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As 'Nature Works Dialectically', Explicating how Engels and Marx Analysed Climate and Climate Change Dialectically.

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'Unsystematic philosophizing can only be expected to give expression to personal peculiarities of mind, and has no principle for the regulation of its contents' (Hegel, Hegel's logic 1975, 20) (7).

ABSTRACT: The premise of this article is based on the assertion that Engels made which he suggested that 'nature works dialectically'. Consequently, concrete organic reality is not a solid thing-like entity but a complex matrix of interconnecting processes that form an organic totality. The existence of a dialectical reality has profound implications for how we can conceptualise that reality and even more critically how we physically relate to and engage with that dialectical reality, especially when that reality is also organic. The organic processes of nature, according to Engels and Marx, are dominated by the climatic process, that 'life-awakening force' of soil fertility. However, what determines the form of the local weather system (the local manifestation of the climatic process) is how that system interconnects with the other organic processes of nature – geological structures, vegetation and the soil processes and they all are subsequently moments of that overall climatic process. The presence of interconnecting processes determining concrete reality, questions the validity of linear cause and effect formulation to account for the determination of that dialectical reality. This one-sided form of causation has to be replaced by a many-sided formulation as expressed in Marx's famous proposal that the 'concrete is concrete because it is the concentration of many determinations. Hence the unity of the diverse'. The new epoch of planning our relationships with nature, has to include the adoption of the dialectical framework, conceptually within the sciences and practically in the processes of cultivation.

KEYWORDS: climate system, dialectical nature, interconnecting processes, deforestation, desertification, immediate and remote consequences, Ireland.

Introduction

Engels in the following suggests that there is similarity between Darwin's 'struggle for existence' and the bourgeois idea of free competition and how conscious planning can overcome this competitive condition of existence:

> Darwin did not know what a bitter satire he wrote on mankind, and especially on his countrymen, when he showed that free competition, the struggle for existence, which the economists celebrate as the highest historical achievement, is the normal state of the *animal kingdom*. Only conscious organisation of social production, in which production and distribution are carried on in a planned way, can lift mankind above the rest of the animal world as regards the social aspect, in the same way that production in general has done for mankind in the specifically biological aspect. (Engels 1986, 35).

However, what I want to propose in this article is that the same holds true for the organic world of nature as it is for the social world of bourgeois capitalism. We equally need to engage with nature 'in a planned way' in order to overcome the catastrophic damage we are inflicting on the diverse ecologies of the earth. This assertion I hope to prove reflects Marx and Engels views as derived from their dialectical analysis of organic nature and society's relationship to that organic structure. The 'conscious organisation of social production' and our relationship to organic nature, according to Engels, will bring in a new epoch in the historical evolution of humanity:

> Historical evolution makes such an organisation daily more indispensable, but also with every day more possible. From it will date a new epoch of history, in which mankind itself, and with the mankind all branches of its activity, and particularly natural science, will experience an advance that will put everything preceding it in the deepest shade (Engels 1986, 35).

It is more than interesting that Engels explicitly identified that natural science would experience this epoch changing conscious organization in planning our relationships with concrete reality. We have to presume that this 'advance' in these sciences would have to manifest itself as a conceptual one, in fact as a fundamental paradigm changing occurrence. What I want to suggest is that this advance in natural science is to be achieved by the necessary adoption of the dialectical framework within the natural sciences and its subsequent application to organic nature. The reasons for the

need of dialectical analysis, is that the concrete reality in general and its natural form in particular, are determined by dialectical laws of evolution, which is succinctly expressed by Engels in the assertion that 'nature works dialectically' (Engels 1987, 24). However, the above is concerned with the epistemological problematic of this article, the more substantive aspect is concerned with Marx and Engel's analysis of climate and to a lesser extent climate change and with Ireland as the empirical case study of this change.

In contemporary debates of the Left on climate change, there is little to no reference to what Marx and Engels had to say on this subject matter. This is rather surprising as there are numerous comments on climate spread throughout their works as little vignettes of insights. The problem with them is that there is no extensive discussion of these insights and they remain hidden as mere passing comments. However, there is one location that has the possibility of providing a conceptual framework that would allow us to order these discrete conceptualizations into a conceptual apparatus and that is in Engel's work on the dialectics of nature in his unfinished book – *The Dialectics of Nature*. In this, much neglected work, Engels does provide us with the opportunity to explicate such a theoretical framework, which conceptually incorporates climate within an in-depth analysis of the organic processes of nature and allows us to assess change within those complicated organic relationships. This article attempts to redress this lacuna and to go on to demonstrate that it is possible to construct such a coherent dialectical framework, which can conceptually grasp the complexity of the organic forces of the earth's climates. More importantly, Marx and Engel's analysis of climate and climate change has the potential to inform the contemporary debates of conceptual formulations that go beyond the empirical paradigms of the natural sciences, especially with regard to explicating the 'causes' of this global phenomenon of climate change.

To help the process of exposition I want to examine in detail Engels's investigation of the climate and the weather systems of Ireland. Within, we have an example of how a dialectical analysis can enlighten our understanding of the complexity of the organic forces of nature, including climate, manifesting themselves at a concrete and local level. Engels provided detailed information of the Irish ecological conditions in a chapter, entitled 'Natural Conditions' in his unfinished book on the *History of Ireland*.

In order to highlight the unfolding arguments of this article, I have provided a summary of the main conceptual points made at the end of each section within a shaded box so that we can follow the trajectory of the conceptual framework that is emerging. In the conclusion, I summarise these 'shaded' conceptual points in order to provide a clearer overview and more abstract insight of the unfolded dialectical framework.

The conclusion reached is that neither organic nature nor cultivated nature is a solid a thing-like entity but its opposite – a fluid interplay of interconnecting processes, which are not only metabolising with each other but also with regard to cultivation they also metabolise with societal processes. This fundamental reinterpretation of organic reality in which 'nature works dialectically' critically challenges the conceptual ability of the linear form of cause and effect to explain this dialectical reality.

A dialectical epistemology for a dialectical world

In a letter that Marx wrote to Engels on 27 June 1867, Marx identified the epistemological orientation that determined how vulgar economists perceive reality:

> Here it will be shown how the philistines' and vulgar economists' *manner of conceiving things* arises, namely, because the only thing that is ever reflected in their minds is the immediate *form of appearances* of relations, and not in their inner connections.

These theorists, unfortunately they are no longer confined to economics, are vulgar because they conceive reality as not only being made up of thing-like substances but also those 'real' substances form a vast collection of diverse isolated objects. Therefore, what distinguishes one thing-like entity from another is their 'immediate form of appearance' so that in attempting to understand the workings of this particular 'reified' reality it is sufficient to remain at the surface level of reality[1]. However, in opposing this vulgar conceptualisation of reality, scientific endeavour, according to Marx, enters into an examination of not just the inner essence of these supposedly discrete entities (as enshrined in the methodology of bourgeois science) but also into their 'inner connections' (as the essential trajectory of dialectical analysis). However, with regard to the vulgar 'reified' ontology Marx proposed that: 'Incidentally, if the latter was the case, we surely have no need of *science* at all'. (Marx to Engels 27 June 1867). So dialectics is firmly located within the scientific tradition of reductionism, but it fundamentally differs from that tradition in that it is the 'science of inter-connections' (Engels). It is these 'inner connections' and their 'form of interplay' that distinguishes dialectics from the 'rest' of scientific endeavours:

> What all these gentlemen lack is dialectics. All they ever see is cause on the one hand and effect on the other. But what they fail to see is that this is an empty abstraction, that in the real world much metaphysically polar opposites exist only in crisis, that instead the whole process takes place solely and entirely in the form of interplay – if of very unequal forces of which the economic trend is by far the strongest, the oldest and most vital – and that here nothing is absolute and everything relative. So far as they are concerned, Hegel might never have existed (CW 49 -1890-92 –Engels: 63).

Marx and Engels were life-long advocates of dialectical analysis and they continually asserted that it was the only form of enquiry that could not only conceptually grasp the complexity of a totality but it could also adequately comprehend and convey the constant movement between processes that determine that organic totality. Engels in the following suggests that the difference between the dialectical approach and the natural scientist's 'metaphysical[2]' (empirical) understanding of the real world:

> Dialectics, on the other hand, comprehends things and their representations, ideas, in their essential connection, concatenation, motion, origin, and ending. Such processes as those mentioned above are, therefore, so many corroborations of its own method of procedure. Nature is the proof of dialectics, and it must be said for modern science that it has furnished this proof with very rich materials increasing daily, and thus has shown that, in the last

[1]Engels stated that [t]he empiricism of observation alone does not adequately prove necessity. *Post hoc* but not *proper hoc*. (Engels 1986, 229).

[2] Engels defines metaphysics in the following:

> If, however, we adhere one-sidedly to a single standpoint as the absolute one in contrast to the other, or if we arbitrarily jump from one to the other according to the momentary need of our argument, we shall remain entangled in the one-sidedness of metaphysical thinking; the inter-connection escapes us and we become involved in one contradiction after another (Engels 1986, 167).

> resort, nature works dialectically and not metaphysically (Engels, Anti-Duhring MECW vol. 25, 23/4) (emphasis added)[3].

The first underlined conceptualisation of Engels is a good summary of the essential components of the epistemology of dialectical methodology as developed by Marx and Engels. It concerns uncovering the interconnections that exist between processes and how they constantly change over time. But this approach is not just applied to the evolution of the economic forms of societies as Marx did in Capital, but according to Engels it can also be adopted to investigate the organic forms of nature because 'nature works dialectically'.

