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Change in Nature and Change *via* Nature: A Brief Review of Ideas of 'Change' and their Implications for Nature[1]

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Abstract

Even as interactions between human beings and nature have assumed increasingly complex and uncertain forms, the theorization of nature in both the natural and social sciences has seen many shifts and developments. One concept which has been crucial across different disciplines and over varied time periods is 'change', although there are wide variations in the meaning, implications and normative value accorded to it. This paper will review three strands of literature on 'change' which have shaped contemporary environmental discourses in crucial ways. The first strand – referred to as 'change in nature' – deals with differing opinions in the natural sciences about the changing behavior of nature. In the second strand called 'change via nature', change in human societies is the primary focus and nature is viewed mainly in terms of its potential for societal change (with a particularly instrumental view of nature being present in modernization theories of development). The third strand questions the separation that is often made between nature and society in the first two strands and instead conceptualizes *change in nature* and *change via nature* in an interconnected fashion. Apart from bringing together disparate strands of thought on 'change' and 'nature', the aim of the paper is to indicate new ways to reconceptualize and reframe society-nature relations.

Keywords: Nature, Change, Progress, Development, Biophysical Transformation

In his famous essay "Ideas of Nature" in *Problems in Materialism and Culture* (1980), Raymond Williams points out how "…the idea of nature contains an extraordinary amount of human history."[2] The task of reviewing the histories of society and nature or the relation between them is thus an important one and one which would also need to take into account the differences in this across societies. Williams' essay briefly traces a history of different views of nature and particularly talks about the form that the separation of nature from society takes in the post-industrial revolution period and the implications thereof. The task of this paper is far more modest – to briefly review the concept of 'change', which is an inherent part of any discussion of nature and of human societies, and which one encounters in different disciplines across the natural and social sciences. More specifically, this paper will review three strands of literature on 'change' which have shaped contemporary environmental discourses in crucial ways. The first two strands can be thought of as roughly corresponding to what I call 'change in nature' and 'change via nature'. The first strand refers to differing opinions in the natural sciences

[1] This paper is based on a presentation first made at an ICSSR-sponsored seminar on *'Re-Imagining Human-Nature Relationship: focusing North Bengal'* organized by Department of Political Science, Salesian College Sonada and Siliguri on 21 and 22 November, 2014.

[2] Williams Raymond, "Ideas of Nature", in *Problems in Materialism and Culture* (London: Verso Editions, 1980), 70.

about the changing behavior of nature while in the second strand, change in human societies is the primary focus and nature is viewed mainly in terms of its potential for societal change (with a particularly instrumental view of nature being present in modernization theories of development). In both of these, there is often a separation made between nature and society although there are also interesting parallels between the way in which change in nature and change in human societies is theorized. In the third strand, society and nature are conceived as interconnected and therefore *change in nature* and *change via nature* are also viewed as being intertwined; one example of this is to be found in certain Marxist formulations.

The division of these three strands is a rough one and is merely meant to help bring together the wide range of debates that have taken place around questions of 'change' and 'nature', which although related, often take place in separate arenas. The brief review of these debates given here cannot claim to be comprehensive or exhaustive but the aim is to highlight the need to connect these disparate strands of thought and how this might help us reconceptualize and reframe society-nature relations. I will briefly reflect on this in the concluding section, although this would be more in the nature of preliminary thoughts.

With this introduction, I turn to the shifts over time in the idea of *change in nature*, drawing on debates in the natural sciences.

From Orderly Nature to Chaotic Nature[3]

Underlying different theorizations of nature in the natural sciences is the idea of 'change', its desirability, and what it implies, among other things, for the question of predictability of natural phenomena and for modes of explanation (deterministic versus non-deterministic). For instance, Botkin (2012) points out that the idea of a nature undisturbed by human influence is the point of view found in popular environmental literature, ecology textbooks, and in twentieth century scientific theory about populations and ecosystems. Broadly, though, there are three common metaphors which have historically been associated with nature and which have been used to explain its working – the organism, the divine and the machine. The idea of nature as an organism implies that nature is always changing; further, such change is "seen as inevitable, to which…human beings must yield" whether "they like it or not."[4] At the same time, change is seen as being cyclical and the belief is that there is orderliness and regularity in nature. But the major metaphor in the pre-industrial revolution period was not nature as organic but nature as divinely created. In such a view, nature has order which is maintained as long as every creature plays its proper role and there is a proper relationship between different beings. Further, the stability of nature meant that even "when disturbed, it returned to that constant condition which was desirable and good."[5]

