognized also in his most known book, significantly titled *Science in History* (Bernal, 1950).

But his books cannot be praised for decisive achievement, while his original thesis met a fierce opposition from internist historians.⁸ In later books Bernal has decreased his effort for linking science with society. Moreover, in meantime Western society was changed, and also SSSR. As a matter of fact, after Bernal's first books, no more great contribution was offered in the same direction by the other components of the British group. Did represent it a dead end of a generous effort? In order to answer this question, let us come back at the historical origin of this effort.

⁶Historical accounts on this period may be found in (Joravsky, 1961) and (Vuchinich, 1970).

⁷One more authoritative figure was Joseph Needham (1900-1999) who in 1954 started the monumental study edited some decades later (Needham, 1954-2015).

⁸An appraisal on Bernal's viewpoint on history of science is given by (Ravetz, 1981).

3. Science and Society According to Bogdanov

The original proclaim of Russian delegation in London, which influenced the above-mentioned group of English scientists, wanted to recognize a whole alternative into the dominant science and the scientific culture. This program (whose origin is in Bogdanov's books) was in opposition to Lenin's attitude on philosophy of science, in a parallel way the consiliarist Marxists (the grassroots branch of Marxist movement, which Bogdanov has belonged to⁹) was in opposition to Lenin's authoritarian political leadership in the post-war Russian revolution.

According to Bogdanov, even natural science is a socially determined activity; hence, proletarian class has to perform a whole cultural revolution by building anew its own culture, natural science included (Bogdanov, 1918). He launched a program for an alternative science, to be achieved in a parallel way Karl Marx' (1818-1883) achieved an alternative science in economics. He has cleverly qualified this alternative as a change in the basic viewpoint by which to see science,¹⁰ rather than as a search for alternative laws. Moreover, he offered a sketchy history of natural science, whose main periods are cleverly characterized, even in their didactical aspects. The final end was foreseen in a scientific revolution which paralleled the political revolution forecast by Marxist thinking. In philosophy of science Bogdanov has considered Mach's analysis of individual sensations as the best philosophical viewpoint of reference, although partly to be rejected, owing to the individualistic character of the building process. Rather, he immersed the human work of elaborating sensations in a social framework, whose basic structure is recognized in the *organisation of social work*, which gives origin also to all institutions, the economic and the social ones. No idealistic notion is allowed by Bogdanov. Rather mental notions are produced by mind's representations of well-determined social situations; he called them "sociomorphisms". In these processes the mutual relationships among all social subjects, mind included, are all well-defined in materialist terms. Unfortunately, he then suggested in an intuitive or philosophical way some ideas that had already been formalized by some decisive contributions. Bogdanov has ignored Marx' mathematical papers, Mach's analysis of thermodynamic theory, the thermodynamic notion of entropy as measuring an organization (Drago pre-print; Foster & Burkett, 2008). However, after him no one politically motivated suggestion for an alternative natural science overcame such his level of awareness of the scientific developments.¹¹

4. Science and Society According to Sohn-Rethel

Some decades ago Alfred Sohn-Rethel (1899-1990) offered in a seemingly independent way a relevant contribution to a Marxian history of ancient times science (Sohn-Rethel,

⁹Let us recall that Bogdanov saw in Soviets a lever for a Russian revolution; in 1905 he was arrested together with all the participants to the Central Committee of Soviets in Moscow. Together Lunacharskii he founded in Capri a revolutionary school, whose management was decided by all participants, in a Soviet style (Scherrer, 1978).

¹⁰His idea may be considered an anticipation of a paradigm-shift in a Kuhnian sense (Kuhn, 1969).

¹¹One may oppose Friedrich Adler's attempt for a new theory of special relativity (Adler, 1920); however it belongs to the long list of deviant theories.

1975). He linked the origin of basic scientific notions with the economic development that occurred near the 7th Century B.C. In this time coin was introduced in the market and its circulation has replaced barter economics. Sohn-Rethel emphasizes that owing to the coin invention, for the first time the act of both selling and buying forced human minds to include some abstract ideas, in particular the coin value of the good at issue. It was at that time that Greeks have produced by abstraction processes a world of ideas. Hence, Sohn-Rethel has suggested a first interpretative category, an *abstraction* process, generated from the new economic processes determined by the introduction of coins. In my opinion, Sohn-Rethel's contribution solves in Marxian terms a long-debated question on the origin of our abstract ideas. For instance, the idea of labor-power in Marx's theory of society.¹²

Moreover, Sohn-Rethel has suggested that the introduction of money circulation produced a historical transition between two kinds of society; a change occurred from a *production society*, in which the products are allocated by means of barter, and an *appropriation society*, in which the processes of commodities production are dominated by the processes of selling and buying commodities.¹³ By means of these two categories he offered a suggestive picture of Greek science, which however does not add any important novelty.

5. From the above Categories to a Basic Dichotomy in the Foundations of Science

When characterizing ideas as originated by means of abstraction processes of money circulation, Sohn-Rethel actually conceived them exactly as Bogdanov defined sociomorphisms. In other words, the birth of abstract ideas (playing a basic role inside a systematic organization of a scientific theory) are explained in a same way by both Marxist scholars, provided that one includes the market exchanges in the organization of the social work, i.e. one adds the market work to the work for producing the survival means. Indeed, their basic categories share the common notion of "organization" (respectively the organization of work in Bogdanov's analysis, the organization of society in Sohn-Rethel's). Moreover, Sohn-Rethel's category "production society" can be intended in a similar way to Bogdanov's category "organization of work"; both categories represent a society organization based upon a *basic problem*; i.e., the survival of mankind with respect to the common struggle for survival; I call it a *problem-based organization (PO)* of society.