However, this dialectical methodology is fundamentally the opposite of the approach adopted by the natural sciences, which has a tendency to 'reify' concrete reality as Engels proposes:

> The analysis of Nature into its individual parts, the grouping of the different natural processes and organic objects in definite classes, the study of the internal anatomy of organic bodies in their manifold forms – these were the fundamental conditions of gigantic strides in our knowledge of Nature which have been made during the last four hundred years. But this method of work has also left us with a legacy the habit of observing natural objects and processes in isolation, apart from their connection with the vast whole, of observing them in repose, not in motion, as constants, not as essentially variables, in their death, not in their life' (Engels, Anti-Duhring MECW, vol.25, 22) (emphasis added).

Thus, the framework of the non-dialectical sciences, is embedded in understanding of concrete reality as consisting of 'natural objects and processes in isolation' without any 'connection with the vast whole' of the organic totality of concrete reality. It could also be suggested, that this inherent tendency is intensified because of how these empirical disciplines perceive their scientific task as providing 'practical' solutions to immediate problems. The overall consequence of these tendencies within non-dialectical sciences is that the trajectory of their research is to investigate the 'internal anatomy of organic bodies in their manifold forms' without any attempt to explore the possibilities of determinant interconnections between the supposed discrete and isolated entities that are their misconceived aspects and conditions of existence of reality. Accordingly, these non-dialectical theorists cannot adequately conceptualise the causal link between differing entities, because they are under the hegemonic impression that there is no linkage nor interconnection between the 'things' of the concrete world.

This inherent weakness is not obvious to the non-dialectical eye where concrete reality and its contents appear to be made up of a vast array of separate and independent entities, whose apparent relationship with each other is that they merely inhabit the same earth. However, this is a topsy-turvy world, in which the real determination of objective mundane reality is the opposite of its reified appearance in that everything is connected and is in a constant state of motion[4]. As

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[3]The consequence for the natural scientists – confusion leading to despair:

> But the naturalists who have learned to think dialectically are few and far between, and this conflict of the results of discovery with preconceived modes of thinking explains the endless confusion now reigning in theoretical natural science, the despair of teachers as well as learners, of authors and readers alike (Engels, Anti-Duhring, MECW, vol.25, 24).

[4] This dialectical perspective of the concrete world is confirmed by Marx's own words from 1842 in which he refers to 'the contents of the world' as an 'unorganised mass of the whole' with a 'fluid essence of the content' Marx MECW, vol. 1, 1975 page)

Engels stated ‘the whole of nature lies spread out before us as a system of inter-connections and processes (Engels 1986, 198) and even the most unlikely of things are connected such as ‘e.g., a meteorite and a man’:

> If we consider two extremely different things – e.g. a meteorite and a man – in separation, we get very little out of it, at most that heaviness and other general properties of bodies are common to both. But an infinite series of other natural objects and natural processes can be put between the two things, permitting us to complete the series from meteorite to man and to allocate to each its place in the inter-connection of nature and thus to *know* them ...’ (Engels 1986, 232/3).

A further complication has to be added to this ever-increasing complexity, is that these essential interconnecting processes of concrete reality, and particularly the organic processes of the natural world are increasingly being penetrated by societal forces in a process of metabolisation. However, rarely are these socio-organic processes acknowledged as being present within concrete reality because supposedly isolated entities can only be externally related to each other as their individual anatomies are determined by internal factors only. It is impossible to find under a microscope a physical entity, which reveals bits of society fusing with organic particles.

In summary, the reason for this misguided bourgeois perspective is that society tends to perceive the concrete reality of the world as a thing-like substance and not as Engels maintains as ‘an endless entanglement of relations and reactions in which nothing remains what, where and as it was, but everything moves, changes, comes into being and passes away. […] for everything is *fluid.* (Engels, Anti-Duhring, MECW, vol.25, 21).

However, before we attempt to uncover the dialectical interconnections within climate and between the climate and the other organic processes of nature we first need to outline the empirical extent of these processes form an organic totality and how those organic process manifest themselves on the surface of the earth/society:

> We all agree that in every field of science, in natural as in historical science, one must proceed from the given *facts*, in natural science therefore from the various material and various forms of motion of matter; that therefore in theoretical natural science too the interconnections are not built into the fact but to be discovered in them, …. (Engels 1986, 47)[5].

Engels and Marx were very much aware of their achievement with regard to their development of dialectical materialism. However, they also warned us that this methodology in itself was not sufficient to fully understand the dialectics of nature and cultural history, as we had to have also an understanding of natural science and mathematics as Engels suggests:

> Marx and I were pretty well the only people to <u>rescue conscious dialectics</u> from German idealist philosophy and <u>apply it in the materialist conception of nature and history</u>. But a knowledge of mathematics and natural science is essential to a conception of <u>nature which is dialectical and at the same time materialist</u>. (Engels, Preface to second edition his *Anti-Duhring* MECW, vol.25, 11).

[5]Engels reiterated this point in his 1885 Preface to his *Anti-Duhring*:

> And finally, to me there could be no question of building the laws of dialectics into nature, but of discovering them in it and evolving them from it (Engels, 1885 Preface to his *Anti-Duhring*).

The reason why a knowledge of natural science and mathematics is required is because the dialectical framework reformulates the epistemological forms of mathematics and natural science rather than replacing them.

Climatic zones determining the general organic conditions of existence for societies

Engels in the following highlights another way in which humans differ from animals with regard to their relationship to the climates of the world:

> Just as man learned to consume everything edible, he also learned to live in any climate. He spread over the whole of the habitable world, being the only animal fully able to do so of his own accord. The other animals that have become accustomed to all climates – domestic animals and vermin – did not become so independently, but only in the wake of man (Engels 1986, 177).

Human societies, in moving into the diverse climatic regions across the globe, were not overwhelmed by any particular climate to the extent that they were prevented from inhabiting those adverse climatic zones. They 'learned to (adopt especially their production techniques and were as a consequence able to) live in any climate'. However, the differing types of climatic zones demanded 'new spheres of labour' from human societies that moved into diverse climatic regions:

> And the transition from the uniformly hot climate of the original home of man to colder regions, where the year was divided into summer and winter, created new requirements – shelter and clothing as protection against the cold and damp, and hence new spheres of labour, new forms of activity, which further and further separated man from the animal (Engels 1986, 177) (emphasis added).

The difference between hot and cold climates and society's movement from the latter to the former provides a transition in the evolution of societies. The first form, 'the original home of man' as determined by the 'uniformly hot climate' naturally provided the objects of subsistence without too much effort on behalf of society. While the second form which was subsequently located in the 'colder regions' of the world demanded 'new spheres of labour' to produce the necessary physical requirements that the members of society needed to survive in these colder climate zones. Marx, in Capital, provided a more explicit categorisation of these two forms of societies with regard to the presence of differing forms of natural conditions (including the climate):

> 'Even if we leave aside the question of the level of development attained by social production, the productivity of labour remains fettered by natural conditions. These conditions can all be traced back to the nature of man himself .... and to the natural objects which surround him. External natural conditions can be divided from the economic point of view into two great classes, (1) Natural wealth in the means of subsistence, i.e. a fruitful soil, waters teeming with fish, etc., and (2) natural wealth in the instruments of labour, such as waterfalls, navigable rivers, wood, metal, coal, etc. At the dawn of civilisation, it is the first class that turns the scale; at a higher stage of development, it is the second' (Marx 1976, 647/8).

Accordingly, these natural conditions that assist society to reproduce itself materially were classified by Marx into two 'economic' and productive categories – societies in which nature provided its members with immediate objects of subsistence and those societies that needed to develop instruments of labour in order to provide themselves with subsistence. In the former 'garden of Eden' form, less labour was required for the production of physical subsistence:

> ‘The smaller the number of natural requirements imperatively calling for satisfaction and the greater the natural fertility of the soil and the kindness of the climate, the smaller the amount of labour-time necessary for the maintenance and reproduction of the producer’ (Marx 1976, 648) (emphasis added).

But the ‘kindness of the climate’ is not solely concerned with human comfort in general as it is essentially whether a society needs to engage in agricultural production or not. If organic Nature is too bountiful and its climate is too comfortable and favourable there is no necessity for society to develop intensive productive activities for its own subsistence, beyond hunting and gathering. However, if less bountiful conditions within the natural and climatic processes exist not only were productive forces developed but also out of such ‘adverse’ conditions of existence capitalism emerged:

> Where Nature is too lavish, she “keeps him in hand, like a child in leading strings”. She does not impose on him any necessity to develop himself. It is not the tropics with their luxuriant vegetation, but the temperate zone that is the mother country of capital’ (Marx 1996, 514/5) (emphasis added)[6].

The temperate climatic zone is ‘the mother country of capital’ because its natural conditions were not too lavish and this deficit in its ‘bountifulness’ spurred society on to subdue the natural conditions in order to produce products so that society could survive and in doing so industry came into being:

> ‘It is not the mere fertility of the soil but the differentiation of the soil, the variety of its natural products, the changes in the seasons, which form the physical basis for the social division of labour, and which by changes in the natural surroundings spur man on to the multiplication of his wants, his capabilities, his means and modes of labour. It is the necessity of bringing a natural force under the control of society, of economising, of appropriating or subduing it on a large scale by the work of man’s hand, that first plays the decisive part in the history of industry’ (Marx 1996, 515) (emphasis added).

What Marx is proposing here is that there is an apparent ecological reason for the rise of Capitalism in the West in which the inherent climatic conditions were neither too favourable as to be lavishly bountiful nor too unfavourable to be adverse for agricultural cultivation. Consequently, the climatic constraints of the temperate zone, ‘spurred on’ those inhabiting societies to toil with the forces of nature by appropriating them for societal production purposes. In this tremendous ecological effort to subdue nature, that capitalism was eventually born.

