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IIRE Working Paper Number 41:
Reality, knowledge and forecasting

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Reality, knowledge and forecasting

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This essay is based on a presentation given at the conference Le troisième âge du capitalisme, sa physionomie socio-politique à l’orée du XXIe siècle. En mémoire d’Ernest Mandel (1923-1995). Held on May 20-22, 2015 in Lausanne, Switzerland.¹

Warning to the reader:
This paper is a "dynamic document" to use a fashionable term in the field of electronic publishing. It is the next step in an attempt to attack the problem of human knowledge from a materialistic and dialectical point of view. A first skeleton was published in the anthology Returns in Marxism.²

What follows below is more an exercise in stock-taking and in posing the question. What does it mean to say a dialectical and materialistic approach to the understanding of human knowledge? After the dogmatic period of the Stalinist philosophy of science, we balance on a tightrope, as it is easy to retreat to empty dogmatic notions, whilst the far end of the rope is still not visible. The theory is still in the making and only after a full understanding (or a mature view), can you explain something comprehensively as if it were obvious. Unrolling thoughts and investigations map out a bumpy road. So, what follows below represents a more inductive approach than derived from the so-called hypothetical deductive method, where the author supposedly has a firm idea and consequently tries to prove or disprove it. New ideas largely pop up intuitively.³

End of warning

¹ See: http://alencontre.org/forum/forum-international-20-22-mai-2015-lausanne-suisse.html#more-27637
³ Even in mathematics. See: Jacques Hadamard, The mathematicians's mind, Princeton UP, 1996 [1945]. But intuition dependents on what we already know. As Louis Pasteur famously said: mais souvenez-vous que dans les champs de l'observation le hasard ne favorise que les esprits préparés. (7 December,1854). https://fr.wikisource.org/wiki/Discours_prononc%C3%A9%20_Douai_le_7_d%C3%A9cembre_1854_%C3%A0_l%E2%80%99occasion_de_l%E2%80%99installation_solenlle_de_la_facult%C3%A9_des_lettres_de_Douai_et_de_la_facult%C3%A9_des_sciences_de_Lille
Introduction

In this essay, I deal with the issue of understanding nature in order to develop a conscious policy to adjust humankind and nature to the benefit of the survival of humankind. I deliberately say humankind AND nature as humankind is part of nature and interacts in a nonlinear fashion that indicates mutually determining, in accordance with nature. Changes in human behaviour will induce changes in nature, e.g., the climate, whilst changes in nature induce changes in humankind, e.g., pigmentation. In other words, the question is how does humankind survive? For some people, the notion 'adjusting humankind' might sound rather strange. But we have to realise that we, as human beings, are constantly adjusted to changing environments and not only by biological evolution. The whole medical field is an attempt to help people survive and be in a position to procreate through human interventions, such as vaccination and prenatal diagnosis, and this on top of our cultural changes due to changes in food and habitats.

Nature, including mankind, is a whole, but humankind has no overall theory or even idea of how it all fits together. We have a patchwork of research fields, and often the fundamentals of one field do not dovetail with those of others. This, despite ambitious attempts to suggest an order among all various scientific endeavours.

Humans are an evolutionary result of the way our planet has evolved. Humans are a given and not a necessity. But humans, just like many living species before us, can disappear due to natural disasters (a disaster for the species, not for nature), and in our case also due to conscious human interventions. The last fact is a humanistic concern not a natural one. Understanding the interplay between humans and nature demands knowledge encompassing theories of nature in all its components, including humanity. This spans all crafts, arts and sciences.

Due to our lack of understanding, for practical purposes, we split this vast arena of the unknown into separated fields of investigation, each with its own history of investigative methods. The hope is that, on a certain level of understanding, we can merge fields of investigation and transcend to a more comprehensive and integrated view and theory. Traditionally, this more comprehensive understanding is called a higher understanding, which suggests a subordination of its constructive parts. However, it is still an open question as to whether we can indeed always carry out a reduction from a "higher" theory to "lower" levels, or as to whether we are dealing with a constructive process from below. After all, as far as we now believe, the origin of the universe was simple.

We have to deal with the remarkable fact that fairly simplistic logical reasoning enables the building of the gothic churches of mathematics, which turns out to be tremendously effective in the natural sciences and in technology. For that reason, these fields are often taken as a guide for less formal fields. This is not a problem as such, as long as we understand the intrinsic limits of these borrowed methods.

Moulding fields of investigations that are not fully understood in formal models might help to make progress but does not guarantee success. Hence, the methods borrowed from technology and used in understanding social behaviour can be helpful in trying to find, e.g., physical or neurological deviations. The possible social consequences of certain brain structures are still, to a very large extent, unknown. The mutual determinations and influences are slowly understood in ongoing and relatively novel research. For a long time, social rules of behaviour or civilisation have been seen as a main result of nurture, because we had no idea about the way biological metabolisms influence a person. However, the interplay between biologically-induced behaviour and socially-impressed

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behaviour was always a concern. In previous centuries, we dealt with the four humours: blood (air), black bile (earth), yellow bile (fire) and, phlegm (water) as a first attempt to model the problem. An aggressive person might have too much yellow bile. Very slowly, the interplay between mind, brain and metabolism and the transmission of features by heritage and culture has been getting some leverage in the debate. Hence, we have to consider all mutually influencing forces and structures in a holistic way and only consider independent linear responses as operational trails.

Hence, in the following, I deal with the general issue of framing knowledge about the world and the process of acquiring knowledge that enables conscious action. In this process, there are many starting points. As I see it, we can posit two extremes as starting points; on the one side, we have physics as a highly structured science, often even named the queen of sciences. On the other hand, we have the fast developing field of heredity and the interplay between the genotype (the genetic code) and the phenotype (the resulting living species). In order to keep this essay within limits, I will take physics as a mature example and only sparsely deal with heredity as a field where novel ideas are rapidly developing. As some readers might feel unnecessarily uneasy with physics, at the end of this paper, I add a short note on fundamentally ontological questions in physics. Here, I hope to convey that deriving from these fundamentals, this successful field of research is not as rock solid as people might think.

To pay tribute to the ultimate goal of how we hammer out a policy for emancipation beyond the present suppression of humans by humans, I also add a note on Lenin and his appreciation of modern scientific ideas around the start of the last century, not as an exercise in historiography or proof of this genius, but because the issues of his concern are still on the table.

Following this introduction, I will explore some deeper notions in order to try and define what we can make out of scientific socialism, a most misused notion.

The contingency of knowledge

In normal speech, the main objective of a science is the understanding of what happens in the world, preferably expressed in regularities — named laws —, and subsequently the applications of these laws in day-to-day social practice. We humans wish to organise our lives to the best benefit of humankind and henceforward we research our direct habitat, and even beyond planet earth, to determine ways of operating our society in a way that enables our desires and goals to be reached.

It goes without saying that this "to the benefit of humankind" is highly contextual. The content depends on the social position of the speaker. In general, the benefit of humankind deals with the very biological structure of mankind and its survival as a species. This means the best integration of humankind as part of nature in nature, and in particular the inter-relationships between humans, animals, plants, and bacteria. Through experience, humans, as part of nature, know the world of which we are products as well as constituent part of. From a phenomenological description, we try to develop an understanding of its internal behaviour or metabolism and this for all levels from the simplest cells to human social structures.

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5 In the best benefit of mankind is an ambiguous notion. This lofty idea is often a good reason for slaughter and depends highly on the level of education, culture and place in society of the individual who claims it. Nevertheless, it is a good humanitarian goal as long as we keep within the framework of Trotsky's Their Morals and Ours. [https://www.marxists.org/archive/trotsky/1938/morals/morals.htm](https://www.marxists.org/archive/trotsky/1938/morals/morals.htm)
Traditionally, we develop the study of the world around us, in two broad divisions; the study of the material (non-living) world and the living world. The latter is again divided into the human — thinking — living material world and the big non-human world of animals, plants and bacteria, etc.

In this approach, it looks as if the science of society is a young branch of knowledge as the society of humans is historically a fairly young spin-off of world history. However, it is the society of humans that gave rise to our knowledge systems with which we tackle our non-living material environment. Hence the sciences of society (sociology, philosophy, history, anthropology, economy, etc., etc.) are essential to understand how, when and why some natural scientific theories take off and transcend to an almost independent craft with relative success and even impose methodological demands on the social sciences.

