Visit the exotic birthplaces of Transdisciplinarity

Research · August 2016

DOI: 10.13140/RG.2.1.1511.7048

4 authors, including:

Jane Burt
Rhodes University
39 PUBLICATIONS **73** CITATIONS
SEE PROFILE

Jessica Cockburn
Rhodes University
13 PUBLICATIONS **30** CITATIONS
SEE PROFILE

Visit the exotic birthplaces of Trans-disciplinarity.

JANE BURT, JESSICA COCKBURN, ATHINA COPTEROS & HELEN FOX

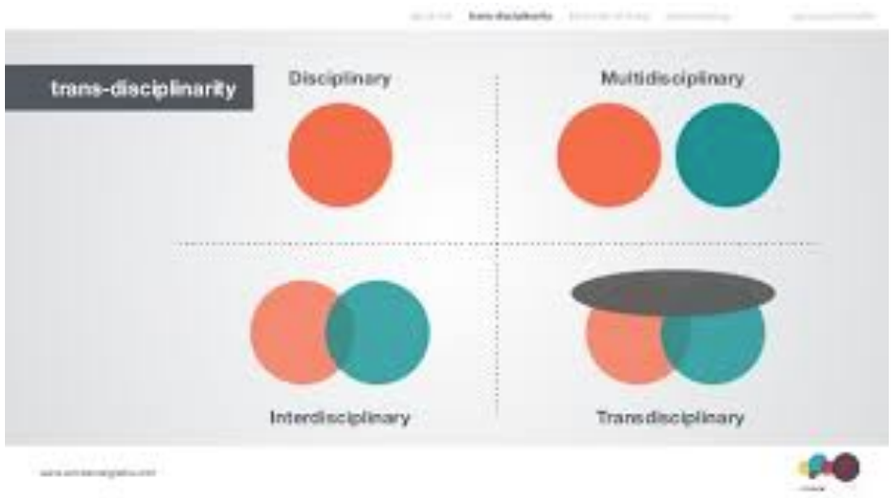
Why a new approach to science?

The world we live in is very different to the world of one hundred years ago. The world has never been so populated by humans and never before have the species 'human' influenced and manipulated the natural world in the way in which we do now. Academics are calling it the age of the Anthropocene. In the age of the Anthropocene we face different challenges to what humans faced centuries ago. As we find ourselves in this new age we have had to not only question 'what we know' but also 'how we know' and whether the 'how we know' is the right kind of 'how' for the problems that we face today. This has led to a questioning of the way in which we generate knowledge and the way in which this knowledge is used. This critique is not aimed at all knowledge generation it is mostly a frustration that has arisen out of the physical and biological sciences with the realisation that doing good science is just not enough to bring about meaningful change in the world.

Trans-disciplinary scientists and practitioners have begun this journey in search of a new kind of science - A science in service of society! This tourist trip will retrace the few first steps of these emerging ideas so that we can understand where these new ideas have come from and how they may influence our own research

What is Trans-disciplinarity?

This is a journey into *why* scientists of all colours and flavours have turned to trans-disicplinary research as a potential answer to dealing with the difficult and complex problems we face in the world today. Problems such as climate change, globalisation, inequality and depleting resources. Before we leave for this journey it might be a good idea to give you a small glimmer into *what* trans-disciplinarity is. It is often used and defined differently by different theorists but there are some similarities which we can start off with. Look at the diagram below. This gives you a good visual idea about what trans-disciplinarity is.



Disciplinary work is when you work within a particular defined field of study such as Mathematics.

Multi-disciplinary work is when people from different disciplines work on a similar question but from within their own disciplines.