However, the analysis of the prevailing climatic conditions of existence within the earth’s climatic zones has to be superseded by an investigation into the specific operations of the diverse organic processes of the climate and how they metabolise not only with each other but also with the

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[6]Marx included the following footnote from J. Massie to highlight these climatic consequences:

> ‘There are no two countries which furnish an equal number of necessaries of life in equal plenty, and with the same quantity of labour. Men’s wants increase or diminish with the severity or temperateness of the climate they live in, consequently, the proportion of trade which the inhabitants of different countries are obliged to carry on through necessity cannot be the same nor is it practicable to ascertain the degree of variation further than by the degree of Heat and Cold: from whence one may make this general conclusion, that the quantity of labour required for a certain number of people is greatest in cold climates, and least in hot ones for in the former men not only want more clothes, but the earth [need] more cultivating than in the latter’ (An Essay on the Governing Causes of the Natural Rate of Interest – London, 1730) (emphasis added).

other organic processes of nature. To do this we need to move the analysis away from the examination of the global aspects of the earth's climatic zone system to an investigation into the particulars of a local weather system. Within this system, the atmospheric climate becomes an aspect and condition of existence for the localised weather system. This is so because we need to explicate its interpenetrating relationships of climates' metabolising processes and with the other organic processes of nature that are 'grounded' within the physical surfaces of the earth. In addition, because of these constantly changing diverse processes of climate we have to examine them in detail within a particular bioregion. The region I have chosen is Ireland and specifically Engels in-depth analysis of its 'natural conditions', including its climate and weather system[7].

1. Marx establishes a dichotomy between climate and labour and their ability to induce fertility of the soil.

2. Climatic zones determines society's wants for necessities, e.g., food, clothing and shelter.

3. Climate therefore is one crucial determinant in the division of labour between trading societies.

4. Less favourable or bountiful climatic conditions spurs societies on to produce what climate does not provide organically.

Engels on Irish weather: How the 'heavy Atlantic rain clouds' metabolises with the Irish geological processes

Engels begins his analysis of the climate of Ireland by suggesting that the dominant determinant of the overall process of Irish weather conditions is its position with regard to the Gulf Stream:

> Ireland's climate is determined by her position. The Gulf Stream and the prevailing south-west winds provide warmth and make for mild winters and cool summers (Marx and Engels 1971, 183).

Although this Atlantic warm current has a moderating effect on Irish temperatures, the prevailing winds also function in this regard. Accordingly, the mildness of the climate is determined by the interaction of the warmth of the Gulf Stream with the prevailing westerly winds as Engels suggests in the following:

> Prevailing winds were west and south-west, then came north-west and south-east, and most rarely north-east and east. In summer, autumn and winter west and south-west prevail. East is more frequent in spring and summer, when it occurs as frequently as in autumn and winter; north-east is most frequent in spring when it occurs twice as frequent as in autumn and winter. As a result of this, the temperatures are more even, the winters milder and the summers cooler than in London, while on the other hand the air is damper' (Marx and Engels 1971, 186) (emphasis added).

The consequence of this particular form of mildness is the ever-present 'dampness of the air', which is also a consequence of its westerly position as 'Ireland also suffers the first powerful

[7]Engels chapter entitled 'Natural Conditions' of his unfinished work – the History of Ireland (Marx and Engels, 1971).

downpour of the heavy Atlantic rain clouds (Marx and Engels 1971, 184). It is so damp that salt, sugar or flour left out in an unheated room will soak the dampness out of the air (Marx and Engels 1971, 186/7). Ireland's average rainfall is at least 35 inches, which is considerably more than England's average (Marx and Engels 1971, 184). But:

> 'In spite of this the Irish climate is decidedly pleasanter than the English. The leaden sky which often causes days of continual drizzle in England is mostly replaced in Ireland by a continental April sky; the fresh sea-breezes bring on clouds quickly and unexpectedly, but drive them past equally quickly, if they do not come down immediately in sharp showers. The weather, like the inhabitants, has a more acute character, it moves in sharper, more sudden contrasts; ….; here also rain and sunshine succeed each other suddenly and unexpectedly and there is none of the grey English boredom' (Marx and Engels 1971,184).

The difference between the weather systems of Britain and Ireland is not determined by the amount of rain that falls but '*how* and *when* it falls' (Marx and Engels 1971, 185). The 'how and when' of the Irish rainfall is apparently determined by how 'the fresh sea-breezes bring on clouds quickly and unexpectedly drive them past equally quickly, if they do not come down immediately in sharp showers'. Thus, the specific form of Irish rainfall is the determining essential climatic process of this organic totality. It – the constant fleeting nature of rain showers - is the 'active middle' process of this Irish weather system and consequently it determines simultaneously its mildness and dampness:

> '...there are seldom more than two or three consecutive dry days in summer; and in late autumn it is fine again. Very dry summers are rare and dearth never occurs is because of draught but mostly because of too much rain' (Marx and Engels 1971, 186).

This succinctly captures the essential and dominating determinant of the Irish weather system, its incessant rain all year-round rain that is not just caused by passing rain clouds but clouds that interact with other organic processes of the topographical kind. The specific form of a weather system is essentially a complex matrix of dialectical relationships that are a result of metabolising organic processes. These are initially identified, within the medium of the atmosphere. Nevertheless, these apparently atmospheric moments of climate are by necessity earth bound. Since the climate/weather system does not operate in a void – even an atmospheric one - they have to form relationships with the physical surfaces of the earth. Moreover, in doing so the climatic processes of the earth metabolises with the geological processes of that same earth. The specific way they in the local context metabolise is best identified in concept of the local weather system.

In geological terms, Ireland is shaped like a saucer with a central plain encircled by a mountain chain, which hugs its coastal perimeter. This plain, 'the foundation of the whole of Ireland consists of the massive bed of limestone' was formed during the Carboniferous period (Marx and Engels 1971, 172). Engels continues:

> The centre of Ireland, to the north and south of a line from Dublin to Galway, forms a wide plain rising to 100-300 feet above sea-level. This plain, the foundation so to say of the whole of Ireland, consists of the massive bed of limestone (Carboniferous limestone), … In the south and the north, this plain is encircled by a mountain chain, which extends mainly along the coast, and consists almost entirely of older rock-formations, which have broken through the limestone (Marx and Engels 1971, 172).

These geological formations have created an unusual physical configuration[8] and especially in the central plain as Engels explains:

> While the mountains are mainly along the coast, the watersheds between the inland river basins are mostly low-lying, and therefore the rivers are incapable of carrying all the rainwater out to the sea. Thus, extensive peat bogs arise inland, especially on the watersheds (Marx and Engels 1971, 182).

In addition, the reason why these inland peat bogs have emerged is how the low-lying geological base has metabolized with the rainfall:

> In the plain alone 1,576,000 acres are covered with peat bogs. These are largely depressions or troughs in the land, most of which were once shallow lake basins, which were gradually overgrown with moss and march plants and were filled up with their decomposing remains (Marx and Engels 1971, 182).

Thus, the westerly blown rain clouds have metabolised with the central plain's geological structure to create a particular weather system that has subsequently allowed the great peat bogs of inland Ireland to emerge. The crucial point to emphasise is that both aspects of this metabolising climatic process – the excessive rainfall and low-lying nature of the plain with its physical depressions and troughs - form essential interconnecting moments of that process. However, elsewhere and beyond the confines of midland bogs, limestone again occurs but because this particular bedrock is not as low-lying as the central plain, it metabolises with the rainfall in a diametrically opposing way:

> The limestone is known to be full of cracks and fissures, which let the excess water through quickly (Marx and Engels 1971, 185).

Accordingly, the particular geological aspect of this limestone bedrock does not encourage peat bog to grow but it crucially absorbs the excessive dampness by allowing the incessant rainwater to pass uninterrupted into the 'bowels of the earth'. However, it is not just the permeability of the limestone bedrock that allows cultivation to continue but also the presence of stony soil lying on that sieve-like base:

> At the same time, he (Arthur Young) points out that the soil of Ireland counteracts this dampness of the climate. It is generally stony, and for this reason lets the water through more easily (Marx and Engels 1971, 185)

Therefore, both the limestone bedrock and the stony soil function as a metabolising process that naturally lessen the effects of excessive rainfall and the inherent dampness associated with Irish weather system.

However, this type of metabolising relationship between rain/wind and the geological processes can dramatically change when the geological entities encountered also changes. For example, when the climatic processes of wind driven rain sweep over mountain ranges rather than rolling across low-lying plains the consequence can be a dramatic change in rainfall. For example, on the western

[8]Sweeney elaborates on the uniqueness of this physical structure:

> Ireland also has its own distinctive geographical climate fingerprint. This results from what is an unusual physical configuration for an island of its size, comprising of a mountainous perimeter of hard ancient rocks and relatively soft, low-lying interior. This combined with the fretted coastline of the west and south provides a surprisingly varied climatic mosaic to the island (John Sweeney, 2011:2).

mountains the ‘annual rainfall totals over 3 metres, these gave way to values as low as 710 mm’ (Sweeney 2001, 2) in the mid-lands and along its eastern seaboard[9].

So, it is not only the volatile organic processes of the atmosphere but also by how those dynamic forces metabolise with the solid geological processes of the earth that constitute the essential overall form of the Irish weather system. Both processes metabolise with each other to become essential moments of the local weather system.

However, when the organic processes of the Irish climate metabolise with the geological structures of the island they also by necessity metabolise with the flora that naturally cover those structures. Thus, the type of flora that acts as a mantel over the geological base is very much determined by how the predominant determinant of rainfall of the weather system metabolises with the particular geological entities within differing bioregions of Ireland. As Engels, has highlighted in Ireland’s central plain peat bog is the dominant flora but in the rest of the low-lying terrains of the island, it is grass:

> *‘Arthur Young* considers that Ireland is considerably damper than England; this is the cause of the amazing grass-bearing qualities of the soil’ (Marx and Engels 1971, 185).