The complicated dialects of this process in which society gives birth to sciences that claim to explain their own fertilisation, gestation and birth, thereby seemingly positioning themselves outside society, form one of the most important issues to be understood in appreciating the role of science and the so-called scientific method. One way or another, human society is intrinsically able to produce reflective theories that try to describe, understand, and steer human society.

Our best intentions are always a product of our world view and hence contextual. Humankind — as far as we know — is unique in being able to think teleologically: goal oriented. Instead of unconsciously following the streams of our interactions with the rest of nature by only evolutionary changing our bodily features and metabolism (like the capability to drink milk), our social behaviour is also under development. Thereby, evolutionary development is not only a consequence of the changing patterns of our habitat, earth, as in the case of most living creatures, but humans resist this by active participation. Increasingly, we try to intervene in "blind" evolution with modern medicine as trail blazer and mechanics and robotics as helpers. However, we do change as a species and the discussion to what extent this is measurable is part of the discussion with the so-called evolutionary psychologists who claim 'to explain all aspects of human behaviour, and thence culture and society, on the basis of universal features of human nature that found their final evolutionary form during the infancy of our species some — 100-600 thousand years ago'.

The human capacity of reflective thinking transcends a more-or-less passive interaction between humans and the rest of nature in which we are embedded, to a situation where we are at the same time the result, the interacting partner and the navigator of our natural past, present and future.

I say natural, because only those events can happen which are "allowed" by nature and our place in it. We cannot fly by ourselves. But importantly, our understanding of nature allows us to invent aircrafts or bombs of all kinds, but always within the strict rules nature adheres to. In this paper, I don't deal with moral categories, as morality is an evolutionary cultural phenomenon deliberately developed over time as a stabiliser of society, and certainly — but

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7 The fascinating issue here is that we can "invent" contraptions which will never evolve evolutionarily, such as the bike. Once invented, in a particular socio-historical setting, such inventions remain forever and become trans-historical, this while the mental understanding of the inner functioning might change or even get lost over the centuries.
Often, moral categories are in a "stable" culture unconsciously replicated and accepted as a "natural" norm, and then serving as stabiliser of that culture. A rule of thumb is: do not relish the brains of sick people (dead or alive). Such rules of thumb developed throughout our history, reflect over the millennia-old Kashrut, the Jewish dietary laws for food, and the related Islamic Halal food rules. They clearly find their rationale in the environmental conditions of the old Middle-East. We don't consider cannibalism as an advanced human feature, though our repulsive attitude towards cannibalism might be the result of various experiences of eating dead human bodies having given rise to terrible diseases. The conditions, we experience and learn to handle without even having the faintest idea of the why-to-wherefore. This particular taboo is now rationalised by the "scientific" warning against prions. On the other hand, in very serious situations of acute food shortage, cannibalism is not uncommon, but is always shrouded under the veil of cultural taboo.

In the same way, incest, being a source for degradation, has also developed into a cultural taboo, less absolute, because its randy commercialisation in pornography is rife. It is not necessary to expand further into the discussion of who was first: the laws or the experiences. All dietary or hygienic rules, such as washing your hands before you assist in child delivery, can be brought back to practical experiences. However, to make an experience a fully accepted social practice, humans need social cultures and rules, and as the best way to link human forces is still to invent an enemy or super power from somewhere else, we create belief systems, religions, and scientific theories which enable us to act in our societies as if we are in conformity with higher rulings which we accept, for all practical purposes (FAPP), as social glue.

Wait! I hear you calling, isn't the difference between belief systems and scientific theories the "fact" that the first category is fake and the second, at least the best approximation to the reality we experience? Indeed, I will retreat a small step, without becoming a post-modernist. However, the line between serious not-yet scientifically expressed belief systems such as the taboo of eating the brains of sick dead people and understanding why, is thin. The same is true for the use of medicinal herbs.

Developing knowledge for use in our daily lives is like rebuilding a ship while sailing, and doing so, finding out that the ship is not of the kind we thought it was when our predecessors started the overhaul.

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9 A recent example is the transmission of prion-based infections as we saw with the Mad Cow Disease (BSE) outbreak inducing mortal brain damage. The very notion of misfolded proteins (prions) is hardly half a century old, and proves the "intuition" that feeding cows with the remains of other cows is not a good idea. The "reality" is that entities, we now call misfolded proteins can damage our existence.
10 For an interesting discussion on this issue, particular in relation to morality see: Jesse Prinz, *Beyond human nature, How culture and experience shape our lives*. Penguin Books, 2013, pp. 322-328
11 For the non-scientist as well, a good introduction from a biological rather than a physical science background can be found in: Tim Lewens, *The meaning of science*, Pelican Books, 2015.
12 To borrow an expression of the physicist John Bell, famous for his research on quantum mechanical riddles.
About Framing

The understanding of a thing or phenomena is always framed in a context. The context provides the meat on the bones of the very notion of a thing or phenomena (an object). Every notion is dressed in the language of a historically determined social context. This holds for abstract notions such as a cosmological Black Hole, as well as for a practical notion such as a Democratic Right. Typically between the various fields of human endeavour, we use metaphors and analogues to communicate and discuss the meaning of a thing, and to develop a deeper understanding of the value and purpose of the thing or phenomena we experience. In the language of the important developmental psychology school of Lev. S. Vychotsky, a learning process starts at the zone of proximal development, i.e., we learn and understand something new if we can relate it (metaphorically) to something we already know and understand. This is an inductive process with concrete experiences of life as the starting point. The multitude of look-alike experiences have been transcended into a theory that encompasses the variety of experiences, experiences that often belonged to different contexts. A theory tries to combine as many experiences as possible into one intellectual model or frame. The value of such a theory is to expand, heuristically, its applications into a broader understanding of related issues or to forecast novel phenomena, preferably beyond the understanding of preceding generations. The major examples are obviously from, with hindsight, relatively simple fields such as chemistry and physics. Here we see the coming and going of theories that in themselves served the understanding of phenomena for some time. The standard approach is that the theory that encapsulates a larger fraction of our experiences and phenomena replaces older theories. Though each theory is supposed to be self-consistent in its, limited, domain, the major steps are taken when we change our basic notions about experiments and experiences. In terms of Thomas Kuhn\textsuperscript{13} it is called a paradigm shift or in terms of Fleck a change in a thought collective (Denkstil or Denkkollektive).\textsuperscript{14} In other words, we are temporarily trapped in a hegemonic way of seeing and knowing the world. In order to escape from this trap, quite some effort (activation energy, to use a chemical metaphor) is needed. Obviously these Gestalt-type switches dovetail with the discussions on ideology and superstructure such as discussed in Jakubowski's famous \textit{Ideology and Superstructure in Historical Materialism}.\textsuperscript{15} Societal changes, change people's outlook and therewith their receptivity to novel approaches. However, although there is an obvious relation between the societal structure and the hegemonic scientific theories, the various mappings of our experiences onto theories cut through the mapping according to class interests. We don't have feudal, capitalist or socialist chemistry, but we have research directions that are strongly ideologically driven.\textsuperscript{16} A certain socio-economic environment promotes some research lines and keeps others distant, as is best illustrated by the development of ancient Chinese science contrary to the developments in early European capitalism. The hopes that a true democratic proletarian society will by itself generate the ultimate science and humanities are purely idealistic. Here, we see the tension between the nature of nature and the social capacities of applying these natural "forces". In concrete terms;\hfill

\textsuperscript{13}Thomas Kuhn. \textit{The structure of scientific revolutions}. 2nd enlarged edition. Univ. of Chicago Press, 1970. Note that the book was originally published as part of Otto Neurath's, logical positivist \textit{International Encyclopedia of Unified Science}.

\textsuperscript{14}Ludwik Fleck, \textit{Genesis and Development of a scientific fact}, Univ. Chicago Press 1979 [1935].

\textsuperscript{15}Franz Jakubowski, \textit{Ideology and Superstructure in Historical Materialism}, 1936

the type of nuclear power technology which we presently employ will not be safer under communist workers' control, but this does not mean that, intrinsically, humankind will not be able to employ nuclear power; others schemes are possible, but not fully researched. The perceived social neutrality of technology is at the root of the disastrous industrial development policy of the Stalinist era. There the idea was that social control will curb intrinsic dangerous technologies, whilst the flip side of the same ossified reasoning is that power generated by nuclear fission is under all circumstances a type of no-go area.

An important ingredient in this process of framing is the interplay between formal knowledge systems and informal systems. On the one hand, we try to explain, e.g., a complicated chemical reaction in "normal language", and use remarkably versatile metaphors, but at the same time, we use formalised language to explain fuzzy notions. In organic chemistry, stick and ball models are still extremely useful. In this model, atoms are depicted as balls of various sizes and the chemical binding is represented by sticks of various colours, lengths and strengths.