With the Renaissance and the Industrial Revolution, new metaphors of nature emerged, and particularly the idea of nature as a machine became dominant. Strangely, like the divinely

[3] The discussion in this section draws heavily on Botkin, Daniel B, *The Moon in the Nautilus Shell: Discordant Harmonies Reconsidered* (Oxford: Oxford University Press, 2012); Collingwood, R G, "Introduction" in *The Idea of Nature* (Oxford: Clarendon Press, 1945), 1-27; and Worster Donald, "Disturbing Nature" in *Nature's Economy: A History of Ecological Ideas* (Cambridge: Cambridge University Press, 1994).

[4] Botkin, *The Moon in the Nautilus Shell,* 16.

[5] Williams, "Ideas of Nature".

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ordered image, the mechanical image of nature also leads to the idea of nature "as constant unless unwisely disturbed, and as stable, capable of returning to its constant state if disturbed."[6] The idea of nature as a machine, whose movements and their regularity are due to laws of nature imposed from outside, also opens up the possibility of controlling nature and leads to an instrumental view of nature, as we will see in the next section.

But from around the end of the eighteenth century, change in nature began to be thought of in terms of evolution. The intellectual basis of this is Darwin's theory of evolution (expounded in his 1860 book *The Origin of Species*) wherein species are not believed to be "…fixed entities, or ideal types, created by God in the beginning of time…" but rather as evolving over time via the forces of random mutation and natural selection.[7] Such a conception of nature differs from earlier conceptions in important ways. As Collingwood (1945) points out, under an evolutionary conception of nature, change is not cyclical as in the case of the organic metaphor, but progressive in the sense that there is always something new (though not necessarily better) emerging. This, in turn, would further imply that change needs to be considered over a longer time period and "historicized" as Worster, puts it. Collingwood (1945) also points out how an evolutionary view would imply that a mechanical conception of nature would have to be abandoned, since a machine is a "finished product or a closed system"[8] and therefore cannot develop any further. Yet there is one feature associated with the mechanical view of nature which persists even with the emergence of an evolutionary view, and that is the idea of scientifically knowable change.

At this point, it is important to note an important debate that exists in discussions of nature involving change; which is with regard to whether change necessarily implies lack of order or whether at least certain kinds of change can be conceived as being compatible with order. For instance, Worster argues that an evolutionary view of nature does not necessarily mean a view of nature as stochastic but rather one wherein "competition…the dominant process in nature… always produced a tightly interwoven structure of balance and order". However, Worster points out that there is a difference of opinion about whether the balance is because of the sum of individual actions (and therefore in keeping with capitalistic and libertarian values) or a reflection of community properties.[9]

In the twentieth century, the idea of equilibrium in nature gave way to the idea of nature as inherently unsettled. Worster (1994) brings out how a variety of different ideas fed into such a view. For instance, whether stability is necessarily the outcome of ecological succession began to be questioned along with the very meaning of stability. Similarly, the idea of natural disturbance (in the sense of an extreme exogenous change not caused by humans) has become increasingly important e.g., disturbances caused by climate change. Worster argues that irrespective of whether one believes that the acceptance of a lack of order, and of stochasticism and instability, is a reflection of a larger cultural shift,[10] the result of these new ideas is a

[6] Botkin, *The Moon in the Nautilus Shell,* 16.

[7] Worster, "Disturbing Nature", 402-403.

[8] Collingwood, *The Idea of Nature,* 110.

[9] Worster, 402.