However, it is not the amount of rain that falls that differentiates the grass growing ability of England and Ireland but crucially how that rainfall metabolises with the inherent permeable condition of the Irish soil (and its geological bedrock) contrasted with the impermeable conditions of the English clay soils as Engels suggests in quoting Arthur Young:

> ‘*If as much rain fell upon the clays of England (a soil very rarely met with in Ireland, and never without much stone) falls upon the rocks of her sister-island, those lands could not be cultivated. But the rocks clothed with verdure; - those of limestone with only a thin covering of mold, have the softest and the most beautiful turf imaginable’* (Arthur Young, vol.2, Part 11, pp.3-4).

Moreover, this grass growing ability is not just a natural consequence of metabolising organic processes but it is also a result of being a consciously sown field crop - one that has been cultivated by the human activity (Slater, 2013). Therefore, unlike Young’s inherent naturalism in the above quotation, in which it is conceived as a one-sided determination, in fact grass is a multi-sided phenomenon and consequently it is a concrete manifestation of the concentration of social and natural determinations. In a very real sense, it is the unity of diverse determinations. Within agricultural cultivation, the ‘tillers of the soil’ appropriate the inherent organic processes of the Irish weather system, which includes the atmospheric forces, geological aspects and the constituents of the soil, transforming them into natural agents of production.

5. The Gulf Stream and prevailing south-west winds determine that Ireland has a damp climate.

[9] Moreover, this difference in weather conditions, between the mountainous edge of the island and its internal low-lying valleys is also reflected in the number of storms occurring. Fifty days on average of gale force winds can be experienced in the typical year on the north-west coast; this reduces to only two in the sheltered inland valleys of the southeast (Sweeney 2011, 2).

6. ***This dampness is caused by incessant rain and which is itself determined by constantly moving rain clouds.***
7. ***Accordingly, the amount of rain that falls is very much determined by how those rain clouds interact with the topographical structures.***
8. ***What determines the weather system is the interconnections that occur between that system and the diverse topographical processes,***
9. ***When the Irish climatic process metabolise with the geological structures they necessarily metabolise with the organic flora that naturally cover those structures.***
10. ***Flora like grass is not exclusively determined by the weather system and the other organic forces of fertility but by how it is a sown crop – sown by society.***

Marx on how the organic processes of climate become natural agents of production

In Marx's discussion of 'Differential Rent 1' in vol.3 of Capital, he begins his discussion of soil fertility by noting that with regard to the soil itself it is the chemical constituents that appear to be the dominant determinant in the formation of natural fertility. Yet this innate 'causation' only comes into being when the climate conditions are suspended:

> 'Apart from climatic and similar aspects, differences in natural fertility are differences in the chemical compositions of the soil, i.e. variations in the amount of nutrient elements for plants it contains' (Marx 1981, 790)[10].

The implication of setting the 'climatic factors' aside is that they must have a significant impact on soil fertility as well as its chemical composition. Moreover, what is also important to highlight is that the climatic relationship to the soil is an external one, where the climate has a direct 'impacting' relationship on the soil and not just providing an environmental backdrop to the inner mechanics of the soil[11]. The sun as an essential moment of the climate process has such an external relationship to the plants of the soil:

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[10]Marx quotes Kirchhoff making the same point:

> '..... since fertility does not just depend on the quality of the soil, but also on the year's weather...' (Marx, quoting Kirchhoff, vol.2.325).

[11]'A being which does not have its nature outside itself is not a *natural* being, and plays no part in the system of nature. A being which has no object outside itself is not an objective thing. A being which is not itself an objective for some third being has no being for its object, i.e., it is not objectively related. Its' being is not objective' (Marx, The Economic and Philosophical Manuscripts of 1844, pp.180-183).

> ‘The sun is the *object* of the plant – an indispensable object to it, confirming its life – awaking ...just as the plant is an object of the sun, being an *expression* of the life-awakening power of the sun, of the sun’s *objective* essential power’ (Marx, The Economic and Philosophical Manuscripts of 1844, pp.180-182).

Therefore, this particular ‘indispensable’ aspect of the climate – the sun – has the essential function in Nature as the ‘essential power’ that is ‘life-awaking’. The soil is not soil, or at least fertile soil, without its indispensable relationship to the immediate weather system, as this later process provides the motive power for vegetative growth in the soil. Therefore, the functioning soil – functioning to be fertile – is not determined exclusively by the internal constituents of the soil but by its intricate and diverse relationships between those constituents and the mediating weather system. Accordingly, the soil and its inherent essential processes form with the local weather system an organic totality of metabolising processes. The wholeness of the soil’s organic totality is not exclusively retained within the physical contours of its thing-like appearance – *terra firma* – but by its interpenetrating relationships with a constantly changing matrix of metabolising processes, some within the soil and others without. This particular dialectical insight challenges the ability of our sense perception to uncover the workings of concrete reality since we tend to perceive that reality as being made up of isolated and self-contained entities – a reified world – while in fact according to Engels, it is essentially dialectical.

Marx in his discussion of Russian agriculture reiterated the beneficial aspect of weather system on nature, in this case of crop harvests and as we cultivate the soil, we simultaneously appropriate the forces of the climate that affects the soil:

> ‘Good harvests [which favourable weather conditions sometimes draw from the land] are matched by periods of famine’ (Marx in his draft letter to Vera Zasulich quoted by Shanin ? p.115).

Here, the weather conditions are conceptualised in such way that they are not about providing a mere atmospheric layer for plant growth but they are conceptualised by Marx to be a forceful catalyst in crop production as they ‘draw’ the harvest ‘from the land’[12]. However, it is not just ‘favourable weather conditions’ alone that ‘fortuitously induce’ good harvests from the soil, we also have to include society’s attempt to improve the soil as Marx indicates in the following:

> ‘A general increase in the fertility of the land resulting from improvements presupposes these conditions, as against the fertility fortuitously induced by a favourable season’ (Marx to Engels -7th Jan. 1852, Collected Works, Letters, vol. 38:261).

Therefore, Marx appears to be unfolding a conceptual perspective in which natural factors such as climate metabolise with society’s attempt to cultivate the soil in order to produce organic products for society’s use. And in doing so the natural conditions become agents of production as Marx states in the following with regard to natural conditions pertaining to the motive forces of flowing water in a water-fall but the same holds true for climatic conditions (remembering that flowing water is somewhere and sometime a consequence of rain clouds):

[12]However, the possible existence of famine conditions also suggests that these weather conditions can have a detrimental effect on the harvest. If we exclude the possibility of the famine conditions caused by human strife, we appear to have a determination of a devastating collapse of a harvest due to natural conditions – a diseased crop such as occurred during either the Great Irish Famine or adverse weather conditions causing dearth. Either way natural, conditions, including climate, play a critical role in crop production.

> ‘In the first instance, to a natural force, the motive force of water-power which is provided by nature itself and is not a product of labour... It is a natural agent of production, and no labour goes into creating it. But this is not all. [....] . It (the increased productivity of labour) arises from the greater natural productivity of a labour linked with the use of a natural force, but a natural force that is not available to all capital in the same sphere of production, as is for example the elasticity of steam; its use therefore does not automatically occur as soon as capital is invested in this sphere’ (Marx 1981,782). (Emphasis added)

Therefore, the motive force of nature does play a role in the production process as it functions as a natural agent of production. The ‘increased productivity of labour’ is determined by the presence of natural processes that operate within the immediate locality of the production process. Those motive forces of nature when they physically enter the production process metabolise with the labour power of the producer, thus making that labour power more productive. The ‘harnessing’ of the weather as a natural agent of production is a necessary aspect of agricultural production – past, present and the future. Even in the developed economies of the temperate climatic zone, the growing period of field crops is very much restricted by the seasons and ever-changing fortunes of the weather within those seasons:

> ‘In our temperate climates, the land brings forth grain once a year. The shortening or lengthening of the production period (an average of nine months for winter sowing) is itself dependent on the alteration of good and bad years, and hence cannot be precisely determined in advance and controlled, as in industry proper’ (Marx 1978, 318) (emphasis added).

Marx’s final comment highlights an important conceptual trend in his attempt to understand the specific structure of agricultural production and that in contrast to the ‘workings’ of the industrial labour process, the agricultural production process is dependent on the vicissitudes of the local weather system. In this constant attempt to bring ‘a natural force under the control of society, of economising, of appropriating or subduing it’ society according to Marx will never ‘master’ the organic processes of nature as it has done in the inorganic processes of the industrial labour processes[13]:

> ‘[....] capitalist production has not yet succeeded, and never will succeed in mastering these processes [i.e. organic processes] in the same way as it has mastered purely mechanical or inorganic chemical processes’ (Marx [1861-1863] 1976 82; 1809 – quoted from Roth ‘Marx on technical change’ 2010, p.1243).

What Marx and Engels appear to be conceptually unfolding is that nature and its complex range of diverse processes can never be totally mastered by society, they can only be appropriated and thus given a social form that enhance their productive capabilities for agricultural cultivation. Climatic factors and the essential processes that determine those factors are similarly utilised by the way they are integrated into society’s processes of cultivation.

Nevertheless, these forces of nature when they are appropriated into a labour process can also be enhanced and thereby making labour even more productive as Marx suggests with regard to a waterfall:

[13] Marx states that: Agriculture forms a mode of production sui generis, because the organic process is involved in addition to the mechanical and chemical process, and the natural reproduction process is merely controlled and guided….(Marx, 1973, p.726).

> A waterfall can be artificially channelled to make its motive powerfully usable; a water-wheel can be improved in order to use as much of this water-power as possible where the ordinary type of wheel is not suited to the supply of water, turbines can be used etc., (Marx, 1981,784).