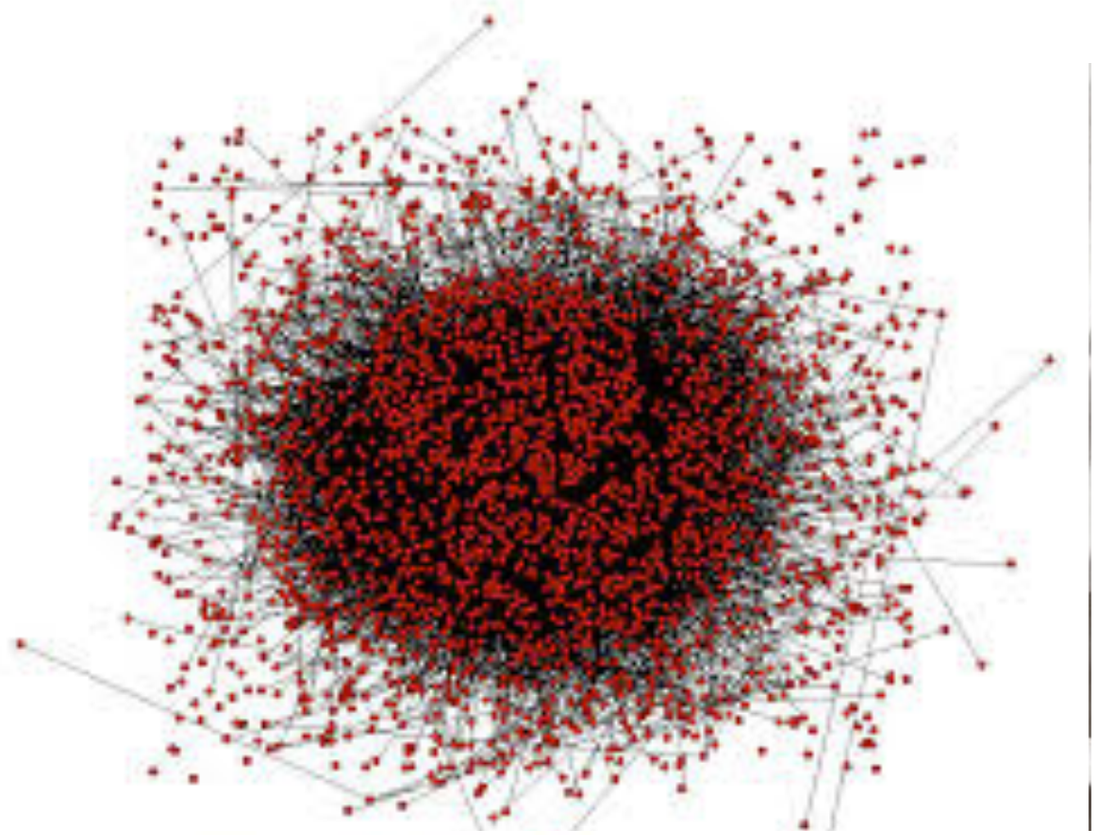
Inter-disciplinary work is when researchers draw on many different disciplines to answer a common question.

Trans-disciplinary work is the integration of different knowledge systems into a new theory or new understanding of a question. Trans-disciplinary work also tends to draw on knowledge outside of the structures of disciplines altogether such as knowledge that is developed through working in a particular way or from practicing something.

Why trans-disciplinarity for a complex world?

A challenge to scientists

The first leg of our journey is to follow the path that the traditional sciences such as mathematics, cybernetics and physics took towards trans-disciplinarity and help us answer the question ‘Why trans-disciplinarity for complexity think-ers?’



SECTION 1

Introduction

PRINCIPLES OF A COMPLEXITY APPROACH TO TRANS-DISCIPLINARITY

1. Internally inhomogeneous system;
2. Non-linear interactions between parts of the system;
3. Net-like causal structure which means there are high levels of connectivity between aspects of the system;
4. The system is continually changing and adapting which acknowledges the role of agents in the system. This is what complexity theory refers to as emergence;
5. Radical openness;
6. Contextuality.
7. AND: Trans-disciplinarity is about engaging in an ethical science

The first leg of our journey is to follow the path that the traditional sciences such as mathematics, cybernetics and physics took towards trans-disciplinarity and help us answer the question 'Why trans-disciplinarity for complexity thinkers?' This journey will take us to *South Africa*, *Austria, England* and *Chile*.

To start our journey we need to go back to the 1920's to the very tip of Africa where we find some of the very beginnings of systems thinking emerging in our own backyard with Jan Smuts and his ideas on holism.

Holism: The concept Holism was used by Smuts to explain his theory of the Universe which he believed was made up of 'whole's meaning systems. His theory went on to say that systems should be seen as wholes and cannot be understood as a sum of their parts. This is a direct challenge to the epistemological approach of modern science which was to break down systems into their smallest parts and to understand how these parts interacted in order to understand a system. Smuts believed this did not give us the understanding we were looking.

"In all the previous cases of wholes, we have nowhere been able to argue from the parts of the whole. Compared to its parts, the whole constituted by them is something quite different, something creatively new, as we have seen. Creative evolution synthesises from the parts a new entity not only different from them, but quite transcending them. That is the essence of a whole. It is always transcendent to its parts, and its character cannot be inferred from the characters of its parts - Jan Smuts,, 1962 Holism and Evolution, pg. 342"

These ideas were further developed by Ludwig von Bertalanffy who was an Austrian Biologist and the founder of 'general systems thinking". General systems thinking is often described as an interdisciplinary practice because it drew on the disciplines of biology, cybernetics and other physical and biophysical disciplines. This was way back in the 1940's so these ideas have been around for a very, very long time. The next leg of our journey takes us to England where in the 1950's Ross Ashby with his work on cybernetics added his voice to this new movement in the world of science.

Now before we travel any further let's consider why scientists started thinking differently about the way the world works and why they needed to come up with a new way of doing science?

Well things were happening in the world of science which were getting difficult to explain. The more they knew about the world, the more difficult it became to describe what they knew using the theories and methods that they had at their disposal. Instruments like the microscope and the telescope opened them up to a world we can't see and as technology allowed them to look at this unseen world more closely so their ideas about how to study and know this world were challenged.