However, nobody believes that atoms are balls and chemical binding is a stick. Formalised, axiomatic, language based on unambiguous definitions is used in cases where the interlocutors, given their social context, disagree, such as in law, or have no elaborate visualisation at hand, as in formal fields such as theoretical physics, in order to remain on track and to try to dig deeper into the understanding of a problem, leaving, for the time being, second thoughts at bay. Ceteris Paribus reasoning in other words. We move slowly by only changing one parameter at a time and allow for temporal approximations or simplifications.

Even the word frame, so often used in social and political texts, is borrowed from physics where one tries to describe things within a frame, named a coordinate system, preferably one with non-interacting, so-called orthogonal, coordinate axes or dimensions. Such a frame can make use of the mathematics of geometry and allows for undisturbed (value free) manipulation, provided we stay within the rules of the game. Different points of view can be construed in projecting (mapping) one frame onto another, just as we map planet Earth onto a road map. This powerful field of projecting objects using coordinates and manipulating the coordinate frame is one of the most versatile methods in many sciences. Different frames or, in other words, different angles of view, provide different perspectives leading to changing outlooks. Playing with mappings is an art in itself nowadays.

The importance of models and metaphors, as a linguistic tool "framed" in mathematical terms is at least two-fold. Firstly, framing objects and observation in "neutral" terms that allow for rigorous manipulation enables us to unify data from various experimental conditions and situations into models. Scientific theories are nothing more than models based on the best knowledge we have and valid For All Practical Purposes (FAPP). Using these models, based on exhaustive experimental

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17 See also my Technological Utopianism in the early USSR, and what does that mean for us now, IIRE working paper 40: http://fileserver.iire.org/working_papers/WP40_Kircz.pdf
research, we might arrive at regularities that, within the model, allow for predictions and forecasting. We call these regularities; natural laws.\textsuperscript{21}

We are immediately confronted with tensions between the rigour of so-called logical inferences, or in other words the straight-jacket of mathematics, and, on the other hand, the idealisations we applied in order arrive at a rigorous model. Reality, also in physics is never clean-cut.\textsuperscript{22}

It is important to realise that the concept of proof, the idea that things relate with an iron consequence (a typical metaphorical expression) to each other only holds within mathematics. In all other fields, such mathematical proofs are used in modelling, but no natural or otherwise scientific theory can ever be proven in this vein.

The tension between real world phenomena and mathematical models can be relaxed by a variety of approaches, e.g., by relaxing the mathematics or by introducing all kind of modal or fuzzy logics, or by forgetting higher-order terms in an expansion. Another option is to introduce new parameters that keep the model alive and make up for yet undescribed phenomena. The prime example here is particle physics, where mathematical reasoning about symmetries is equated with newly defined particles. Many a physicist feels ambiguous about the measurement of the recent Higgs boson, as it matched so well the so-called standard model of particle physics, but doesn't answer outstanding questions beyond this heuristic model, which seems self-contained but is still full of unknowns.

The success of the natural sciences suggests that the methods used there can be taken as examples for research in other fields where a full theory is not yet developed. In such a situation of a lack of an overarching theory, statistics is a beautifully inductive tool. In modern statistical methods, now the working horse of most of sociology and psychology where we lack deep theoretical models, we use massive amounts of data and try to extract, by statistical methods, and within predefined confidence limits, "dimensions" which act as the axis in a coordinate system. Relationships are now popping up numerically, often without any theoretically underlying heuristic model. After the job, more-or-less stable "dimensions" are equated with meaning. It goes without saying that, in particular in medically related fields, this is the only thing we have and the basis of the successful evidence-based medicine. Without a model for the genesis of lung cancer, we can show that smoking increases the risk of getting cancer. In other fields like sociology, the method is more a testimonium paupertatis, due to lack of theory and only useful for short-term policies.

In economics studies, particularly in the neo-classical school, we also see a strong tendency to application of models from the natural sciences. Economics studies try to comply with and adhere to the dogma that "the scientific method" of the natural sciences is all the wisdom and methodology we have. Hence, economics is now called "a science", even though no economics crisis is ever properly predicted by the aficionados of The Markets as final judges of truth.\textsuperscript{23}

The above is not an attempt to praise the natural sciences, but much more a sincere concern as to why the natural sciences are used as almost sole metaphors for fundamentally completely different fields of enquiry. It goes without saying that mathematical methods are polyvalent versatile tools, but the question is not that mathematics might be applicable to a certain

\textsuperscript{22} Nancy Cartwright, \textit{How the laws of physics lie}, Oxford Univ. Press, 1983.
\textsuperscript{23} On the misuse of, e.g., thermodynamics in economics see: Philip Mirowski, \textit{More Heat than Light, Economics as social physics, physics as nature's economics}, Cambridge UP, 1989.

problem. The real question is what and how formal, including mathematical, methods can be
developed to deal in specific fields of the humanities. The example of statistics is the only case
in which a powerful method was originally developed outside the natural sciences.24

What is a science, is therefore more a rhetorical question than a helpful one, except in cases
where we use it as an argument against plain nonsense.

Often Marx' quip is cited that history is the only science. This demands some analysis as the
statement is not so clear at all. We can say that human knowledge, put together in more-or-less
formal systems of investigations or sciences, is historically contingent. In that sense, the
inversion of that understanding makes history the gauge for science and therewith the ultimate
science. But another important Marxist notion is that history never repeats itself. In the natural
sciences, we learn by repeating experiments. Even in some sociological fields, we can do so,
e.g., in understanding crowd control methods at soccer matches. However, in history we only
have look-alike situations and the frequently used term "learn from history" is only of a limited
value as history is the study of evolving human activity and not of recurring activity. Only in
the most operational sense can we detect exact recurring human behaviour and this is what all
behaviourists try to take as basis for managing people in all aspects of life, starting with
education.25 History in the sense of analysing the human social trajectory, implicitly has to take
the social, biological and technological aspects into account. Limiting history as a descriptive
log of human activities might lead to a good reading experiencing but not to understanding.
Within the limits of this essay, I will not dwell further on the important and extensive discussion
on the social roots of scientific modelling and the interaction of scientific models with the
political and social public discourse.

The early attempts of M&E

In most cases, uncertainty and lack of knowledge dissolve in operational pragmatic rules of
thumb in an attempt to understand reality and act in daily practice. With the advent of modern
science, more and more regularities were found, systemised, and cast into theoretical models
that turn out to be practical applications in daily life. It is within this success of modelling,
which rapidly developed in the 19th century, that Marx and Engels saw a possibility to
"reframe" the political economy of their time into a coherent alternative model. Not anymore
just moral critique and idealistic dreams of a better future as in early socialism, but in line with
modern times a "scientific" critique of the actual in order to transform the present into a new
and coherent future. In analysing the concrete economical activities within a political
humanitarian context, they built their own theoretical system, as a reference for political action.

24 The present fashion to go over to "big data" is on the one hand a beautiful method to comb and
stratify the many loose leaves in the humanities. On the other hand, it is only a first attempt for
categorization and induction. Data without a theory are still just data.

25 What did you learn in school today,
    Dear little boy of mine?
    ...
    I learned that policemen are my friends.
    I learned that justice never ends.
    ...etc..
    Pete Seeger: What Did You Learn In School Today?
Not with profit as the pivot of the economy, but materialistically, with labour power as driving force (which in itself is a metaphor for newly emerging industry). From the MEGA2 publication, we can see that both friends feverishly derive the exploding scientific literature from biology, via geology to chemistry and physics.26

As an aside, I want to state that the enthusiastic notes by Engels in his Anti-Dühring27, and particularly his private notes on dialectics of nature28, in no way were meant to become unconditional catechisms for socialist theory development. Anti-Dühring became the prime textbook for root learning in the early social-democracy and later Stalinist Diamat, but usage of Engels’ works that way are totally against all notions of the historicity of knowledge, defended by him.29

We encounter with Marx and Engels a thirst for experimental and theoretical knowledge as fodder, examples, and metaphors, for developing their own ideas. In this process, Marx and Engels expressed the need to relate issues in a non-trivial way. They exploited the notions of Hegelian dialectics, a worked out system of the mutual determination of the object of study and the investigative subject and vice versa. A crucial notion here is totality. Only in totality can we declare, e.g., the proletariat and the capitalist as negations of each other, they don't even exist without each other, or in more semantic terms, by naming an object we posit it in opposition to the environment it belongs to. No object stands alone. It is always referential to others. This is also a main feature in modern physics.