With regard to enhancing the weather process within cultivation, it is not concerned with changing the internal dynamics of that atmospheric climatic processes but changing with what they impact upon, that is the topographical aspects that it metabolises with and doing so changing the entire workings of the organic totality of cultivation. If the predominant determinant of local weather system is rain – excessive rain, the cultivators could harness this rain and simultaneously reduce its excessiveness by developing soil drainage systems.

Therefore, it should be stressed that the crucial difference between the inorganic industrial production process and the organic agricultural production process is the determining presence of climate as dominant natural agent of production within agriculture. An excellent example of this natural determination within the cultivation process of agriculture is Marx's commentary on Russia's adverse winter climatic conditions compressing agricultural production into a very short growing season:

> 'Thus, the more unfavourable the climate, the more the agricultural working period, and hence the outlay of capital and labour, is compressed into a short interval, as for example Russia. 'In some of the northern districts, field labour is only possible during from 130 to 150 days in the course of the year....' (Marx 1978, 318)[14].

Consequently, what we need to be aware of is that in appropriating the natural processes of a waterfall or climate in the cultivation process we must recognise the independently determined forces of those organic processes of nature. In the following, Marx recognises the independent powers of Nature embedded in the earth and how they combine with the 'powers given by human industry':

> …the earth is the reservoir, from whose bowels the use-values are to be torn. […] <u>The soil has no 'indestructible' powers.</u> […] By 'original' powers of the land we understand here those, <u>which it possesses independently of the action of human industry</u>, although, on the other hand, the powers given to it by human industry, became just as much its (245) <u>original powers as those given to it by the process of nature</u> (246). (Theories of Surplus Value, part 2) (emphasis added).

In fact, since we cannot produce them in an industrial production process all we can do to them in agricultural production is to provide them with is a particular trajectory – a social form[15].

[14]Marx quoted the following: 'The number of working days for the three main working periods is assumed to be as follows in the different districts of Germany, with respect to the climatic and other conditions involved: the spring period from mid-March or the beginning of April up to middle of May, 50-60 days; the summer period from early June to late August, 65-80 days; the autumn period from early September or to the or the end of October or the middle of November, 55-75 days. As far as winter goes, there is simply the work suited to that period, such as haulage of fertilizer, wood, goods for the market, building materials, etc., F. Kirchhoff – (Marx 1978, 318).

[15]Therefore, in the everyday activities of cultivation human confrontation with nature gives a form to nature's complex material processes, as the following indicates:

11. ***Climate is an essential element of soil to such an extent that as we cultivate the soil we simultaneously appropriate the organic forces of the immediate climatic conditions.***
12. ***Climate is therefore an indispensable aspect of cultivation as it provides the 'life-awakening' force of soil fertility - vegetative growth.***
13. ***By appropriating the organic forces of climate within the cultivation process, those natural forces become natural agents of the agricultural production process.***
14. ***Accordingly, since we cannot control the specific forces of climate, we can never master the organic forces involved in cultivation.***
15. ***But we can enhance these climatic forces by manipulating what they impact upon.***

Engels on appropriating the Irish weather system as the essential natural agent of cultivation

On a number of occasions throughout his chapter on Ireland, Engels highlights why he is investigating these natural conditions of Ireland, which includes its climate:

> And indeed the climate only concerns us here insofar as it is important for agriculture (Marx and Engels 1971, 185).

This research problematic is not determined by the mere empirical presence of these entities within the same bioregion but by how they dialectically metabolise with each other as processes. Again, they form a complex relationship, which was characterised by how climate in general and the Irish weather system in particular was appropriated by Irish agricultural production processes in diverse ways. If this form of appropriation is done properly, the results can be spectacular as Engels quotes Wakefield:

> *'The soil of Ireland is so fertile, and the climate so favourable, under a proper system of agriculture, it will produce not only a sufficiency of corn for its own use, but a superabundance which may be ready at all times to relieve England when she may stand in need of assistance'* (Wakefield vol. 2, p.61).

In the context of our analysis of climate, the 'proper system of agriculture' must relate to how that climate process is successfully integrated into the process of Irish cultivation. This involves both the content and the form of cultivation and how they respond to the diverse moments of the

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> Man not only effects a change of form in the materials of nature; he also realizes his own purpose in those materials' (Marx, 1976, 284) (emphasis added).

And:

> The product of the process is a use-value, a piece of natural material adapted to human needs by means of a change in its form (Marx, 1976, 287) (emphasis added).

The two essential characteristics of the physical product of the labour are its form and substance in the labour process. The latter is provided by nature and the form by society and 'this humanistic form is temporary and accidental compared with natural substances' (Han 2010 :2)

localised climate process - the Irish weather system. As we have already uncovered the Irish weather according to Arthur Young 'is the cause of the amazing grass-bearing qualities of the soil' (Marx and Engels 1971, 185), but this is not sufficient in itself as it needs to 'metabolise' with the permeable structures of the soil and its limestone bedrock (Slater, 2017). Although this particular metabolic relationship appears to intensify the growth of grass, it does not hinder the growth of corn:

> '..., *nowhere* does he (Wakefield) state that it (climate) provides a serious obstacle to the cultivation of corn. In fact, he finds, as we shall see, that the losses incurred during the wet harvest times are due to entirely different causes, and states so quite explicitly' (Marx and Engels 1971, 188) (my inclusion in brackets).

The inherent variability of Irish weather is not just determined by passing rain-carrying clouds but as we have pointed out how they metabolize with the diverse geological formations of the island. Due cognisance of these particular metabolising moments should be taken into account with regard to the contents of the crops grown within these bio-geological regions:

> Of course these are the regions, in which because of proximity of mountains the rainfall is always greater, and which are less suited for wheat-growing – notably in the south and west. [….] Ireland's principal grain was and still is oats. […] And in any case, oats can take a considerable amount of rain (Marx and Engels 1971, 189).

Although these damp conditions affect grain production it has not stopped grain being sown as 'Ireland has grown corn since ancient times' (Marx and Engels 1971, 188).[16] Nevertheless, the particular type of grain grown is very much rain determined – oats:

> Ireland's principal grain was and still is oats. In 1810, no less than 10 times as much oats as of other sorts of corn put together (Marx and Engels 1971, 189).

When the rain-dominated weather system metabolises with high mountains what is generally sustainable is oats and not wheat unless the rain determination on the grain crop is curbed if not eliminated by societal intervention strategies. One strategy adopted, which has already being highlighted by Engels, to minimise the dominant determinant of rain in the agricultural process is of course to plant more rain resistant crops, such as potatoes, rather than the other grain species e.g. wheat. Another strategy was to engage in the post-cultivation activity of extracting the dampness from the grain by drying it, as Engels quotes Wakefield in the following:

> *Even in summer, salt, sugar, flour, etc., soak dampness out of the air, and corn must be kiln-dried,* (Wakefield, vol. 1: 172-81).

Apparently, kiln drying was 'a practice unknown in *some parts* of England (Engels 1971, 186). The most used strategy to overcome the threat from rain was to increase vigilance at harvest time, which Engels suggests by quoting Patterson:

> *'If frequent summer and autumn showers make our hay and corn harvests risky, then vigilance and diligence would be just as successful in such exigencies as they are for the*

[16]Engels continued:

'After the English invasion, the cultivation of corn diminished because of continual battles…. If Ireland were not suited to the cultivation of corn, would it have been grown for over a thousand years?' (Marx and Engels 1971, 189).

> *English in their 'catching' harvests, and improved cultivation would ensure that the seed-corn would aid the peasants' efforts'* (W. Patterson, An Essay on the climate of Ireland, Dublin, 1804:164).

However, the most effective way that the majority of the peasant cultivators in the Pre-famine period dealt with excessive rainfall was to engage with ridge cultivation using spade husbandry[17].

The crucial aspect of the productiveness of Irish crop production is how society was able to deal with the predominate determinant of the constant dampness of the Irish weather system. This is concerned with how the organic countertendencies of the indigenous geological processes can counteract the inherent dampness of the weather system and how these powerful organic forces are themselves augmented by the social forms of cultivation. Choosing the right crop for the particular climatic zone was a necessary requirement in this regard. However, on the other hand, climate in general and the weather in particular are never just given entities with unchanging characteristics, they, on the contrary, are fluid and dynamic processes with diverse forces that need to be appropriated in a production process as natural agents of production. But, this necessary appropriation is not always successful, in certain seasons the weather can actually damage the crop output.

The form of cultivation adopted to productively cope with the vicissitudes of the local weather system was not discussed in detail by Engels in this chapter. However, what was discussed was how the British colonialists and some of their ideological prize-fighters claimed that the majority of the Irish peasantry should be removed from the land to make way for livestock production as determined by the propensity of the damp climate to produce grass pasture:

> From Mela to Goldwin Smith[18] and up to the present day, how often has this assertion been repeated – since 1846, especially by a noisy chorus of Irish landowners – <u>that Ireland is condemned by her climate</u> to provide not Irishmen with bread but English men with meat and butter, and that the destiny of the Irish people is, therefore, to be brought over the ocean to make room in Ireland for cows and sheep! (Marx and Engels 1971, 185) (emphasis added).

The reason why this was proposed was the existence, in the context of Ireland (and Britain in comparison to France), of a comparative advantage for grass pasture rather than tillage cultivation as determined by its distinctive wet climate:

> Compared with England, Ireland is more suited to cattle rearing on the whole; but if England is compared with France, she too is more suited to cattle-rearing (Marx and Engels 1971, 190).