In order to further compare their categories, I now introduce some novelties. According to Sohn-Rethel in the appropriation society each individual buyer, being interested in a maximum of commodities in correspondence of a given sum of money, ignores the social production of the commodities themselves; now he has lost a common view on the social organization, beforehand shared by all people through the production links. Therefore, Sohn-Rethel calls the new society an "anarchist" society.

But Sohn-Rethel forgot that, just for managing such an anarchist trend, eventually

¹²About the notion of the abstraction and its methodological consequences see (Nowak, 1980a; Nowak, 1980b).

¹³Also the history of the Chinese society gives evidence for this view. See (Iannaccone, 1988; Iannaccone 1989).

the richer buyers promoted the birth of a State. By adding this historical fact, “appropriation society” is characterized as ruled by an *élite* of money owners, represented by either a poliarchy or a king. In other words, this kind of society is characterized by a hierarchical, *authoritarian organization* of the relationships among social groups (AO). In sum, in Sohn-Rethel history I recognize two opposed kinds of society. He represented this opposition of two kinds of society according to a historical evolution substituting the latter kind of society for the former one, I suggest that these two general kinds of society are mutually opposed in all times. In loose terms they are the societies corresponding to either justice or freedom (of economic enterprise, and hence in modern time the capitalistic society), the latter one trying to supersede the former one and the former one which is revived by the social groups opposing the latter one.

Even in natural science one may recognize two similar kinds of organization of the experimental data, notions, mathematical techniques, laws and principles which all together compose a theory. Sohn-Rethel forgot also that, in correspondence to the birth of appropriation society eliciting an anarchist trend, a parallel movement born and was very strong inside the intellectual life of Greek society, i.e. the Sophists movement. Their disastrous results have undermined the common trust in human reason. The subsequent Greek philosophers, Socrates, Plato and Aristotle, wanted to re-establish the trust in the human reason. In particular, Aristotle (384-322 BC) suggested a model of the scientific organization (i.e. the “apodictic science” (AO)), which authoritatively dominated human minds along almost two millennia. At the starting of the organization few axioms are stated, from which all truths are drawn in a full deductive way. This is exactly the well-known organization of both Euclidean geometry and, a millennium after, Newtonian mechanics.¹⁴ The pictorial representation of this theoretical system is the same of the picture of an approximation society, i.e. a pyramid. Yet, there exists the model of a scientific organization which is the opposite one. At the beginnings, an universal problem is enunciated. For instance, the theoretical organization of classical chemistry is based upon the universal problem of discovering matter’s elements; S. Carnot’s thermodynamics is based upon the problem of determining the efficiency of the process of work production from heat; Lobachevsky’s non-Euclidean geometries upon the problem of how many parallel lines exist. Afterwards the scientific theory organizes notions, arguments and techniques in such way to invent a new scientific method which is capable to solve the problem at issue.¹⁵ The original books of the above-mentioned theories present this kind of organization. Each of them solves the respective problem by inventing a suitable scientific method (e.g., the methodology of chemical reactions in order to discover the elementary components of matter) which was new with respect to

¹⁴(Beth, 1957: sect. I, 2) illustrates at best this point.

¹⁵(D’Alembert, 1770-1775: p. 501), illustrates two kinds of organization of a theory, the “rational” one and the “empirical” one. L. Carnot has devoted some pages to describe this dichotomy in the organization of a scientific theory (Carnot, 1783: pp. 101-103; L. Carnot, 1803: xii-xvi). Moreover, he founded anew geometry, calculus and mechanics according to a PO organization. Unfortunately, his scientific work was ignored along one century; it was re-evaluated by (Gillispie, 1971). By ignoring these previous illustrations, the opposition of two kinds of organization has been independently re-discovered by Lorentz, Poincaré and Einstein; see (Flores, 1999).

the previously known ones. This alternative model of scientific organization corresponds to the above former category, a PO society, which is also based on a basic problem. As a consequence, also in science there exists an opposition between two basic categories; it corresponds to the mutual opposition of the above two social categories.

In synthesis, I interpret the historical transition described by Sohn-Rethel from a production society to an appropriation society as constituting a social situation allowing the abstraction of the sociomorphism (in Bogdanov's terms) of two opposite organizations of a scientific theory.

6. The Addition of Another Basic Dichotomy

Let us come back to Sohn-Rethel's account of the history of natural science. With respect to the entire historical development of science, the ancient period to which his analysis primarily refers represents no more than an anticipation of modern science. Thus Sohn-Rethel attempted to explain also the birth of modern science; whose starting point is considered by him the inertia principle. His analysis on this subject was unsuccessful, because he suggested a representation of this principle by means of an unlikely abstraction from the basic economic process of "money circulation" (Drago, 1987; Drago, 1994: sect. 8).