In the fluidity of human relations, we will never be able to declare fixed natural frames of reference as in the natural sciences, but we do have referential notions such as class interest, sexual desire or ethnic oppression.

The example of modern 19th-century science paved the way to try and define rules of motion that might act as reference system for political and social activities, in other words, the development of a "science of society" preferable with a keen eye on the natural sciences as example (as part of the human endeavour), which is positive. However, in the early social-democratic enthusiasm, it also became a model to strive for, which is negative. It is in contrast to development of an independent frame of reference where the mathematical models of the natural sciences only serve as metaphor. The so-called two cultures are two approaches to an understanding of the world but in no way formal antagonisms. Both cultures influence each other and must induce novel approaches to each other.30

As mentioned above, in socialist circles, the hope for a rational approach of emancipation, in particular aired by Engels, became the basis for system builders blinded by their desire to mimic the perceived eternal truths of the natural sciences, thereby declaring Marxist notions as transhistorical truisms. This deterioration in socialist circles became even stronger in reaction when the more-and-more hegemonic position of the Anglo-Saxon positivist and operationalist tradition with its beneficiation of "the scientific method" became apparent.

Incorporation of nature as such in historical materialism — the idea that the human

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26 See the fourth part of the MEGA2 series: Excerpts, Notes and Marginalia. In particular vol. 31, Naturwissenschaftliche Exzerpte und Notizen, Mitte 1877 bis Anfang 1883.
27 MEGA2, first part, vol.27.
30 Cf. the popular, but highly unproductive discussion on C.P. Snow’s book, The Two Cultures. Cambridge UP, 1959 and reprinted ever since.
environment and the human activities are grounded in the human being in its metabolic interaction (Stoffwechsel) with and in nature — has been started by the early social-democratic theoreticians. However, in the Stalinist dead-end street, it deteriorated in mapping all human creativity and knowledge onto a semi-scientific frame of perceived dialectical-materialist eternal laws. This rigid system allows for a description of processes in Diamat terms, thus formal re-framing, but hardly induced creative thinking. However, Stalinism was not the only victim of an over-appreciation of "modern” scientific approaches. The whole of the left believed that conscientious rational methods could advance emancipation beyond the perils of capitalism.

Dancing or going astray?

Two important notions on framing have to be mentioned concerning this point. Firstly, Marxist dialectics is dynamic, but not a dance according to the samba like the choreography of Ollman. Nor even a street brake dance where we witness ruptures and jerky motion. Historical materialism is a method of seeking ontological understanding based on what, within our epoch, we can genuinely experience of reality: the world we live in. Dialectics is a powerful tool to delineate and structure interpenetrating and antagonistic aspects of a totality. Thereby, it is impossible to fit matters into simplistic rules of thumb.

In the dynamics of theory development, the cross fertilisation between human practice, social-economic situation and formalised "scientific" practice is fundamental. Obviously, we have to 'dance' from one view to another and from one projection to another to sharpen the mind and determine where various frames do not overlap one to one in order to peek further into the unknown. But there is no choreography or fixed rhythm. Only in the confrontations between distinct descriptive models and world views are we forced and able to image novel ideas and approaches. However, the only way we can proceed with a long-term vision is not to try and find local, here-and-now, regularities and harmonies, but rather by an ever further understanding of our ontological notions, notions that are, we have to repeat, historically contingent.

Secondly, the notion of framing is closely related to alienation and reification (Verdinglichung).

31 See the nice contribution by John Bellamy Foster, Marxism and Ecology: Common Fonts of a Great Transition.
http://www.greattransition.org/publication/marxism-and-ecology

32 An anti-Stalinist proponent of rationalizing human life was the creative thinker A.A. Bogdanov, who more-or-less invented the field of operational research or cybernetics. He died fortunately through a blood infection, due to his own experimenting with blood exchange, before the Jesuits of the new eternal, all encompassing, state religion took full power. Cybernetics, aka Operational Research is the field where mutually interacting forces (aka feedback loops) are central. See: Joost Kircz, Technological Utopianism in the early USSR, and what does that mean for us now. Note 16.

33 Bertell Ollman, Dance of the dialectic, steps in Marx's method, Univ. of Illinois Press, 2003, picture on page 169.

34 Unfortunately, only the elder Georg Lukács dived deeply, and due to his style of writing (or must we say his typical swimming stroke) is often difficult to follow. In his analyses, he clearly posits human labour as the ontological prime coordinate in understanding humans in history. See: Georg Lukács. Prolegomena Zur Ontologie des gesellschaftlichen Seins. In: Frank Benseler (ed.), Georg Lukács Werke, band 13, Luchterhand 1984. Obliviously, only some simple parts are translated into English, happily including the chapter: Labour (translation David Fernbach) Merlin Press, 1980.
After all, if we project experiences and thoughts onto a frame, we can be easily carried away with it and take the projection as the real. Our current reference in appreciating experiences (physically as well as politically) is deeply grounded in our culture. A new frame can enlighten (see "the light", a truly religious framing) people and induce conscientious action against or beyond the present frame. This is the political lynchpin around which all socialist policies turn. Only if we understand (limited to our socio-historical context) our situation, can we envision and strive for change. Again, this does not exclude that other frames cannot induce the same type of action; for example, the trust in the nascent coming of the kingdom of some God might stimulate people to fight war and poverty (although the opposite, namely the coming of God as the ultimate massacre is now very popular under Wahhabist currents). The interest of the Marxist school in the natural and biological fields is exactly this understanding that we are no angels and cannot fly. Societal change has to be grounded in the material potentialities of humankind. It is certainly not, pace Diamat, of interest to prove that our present knowledge can be all projected onto three perceived ontological dialectical laws.

Although the notion of alienation is one of the most versatile notions in understanding why people accept suppression to the detriment of their own well-being and health, it also induces a notion of true versus false, in other words, a notion that there is truth just around the corner and we only have to reveal it. Turning corners is unfortunately not by agitprop alone. Establishing novel belief frames are seldom the result of superior reasoning, but most often by real life experiences. However, in that process an alternative must be visibly available.

Obviously, the world is as it is and thereby true. However, the essential issue is to what extent can we actively understand this truth? This is one of the main tenets of historical materialism; contrary to Hegel's projection of the truth of reality in the Absolute Idea, histomat emphasises the social-historical process of ever changing context and contingency of our knowledge, leading to a conscientious teleological outlook, to save humanity as an evolutionary phenomenon.

The process of knowing and forecasting

Knowing what is true and real is a tool for conscientious change, be it for personal or societal goals. Over the centuries, science and philosophy have struggled with this issue and this struggle will stay with us as the subject is continuously changing in context.  

We can define the problem as a coupled problem of naming objects, and based on that, naming (a) regularities and (b) possible pragmatic rules or even fundamental laws between these objects. As soon as we realise that named objects, including scientific notions, and rules are historically contextual, we have to analyse communication and in particular language and the use of it. In a social group, commutation is an essential feature of group behaviour. We believe (FAPP) that human language is the only versatile way of developing abstract thinking. This is one of the great outstanding issues if we try to define new notions and ideas. In our daily human practice, we can only socialise knowledge about something by naming it and by naming its interactions with other named objects. Advanced language skills are needed.  

Human nature is particularly build for, and fantastically versatile in, playing with words. Over the centuries, it

35 In this context, Paul Feyerabend's Against method (Verso, 1975) is still important. See also his 'Realism and the historicity of knowledge', in The journal of philosophy, Vol 84, 8 August 1989.
36 Therefore human sign-language, like speech, is a real and developed language.
became our most important capacity for organising our lives and habitat. It is certainly an important aspect to research on when and how language, the ability to communicate between each other, developed. As well as how this relates to our capacity to remember these communications. The evolutionary development of language skills as we have it, is still an open research question. If Chomsky is right that we have an inborn language capacity that enables the learning of whatever language we are confronted with firstly after birth, this heuristic notion does not more than try to solve the riddle of the acquisition of speech by babies. In this well-known discussion, we see immediately remnants of 19th century thinking. We have objects and interactions between them and by understanding the "engine", in this case Generative Grammar, we "only" crank the handle and there we go. A most sympathetic idea from a totally different field, is that the language skills are the result of a co-evolution of the hand and arm and primitive communication. In his fascinating book, *The Hand*, the neurologist Frank R. Wilson starts from biomechanics and the differences between the anatomy of the human hand and that of the great apes.37

He follows the fossil record in showing how making communicative gestures became possible by the very developed musculature of hand, wrist, arm and shoulder. This is more than the opposing thumb. It covers the whole upper extremity from shoulder to finger-tips. Only humans can throw overarm, which is a great advantage, while chimps throw mostly underarm.38

Being able to operate such a delicate instrument that allows articulated hand control and hence subtle manipulation of objects as well as repetitive communicative gestures, is a very demanding task for the brain. Wilson's suggestion is that manual manipulation is in co-evolution with the language faculty. This fascinating idea might give us a better idea of how learning a language and therewith the development of structured thinking emerged in concert with the development of the grip.