[10] For instance, Gandy (2008) points out how an emphasis on complexity, indeterminacy and more sophisticated conceptions of space and time (specifically, a shift from cyclical to historical or non-cyclical conceptions of time

view of nature that makes it difficult to predict it. Nature is either non-linear and chaotic or complex with the outcome of interaction and adaption between different agents in the system being uncertain. Worster also draws our attention to the dilemmas that the new waves of thinking pose for environmental ethics and politics. For instance, how does one think about environmental damage or conservation in a natural world subject to various kinds of change and unpredictability? In other words, in terms of the concept that is the focus of this paper, viz. change, how does one react to different kinds of change? While there is no simple answer to these questions, Worster makes two important points that are useful in thinking about environmental ethics and politics. One, he emphasizes the need to react differently to different kinds of change. As he puts it eloquently, "the fact that ice sheets once scraped their way across Illinois does not provide any kind of justification for a corporation that wants to strip coal from the state."[11] Two, he uses the very lack of certainty about "…which changes are vital and which are deadly" as a reason to conserve a wide variety of changes (that is, an emphasis on biodiversity).[12]

If nature and changes in it are directly the subject of theorization in the natural sciences, a lot of discussion of nature in the social sciences has taken place in terms of its relation to societal change. In the next section, I deal with two instances of such discussion.

Role of Nature in Ideas of Progress and Development

There is a distinct trajectory of the concept of 'change' in the social sciences which typically relates to change in human societies. Nature (and more specifically, *change in nature*) is related to such societal change although the precise nature of the relation is not always theorized or even acknowledged in all discussions of change in societies. I will focus in this section on two instances which theorize societal change and how it involves *change via nature*. The first instance would draw on what are broadly referred to as modernization theories of development where nature is viewed in an instrumental manner, while the second instance would draw on Karl Polanyi's work to give a more critical view (than in the first instance) of the interrelationship between change in nature and change in society. Polanyi is, of course, only one among a now large number of authors who have critiqued the kind of instrumental view of nature that is present in modernization theories and in the third section, we will consider a view in the Marxist tradition that emphasizes how change in nature and change in society are intertwined in any production process.[13] But it is useful to start by briefly considering the idea of change in human societies which has a long trajectory and also has parallels with some of the shifts that have taken place with regard to the idea of *change in nature* in the natural sciences.

Like in the case of discussions about the idea of change in the natural sciences, there is a concern with order in the social sciences too. Similarly, cyclical and organic metaphors of change were once used, particularly in older theorizations of change in human societies. Thus

in combination with relational rather than fixed conceptions of scale) are common across the natural and social sciences. Gandy Matthew, "Above the treetops: nature, history and the limits to philosophical naturalism", in *Geoforum* 39, (2008): 561-569.

[11] Worster, 432.

[12] Worster, 433.

[13] The relation between Polanyi and such views in the Marxist tradition is briefly discussed at the end of this section.

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Cowen and Shenton talk about a pre-modern/pre-classical concern with progress which drew on an organic idea of change; this involved the idea that a society's potential would unfold through natural cyclical sequences and "positive, or constructive, change was created out of the negative moments of destruction and decay."[14] But the concept of change that is most important from the point of this paper is the evolutionary version in place from about the seventeenth century, which took on different forms in later periods such as 'progress', 'improvement' and 'development'. As Cowen and Shenton (1996) point out, the attempt here continues to be the resolution of the Hobbesian problem of attaining social and political order. However, what is new is that the evolutionary idea implied an unlimited potential for human improvement and the important question then became the conditions required to ensure that this potential would be realized. Classical thinkers like Adam Smith made the recommendation of a self-regulating market economy. But as the problems of early capitalist industrialization began to become evident, the idea of change as something to be brought about by design came in. In fact, Cowen and Shenton (1996) argue that development discourses – both the ideas of improvement that were found in the context of colonization as well as the post-World War II version in which new international institutions (such as the World Bank and the United Nations) and national-level planning all sought to deal with the problem of 'underdevelopment'[15] – have its roots in attempts in the nineteenth century to reconcile progress with order and in ideas of trusteeship which underlay consciously designed change and the (deliberate) transformation of societies.