Actually, he ignored that Galilei could agree with him. Although Galilei correctly applies the inertia principle to local motions, he rejects the notion of an infinite rectilinear motion as impossible; rather he supports the idea of an infinite circular motion of both the bodies around the Earth and the celestial bodies. However, modern inertia principle is unavoidably linked to an infinite rectilinear motion; both Galilei and Sohn-Rethel are wrong.

However, I discovered that by means of some minor changes Sohn-Rethel's categories overlap on the categories of Alexandre Koyré (1892-1964)'s celebrated analysis on the birth of modern science. When we restore the scientific truth (i.e., the inertia principle is unavoidably linked to a rectilinear, infinite motion) we have to add a new notion with respect to Sohn-Rethel's categories; i.e., infinity, just what Greek scientists deliberately refused to explore. In fact, among the several notions resulting from the variety of abstraction processes there exists a qualitatively different notion, *the notion of infinity*, which is an *extreme* abstraction because it appears as the limit of mind's notions. By assuming this notion as his basic category Koyré's analysis of the original texts has shown the notion of infinity has played a crucial role in the birth process of modern science. Also at present time Koyré's (internist) analysis on this birth is the best (Koyré, 1957). In addition, he has illustrated a harsh debate between the supporters of the notion of *actual* infinity (AI), i.e. the infinity considered as the result of an action (e.g., to give reality to the end-points of a straight line), and the supporters of *potential* infinity (PI) (e.g. the kind of infinity of the counting of natural numbers, which is a merely unlimited process, never achieving a final number).

All that amounts to consider one more basic category, i.e. the infinity, which has to be viewed as split in two mutually opposing notions, AI and PI. This result, together

with all that was obtained in previous section, suggests that the foundations of science are constituted by two basic dichotomies; one dichotomy concerns the kind of organization (AO/PO), the other dichotomy concerns the kind of mathematics (AI/PI). By crossing them together we obtain four couples of choices: AO&AI, AO&PI, PO&AI, PO&PI.

Let us remark that Koyré made use of these basic dichotomies, although in an implicit way. Beyond the dichotomy of infinity, he made use of the basic notion of “space”, which he has considered under two different meanings, i.e. the Greek “Cosmos”, which in modern times was abandoned, and the Cartesian space, which gives a specific location to each physical phenomenon. In the light of previous analysis one can even see the category of space in abstract terms, i.e. as an representation of the dichotomy between two kinds of organization of a scientific theory, i.e. either PO (because the notion of Cosmos was aimed to give an answer to the basic problem of ancient times, how it is composed the world), or the deductive organization of the laws of a scientific theory, AO—for two reasons; because inside the Cartesian space few specific laws organize the locations of all objects, and because the first and most important scientific theory of modern times, Newton’s, was organized in a deductive way from few principles.

The category of the infinity is basic also in the historical analysis of a capitalist society. The capital, being in its essence an infinitely accumulation process, is the first social phenomenon which has introduced the infinite process in the history of modern society. This mythical, absolutistic growth (AI) contrasts with the step-by-step increase of the interpersonal interrelationships (PI).

Let us remark that the above illustrated modifications joins both Bogdanov’s and Sohn-Rethel’s categories with Koyre’s categories. This joining constitutes a reconciliation of some prominent instances of externalist historiographies and a celebrated internalist one. In this way, from the notions of an intuitive or philosophical nature which founded the above-mentioned historiographies of science, we have achieved a common view on the basic structures of the history of both science and society.

7. A Sketchy Account of the History of Physics and Chemistry

Let us apply the above categories to offer a sketchy account of the history of Physics.

It is easy to recognize that Newton’s mechanics has constituted a scientific revolution since not only it has organized in a systematic way several notions and laws accumulated along two millennia, but also it suggested the three principles-axiom from which to deduce all mechanical laws. Under the light of the basic dichotomies this theory is characterized by *i*) its AO organization because it is organized in a full deductive way from three principles-axioms; and *ii*) its AI mathematics, because including the actual infinity of the infinitesimal analysis (where an infinitesimal is defined as $1/\infty$) (Drago, 1988).

In the subsequent development of science, its marvelous results have so strongly influenced the following scientists that they have attributed to this scientific theory the character of a paradigm—i.e. the theory of reference for all others; and in opposition, they have evaluated as “immature” theories those scientific theories which later have been

founded upon different choices; in particular, classical chemistry and thermodynamics, whose choices were PI (since their mathematics does not use the infinitesimals) and PO (since they wanted to solve two problems), respectively how much elements exist and how heat may be transformed in work at best¹⁶. Hence, the history of exact sciences in 18-19th Centuries appears as a struggle between the Newtonian paradigm and the above-mentioned alternative scientific theories.

Moreover, one can define in an appropriate way a scientific revolution as the birth of a new scientific theory whose basic choices are different from the choices of the dominant theory or paradigm. Hence, the birth of the three theories, Lavoisier's chemistry, L. Carnot's mechanics and S. Carnot's thermodynamics, represent a scientific revolution because the choices of each of them are PI and PO, and these choices are the opposite ones to Newton's. In fact, their influence has attempted to dethrone Newtonian paradigm.¹⁷ The two dichotomic choices led us to recognize that since that time (to the suggestion of Kuhn's account of an abrupt superseding of a paradigm by the subsequent one) there existed beyond a paradigm, different models of scientific theory which co-existed with it in a mutual competition, although the influence of the paradigm on the scientists dominated the influence of the other theories.