The problem with the comparative advantage framework is that of overemphasising how one particular climatically determined crop has an organic advantage over other sown crops between regions or countries as determined by differing climatic conditions. In doing so however, it fails to

[17]Not only is the seedbed raised above the water table, but the trench serves as a drainage channel…. The ridges allow the soil to be warmed from the sides as well as the top and they were, moreover sloped to catch the maximum sun (Evans 1992, 40).

[18]Engels stated the following in footnote: Goldwin Smith, *Irish History and Irish Character*, Oxford and London, 1861. – What is more than amazing in this work, which, under the mask of "objectivity", justifies English policy in Ireland, the ignorance of the professor of history, or the hypocrisy of the liberal bourgeois? We shall touch on both again later.

recognise how within specific regions there are always coexisting microclimates that can counter the generalized dominant crop condition as proposed by the comparative advantage framework. Engels suggests this critical point in the following:

> If one looks at the matter impartially and without being misled by the cries of the interested parties, ..., one finds that Ireland like all other places, has some parts which because of the soil and climate are more suited to cattle-rearing, and others to tillage, and still others – the vast majority – which are suited for both (Marx and Engels 1971, 190).

This type of over-generalising assertion, endemic in the comparative advantage framework, is very much a one-sided form of conceptualisation as it emphasises one determinate from a diverse array of many that determine the organic totality of cultivation. Accordingly, it leads to not only bad science (both natural and economic) but also it fails to take into account the practical necessity known to all 'tillers of the soil' that cropping has to include rotation systems in order to break the disease cycle associated with certain crops. Thus, 'non-advantaged' crops have to be sown as much as 'advantaged' crops if cultivation is to continue. However, in order to cultivate tillage crops including grass it was necessary to clear the native and natural vegetation, usually primeval forestry, so that cultivated crops could be planted. In doing so, society created the potential to change certain aspects of the local weather system.

16. ***The appropriation of the Irish weather system as a natural agent of production has to include its ability to metabolise with topographical moments,***

17. ***The effect of dominant determinant of incessant rain was dampness can itself be determined by these topographical moments. High mountains intensify rainfall, while the sieve-like limestone absorbs it and the hallow lakes of the midlands retain it within their peat bogs.***

18. ***The diverse moments of the Irish weather system consist of not only of the atmospheric forces that circle the earth and the island's geological structures but also the vegetative land cover that naturally overlays those physical structures.***

19. ***The 'apparent' naturalism' of the Irish weather system and its determination of particular vegetative growth can not only be appropriated but also enhanced in the process of cultivation.***

Climate change as determined by changing the vegetative land cover system

Engels in the following succinctly summaries the extent of humanity's' impact on the diverse aspects of the earth:

> There is devilishly little left of "nature" … The earth's surface, climate, vegetation, fauna, and human beings themselves have in definitely changed, and all this owing to human activity, (Engels 1986, 231)

This ability of human society to transform life on earth and the physical aspects of that earth itself is not just confined to the past but as Marx suggests 'climate and flora change in *historical* times'. (Marx to Engels, 25th March, 1868, CW 42, 1987:558). Nature has been and continues to be changed by society and consequently in doing so creating new 'organic' conditions of existence for

humanity and all other life forms that exist on earth. In addition, the transformation of the earth's 'climate and flora' is not a coincidence but they form 'an endless maze of relations and interactions' (Engels anti-duhring:) not only between themselves but also with human society as society appropriates them in the process of cultivation. Much of this societal induced change is not only spatially extensive but also inherently destructive:

> 'Man destroys it [vegetation of a locality] in order to sow field crops on the soil thus released, or to plant trees or vines which he knows will yield many times the amount sown. He transfers useful plants and domestic animals from one country to another and thus changes the flora, fauna of whole continents.' (Engels 1986, 178).

Thus, all of nature until the end of life on earth is changed, by the hand of society even the climatic conditions are altered:

> 'Man alone has succeeded in impressing his stamp on nature, not only by so altering the aspect and climate of his dwelling-place, and even the plants and animals themselves, that the consequences of his activity can disappear only with the general extinction of the terrestrial globe' (Engels 1986, 34) (emphasis added).

This destructive transformation of organic nature is done because humanity needs the diverse forces of nature to reproduce itself physically. In essence, societies down through the ages were not just passively adapting to the organic productiveness of nature but were in fact always attempting to harness its diverse motive forces as a way of enhancing its cultivation capabilities. Consequently, the form in which the climatic factors impacts on the soil and its plant life is fundamentally changed by society, when for example, society replaces the original and the organic forms of vegetation of a locality with a social form of field crops. In short, a natural ecosystem of biodiversity is displaced by a socially determined agroecosystem of monocrops, which often in its wake causes climate change at a micro level. A good example of such a microclimate change is when a forest is cut down and thus the effect of climate on the earth's surface can be profound. If the dominant determinant of the weather system is extensive sunshine with its intense heat, eliminating the tree canopy and its shading qualities, which traps moisture beneath, could cause the top soil to dry up and blow away in a process of desertification. In turn, this would establish new structural moments in the local weather system. Engels identifies some historical examples of ecological catastrophes, as determined by climate change, in the following:

> The people, who, in Mesopotamia, Greece, Asia Minor and elsewhere, destroyed the forests to obtain cultivable land, never dreamed that by removing along with the forests the collecting centres and reservoirs of moisture they were laying the basis for the present state of those countries. (Engels 1986, 180).

In removing the tree cover, they removed critical moments of the local climate system associated with the 'reservoirs of moisture' and thereby changed the ecological bases of those bioregions. In discussing Fraas' book, Marx reiterates the same point but also suggests how to deal with these disastrous climatic consequences of deforestation in a socialist context by consciously controlling it:

> He (Fraas) claims that the cultivation – depending on its degree – the moisture' so beloved by the peasants gets lost (hence also the plants migrate from south to north), and finally devastating through deforestation, etc. …The conclusion is that cultivation – when it

> proceeds in natural growth and is not *consciously controlled* [19](as a bourgeois he naturally does not reach this point) – leaves deserts behind it, Persia, Mesopotamia, etc., Greece. (Marx to Engels, 25, March, 1868, MECW, vol. 42, 557).

Consequently, when deforestation takes place and cultivation 'proceeds in natural growth' – without due consideration for its ecological consequences this can lead to the process of desertification. What appears to be critical in the forest functioning as a land-cover is that its canopy apparently creates the essential condition for an internal microclimate to emerge in which moisture is retained under the canopy.

However, the consequence of such disastrous vegetative change in the land cover terms is not just the 'desertification' of plant life but also the 'desertification' of the weather system itself, where in the above historical examples, the removal of the forest's vegetation also got rid of the 'reservoirs of moisture' and thereby causing the drying up of the climate of these regions. This acted as a further catalyst to the overall process of desertification. Historically, society has changed the climate of the earth – the localised weather system – by changing the vegetative land cover. Often, within in this matrix of metabolising processes, societies have used grazing animals, and their natural propensity to graze low-lying vegetation, to change the vegetative land cover of a chosen location, as Engels continues:

> We have seen how goats have prevented the regeneration of forests in Greece[20]; on the island of St. Helena goats and pigs brought in by the first arrivals have succeeded in exterminating its old vegetation almost completely, and so have prepared the ground for the spreading of plants brought by later sailors and colonists (Engels 1986, 178).

Engels also highlights how humans change not only the immediate environment through cultivation but that changed environment can subsequently change human society:

> Animals, as has already been pointed out, change the environment by their activities in the same way, even if not to the same extent, as man does, and these changes, as we have seen, in turn react upon and change those who have made them (Engels 1986, 178) (emphasis added).

Thus, changing the climate as determined by deforestation changes in turn not only the immediate environmental conditions but also these transformed ecological conditions impact back on how society is physically able to sustain itself. In this changed environmental context, the local inhabitants may have to transform themselves from being, for example, forest dwellers into being desert nomads. The essential point to be stressed here is that when the induced changes in the environment impact back on the 'inducers' and it – this ecological transformation – crucially changes them as well. According to Engels, it is necessary to highlight this dialectical relationship in order to avoid falling into naturalism:

> The naturalistic conception of history, … as if nature exclusively reacts on man, and natural conditions everywhere exclusively determined his historical development, is therefore one-sided and forgets that man also reacts on nature, changing it and creating new conditions of existence for himself (Engels 1986, 231) (emphasis added).

[19]It appears that Marx is referring to socialist planning where there will be scientific understanding of the remote consequences of such destructive ecological activity and attempt to avoid it, yet still engage in cultivation.
[20]Engels stated that: 'the goats in Greece that eat away the young bushes before they grow to maturity, have eaten bare all the mountains of the country'. (Engels 1886, 175)

However, if on the other hand, the dominant organic process of the localised weather system is heavy rainfall, cutting down the forest and removing the tree canopy can give rise to severe soil erosion leading to, in extreme circumstances, the washing away of the top soil as Marx suggests in the following:

> What cares the Spanish planters of Cuba, who burnt down the forests on the slopes of the mountains and obtained from the ashes sufficient fertiliser for one generation of very profitable coffee trees – what cared they that the heavy tropical rainfall afterwards washed away the unprotected upper stratum of the soil, leaving behind bare rock! (Marx and Engels, CW, vol.25, 463).