In line with debates in the natural sciences that interrogate the idea of equilibrium and stability in nature, whether one thinks of development processes as necessarily having a telos has been questioned as also the precise goals of development and the relation between goals and means. Various alternatives/dimensions have been added to the concept of development in the twentieth century, so that the idea of change in societies that is considered desirable has not been a constant one.[16] Finally, the actual changes that have taken place have often not been in line with what has been planned; there are unexpected 'side effects',[17] so that, as Gidwani puts it in the context of a slightly different argument, "…the failure of the state to deliver…is the failure…to *contain* the power of development."[18] That is, similar to the manner in which uncertainty in change in nature affects the extent to which predicting it is considered feasible, there is also uncertainty in the way in which human societies are changing although this has not necessarily come in the way of attempts on the part of governments to plan and regulate such change.

With this brief background of the idea of change in human societies, I turn now to the major point of focus of this section, that is, the relation between change in nature and change in societies. I start with the form that this relation takes in the context of what are broadly called

[14] Cowen, M P and R W Shenton, "The Invention of Development" in *Doctrines of Development*, (London: Routledge, 1996), 12.

[15] The emergence and implications of this term is discussed in the context of modernization theories. Peet Richard and Elaine Hartwick, *Theories of Development: Contentions, Arguments, Alternatives*, (New York: The Guildford Press, 2009).

[16] This would be evident from many discussions of the meaning of development such as, for instance, in Sen (1999). Sen Amartya, *Development as Freedom*, (New York: Alfred A Knopf Inc., 1999)

[17] Ferguson James, "*The Anti-Politics Machine: "Development", Depoliticization and Bureaucratic Power in Lesotho*", (Minneapolis: University of Minnesota Press, 1994).

[18] Gidwani Vinay, *Capital, Interrupted: Agrarian Development and the Politics of Work in India*, (Ranikhet: Permanent Black, 2008), 136.

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modernization theories of development, which emerged towards the middle of the twentieth century to deal with the transformation of the countries that had been colonized (and which continues to be the dominant idea of development even today). It is at this juncture that the term 'underdevelopment' began to be used in the sense of an absolute lack or deficiency that has (seemingly) nothing to do with historical circumstances. Associated with this is an idea of change in the direction of a final state along with optimism about the possibility of bringing about such change as long as a certain path is followed.[19] The final state is, of course, that of development which was initially equated to economic growth and then took on a broader meaning. In addition, modernization theories also include an emphasis on changes in values, social structures and political institutions. In terms of an understanding of nature and of the relationship between human beings and nature, two kinds of connections can be made in the context of modernization theories. One is the idea – that has its roots in the Enlightenment in Europe – that nature is there for using and that the domination of nature is a *feasible* project.[20] Further, such control and domination is *necessary* to bring about development. Second, forms of produced nature – embodied in infrastructure projects such as dams and flyovers – have also become symbols of modernity and carry the dream and promise of a better life.[21] Sometimes, especially with increasing urbanization, controlled and transformed nature (such as manicured lawns and riverfronts) take on a phantasmagoric character and become objects of desire in themselves. It is important to note here that whether one is talking about the role of nature in development or its associations with modernity, the availability of nature is usually taken for granted in modernization theories even if there is some acknowledgement of the limits to nature. The optimism about the possibility of development extends to optimism about the availability of nature and the possibility of using it; at the most, there are debates about the best way of using nature such as the most suitable institutional apparatus (markets, states, or communities).

But critiques of the instrumental view of nature in modernization theories also have a long history and often involve questioning both the kind of change that is taking place in societies (or is recommended for them) as well as the kinds of change in nature that this is related to. These then constitute the second set of views about the relation between change in nature and change in societies. While there are many different versions of such critical views, my focus will be on Karl Polanyi's argument as laid out in his *The Great Transformation* (1944). Polanyi focuses on the transition to a market system (with self-regulating markets) in the case

[19] Rist Gilbert, *The History of Development: From Western Origins to Global Faith*, translated by Patrick Giller, (London: Zed Books, 2008). For many, such as Escobar (1995), Point Four of the Inaugural Address of the United States' President Truman on 20 January 1949 represents the watershed event in terms of putting forward such an idea of underdevelopment and the emergence of a specific discourse of development in the mid-twentieth century. Rist Gilbert, *The History of Development: From Western Origins to Global Faith*, translated by Patrick Giller, (London: Zed Books, 2008).