This situation changed when one more revolution occurred in the first years of 20th Century; Newtonian paradigm was eventually dethroned by, on one hand, the birth of quanta, which obliged theoretical physics to include the choice PI; and, on other hand, special relativity was aimed to solve the problem of making mechanics invariant to the Lorentz' group of transformations (PO) and as a consequence radically changed the basic notions of AO Newton's mechanics, i.e. absolute space and absolute time.¹⁸

Yet, the final formulation of quantum mechanics relies on the principles of the Hilbert space and the amplitude of probability, hence the choice AO, by making use of the most sophisticated mathematics (e.g. Dirac's delta function), hence the choice (AI). In sum, the two Newton's choices. As a matter of fact these two theories resulted to be mutually incompatible, for instance because the non-linearity of the relations of indeterminations.

The scientists could make expedient of these revolutions in the foundations of physics for recognizing the basic choices of theories. Instead they did not discover a well-defined reason explaining the occurrences of the new theories. At last, the very foundations of science remained ignored.¹⁹

8. Interpretation of Marx' Theory of Society

An even more interesting result is obtained from the resulting view on the social history. Under the light of the two dichotomies one may obtain a similar bird's eye history of

¹⁶(Drago, 1990a). More in general the PO is analyzed and accurately defined by my paper (Drago, 2012).

¹⁷Notice that the celebrated Kuhn's account (Kuhn, 1969: p. 105) has obscured Chemistry's revolution as included inside the Newtonian paradigm owing to some "supermechanical factors".

¹⁸Special relativity's choices are characterized in a detailed way by (Drago, 2010); the choices of Einstein's paper starting quantum mechanics are characterized by (Drago, 2013).

¹⁹Through the above foundational categories I successfully have interpreted all categories that previous historians of science ingeniously suggested (Drago, 2001a).

Economics through the characterization of its two main theories.

In the above it was remarked that in the history of Western society the notion of infinity was first represented by the social process of an unbounded, absolute accumulation of the capital.²⁰ Then it is easy to characterize Smith's "invisible hand" as a tale for covering the capability of few capitalists to organize a society according to an AO, considered without any credible alternative. This consideration leads us to recognize that the extreme instance of an appropriation society (AO) is a capitalist society (AO), that born at the same time when modern science born, mainly through geometrical optics and Newton's mechanics, both AO theories. This result connects Sohn-Rethel's analysis of ancient economic processes with the analysis through the two dichotomies of the economics of modern society. In addition, the two dichotomies lead to recognize in Smith's "nation's wealth" an ever more accumulating capitals inside a country which in that time was pumping an unlimited quantity of resources from great part of the World (AI).

Let us now characterize Marx's criticism to Smith's and the results of classical economics. It is well-known that the young Marx, in order to qualify his viewpoint in opposition to capitalist society, began a critical review of all intellectual fields. He started from Hegel's philosophy of Right, but then the study of economics has attracted him and thereafter it has absorbed almost all his energies. At his death, his gigantic program was remained unaccomplished, even in economics; great part of his main book, *The Capital*, was edited after his death. Hence, later the definition of what Marx' theory essentially is, constituted a matter of interpretation.

According to the two dichotomies Marx' theory is characterized as wanting to solve the problem of justice by means of a revolution abating the capitalist organization (by him called "the capitalist relations of production/economic structure") of society, i.e. AO; hence the choice of his theory is PO (Marx, 1959). By representing the dichotomy on the kind of organization AO/PO in social terms of the value dichotomy freedom/justice (or even the political terms right/left) Marx's political-economic theory is based on the problem of how proletarian class can expropriate capitalists' production tools in order to organize these tools for producing in a self-reliant way goods for all. This representation gives a more vivid characterization of the theory as PO theory.

More cumbersome is the characterization of Marx's theory about the dichotomy AI/PI. Marx' criticism to classical economists characterizes the main economic process (the growth of capitalism—as an infinite, absolute process, which represents in society the choice AI).

Accumulate, accumulate! That is Moses and the prophets!²¹

Marx surely wanted to stop the infinite capital's growth for rather pursuing an alternative development of mankind; this development has to be managed by the proletarian class according to the program of improving and expanding human relationships

²⁰It is unfortunate that the scholars of the Philosophy of Economics have ignored this category, as if the Capital was either an unanalyzable premise of their macroeconomic analyses or a final, remote result of their microeconomic analyses.

²¹(Marx, 1990: end of chp. 22). However, the further characterization of the life of a capitalist was left to a bourgeois scholar (Weber, 1930). It is an ascetic spirit—which has prolonged that of middle ages—that is required from a capitalist life in order to support the infinite growth of the capital.

in such a way to obtain “the human society and the social humanity”; that means the choice PI.²²

In synthesis, according to the viewpoint illustrated in the above, Marx’s theory of society has to be characterized in a first approximation as a PO theory, whose main problem is how establishing justice in society, and a PI theory, since it opposes the infinite, absolute *increase* (AI) of capitalism inside the history of mankind for establishing an alternative social development. In social terms, Marx’ original theory is characterized as a theory relying on the two following choices; i.e. a consiliarist (grassroots) organization (PO) and the supremacy of human relationships on money and its accumulation process, capital (PI). The above two choices characterize Marx’s theory of society as an alternative theory since they are exactly the opposite choices to the dominant choices in both natural science and economics, respectively Newton’s choices and the choices of bourgeois society developing the capitalism. Moreover, this new characterization corresponds to his claim to have produced a *scientific* theory of political economics, because it is based on the same choices characterizing the foundations of the alternative sciences.