The immediate consequence of this particular act of deforestation, was the growth of 'highly profitable coffee trees' but the remote and unintended consequences were those associated with the process of desertification, which were apparently not foreseen by these Spanish 'tillers of the soil' and therefore 'not consciously controlled'. They sought the 'most tangible result' of badly needed and locally sourced fertilizer for their coffee plantations. The remote consequences were caused by the continuing presence of the 'tropical rainfall' metabolising with a changing form of vegetative land cover. Thus, the initial burning of the trees and the subsequent removal of the protective tree canopy meant that the tropical rainfall was now metabolising with weaker forms of vegetative land cover, which eventually failed to protect the soil from being washed away by the seasonal tropical rains. These latter events as remote consequences were determined by the continuing metabolising of the remaining organic processes that were slowly changing. Finally reaching a point (currently known as a tipping point) when a number of aspects and conditions of existence of the original metabolising processes were eliminated – the vegetative land cover and the soil that originally supported that land cover. The difference therefore between the immediate and the remote consequences is that the initial intervention was that of the removal of the phenomenal form of the tree canopy – the immediate consequence – was simultaneously a thwarting of the 'abstract' metabolising processes, that eventually over time led to the remote consequences, associated with desertification. Therefore, that same action of wrenching of a concrete object[21] from its immediate environment also eliminated that physical moment from its functional role it performed within the matrix of metabolising organic processes. In removing this relational interconnection, in which that original canopy was functioning as an essential moment in the reproduction of that local Cuban weather system, the metabolising operations of the organic processes of this system became so completely transformed, that the remaining organic processes could not re-establish the forestry nor its canopy, even when left to its own organic devices.

Despite the fact that Ireland does not have any deserts, it still has undergone a process of desertification with the occurrence of blanket bog. In the mountainous regions of Ireland, the economically determined deforestation led to the leaching out of essential nutrients from the soil and consequently allowed blanket bog to emerge in place of the original woodland[22] as Engels suggests in the following:

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[21]Ilyenkov argued that Marx perceived any individual entity as essentially a moment within a process: 'That means that any individual object, thing, phenomenon, or fact is given a certain concrete form of its existence by the concrete process in the movement of which it happens to be involved;….'(Ilyenkov 1982, 118)

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[22]Rain that falls on a protective tree canopy and their necessary dialectical relationships (interconnections) are able to maintain the integrity of the soil beneath, which in turn sustains the forest growth and its canopy. In removing the forest trees and their essential land-cover function, society drastically realigns the metabolising matrix of the organic interconnecting processes within the Irish weather system.

> Besides these low-lying peat bogs, there are 1,254,000 acres of mountain moor. These are the result of deforestation in a damp climate and are one of the peculiar beauties of the British Isles. Wherever flat or almost flat summits were deforested – this occurred extensively in the 17th century, and the first half of the 18th century to provide the iron works with charcoal – a layer of peat formed under the influence of rain and mist and gradually spread down the slopes where the conditions were favourable (Engels 1986, 183).

Although all the bogs of Ireland have the same concrete phenomenal forms with regard to their vegetative form and contents, the blanket bogs of the mountaintops are different from the midland bogs in that they were formed under differing 'interconnecting' conditions. While the low-lying bogs of the midlands are exclusively organically determined in that society played no part in their formation, but this is not so with regard to the mountain blanket bog, where their emergence is due to the metabolising and thus interconnecting processes of nature and society. Historically, society cut down the mountain forest and subsequently the blanket bog 'formed under the influence of rain and mist' (Engels 1986, 183).

20. ***Nature has been and continues to be changed by society and consequently creating new 'organic' conditions of existence for all life on earth***

21. ***Societies transform the organic vegetative land cover in their attempt to cultivate crops, especially through deforestation.***

22. ***The deforestation can in certain bioregions cause desertification to occur.***

23. ***In removing the forest tree canopy and depending on the particular organic interconnections of the organic totality in existence, desertification can cause climate change.***

'This changes everything' as everything is reciprocally interconnected within the dialectical processes of concrete reality

The actual physical presence of any process, such as the local weather system, manifests itself in how it impacts on, or effects other physical structures but also how those impacted structures subsequently impact back on the determining process. All causes and effects provide essential moments for that process. In short, it is a complex interplay between causes and effects within metabolising processes. For example, as we discovered with regard to the topographical features of the Irish weather system, although they appear to be external to the actual weather system, they are in fact essential and determinate moments of that organic system. Consequently, the essential determining force of this particular organic totality is the metabolising combination between the internal dynamic forces and its external conditions of existence, which these forces engage with. Change any of these moments of this organic totality, either its internal or external moments, and because of their inherent interconnecting relationships, they will change the essential

structure for the whole organic totality. This is so because concrete reality and 'Nature works dialectically'[23].

Intentionality, that instrumental rationality which is one of those determining characteristics that has defined us as human beings, has historically tended to be linear in its formulation – one course of action pursued for one intended reaction – as a form of an attempted engagement with concrete reality. In fact, it is a form of reductionism, in two senses of the term. Firstly, as a conceived abstract formulation of concrete reality and secondly as a particular physical intervention into concrete reality. In the latter case, it is a one-sided attempt to impact on one aspect of that reality, yet it will always have an effect or even effects beyond the intended point of intervention, because that 'interfered with' reality is in fact not a reified solid object but a dialectically determined process(s), as Engels suggests:

> We find that there still exists a colossal disproportion between the proposed aims and the results arrived at, that unforeseen effects predominate, and that the uncontrolled forces are far more powerful than those set in motion according to plan (Engels 1986, 35) (emphasis added).

This is especially so with regard to the so-called economic 'planning', where physical engagement with concrete reality, is done for the sake of immediate profit with no necessary recognition of a following on series of ecological consequences. Therefore, the actual consequence of an intended action, although rarely recognised, are in fact multiple consequences beyond the immediate intended consequence[24]. Accordingly, they are not only remote but also logically unintended from within the perspective of linear causality. Linear causality is not just a one to one cause and effect determination, as much as certain theorists would like it to be, but it is actually, a complex interconnected transformation of a whole range of interpenetrating processes, which fundamentally reverberates throughout the entire organic totality. Accordingly, when processes metabolise, what is an effect in one instance becomes a cause in another and so on. This is essentially a form of 'reciprocal action', in which, according to Engels:

> We see a series of forms of motion,…..pass into one another, mutually determine one another, are in one place cause and in another effect, the sum total of all motion in all its changing forms remaining the same… Thus natural science confirms what Hegel has said,…, that reciprocal action is the true *causa finalis* of things (Engels 1986, 231) (emphasis added).

The one point of induced change can simultaneously function as a cause and effect for differing metabolising processes. Therefore, a consciously orchestrated intervention will not only have an

[23]If the real determination of causality is the concrete concentration of many determinations, hence the unity of the diverse (Marx 1973, 100) – an effect is diametrically the opposite – it is the concrete dispersal of many determinations that effects a wide range of processes in diverse ways (remote consequences).

[24]As Engels suggests:

> In relation to nature, as to society, the present mode of production is predominantly concerned with the immediate, the most tangible result; and then surprise is expressed that the more remote effects of their actions directed to this end turn out to be quite different, are mostly quite the opposite in character; that the harmony of supply and demand is transformed into very reverse opposite, as shown by the course of each ten years' industrial cycle… (182/3).

immediate effect (intended or unintended) but also crucially it will have remote consequences – 'unforeseen effects'. This has to do with how the dialectically metabolising processes become thwarted in their operation as they attempt to accommodate themselves to the impact of the initial intervention. The added complexity of having to deal with remote consequences as well as immediate consequences undermines our ability to completely hold sway over nature as Engels suggests:

> 'Let us not, however, flatter ourselves overmuch on account of our human victories over nature. For each such victory nature takes its revenge on us. Each victory, it is true, in the first place brings about the results we expected, but in the second and third places it is quite different, unforeseen effects which only too often cancel the first (Engels 1986, 180).

Here, Engels introduces another dimension to his dialectical exposition in which the new introduced concept of place(s) and its sequential ordering allows him and us to compare consequences over a long-time frame. In addition, it allows us to assess their impact on each other, e.g. where Engels suggests that remote consequences can 'cancel the first' place immediate effect. As we have uncovered, the immediate consequence on the inherent organic processes tend to manifest itself on the level of surface appearance within its phenomenal form, without recognising it also as being a moment of the underlying essential processes. This is where the 'first place' effect or immediate consequence occurs. The 'second and third places' are remote consequences which have to be the result of the essential organic process being thwarted by the initial form of the intervention. The impeded process continues to operate in its changed condition and only manifests this thwarted condition when it metabolises with other organic processes. Herein, lies the time delay between the immediate 'first place' result and the subsequent 'second and third places'. The recognition of this complex relationship between the differing places where consequences emerge and even contradict each other, challenges our attempt to 'rule over nature' despotically:

> Thus at every step we are reminded that we by no means rule over nature like a conqueror over a foreign people, like someone standing outside nature – but that we, with flesh, blood and brain, belong to nature, and exist in its midst, and that all our mastery of it consists in the fact that we have the advantage over all other creatures of being able to learn its laws and apply them correctly (Engels 1986, 180).

Our control of, and possible mastery over nature can be achieved by us, by moving away from perceiving and engaging with nature as a concrete static entity - 'a rigid system of an immutably fixed organic nature' (Engels 1986, 29) - out there beyond ourselves but by us investigating the laws of nature dialectically so that we can appropriate those organic forces without undermining or destroying them. This essentially means becoming aware not only of the immediate but even more so of the remote consequences of our actions and to do this we have to crucially realise that we are interacting with a complex matrix of metabolising processes rather than a solid unchanging concrete reality. Ignoring the remote ecological consequences, coupled with not being aware of their interconnected relationship, is having a devastating effect on our global environment, e.g. from desertification to global climate change, etc. The problem remains how can we learn these dialectical laws of nature correctly. The answer lies, in following the conceptual steps as laid down by Marx and especially Engels on the dialectics of nature, by not only adopting a dialectical approach but also attempting to explicate those results that empirical investigation consistently fails to comprehend - the indirect effects and remote consequences:

> But in this sphere, too, by long and often cruel experience and by collecting and analysing historical material, we gradually learning to get a clear view of the indirect, more remote

> effects of our production activity, and so are afforded an opportunity to control and regulate these effects as well (Engels 1986, 180).