A somewhat older study by Woolfson discusses in the tradition of Engels the issue of the linking of tool-making and language.39

I mention this because it might help in understanding how our whole biological 'system' is in synch with our mental evolution, as well as being in synch with the essence of mechanics, chemistry, etc. By experiencing our environment in a novel and different way from apes, we develop the ability to communicate and henceforward to bootstrap abstract thinking. We have made great steps and it will take decades to realize a fuller picture. The message is that our senses and communicative systems are not haphazardly endowed on us. They all developed in co-evolution that enabled us to become the unhappy masters and conscious spoilers of nature; however not in opposition to nature, but as a consequence of it.40

Evolution has no direction; therefore conscientious human teleology has only a limited free maneuvering space for political action, without damaging all there is. It goes without saying that we do not have to enter into a discussion of the stop-gap argument that it is all only "sexual gratification" that is the evolutionary ruling commodity in the struggle for primacy.

The above-mentioned type of co-evolutionary thinking allows us to tackle our notion of reality.


38 In that sense, that the opening scenes of Kubrick's *Odyssey 2001*, are evolutionarily wise, is most questionable.


40 Reiner Grundmann, see note 3.
How unique are we in the universe and how do we define this uniqueness? Is there anybody out there, is a problematic question. Firstly, the notion of ‘anybody’ already suggests that "we — humans — are not alone in 'the' universe", that our evolutionary history is the only road to comprehensive understanding of "what is going on". The so-called anthropomorphic world view says in a subtle way that we are here because it cannot be otherwise. It is important to note that there is a fundamental difference between a logically necessary outcome of evolution into humankind and the very fact that humankind can only evolve within certain limited parameters. That it happens does not imply that it has to happen. The notion out there is typical for a human notion of the self and the body as more-or-less independent entities.

I think that we can only can say that reality is that which we experience with all senses, techniques and intuition we have, but nothing more. The "real" problem is how we frame these senses, experiences and intuitions in language, as discussed in the previous section.

In fact, if we speak about reality we mean those parts of nature which we experience one way or the other and can name in a comprehensive way. As soon as it escapes our rational linguistic culture, we are lost, and phantasy, religion and new-age philosophy have a free shooting range. Just to give a simplistic example. If our present understanding of the universe is correct, out there is only beyond the so-called event horizon, all other parts of the universe are historically or by force field interactions (weakly indeed) in and with our present self.

It is a popular topos among many natural scientists that we have a 'veiled reality', to borrow a term of the French physicist Bernard D'Espagnat, including firm laws. One can say that this is, on the one hand, obvious because we exist and don't understand how and why; on the other hand, it might suggest an asymptotic progress along the lines we follow in scientific practice. In contrast, in my view, the crux of the matter is that we constantly jump from one outlook to another in human history, and every outlook might be more all-encompassing but not necessarily closer to 'reality', as 'reality in its concrete form is just that which is, but for our understanding of it, and this is what counts for conscious human action, reality is a moving target.

The moving target must be understood by the fact that all our notions are historically contingent.

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41 Pink Floyd, *The Wall*, 1979
42 You see how our communicative language is infected with unclear notions, cf. Heidegger's discussion on the *seiende Sein*. In French we have the distinction between *vrai* and *réalité*.
43 A good example of the transition between phantasy and science is biological magnetism. For a long period, the unhappy claims of Franz Mesmer (leading to the verb Mesmerize) at the turn of the 19th century that magnets could influence the body was enough to oust magnetism from medicine. Only in the 2nd half of the 20th century did biomagnetism become an accepted field of research.
The notion of the atom as an example
An excellent example of changing perceptions of a term is the notion Atom. In the ancient Greek world, it was considered as the smallest part of matter. For a long period, the atomists discussed the form or constitution of these most elementary units of matter (stuff). With the chemical revolution, the notion of an atom changed to the notion of the smallest possible entity of a chemical element. However, in due course this smallest entity was split up into an electrically positive nucleus with negative electrons circling around it. The nucleus is further split into protons and neutrons. As a single chemical element is presently defined by the number of protons whilst the number of neutrons can vary, we have various versions of the same chemical element: so called isotopes. Now the proton and the neutron are considered to be mixed bags of quarks of which we now know quite a number. However the electron remains a fundamental entity (a traditional atom).
But even worse, the unity of an elementary chemical atom as a particle is broken. In quantum mechanical language, the atom behaves as a wave, and, indeed, we can do interference experiments with atoms where they, like light waves, interfere. We can also add energy to the outer electrons, so that they "excite" to a high (Rydberg) orbital and the size swells to that of a small bacterium, which makes the notion of smallest particle ambiguous. Given this fact, we then have to ponder the empty space between the electron orbitals and the nucleus and wonder why this emptiness in terms of matter per volume is way less than that of the cosmos. Nevertheless, in normal speech, the atom is the metaphor for the smallest of something. Just as DNA is now a measure of the uniqueness of, e.g., a consultancy firm for mortgages. Nothing wrong with metaphors but in developing a novel Marxist world view, we have to be careful to be clear about what we mean, want, and try to develop.
Conclusion

In the above, we have touched on a whole series of inter-related issues. The overarching problem is the understanding of how models and theories of the various forms of natural behaviour form inanimate matter, to how social structures influence each other and metaphorically stimulate each other as steps on the cake-walk of progress. Lack of a clear direct walking path is typical for the problems at stake. We always like to try to set out a trail from a starting point to an endpoint or conclusion. But here, we do not know if we take the easy yellow walking path, or the long demanding red trail. At present, we can only conclude that we are dealing with two sets of problems. The first set consists of those processes that determine the interconnection between experimental observations and mental constructs. The second set is how a mental construct forces us towards a certain direction and keeps a tight grip on how we interpret observations within that framework.

Mental constructs immediately influence our behaviour. If we adhere to the idea that God gave nature to humankind for exploitation because, in our development, we use our natural environment opportunistically, then we are free to exploit nature beyond the bare bones. If we consider the question of whether native South-Americans have souls and hence are human, then we have to treat them as such. If we accept that the artificial split between body and soul doesn't hold water, then we have to investigate bi-directionally how thinking and bodily activities mutually influence each other. In the present linear way of systematic thinking (aka logics), this type of exercise is very complicated. It is Hegel's monumental work that can serve as a starting point for a new way of analysing interpenetrating, mutually defining, notions. His system is an attempt to use the model of a spiral to show that a confrontation of opposing notions does not annul one another such as a positive and negative electric charge, nor does it create an equilibrium middle ground, but forces a dynamics into new notions. Hegel's trajectory was guided by the romantic idea of an ultimate calibration of this movement as represented by the absolute idea. The way Engels and Marx took was through abandoning this idealistic end-goal and taking the muddy and bloody reality of life as start and finish. Never did they suggest a final state of pristine beauty. They carefully stayed within the border of the present and analysed the present as the expression of the mode of capitalist production as result of a historical process. The place of the industrial proletariat as agent for change came to the fore as a necessary negation of the extreme tensions between the creation of surplus value and the appropriation and capitalisation thereof by the capitalists. In the age of the revolution of mechanics, thermodynamics, chemistry and electromagnetism, it is obvious that these novel sciences served as example and metaphor. However, it is the next step, the step from description (or interpretation) to actively forecasting (changing) that is essential. To what extent we can extrapolate an identified development is the real question? An answer depends very much on its initial starting point. If we start with the notion that capitalism is defined as the system that put briefly is driven by the notion of profit maximization, then there is no reason why it should only be happening by direct brutal exploitation of labour. There is also no immediate law that tells us that changing technologies or even changing whole industrial sectors are intrinsically impossible. The US World War II economy is an excellent example of how flexible capitalism can be. There is no forbidden zone for switching lock stock and barrel to solar energy, if and only if the pressure is high enough. And, indeed, this might emerge only after whole parts of the

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44 In management language this is the so-called problem of "out-of-the-box" thinking.
45 This discussion resulted in the papal bull Sublimis Deus, of 1538 in which pope Paul III unequivocally declares the indigenous peoples of the Americas to be rational beings with souls, and hence not on a par with animals and thus fit for evangelization.
globe are flooded or just dried up. This not a question of the laws of capitalism, but of the dialectics between political action and established forces. The next historical step in this example would preferably not be a more sophisticated capitalism, but a fundamental change in the process of employing the results of surplus labour. Hence, in the tension between exploiters and employed, new notions for the organisation of the economy have to be developed, not by analysing the intrinsic self-destructive tendencies of capitalism alone, but by using this knowledge to re-frame the process of production in a new setting. In that sense, we have to shred off our own 19th-century modelling. Modern research on self-organising systems in many different fields, as well as the field of non-linear dynamics in which variables mutually determine each other (as in General Relativity) must inspire us beyond simplistic reasoning.46 With the plethora of new insights over the last half a century in almost all fields of science, from brain neurology, via molecular genetics, epigenetics, fundamental physics, chemistry, psycho-pharmaceutics, and so one, we actually create a search for new intuitions that lead to new methods and theories.