As a confirmation of this interpretation let us recall that Koyré has declared his interpretative categories: “The Dissolution [not PO] of the finite [not PI] Cosmos and the geometrization [AI] of the space [AO].” In square brackets I put the corresponding basic choices to which the antecedent words allude. Elsewhere I have suggested the categories for the alternative exact physical theories: “Evanescence [not AO] of the force-cause [not AI] and discretization [PI] of matter [PO]. One may suggest the corresponding, à la Koyré categories for Marx’ interpretation of the birth of the capitalism: “Decomposition [not AO] of the private economic production [not PI] and the capitalist monetization [AI] of the workers’ market [AO].”

Yet, the choice PI of Marx’ criticism concerns the social and historical phenomenon of capitalism, not the productive forces which are instead considered by him as a positive factor of the historical development, so much to address a harsh criticism to Ludd, the mythical worker trying to obstruct technological progress in his factory. This criticism barred any next attempt to question the political problem played by machines in society. According to Marx, the progress of the technological and scientific factors, together with the growth of the social inter-relationships and the human knowledge, determine the destiny of the bourgeoisie, i.e. “to digging up its grave by means of its own hands”. Indeed, his thinking depended from Hegel’s philosophy of the historical development of mankind as a growing of the Absolute Spirit; that represents an AI development. Yet, Marx conceived the productive forces under the control of the proleta-

²²More evidence for this choice comes from Marx’ papers on natural sciences, written in his last years. Being materialist, he rejected any idealistic notion not supported by hard (social) facts. In mathematics this attitude corresponds to use notions only when they are obtained by means of algorithms of effective calculations; that means to use a kind of mathematics which is bounded to use potential infinity PI only—just what pertains to ruler and compass’ geometry, classical chemistry, thermodynamics. I showed that Marx’ mathematical manuscripts (Marx, 1983) share this basic choice (Drago, 1982). He anticipated (Brouwer, 1970) who started a movement in order to ban AI from mathematics. Eventually, (Bishop, 1967) showed that a mathematics making use of PI only—though being very different in qualitative terms from classical mathematics which makes use of AI—obtains in quantitative terms the counterparts of a great part of latter one’s results.

riat as the main contributors to the developments of social inter-relationships, human knowledge and mankind's history, which all represent a PI development; Hence Marx' appraisal on the kind development generated by the productive forces is ambiguous;

Marx never solved this ambiguity of his political program, which left room for an interpretation of his theory as supporting an AI society,

9. Anew Look on the History of Marxist Movement

In past times Marxist *theorists* have commonly characterized the Marxism as materialism plus Hegel's philosophy, whose dialectics had to be "turned up down"; yet, never a common agreement on this point was achieved. Instead the present analysis suggests that Marx's theory had to be linked with history of science which suggests a detailed characterization of it. Moreover, Marxist theorists the attention on subjects pertaining to current economics, without suspecting that Marx' viewpoint may be characterized by the two basic choices on the kind of the social organization and the kind of social development which caught the foundations of Economics and more in general a more adequate social consciousness.

Even more ambiguous than the thinking of Marxist theorists was the history of Marxist *movement*. After a first period, characterized by an organization including the anarchists (the First International) and aimed at solving the problem of overcoming capitalist society (PO) through the growth of proletarian class' consciousness (PI), Second International was based on a leadership (recall that Engels has expelled Duehring—an alternative natural scientist—from the International because the influence of the latter one competed with Marx'). Later, Lenin imposed an even more tight leadership (the Union as transmission belt of the Communist Party) on revolutionary movement and then Russian revolution. At last, under Stalin the Third International introduced an authoritarian organization of all Marxist Parties in the World. In conclusion, the history of the interior organization of the Marxist movement presents a change from the PO choice to an AO choice (each time the change was justified by the need of solving the justice problem in the World society).

Even worse when the Marxism got the power in Russia. It established a political dictatorship which went far beyond the justification of forcing—in name of the proletarian class (a social transition to the social communism). Its AO choice was one of the hardest in the entire mankind history. Even more misfortunate was the choice which already in Marx' thinking was ambiguous, i.e. the choice on the kind of social development. The Marxist movement did not recognize in a clear way the basic dichotomy on social development between a unbounded, absolute increase (AI) (as capitalism pursues it), and a development improving the personal interrelationships (PI). Both the program of the Second International Conference in Gotha (1875) and Engels' book *Anti-Duehring* (1878)²³ barred all ideas for an alternative to the capitalist kind of social and technological development. Their political influences established inside the movement the idea

²³Under this light, Marx' manuscript (Marx, 1970), represents an extreme attempt to invert a dominant trend in Second International. The same trend was later fought by (Bogdanov, 1911) and much later by the Chinese Cultural revolution in the 60's.

that the historical task of proletarian class did not concern a change in the productive forces and the social institutions of the bourgeoisie; this task was reduced to supersede the bourgeoisie in the same management of these forces. A PI society, whose human relationships dominate the productive forces, was postponed to the end of the long historical transition to the new society.