And in doing so, finally we can become aware of the thwarting caused by the immediate intended consequence of profitability, that capitalistic iron cage of calculability which consistently blinkers our awareness and realisation of remote ecological consequences of our intended economic actions. Engels suggests that this mystifying tendency is particularly evident in:

> Classical political economy, the social science of the bourgeoisie, in the main examines only social effects of human actions in the fields of production and exchange that are actually intended. This fully corresponds to the social organization of which it is the theoretical expression. As individual capitalists are engaged in production and exchange for the sake of the immediate profit, only the nearest, most immediate results must first be taken into account (Engels 1986, 182) (emphasis added).

The one-sidedness of such disciplines that are only able to comprehend the 'most immediate results' are part of the problem why we, as inhabitants of the earth, are now obviously destroying the organic processes of Nature that sustain life on earth. Curbing the disparity between immediate and remote consequences therefore is not just an epistemological problem concerning causation but a very real concrete dilemma that global society needs to be attentive of in order to re-orientate our necessary relationship with the earth and its organic processes. In order to change our orientation, we must firstly recognise that 'Nature works dialectically', and then we need to begin to work with that same Nature, dialectically[25]!

Conclusion

This article has attempted to explicate Marx and Engels's conceptualisations on climate and to a lesser extent on climate change, the significance of their conceptual formulations in helping us make sense of the contemporary situation of global climate change is not what they said about climate but how they said what they said. In short, it is their methodology rather than their insightful pronouncements which is critical to our attempt to grasp the complexity of the current global climate crisis. Near the end of his life, Engels highlighted this point in a letter to Sombart (1895):

> Marx's approach was not through a doctrine but a method. It doesn't offer completed dogmas but fertile perspectives for further investigation and the method for this investigation (Engels 2004, 461).

The methodology referred to is dialectical analysis and the really significant and hopeful aspect of Engel's appraisal of this methodology is that it can offer 'fertile perspectives for further investigation and the method *for* this investigation'. Therefore, in fact what their particular form of dialectical analysis presents us with, is a radical epistemological framework that is profoundly more comprehensive in explaining the 'workings' of concrete reality than the non-dialectical and empirical approaches that have dominated our scientific endeavours. With regard to the particular concrete problematic of this paper – climate and climate change – the application of the dialectical framework is to an unfolding of the determinants of the organic totality of nature and its inherent organic

[25] Marx stated the same need to work with nature rather than against it:

> …. labour can work only as Nature does, that is by changing the form of matter. Nay more, in this work of changing the form he is constantly helped by natural forces (Marx, 1969, 571).

processes, specifically with regard to understanding climate but critically including its interconnecting relationships with societal processes. The vast terrain of the concrete reality of the earth is essentially a complex matrix of metabolising processes that are not only interconnected, but are dialectically interconnected (involved in reciprocal movement). Consequently, the fundamental and truly paradigm breaking aspect of this perspective is summarised by Engels in which he stated that 'nature works dialectically'. In certain times in the evolution of science, science came close to recognising the dialectically determination of nature, as Engels suggests:

> The new outlook on nature was complete in its main features; all rigidity was dissolved, all fixity dissipated, all particularity that had been regarded as eternal became transient, the whole of nature was shown as moving in eternal flux and cyclical course (Engels 1986, 30) (emphasis added).

This 'new outlook', the one that is going to usher in the new epoch of 'conscious organisation of social production' including our relationship to organic nature is the dialectical one. The one that Marx and Engels consciously rescued 'from German idealist philosophy and appl[ied] it in the materialist conception of nature and history' (Engels, Preface to second edition his *Anti-Duhring* MECW, vol.25, 11) is, according to them, the only scientific methodology that can adequately comprehend the dialectical reality of the world.

In eliminating the empirical particularities of the Irish organic and social formation from the following summary of our findings of Marx and Engels on climate, it is possible to highlight the essential dialectical workings of this 'organic' organic totality, in which climate is the predominate determinant, even when those organic forces are appropriated by society in the process of cultivation:

1. Climatic zones initially determine society's wants for necessities, e.g. food, clothing and shelter. Less bountiful climatic conditions spurs societies on to produce what climate does not provide organically.

▼

2. The diverse moments of the weather system consist of not only of the atmospheric forces that circle the earth but also the earth's geological structures and crucially the vegetative land cover that naturally overlays those physical structures. Because these non-atmospheric moments impact on the weather system they become part of it.

▼

3. Natural flora is a consequence of the organic interconnection between the indigenous weather system and the other organic processes of nature that mediate each other within the concrete form of the soil. While cultivated flora of crop production is a result of clearing the primeval vegetative land cover and subsequently harnessing the same organic interconnecting forces of plant fertility, topographical aspects and the weather system.

▼

4. Climate therefore, is the indispensable 'life-awakening' force of soil fertility, both organic and socially determined, to such an extent that as we cultivate the soil we simultaneously appropriate

the organic forces of the immediate climatic conditions and that weather system becomes a natural agent of social production.

▼

5. Nature has been and continues to be changed by society cultivating the soil as it transforms the earth's organic vegetative cover, especially through the process of deforestation, and consequently creating new 'organic' conditions of existence for all life on earth, including its cultivators.

▼

6. Deforestation can in certain bioregions cause desertification to occur which in turn can cause climate change to follow at a micro level and thereby creating a distinct microclimate.

In conceptually unfolding these organic processes sequentially as they enfold with each other, from atmospheric forces of the climate system, to topographical structures and then onto the vegetative land cover as they merge as an 'organic' organic totality. Accordingly, these diverse processes appear to form a circle of metabolising organic processes, whose elements are mutually conditioning, 'in which the condition becomes conditioned, the cause becomes the effect, the universal becomes the particular, is a characteristic feature of internal interaction through which actual development assumes the form of a circle' (Ilyenkov 1982, 115). Therefore, the kernel of this natural organic totality is not an essential static structure like a 'solid crystal, but an organism capable of change, and is constantly changing' (Marx, 1867, preface to the German edition). This pulsating organic core is in fact an ensemble of interconnecting processes that determine the concrete reality of nature and as Marx suggests that 'the concrete is concrete because it is the concentration of many determinations, hence it is the unity of the diverse (Marx 1973, 100). However, this particular 'unity of the diverse' organic processes and their circle of mutual conditioning get transformed into a spiral form when this circle of mediating processes become appropriated by society in the social process of cultivation that now creates new socio-organic conditions of existence for society and nature to survive on. Marx has conceptualised this type of expanding movement as a change in form from a circular to a spiral form - '…. the gradual propagation of capital by reproduction passing it from a circular into a spiral form…'[26]It is at this spiral point of reproduction that Engels exclaimed that 'there is devilishly little left of "nature" (Engels 1986, 231). However, since Engels stated this, the socio-organic relationships have developed more spiral forms – more intense forms of interconnections between society and nature that we need to investigate further. Within such continuing forms of transformations of the socio-organic processes of the organic totality of nature, the organic processes of climate and their dialectical interplay of relationships with the other inherent processes, including both the organic and social forms, have been fundamentally changed, beyond this initial process of deforestation. It is this process of deforestation which Marx and Engels highlighted is where society begins to effect climate and causes climate change to occur on a global scale.

In unfolding the dialectical moments that climate performs in the organic totality of cultivation, from pre-history to the present, we can begin to see the complexity of the interconnecting relationships that metabolising processes form within this 'organic' of organic totalities. The essential determinant of climate within this organic totality of nature, and including its integration into societal cultivation practices, is its 'life-awakening' powers that drive the diverse

[26]Marx, *Capital: A Critique of Political Economy*. p.780.

aspects of the fertility of the soil to produce vegetation. However, when the earth's soil is cultivated, the natural history of the appropriated organic processes, including the climate, becomes metabolised with the cultural history of the cultivating society. Both historical developments become not only intrinsically interconnected but both are fundamentally transformed.

With the ever presence of interconnecting processes, that 'work dialectically', cause and effect cannot exist as isolated occurrences within a 'rigid system of an immutably fixed organic nature' (Engels 1986, 29), because such a system only exists as an ideological construct within the mind-set of the investigators and not in the real dialectical workings of concrete reality. Therefore, the cause and effect' determination of reality is a spurious construct that deflects attention away from the real determinants of a dialectical reality. Engels in the following establishes how this misconception of cause and effect as the essential determinant of reality is not only fictitious but also linked to the other fallacy that concrete reality is made up of diverse isolated phenomena:

> In other words, in order to save having to give the real cause of a change brought about by a function of our organism, we substitute a fictitious cause, a so-called force corresponding to the change. Then we carry this convenient method over to the external world also, and so invent as many forces as there are diverse phenomena (Engels 1986, 80) (emphasis added).

In conclusion, Marx and Engels has proposed the cause and effect determination is inadequately one-sided in conceptualising change in a dialectically determined organic reality, and therefore it has to be superseded by a many-sided form of determinations as produced by the complex interplay of interconnecting processes. Accordingly, multiple causes beget multiple consequences that determine dialectical reality. Consequently, the crucial manifestation of the dialectical epoch within science (including the social sciences) will occur when scientists begin to adopt the dialectical epistemology of the many-sided forms of causation instead of the one-sided linear form of cause and effect. According to Engels, this non-dialectical determination of causation has created 'the endless confusion now reigning in theoretical natural science, the despair of teachers as well as learners, of authors and readers alike' (Engels, Anti-Duhring, MECW, vol.25, 24). Whatever happens in the future 'everything changes' whether we leave those organic forces of nature to their own dialectical devices and continue to destroy them in our contemporary non-dialectical forms of intervention or we attempt to 'consciously control' those dialectical forces in a planned and dialectically informed way. Everything changes because as Engels has brilliantly informed us - 'nature works dialectically'.

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