Having said that, it is worthwhile to spend some words on the Golden Calf of today: computer science. Something incredible is going on here. Through ever more extreme precise technology, we are able (FAPP) to mimic motion by binary digitalising of the problems at issue. This approach of mimicking motion by statics started with the invention of the calculus, the art where we approximate a curve by an ever smaller set of discrete steps, to such a level that even the aided eye doesn't see the difference. All motion, in every aspect, is recast into a discrete model. It is not strange that people might think that the world is one big calculator as the successor of Plato’s forms? In my intuition, something is going astray here. As real word phenomena are never sharply defined, but always defined contingently, the extreme approximation of unclear objects by discrete operations must lose some aspects along the line.47 This issue is also up for a reconsideration fuelled by metaphors from other fields than the natural sciences. But in order to carry out this reconsideration, we have to know what is happening in those natural sciences, which after all turn out to be much easier to model than social practice. In that way, we may say that after a period of taking natural sciences as an example, it is time to develop new ideas in the humanities and see whether we can induce change by using them as examples. Recall that Marx himself suggested that Darwin's novel ideas were mimicking modern bourgeois capitalism. In this paper, I have not discussed the important theme of how the successes of new theories are often grounded in the social context of the time of their invention. Not in the sense of framing, as Marx did with Darwin, but in the sense of stepping out of the highly linear formal logical straight-jacket that the sciences and humanities are trapped in.

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A note on Vladimir Ilyich Ulyanov and Dialectics.

Dialectics is an answer to mono-causal reasoning, as well as to fixed defined semantic notions. It enables flexibility which traditionally formal logical systems do not have. The main problem is as always the understanding of motion or dynamics, in the natural sciences, as well as in the

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46 Please be aware that the much heralded field of chaos theory is strictly deterministic. There is a distinct difference between chaos (in the mathematical sense) and randomness.

47 Obviously this entails the philosophical and mathematical discussion on the infinite, see, e.g., A.W.Moore, *The infinte*, Routledge, 1990.
humanities and in politics. We try to understand how one situation (a stable state of affairs) changes into another novel situation (that reaches a new stability). It is relatively easy to describe a stable situation of state. But it is very difficult to describe the transition from one state to another other, only by just observing that one situation is changing into another. We see (or film) it happening, but it is all about the driving mechanisms that makes life so difficult to understand.

Obviously Marx & Engels, as well as their followers, try to develop an epistemology that on the one hand caters for mutually interacting and co-defining notions, and on the other hand is grounded in reality.

In that sense the term Dialectical Materialism or Diamat (following the typical Russian fashion of abbreviating names), is a natural demarcation from idealistic, e.g., Hegelian, dialectics, in which development is pursuing an ever-increasing route towards the absolute idea; the final truth of understanding (which ultimately dovetails with reality).

The crucial difference between Hegelian and Marxist dialectics is that in an idealistic model, we can posit a goal or a final understanding (Nirvana), but that standing in the mud of the material reality, we cannot. We can only, inductively, try and determine directions. Nature (or the Universe) has no goal and allows for jerky changes of direction. Clearly, we encounter (expressed in our present language) tendencies of minimization of energy and related maximization of disorder, but the interplay is an unknown playing field. We, humans, have one innate desire, which is survival. For that reason, we, humans, developed the capacity of dreaming of a better future, or in other words developed teleological models that have to be grounded in the potentialities of the material world to be attainable. But these teleological dreams are always local in the sense that they cannot reach further than our understanding of nature.

The social democratic adaptations of 19th-century sciences as a model, resulted in the firm belief that history, just as natural sciences, has its own iron laws of development, that successive stages of development are consecutive. Barbarism is followed by culture and not the other way around (until Rosa Luxemburg questioned this almost religious hope for a better life after the present).

In Lenin's life, two occasions spurred him into a deeper study of dialectics in order to better understand how the cake-walk of politics diverts from fixed rail tracts and how jumps and jerks become possible.

Both instances were induced by social crises, the first with the collapse of the revolution of 1905, the second with the outbreak of the First World War and the bankruptcy of the 2nd International, through supporting the various national war efforts. In 1908, Lenin wrote, in rage, his Materialism and empirio-criticism. In 1914 he, baffled by the treachery of his former comrades, re-read Hegel's works and annotated them intensively.

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See: https://www.marxists.org/reference/archive/hegel/works/hl/hlconten.htm for the version Lenin used, including the beautiful capacity to link to Lenin's comments as printed in volume 38. The Hegel text on-line is according to the old translation by A. V. Miller, George Allen & Unwin, 1969, the original first published in 1812, 1813, 1816.
In the first round, he countered the response to the crisis as articulated by many fellow revolutionaries, in particular the circles around Bogdanov, Bazarov and Lunacharsky, who tried and found new inspiration in the developments in the then new "modern" physics, referring to the works of the eminent scientist, historian of science, and teacher Ernst Mach, who should become one of the founding sources of positivism. Mach’s popular works had an enormous influence and are still form a good introduction to fundamental physics and physiological problems.

The best review here is the work of Evald Ilyenkov, the dissident Soviet philosopher who wrote his paper on Lenin's 1908 rage, in the year he committed suicide. Mach's approach can be superficially defined as a positivist-empiricist approach to epistemology. He resides clearly in anti-mechanics and takes biological evolution seriously, and was one of the earliest experimental psychologists.

Mach is also the father of powerful ideas, such as the economy of thought and the primacy of sensory perception. He was a philosophical monist and believed in the universal — thermodynamical — idea that equilibrium is a natural goal of motion.

Lenin's attack on Mach's philosophy in its political adoption by many of his comrades had a two-fold background. On the one hand, Plekanov, still the main Marxist theoretician at that time, was a Menshevik and poked fun by attacking Bogdanov for his Machism, equating this with Bolshevism. According to Lenin, Plekanov's critique was correct but not in its political consequences. Hence, as Ilyenkov works out in detail, Lenin had to defend the revolutionary basis of Bolshevism against the social democrats, at the same time as winning the battle in his own ranks. The key issue is here the import of equilibrium thinking in the political arena. Mach's model, as Bogdanov and friends saw it, applied to the politically disastrous situation of the strangled revolution of 1905, would jeopardise the survival of a consequent revolutionary organization and praxis. A central element in Bogdanov’s position is a hope for monism, in other words the unity of natural and social sciences, which Lenin detested.

It is therefore interesting to read how Ilyenkov spends many pages on analysing Bogdanov's scifi novel Red Star, in which all elements of Machist equilibrium dream, and a social practice based on that science, are dealt with. For Lenin, "materialism, matter, the objective reality given us in sensation, is the basis of epistemology, at the same time as for idealism of any type, the basis of epistemology is consciousness." Ilyenkov stresses the continuity in Lenin's thinking, from writing his Materialism and Empirio-Criticism up and until his April theses in 1917 (The Tasks of the Proletariat in the Present Revolution).