Later, when planning the development of SSSR Lenin has launched his program about the technological development through the slogan: “Electrification [AI] plus soviets [PO]”; he thought that workers’ relationships were capable to curb the technical and scientific imperatives. This naivety led to a paradoxical result. After two decades and half, SSSR has built even nuclear weapons for suddenly destroying people at millions, included the proletarian class of the “enemy”. The Chinese Cultural Revolution shared the same naïve attitude about science and technology: The “Red Guards” wanted to teach the workers how had to use the technical tools according to Mao’s “red book”. The result was a great civil war.

Some decades ago the social struggles against arms’ race, Earth pollution, nuclear power, and biotechnologies born in Western countries. These people’s struggles obliged Marxist movement to re-think on the choice AI; a development which is alternative to the capitalist one has not to be necessarily qualified as a Luddist choice. Yet, Marxist movement was unable to take a clear rut choice on the dichotomy on social development; the recent case of nuclear power proves it.

In sum, the birth of the Marxist movement was characterized by a possible complete alternative to the dominant society; but along the history this movement even more lost the features of an alternative for assuming the features of a variant of the dominant society in Western countries.

10. Conclusion

By bringing Bogdanov’s categories close to Sohn-Rethel’s categories I obtained an interpretative category which is more powerful than the original ones: i.e. a dichotomy on the kind of the social organization. By then adding Koyre’s appraisal on the crucial role played by the notion of infinity in modern science, I obtained one more dichotomy on the kind of the social development. Through both dichotomies I have reconciliated the externalist historiographies of science with Koyre’s internalist historiography. This reconciliation allows paralleling the interpretations of the history of social sciences and the interpretations of the history of natural sciences, because both kinds of science share the same kind of foundations. As a particular result, both Marx’s theory of society and Marxist movement have been characterized in their alternative features to the paradigmatic theory of economics. In conclusion, the two dichotomies are capable to interpret both kinds of history providing that the philosophical meanings of the choices of the two dichotomies are qualified in an appropriate way to the specific field of study. In other words, there is almost a continuity between the history of natural sciences and the history of social sciences.²⁴

²⁴In particular, one may consider in a parallel way the conflict among the theories of both kinds of science for suggesting a general theory of conflict resolution (Drago, 1996).

All that puts an open problem for the historians. We have seen that the two dichotomies define in a clear cut way the main scientific revolutions which occurred in the history of the exact sciences. A scientific revolution occurred around the year 1800, when some theories (chemistry, L. Carnot’s mechanics, Sadi Carnot’s thermodynamics, Lobachevsky’s non-Euclidean geometry) born; all they rely on the alternative choices to Newton’s; yet for a long time the new theories have been contrasted and eventually forgotten (L. Carnot’s mechanics), or changed in acceptable terms for the mainstream. A further scientific revolution occurred around the first years of the 20th Century; in such a case the experimental nature of the new results (atoms, quanta, false existence of the ether) won all resistances so that it established a new theoretical science. These two last scientific revolutions occurred in the same periods of the two major political revolutions in the World (French revolution and Russian revolution). The two dichotomies suggest a philosophical connection between the basic choices of both couple of revolutions. Is it possible to establish by means of historical evidences this connection?

The following **Table 1** summarizes these above established connections.²⁵

In retrospect, the historical event of the Second World Congress of the History of Science has correctly evoked an alternative natural science; in fact at present we see that there exists not only one alternative to the paradigmatic ways to do natural science, but also three alternatives to the mainstream scientific attitude, as they are summarized by the three non-Newtonian MSTs, Marxists theory of society, providing that its choice

Table 1. Scientific theories, theory of society and social processes.

NOTIONS AND BASIC OPTIONS OF NATURAL SCIENCES			
	Origin of basic scientific notions	The option between AO and PO	The option between AI and PI
<i>The attitude of TRADITIONAL PHILOSOPHY OF SCIENCE</i>	From both measurement processes and Greek geometry	Ignored. AO only, as an unavoidable aspect of science	Ignored. AI only; the hard core of modern science
<i>The attitude of DOMINANT THEORIES</i>	From Greek philosophers’ idealizations (<i>Sohn Rethel</i>)	Ignored. AO only (few principles and deductive method) { <i>Beth</i> }	Ignored. AI only (nonstandard analysis and limit calculus) { <i>Koyré</i> }
<i>The attitude of ALTERNATIVE SCIENTIFIC THEORIES</i>	By idealisations	PO: organisation based on a problem { <i>L. Carnot</i> }	PI: constructive mathematics { <i>Brouwer, Bishop</i> }
<i>The attitude of MARX THEORY</i>	By idealisations; say, labour-power	Ignored. PO as a social movement aimed to solve an universal problem { <i>Bogdanov</i> }	Ignored. PI: the progress of substantiating an universal justice
<i>BASIC SOCIAL PROCESSES IN WESTERN SOCIETY</i>	<i>Processes occurred when passing from production society to appropriation society (Sohn-Rethel)</i>	<i>Centralized State as an authoritarian organisation</i>	<i>Capitalism as an unlimited process of accumulation</i>
	Introduction of institutions in a society	Society organisation: either authoritarian AO, or self-reliant PO	Development: either unbounded AI or for justice PI
NOTIONS AND BASIC OPTIONS OF SOCIAL SCIENCES			

Legenda: AI = Actual Infinity and mythical progress. PI = Potential Infinity and ecological progress. AO = Aristotelian Organization and centralized society. PO = Problem-based Organization and self-reliant movement. Between brackets the authors emphasizing the notion at issue.