[20] The feasibility of dominating and exploiting nature stems from a view of nature as a machine (as against the organic and divine order views of nature) as well as what Harvey, calls "an overall package of thought, beliefs, sensibilities, attitudes, and practices" which gained ascendancy in Western Europe in the seventeenth and eighteenth centuries – the emphasis on emancipation and self-realization, the development of modern science, the emergence on particular methods of enquiry, and the rise of instrumental and capitalistic values with respect to the human use of nature. Harvey, David, "The Domination of Nature and its Discontents" in *Justice, Nature and the Geography of Difference*, (Cambridge: Blackwell Publishers,1996), 121.

[21] Swyngedouw Erik, "Circulations and Metabolism: (Hybrid) Natures and (Cyborg) Cities" in *Science as Culture* 15(2) (2006a), 105-121.

of Great Britain in the nineteenth century, a process that is typically equated with 'progress'. For Polanyi, there is a price to be paid for this progress in that different domains of society, which earlier used to be embedded in society, become disembedded (or are at least sought to be disembedded); he particularly highlights how the economy's disembeddedness means that it seems to function as an autonomous domain. In fact, as Escobar argues, the economy starts to function as a system of signification in that many aspects of life such as "the nonhuman natural world, relations among people, and relations between people and nature" become "increasingly economized" and "the languages of everyday life became entirely pervaded by the discourses of production and the market."[22] This is evident, for instance, in the fact that nature (along with labour and money) begins to take on a commodified form and are bought and sold in the market. But Polanyi points out that nature, unlike other commodities, is not 'produced' by human beings for sale on the market, and is therefore a fictitious commodity. The negative effects of the extension of the market logic to fictitious commodities, Polanyi argues, give rise to a double movement to check the actions of the market. That is, change in society (more specifically, the shift to a market system) involves a change in nature (with nature being commercialized and commodified), but this in turn brings in its wake further changes in society (in the form of protest movements).

Thus Polanyi offers a critique of the instrumental view of nature found in modernization theories and offers a less optimistic view of the kind of change in societies that one sees with the emergence of industrial capitalism (although the latter is not a term that he himself uses). However, while his work is now drawn on extensively in the literature against commodification of nature (which is often, though not always, situated within a Marxist framework), Polanyi himself does not draw on Marx's writings and his analysis focuses on the sphere of exchange rather than production. While he has therefore been critiqued for missing out the exploitation of labour that underlies capitalist production, there is another lacuna in Polanyi that emerges when one considers theorizations of nature which are situated within Marxist frameworks.[23] The latter emphasizes the manner in which nature or particular elements of nature are transformed in the course of production, so that one cannot think about change in nature and change in society separately. While Polanyi's argument discusses the implications of the disembedding of nature from society, the material transformations involved in this and the barriers to commodification of nature resulting from the biophysical character of natural resources are not found in his work. Such accounts have formed the basis of a growing literature on the environment that talks about the interplay between the transformations in the physical natural resource and the social relations underlying control and use of the resource, on the one hand, and the effects and reactions that this has on human beings in society, on the other hand.[24] In the next section, I discuss one such account that pays attention to the material transformation involved in production and offers a more complex and interconnected conceptualization of nature and society, viz., John Bellamy Foster's use of the concept of metabolism.

[22] Escobar Arturo, *Encountering Development: The Making and Unmaking of the Third World*, (Princeton: Princeton University Press,1995), 60.

[23] The literature that brings together Marxist concerns and concerns about nature is sometimes broadly referred to as 'red-green' literature. Polanyi Karl, *The Great Transformation: The Political and Economic Origins of Our Time* (Boston: Beacon Press, 1944).

[24] Bakker Karen, "Neoliberalizing Nature? Market Environmentalism in Water Supply in England and Wales", *Annals of the Association of American Geographers*, 95, 3(2005), 542–565.