Unfortunately, after setting the record straight, Ilyenkov remains in a state of reassurance that Diamat, correctly understood, is a revolutionary approach and claims with little proof that: "Now an enormous number of scientists, and not only in our country, have become conscious

50 Please note that this is all before quantum mechanics and relativity theory became central players on stage.
54 Ilyenkov p.15.
allies of Leninist dialectics”, a claim many "official" philosophers in the USSR broadcasted. It goes without saying that at this point, he misses the essence that it is not an issue of proving that Diamat is able to describe the scientific developments as a result of socio-historical circumstances, as a pure after-the-fact phenomenology. A solid theory needs to suggest progress and new research endeavours. The stagnation in the USSR and the sometimes bizarre discussion in many fields in the sciences in general is well-known. In these discussions, Diamat had been taken as a stencil to assess novel ideas and to try to fit them into the Diamat model, instead of taking the new phenomena and findings as a material starting point.55

In the same vein as Illyenkov, Sathis Kouvelakis stresses the continuity of Lenin's philosophical thinking in his most interesting study.56 Kouvelakis' work is an important source for Roland Boer's study on Lenin and his flexibility in philosophical and religious issues.57 In some amazingly clear pages in an otherwise typical Žižekian, 172 page long, monologue, Slavoj Žižek also stresses Lenin's consistency.58

To close this note, it would be a bad joke to suggest that Lenin was consistently wrong, as many of his political adversaries claim; then and now. In my view, Lenin very well understood that a new epistemology, a new way of understanding the world has to come from the experiences — in its historical context — of human culture. The point he, but not others raised, is the ontological question. The positivist answer is that ontology is beyond present-day comprehension and hence not a research subject at all. In physics, this attitude is well phrased in the quip "shut up and calculate". As long as our models work, we can better use our time in development and applications than in pondering about the deep unknowns. But this attitude also allows for all kinds of (semi-) religious idealism of people who search for truth beyond the state of scientific art. Declaring that all we have is what we know now, is not the right answer to such feelings of uneasiness, because it is the unknown that matters. This is exactly the critique on the social democratic position that the revolution will follow the "known" path of history. Reality is that which we experience and in that sense it is reflected in our thinking because our thinking (which is hardly understood in its neurological and biochemical roots) is part of the same reality.

The point Lenin did not make, and hardly could image, as the major revolutions in science were still to come, is that this reflexion of the outside world on our thinking, is not one of a firm object (out there) onto a polished mirror in our brain. Our dynamically socialised brain slowly develops a picture of reality as a function of its cumulative human experiences and sensations.59 Reality is not the object and the brain the subject, but our understanding of reality is also the projection back of our contemporary most advanced thinking onto realities that get shaped in human terms, by this dialectical process. We could not form an image of DNA, and now it can be seen and analysed, it even becomes a metaphor for almost everything that has to deal with

59 The most vivid illustration of an almost conflation of material reality and human thinking is given in Andrej Tarkovski's film *Solaris* of 1972 (or Steven Soderbergh's version of 2002). Based on the 1961 novel of the Polish writer Stanislaw Lem's (http://english.lem.pl/).
typical features. Our discourse changed and thus our cultural outlook too. In that sense, we have
to hark back to the Marx and Engels attack on the romantic idealistic socialists of their time.
Social life is in essence practical. Setting out a policy for social change demands an
understanding of all the practical interactions between nature and humankind. Therefore
scientific socialism is a method of organising social change based on an understanding of all
human sciences.

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A note on the fundamental notions of modern physics and the riddle of how can it work
while we don't know what it is.

A simple introduction to fundamental notions such as time and space are more complicated than
some believe and hence modelling sociology and politics following physics is like skating on
very thin ice,

As said earlier, historically, physics serves as the prime example of a science. The questions are
whether this is reasonable, and to what extent it is reasonable to expect that the methods used in
physics are applicable in other fields of human research endeavours. Using successful methods
in one field can certainly serve a positive heuristic role in other fields; however, in the present
academic culture, we are confronted with the idealistic idea of "the scientific method", as if all
human knowledge can be captured in one system.
Before appreciating this discussion, it is important to explain what physics is about and its
relation with mathematics. A prime issue is here that to the bewilderment of many a physicist,
mathematics turns out to be so incredibly effective in tackling physics problems.
This observation lured many people, over the centuries, into some idealistic/Platonist belief that
the human-made craft of mathematics has a higher status than physics or chemistry.
Let me start with a quotation of the great Irish theoretical physicist J. L. Synge:
"….mathematics is not a controversial subject because all mathematicians attach the same
meaning to the terms used in it. Neither is experimental physics a controversial subject. But
theoretical physics is, and always will be. This is inevitable, since the aim of theoretical physics
is to force the vast complexity of nature into a narrow mathematical mould, using idealizations
and simplifications which are absolutely necessary and (to the unsympathetic mind) absolutely
nonsensical". 60

Synge continues in explaining that it is all about equating natural observations (NO) to
mathematical observations (MO), and states: The peculiar fascination of theoretical physics lies
in the art of forcing meaningful truth out of the meaningless equation NO=MO.
An important aspect in our discussion is what kind of methods in our investigations we endorse
and when do we call it scientific? In the history of physics, we witness a great many theories,
which at their time were consistent with the then known phenomena and helpful in
understanding the world. For instance, the science of the Hellenistic period was very advanced
and certainly gave us more than merely technological rules of thumb. 61
The transition from emerging chemistry to the full-blown science we have now, was a tortuous
path encountering serious theories like caloric and phlogiston theories that served as stepping

61 Lucio Russo: The forgotten revolution. How science was born in 300BC and why it had to be reborn,
stones to theories we now embrace. In the standard philosophy of science, it is normally accepted that the theory which encompasses the phenomena explained by one or more other theories as well, and adds new predictions, is superior. This does not mean that some elements of the older theories can be discarded in their entirety. In many cases, the winding mounting trail to higher levels of theory harks back to ancient concepts.

As an example, consider ancient Greek Euclidean mathematics which is coordinate-free. There, we talk about lines, figures, and congruence. After the Cartesian revolution, we talk only about coordination. This was an enormous step forward in performing calculations. Interestingly the essence of modern general relativity is based on coordinate-free geometrical objects, but of a different kind than the ancient Greeks could ever have imagined.

It is claimed that it was Archimedes who has said that if there is a fixed point in the universe and a very long lever, he could move the Earth. This means that in order to relate motion, we need a fixed reference point. A reference frame is the start of our capacity to define motion.

In general, we start with a physical reference system. This can be our study, or a bus or aeroplane which proceeds in constant motion. On this reference frame, we can define a coordinate system, say three rectangular axes called length, width and height. The next step is that we introduce a standard of measure to deal with these axes, such as centimetres or inches. The choice of a coordinate system and of a measuring system is totally free. Note that so-called vector notation is coordinate free.

In order to understand motion and development, all we do is to compare phenomena and objects. The whole of physics, as from the times of Descartes and Newton, is based on the extraction of "laws" using coordinate systems, as helping hands (as the hands of the cuckoo clock) to grasp the changing world around us.

The question is then to what extent reference frames are real physical objects. In Newtonian physics, which is still the most versatile theory we have in everyday life, time and space are infinite real "objects". They serve as the background, or, with a metaphorical excursion into the arts, canvas, whereon reality is painted. Time is an absolute measure of progress.

The notion of an everywhere-available absolute time and (Euclidean flat) space was taken as the concluding point by Kant, and questioned by Leibnitz. Kant, and many others after him, who could not think of a world without time and space in a Euclidean frame. At some point, you have to start somewhere in order to develop a theory and its accompanying practices. However, even necessities such as that mentioned above have their intrinsic problems. The whole Newtonian edifice is built on the two following notions: firstly the notion that we can describe reality by using a flat (Euclidean) space for our coordinate frame. That is, that we can use coordinate axes in flat space that are mutually orthogonal (under right angles), like a pack of milk, and secondly that the speed with which with the gravitational force operates is infinite. If we change the moon here, immediately it will influence the tide there. The laws are shown to be invariant for situations at rest or for situations without acceleration that is to say situations (so-called states) that move uniformly (with constant speed in one direction): a so-called inertial frame. This is named Galilean relativity.

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62 The history of chemistry is an active research field, see, e.g., the recent collection: Matthew Daniel Eddy, Semour H. Mauskopf, and William R. Newman (eds), Chemical knowledge in the early modern word, Orisis 29, 2015.
63 It is not always clear to everybody that in vector notation, the Newtonian laws are coordinate-free.
Physical phenomena are as they are, but our understanding is reached by mapping fundamental notions such as length, duration, and mass onto a suitable reference frame, which we endow with a coordinate system. In fact, choosing a coordinate system is purely opportunistic. These demanding Newtonian principles work that well that it became a revolution in physics, now a century ago, when Einstein challenged some basic ideas. Based on symmetries in real world electromagnetic experiments, and the experimentally found finite velocity of light, Albert Einstein challenged the idea of absolute time in his Special Relativity Theory (SRT) and stipulated as pivot of his thinking that the finite constant velocity of light was also the maximum physical velocity possible.