²⁵I developed this viewpoint in (Drago, 2001b).

about the kind of the social development is qualified as PI, and does constitute an alternative social science. At the time of British group of Marxist scientists has operated, all the above suggested connections were obscure owing to either a too early stage in the analysis of the history of science, which recalls that Koyre's main contribution occurred in the same period of time of Bernal's studies, or during a period of the political repression (in the case of Lenin's and then Stalin's the opposition to Bogdanov's thinking). In these periods of time it was impossible to achieve from an analysis of the history of social and natural sciences the decisive categories for interpreting the historical development of science.

However, according to the above illustration of the alternative natural science, the program launched in the Second World Congress of the History of Science was fulfilled after the mid 20th Century when the scientific theories relying on the alternative choices to Newton's mechanics have been recognised. Under the light of this result, the work by the British group of scientists has represented a decisive contribution under several aspects; first, they have prolonged the program started by some courageous Marxists (mainly Bogdanov) for an alternative in science. Second, they have introduced a kind of analysis upon the scientific development which was free of philosophical pre-conceptions (derived from either Hegelian or Engelsian philosophies). Third, they have emphasized the political relevance of a Marxist interpretation of the historical development of science. In sum, the movement of these scientists has represented a strong, albeit an intermediate step in the historical process leads to a more adequate Marxist interpretation of history of natural science and eventually to an interpretation of science in general.

References

- Adler, F. (1920). *Ortszeit, Systemzeit, Zonenzeit und das Ausgezeichnete Bezugssystem der Elektrodynamik*. Wien: Wienerer Volksbuchhandlung.
- Bernal, D. (1953). *Science and Industry in Nineteenth Century*. London: Routledge and Kegan.
- Bernal, D. (1950). *Science in History*. London: Watt.
- Beth, E. W. (1957). *Foundations of Mathematics*. Amsterdam/New York: North-Holland.
- Biggart, J. (1987). Bukharin and the Origin of the 'Proletarian Culture' Debate. *Soviet Studies*, 39, 229-246. <https://doi.org/10.1080/09668138708411687>
- Biggart, J. (1989). *Alexander Bogdanov, Left-Bolshevism and the Proletkult 1904-1932*. Norwich: University of East Anglia.
- Bishop, E. (1967). *Foundations of Constructive Mathematics*. New York: Mc Graw-Hill.
- Bogdanov, A. A. (1897). *Kratkii kurs ekonomiceskoi nauki [A Short Course of Economic Science]*. Moscow.
- Bogdanov, A. A. (1911). *Kul'turnye zadachi nashego vremeni [The Cultural Tasks of Our Times]*. Moscow: Izdanie S. Dorovatoskogo.
- Bogdanov, A. A. (1918). *Nauka i robotici klass*. Moscow.
- Bogdanov, A. A. et al. (Eds.) (1982). *Fede e Scienza*. Torino: Einaudi.
- Brouwer, L. J. (1970). *Collected Works*. Amsterdam: North-Holland.

- Bukharin, N. et al. (Eds.) (1971). *Science at Crossroad*. London: Cass.
- Carnot, L. (1783). *Essai sur les machines en général*. Dijon: Defay.
- Carnot, L. (1803). *Principes fondamentaux de l'équilibre et du mouvement*. Paris: Deterville.
- D'Alembert, J. (1770-1775). Elemens. In D. Diderot, & J. D'Alembert (Eds.), *Encyclopédie Française* (Vol. 17, pp. 498-502). Livourne: Imprimerie des éditeurs.
- Drago, A. (1982). Le implicazioni teoriche dei manoscritti matematici di Marx. *Testi & Contesti*, 8, 107-116.
- Drago, A. (1987). Money, Objective Scientific Knowledge and Social Consciousness. In J. E. Fenstad, I. T. Frolov, & R. Hilpinen (Eds.), *8th International Congresses in Logic, Methodology and Philosophy of Science* (pp. 85-88). Amsterdam: North-Holland.
- Drago, A. (1988). A Characterization of Newtonian Paradigm. In P. B. Scheurer, & G. Debrock (Eds.), *Newton's Scientific and Philosophical Legacy* (pp. 239-252). Dordrecht: Kluwer Academic Publishers. https://doi.org/10.1007/978-94-009-2809-1_16
- Drago, A. (1990a). History of the Relationships Chemistry-Mathematics. *Fresenius' Journal of Analytical Chemistry*, 337, 220-224. <https://doi.org/10.1007/BF00322400>
- Drago, A. (1994). Interpretazione delle frasi caratteristiche di Koyré e loro estensione alla storia della fisica dell'ottocento. In C. Vinti (Ed.), *Alexandre Koyré. L'avventura intellettuale* (pp. 657-691). Napoli: ESI.
- Drago, A. (1996). A Paradigm-Shift in Conflict Resolution: War and Peace from a History of Science Viewpoint. In P. Koller, & H. Puhl (Eds.), *Current Issues in Political Philosophy* (pp. 106-114). Kirchberg: ALWS.
- Drago, A. (2001a). Un comune concetto di scienza dal confronto delle specificità. *Voci di Strada*, 13, 93-124.
- Drago, A. (2001b). The Several Categories Suggested for the "New Historiography of Science": An Interpretative Analysis from a Foundational Viewpoint. *Epistemologia*, 24, 48-82.
- Drago, A. (2010). La teoria delle relatività di Einstein del 1905 esaminata secondo il modello di organizzazione basata su un problema. In E. Giannetto, G. Giannini and M. Toscano (Eds.), *Relatività, Quanti, Caos e altre rivoluzioni della Fisica* (pp. 215-224). Rimini: Guaraldi.
- Drago, A. (2012). Pluralism in Logic: The Square of Opposition, Leibniz' Principle of Sufficient Reason and Markov's Principle. In J.-Y. Béziau, & D. Jacquette (Eds.), *Around and beyond the Square of Opposition* (pp. 175-189). Basel: Birkhauser. https://doi.org/10.1007/978-3-0348-0379-3_12
- Drago, A. (2013). The Emergence of Two Options from Einstein's First Paper on Quanta. In R. Pisano, D. Capecchi, & A. Lukesova (Eds.), *Physics, Astronomy and Engineering: Critical Problems in the History of Science and Society* (pp. 227-234) Siauliai: Scientia Socialis.
- Drago, A. (Pre-Print). *Bogdanov e la scienza alterativa*.
- Flores, F. (1999). Einstein's Theory of Theories and Types of Theoretical Explanation. *International Studies in Philosophy of Science*, 13, 123-134. <https://doi.org/10.1080/02698599908573613>
- Foster, J. B., & Burkett, P. (2008). Classical Marxism and the Second Law of Thermodynamics. *Organization & Environment*, 21, 3-37. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.704.6913&rep=rep1&type=pdf>
- Gare, A. (2000). Aleksandr Bogdanov's History, Sociology and Philosophy of Science. *Studies in History and Philosophy of Science Part A*, 31, 231-248. [https://doi.org/10.1016/S0039-3681\(00\)00002-9](https://doi.org/10.1016/S0039-3681(00)00002-9)
- Gillispie, C. C. (1971). *Lazare Carnot Savant*. Princeton: Princeton University Press.