Nature, Metabolism, and Production

The basic idea of change in human societies taking the form of capitalist development (as put forward in modernization theories) is not questioned by many Marxist formulations, although the emphasis is on many of the negative consequences of this – be it in terms of distribution, alienation, or destruction of the conditions of production (including natural conditions) leading to crises. Many of these consequences are related to what happens at the site of production. Here my focus is specifically on a concept that focuses on the kind of change/transformation involved in the production process, which one can refer to as metabolism and which Foster (2000) uses to make a link between society and nature (and to change in society and in nature).[25] In doing so, Foster draws on a longer theorization of the concept of metabolism, including, but not restricted to, the work of the German chemist Justus von Liebig which also influenced Marx. The importance of Liebig's work (as discussed in Foster, 2000) is that it not only talks about the kinds of change in nature and society involved in different kinds of production processes, but also connected these to a spatial differentiation that was becoming important in the nineteenth century, viz., the distinction between town and country, with each space specializing in particular kinds of production.

It is useful, however, to start with a brief discussion of the term metabolism itself. Swyngedouw (2006a) points out how the concept of metabolism arose in the early nineteenth century. Initially used to refer to "the material exchanges in the body with respect to respiration", it was later extended to include "material exchanges [of energy and matter] between organisms and the environment as well as the bio-physical processes within living and non-living (i.e., decaying) entities."[26] It is this broader sense of metabolism that comes into play in Justus von Liebig's discussion of the ecological contradictions of industrialized capitalist agriculture. For Liebig, this was evident in the crisis in soil fertility in the nineteenth century which, in turn, was the result of the loss of nutrients via transport of food and fibre to cities which did not return to the soil and polluted the city. In particular, he pointed out how the transport of food and fibre from the country to the city meant that essential soil nutrients, such as nitrogen, phosphorus, and potassium, were transported as well. Rather than being returned to the soil these essential nutrients ended up polluting the cities; at the same time, the natural conditions for the reproduction of the soil in the countryside were destroyed. What is important for the purpose of our argument in this paper is the manner in which changes in society (such as the division between city and country and the development of industrial agriculture) are inextricably intertwined with the transformations of natural elements that take place in the process of agricultural production as well as in the use of agricultural products and the subsequent process of waste production and disposal.

Foster (2000) tries to go beyond Liebig's discussion and talk about *all* labour processes using similar ideas of change and transformation with regard to natural elements and human beings. Typically, the discussion of the labour process within a Marxist approach focuses on the social and economic aspects of exploitation and relegates natural processes to a realm

[25] Foster has a wide body of work on this subject; the discussion here, however, mainly draws on Foster (2000) and the discussion of ideas of metabolism in Swyngedouw (2006a) and Swyngedouw (2006b).

[26] Swyngedouw Erik, "Circulations and Metabolism: (Hybrid) Natures and (Cyborg) Cities" in *Science as Culture* 15(2) (2006a), 107

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outside the social. By using the concept of metabolism, Foster brings out how natural/ecological processes are an integral part of the labour process. Thus one can view the labour process itself as a metabolic physical-material process where ""natural" physical and mental forces and capabilities of humans" are engaged "with other human and non-human actants and conditions."[27] Three important points of the transformation can be emphasized. One is the contradictory nature of metabolism as a biochemical process, since it is "predicated upon fusion, tension, conflict and ultimately transfiguration; this, in turn, produces a series of new "entities", often radically different from constituting components, yet equally re-active."[28] This strand of argumentation sometimes leads to the idea of 'produced' nature. Two, metabolic transformation is not just about biophysical changes but about the social relations (of ownership, power, etc) through which changes are enacted and how this too shapes the form of nature and labour as well as of commodities.[29] Three, the transformation/production of nature and society that is involved in any metabolic transformation is also accompanied by the transformation/production of space.[30]