Einstein's most important point is the so-called perceived simultaneity of events. An event is a happening at a certain place in space at a certain time. Based on the sole fact that, as far as we measure and know, the speed of light is the highest speed nature allows, and even "stranger", the same in every system, independently of the speed of his source, we have to drop Newtonian mechanics. Einstein’s approach concludes with the, proven fact that clocks in reference systems of a different velocity are not synchronous (however the ticks are equally separated). So, two observers experience phenomena and their duration differently, depending on their own path or trajectory (the so-called twin paradox). This is the famous relativity of simultaneity, which has nothing to do with relativity in the sense of unclear notions but only with the fact that whatever reference system we use, the so-called interval (the four-dimensional space-time distances) of two events is an invariant, a coordinate-free measure.

In Einstein's approach, we add the time coordinate in order to obtain not a three-but a four-dimensional flat space, called Minkowski space-time. As said, the object as such is independent of the coordinates it is described by. What is fixed, and independent of the coordinate system, is the notion of the interval. This notion can be easily explained as an extension of the well-known Pythagorean theorem, which states that in two dimensions for a right-angled triangle, the area of the square of the hypotenuse (the side opposite the right angle) is equal to the sum of the areas of the squares of the other two sides—that is, $a^2 + b^2 = c^2$. This "geometrical object" is only dependent on the intrinsic length of the sides of the triangle and not on its coordinates, be it orthogonal or, e.g., polar axes. In relativity theory, a fourth, time-dimension is added to the formula of the three dimensions we already have (length, width, height).

The term special relativity for this theory is unholy. A better term would be restricted relativity as the theory is restricted to systems at rest or in undisturbed linear constant motion (so-called inertial systems), as was the case in Newton's approach.

Einstein's project subsequently tried to deal with general motion. Not only systems at rest or in undisturbed linear constant motion, but systems in any possible smooth motion. He phrased this theory the General Theory of Relativity (GRT). Thus, the second step Einstein took was to also take acceleration into account, which is the change of velocity in value or direction. This turns out to be much more complicated and introduces gravity into the picture. Gravity is a force that pervades everything everywhere. Without going into detail, the upshot of this approach is that we cannot handle things anymore in flat (Euclidean) systems. In special relativity, it is possible to integrate the finite transfer speed of physical interactions (the speed of light) into a Cartesian coordinate system with right angles between the axes (a four-dimensional pack of milk). Now we are forced to include curvature and speak of curved space. This is not an easy concept to envision, as for hundreds of years we equated flat Euclidian space as a one-to-one representation of reality. In flat space, the physical (concrete) coordinates can be equated to the mathematical (abstract) ones. Today, we describe the phenomena of gravity by a curved four-dimensional space-time to save...
the phenomena, but the notion of time and length are not defined in the model itself. Our Archimedean fixed points are now that we have a measure of time and a measure of lengths given: outside the theory. A philosophical question is whether we are ever able to invent a self-contained theory in which measure and the application of that measure are both given as a starting point. In other words: is it possible to invent a theory in which all concepts are intrinsic?65

Or to quote Einstein: " … strictly speaking, measuring rods and clocks would have to be represented as solutions of the basic equations (object consisting of moving atomic configurations), not, as it were, theoretically self-sufficient entities."66

In the philosophical discussions about relativity theory, a crucial issue is the notion of taking a holistic approach, in which only the combination of geometry and physics together can be compared with experiment. You can also say, a certain physical model demands a certain type of mathematical space.

This shows that we can describe the phenomena and their relationships at a high level of confidence, but we have to be very clear about the changing content of basic notions. An extreme example of changing basic notions is that in relativity theory, there is no place for the basic notion matter (stuff) as we know it in chemistry, biology or the building industry. We only have mass, which is defined as the resistance to change of a given motion.67

Although we can describe our experiences very well, it is important to note that this does not mean as the logical positivists believed, that there does not exist an ontological kernel. Einstein himself was convinced that there was more to come.68

A second revolution in physics is given by quantum mechanics (QM). Here we deal with the fact that we must describe phenomena not in terms of continuous change but in terms of well-defined energy packages. The situation is that classically we can describe all forces between particles, such as electromagnetism (which included electricity, radio waves and light) and the forces that hold the atoms together as waves. In QM, particles are described as waves, but as soon as we measure a value, it is by impacting such a wave onto a detector and this is only understandable by switching from a wave picture to a particle picture.

The proper, ontological, understanding of this duality is still unclear. Interestingly, two physicists with a keen love for dialectics arrived at two different solutions. On the one hand David Bohm69 who stipulated that quantum effects are the statistical effect of lower levels of organisation, and on the other hand, Jean Marc Levi-Léblond70 who tried to transcend the duality by positing Quanton's, entities that allow for two expressions, particle and wave. Unfortunately the last suggestion for a solution did not develop beyond a good pedagogical approach, whilst the Bohm’s approach is still struggling to go beyond the status of equivalent results as the standard interpretation of QM.71

65 Think about the notion of labour in Marxism.
67 In the real world, mass turn out to be numerically equal to two other definitions of mass, namely the measure of its reaction to a gravitational field (feeling gravity), as well as the measure of its source strength to produce a gravitational field (attracting another body).
69 David Bohm, Causality and change in modern physics, Routledge & Kegan Paul Ltd., 1957.
QM makes use of a standard three-dimensional flat Euclidian space and an infinite velocity of light, while Quantum Electrodynamics, the integration with electromagnetism, has a flat four-dimensional Minkowski space as background, with a finite velocity of light. A result of QM is that we have to drop the idea of simple locality, as the wave representation allows for infinite extension, whilst the (local) particle representation is needed in a measurement. This means that also here, the very notion of distance is subject to review.

We have tried in the above to explain the essence of relativity theory and quantum mechanics; hence it is useful to stipulate that in daily life, we use Newtonian theory which is framed in flat Euclidean space that allows for action at a distance through an infinite speed of physical interactions. We use it, e.g., in the building industry, biking or walking, and car engines. In quantum theory, and in particular in quantum electrodynamics, we deal with a finite speed of physical interactions, a basic unit of minimal energy transfer (the quantum of action) and a flat four-dimensional, Minkowski, background space, indispensable for all modern electronic appliances in our car. In gravitational theory, we conflate the notion of gravity with the notion of space-time. Curved space-time is here the expression of gravitational interaction, with no fixed notion of length and duration existing in terms of global terms. This theory is integrated in the heart-beat of our Global Positioning Systems (GPS), which brings our car home.

Interestingly, these three "true" theories are at odds with each other on the ontological level of the understanding of space and time. So far, physics is the queen of science.

Aside from the tremendous efforts in deep mathematical projects such as String Theory or Loop Gravity that try to combine all theories into one master theory, the question remains to what extent these efforts overlook some yet not understood basic notions which we take for granted without realising it.

Thus, the lesson to be learned is that more models can live together, although they have a fundamentally different "world view". This suggests that models and their "laws" are to a large extent contingent to a certain context. However, the idea that we can claim that one model is more fundamental is difficult. If we start with the idea that perceived simplicity is more fundamental in understanding the world, we have to start with gravitation theory and try to incorporate the quantum of action as well as the notion of matter, in one form or another. But equally, we can suggest that by discarding essential aspects of social life and philosophical outlook, we can deal with a great deal of phenomena. Physics is just the poor man's rescue boat, for people seeking certainty in borrowing methods.

To me, two things are completely not understandable. Firstly the belief that we will be in a position to reduce complicated issues like neurology or even thinking to computable extensions of physics. This would mean, in essence, a complete mechanical determinism, even if we allow uncertainties such as in quantum mechanics. Because in that field, despite the uncertainties previous to this measurement, the ultimate measurement gives a fixed, well-defined- value. Secondly, that our species will be able to encompass all phenomena as if our constellation is the only expression of nature. Evolution creates species with the capacity to survive in a certain environment. Homo Sapiens’s basic demands were limited to the environment in which our species evolved. In co-evolution with other species and the internal co-evolution of our bodily functions, such as the coordination of the eye, the hand and the brain, we are able to explore our environment. But it remains an open question if humans have such a dynamic brain power that we will understand all of nature. For religious people, these human limitations are projected into a deity. Pantheists solve the problem by equating nature with God. In my view, we simply have...
to except that we don’t know what we don’t know and even if we make conjectures, based on
the best we know (such as the existence of dark matter), then still we are limited by our
evolutionary capabilities, which we only experience by introspection and in experimental
relations with our environment.