- Grille, D. (1966). *Lenin's Rivale: Bogdanov und seine Philosophie*. Koeln: Wissenschaft und Politik.
- Iannaccone, I. (1988). Connection between Monetary Economy and Production of Mathematical Science in History of China. In T. Kampen (Ed.), *Proceeding of 21st Conference of Chinese Studies* (pp. 338-347). London: Kegan.
- Iannaccone, I. (1989). *Scientific Theories Organisation and State Organisation in Chinese History*. Hamburg: Abstracts of 18th International Congress of History of Science.
- Jensen, K. M. (1978). *Beyond Marx and Mach: Aleksandr Bogdanov's Philosophy of Living Experience*. Berlin: Springer. <https://doi.org/10.1007/978-94-009-9879-7>
- Joravsky, D. (1961). *Soviet Marxism and Natural Sciences*. New York: Columbia University Press.
- Koyré, A. (1957). *From the Closed World to the Infinite Universe*. Baltimore, MD: Maryland University Press.
- Kuhn, T. S. (1969). *The Structure of Scientific Revolutions*. Chicago: Chicago University Press.
- Lenin, V. (1927). *Materialism and Empiriocriticism*. New York: International Publishers.
- Lunacharsky, A. (1908). *Religia i sozialism*. Moscow: Shipovnik.
- Marx, K. (1970). Critique of the Gotha's Programme. In K. Marx (Ed.), *Selected Works* (Vol. 3, pp. 13-30). Moscow: Progress Publishers.
- Marx, K. (1959). *Economic & Philosophic Manuscripts of 1844*. Moscow: Progress Publishers.
- Marx, K. (1990). *The Capital* (Vol. 1). London: Penguin Books.
- Marx, K. (1983). *Mathematical Manuscripts of Karl Marx*. London: New Park. https://www.marxists.org/archive/marx/works/download/Marx_Mathematical_Manuscripts_1881.pdf
- Needham, J. (1954-2015). *Science and Civiklization in China*. Cambridge: Cambridge University Press.
- Nowak, L. (1980a). *The Structure of Idealization*. Berlin: Springer. <https://doi.org/10.1007/978-94-015-7651-2>
- Nowak, L. (1980b). On the Idealization Structure of the Economic Theories. *Erkenntnis*, 30, 223-246.
- Ravetz, J. (1981). Bernal's Marxist Vision of History. *Isis*, 72, 393-402. <https://doi.org/10.1086/352789>
- Scherrer, J. (1978). Party Schools in Capri and Bologna. Formation of Party Intelligentsia. *Cahiers du Monde Russe*, 19, 259-294.
- Scherrer, J. (1980). La construction de Dieu marxiste. *Russia*, 4, 173-198.
- Sochor, Z. A. (1988). *Revolution and Culture. The Bogdanov-Lenin Controversy*. Ithaca: Cornell University Press.
- Sohn-Rethel, A. (1975). Science as an Alienated Consciousness. *Radical Science Journal*, 2/3, 65-101.
- Vuchinich, A. (1970). *Science and in Russian Culture*. Stanford: Stanford University Press.
- Weber, M. (1930). *The Protestant Ethics and the Spirit of Capitalism*. London: Unwin Hyman.

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