Since Foster (2000)'s purpose is to bring in questions of nature in a conventional Marxist analysis (or perhaps more accurately, to show that there is already a discussion of nature implicit in Marx), he is interested in the connection between the metabolism of/between society and nature and capital accumulation. Thus he argues that the logic of capital accumulation creates a rift in the metabolism between society and nature, and that restoring this would require transforming the relations of production and a break with the logic of profit of capitalism. Thus the explicit integration of nature into Marxist analysis highlights that the creation of a just society would require both social *and* ecological transformation. But the point that is important to emphasize, in the context of the discussion in this paper, is that the manner in which we think about nature and the inter-relationship between nature and society as well as changes in them, is very different within a conceptualization that emphasizes metabolism. Bringing in metabolism would involve paying attention to biophysical changes and the connection between changes in social relations and in the physical properties and characteristics of resources in all production processes. Further, although Foster himself analyzed these issues within a Marxist framework (and so, for instance, linked the question of exploitation of labour with that of the exploitation of nature), one could also potentially bring in the issues raised by the concept of metabolism within a non-Marxist framework; for instance, within Polanyi's discussion of nature as a fictitious commodity and of movements arising in response to the attempt to disembed nature from a larger society (a point that was also indicated towards the end of the previous section). In a similar vein, Swyngedouw (2006b) argues that the concept of metabolism (along with the concept of circulation) might offer a view of urbanization and nature that avoids the modernist nature/society binary and embody modernity because of their sensitivity to change and movement.[31]

[27] Swyngedouw Erik, "Metabolic urbanization: The making of cyborg cities", in Nik Heynen, Maria Kaika and Erik Swyngedouw ed. *In the Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism*, (Oxon: Routledge, 2006b), 24.

[28] Swyngedouw, *In the Nature of Cities*, 27.

[29] Foster, John Bellamy, "The Metabolism of Nature and Society" (Chapter 5) in *Marx's Ecology: Materialism and Nature* (New York: Monthly Review Press, 2000).

[30] Smith Neil, *Uneven Development: Nature, Capital and the Production of Space* (Oxford: Basil Blackwell, 1990)

[31] Kaika, Maria and Eric Swyngedouw, "Fetishizing the Modern City: The Phantasmagoria of Urban Technoglogical

Conclusion

This paper has reviewed different concepts of 'change' and their relation to nature. Each of the three strands that were discussed offer particular insights with regard to the theorization of human-nature relations. The first strand which summarizes debates about *change in nature* in the natural sciences highlights how there is no singular science of nature and hence the projects of both controlling nature as well as protecting nature are complicated.

The second strand brings out how change in societies implicitly or explicitly involves a *change via nature*, although there are differences of opinion about the particular form that societal change and the corresponding change in nature take. What emerges from this is the need to critically interrogate the kinds of transformation that are sought in society as well as to pay attention to the manner in which nature would have to change for this. Further, these changes would have to be analyzed both at the level of actual concrete changes and at the level of discourse, a point that has not been dealt with in detail in this paper but which is hinted at in Escobar (1995)'s argument about the economy functioning as a system of signification.

The third strand emphasizes the materiality of processes of change, so that one would need to connect biophysical transformations with socio-economic ones as well as the different sites at which transformations (in nature and society) take place. It is beyond the scope of this paper to consider the implications of these insights in specific empirical contexts. But in order to give some sense of the difference that would be made to the reframing of human-nature relations, I briefly consider the example of sand mining, an issue that is relevant to many parts of North Bengal as also other parts of the country.

There are a number of different kinds of discourses around sand mining such as the view that the construction industry and infrastructure development (both of which would generate a high demand for sand) are necessary for 'development' and an environmental discourse that points out the negative effects of sand mining on the health of rivers and calls for either legal/regulatory solutions or invokes notions of indigenous culture to protect rivers. But what is missed out is the materiality of the transformation that sand undergoes in the process of its use in concrete (and therefore the larger question of what kind of materials are used in a lot of construction today and whether alternatives to these are possible) as well as the spatial transfer and inequality involved (since the sites of extraction and use of sand are not the same) and the extent to which this is itself part of the problem. The effect on the river and the possibility of going back to its 'original' state would also be brought into question by the kinds of debates on stability and equilibrium in nature that were discussed in the first strand. Any attempt at understanding and resolving the problem of sand mining and other instances of nature-human relations would therefore benefit by taking into account the debates around 'change' and 'nature' that have been reviewed in this paper.

Networks", in *International Journal of Urban and Regional Research*, 24: 1 (2000), 120-138.