"Modern science is characterized by its ever-increasing specialization, necessitated by the enormous amount of data, the complexity of techniques and of theoretical structures within every field. Thus science is split into innumerable disciplines continually generating new subdisciplines. In consequence, the physicist, the biologist, the psychologist and the social scientist are, so to speak, encapsulated in their private universes, and it is difficult to get word from one cocoon to the other..." Ludwig von Bertalanffy, 1969, General Systems Thinking

SECTION 2

Our Changing world

Our species began populating the world at a rapid rate. In the past our impact and our interest in our impact as scientists was rather limited to level of localized communities. Suddenly, with the explosion of medical science and the industrial revolution we began to live much longer and we began to populate. Our expansion into every corner of the planet meant that we became, more than ever, the dominant and dominating species and this dominance meant that we harnessed an influence on the world and the world's systems like never before. This challenged scientists to think of the world differently. It was not the same world that they were studying many moons ago. It had changed or rather our knowledge of this new world was forcing us to change how we continued to investigate it. It is this challenge that has given rise to systems and complexity thinking. Below are a few key movements in science which pushed this developing theory forward and led to the trans-disciplinary approaches that we are engaging with today.

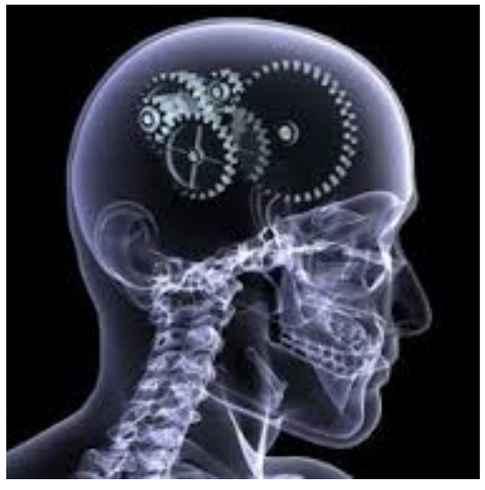
SECTION 3

The complexity of the world is too complex to describe

CONTEMPLATE THIS

Information is valuable but what else is needed for changing the world and how, in your opinion, does trans-disciplinarity begin to try and address this?

There is a branch of complexity thinking called “algorithmic complexity” which is responsible for the metaphor of the human brain as a computer. Our brains, as computers were limited in terms of the amount of information processing needed to make sense of the complexity that scientists were discovering in mathematics and information theory and even in understanding biological systems. In other words knowledge, learning and the ability to influence or bring about change was still linked to the amount of information that humans could process and we were just not cutting it anymore. The drive then was to find new ways of processing all the information that we needed to know in order to understand complex phenomena. This is probably where the love of modeling systems in systems and complexity thinking comes from. It is an attempt to build tools that process information external to the human brain which the human brain could then use to handle all the bits and pieces of information that are needed to know the world.



SECTION 4

A phenomenon does not equal the sum of its parts.

CONTEMPLATE THIS

Read this section and then consider: - How do you think this change of thinking leads us onto the path of TD?

"The world is chaotic and seemingly random but there is an accessible underlying order. Systems can, however, experience large and abrupt changes in some characteristic due to a small change in another" (Manson, 2001).

What does this mean? Well the bigger the systems that scientists were investigating the greater the chaos that seemed to surround the scientists. Imagine, as an astronomer for instance, trying to understand the order of the Universe. What complexity scientists theorized was that what seemed like chaos was only due to the fact that we had not grasped the whole of the system. This led to an absolutely massive shift in science.

The purpose of science is to try and understand the world by understanding what causes certain things to happen. The way science has gone about doing this is by reducing phenomena to smaller and smaller events and parts and observing the effect of one aspect of a part on another aspect of a part. The idea is quite ingenious and goes something like this, "if we can remove all the other influences (variables) except this one thing then we can really know whether this one thing is the thing that is causing that thing". The big super-name for this is linear causality and it really worked when our world was smaller and our knowledge of it seemed to tell us that things did happen in a linear fashion. But as scientists started to investigate aspects of the world that we can't see such as sub-atomic particles or the far reaches of space, they found that they could no longer track causality in a linear fashion. Suddenly the world seemed to be just one big chaotic mess. There

were so many possible variables that could cause one reaction or action that it is surprising that our great scientists didn't just pack up their laboratories and go home for a nice cup of simple tea.

But they didn't. Instead they changed their epistemology which means they changed how they know the world. They did this by realizing that the world of the laboratory is not the world out there (also astronomers could no longer fit the Universe out there into their laboratory) and the world out there may look chaotic but really it was only because we haven't yet learnt to be able to see all the many interconnected variables that lead to a particular phenomena. This experience and understanding led to an increased level of unpredictability because scientists realized that in some cases it was impossible to know all the possible reasons why a complex event occurred and that this often leads to phenomena happening when and where we least expect it.

This is known as the 'butterfly effect' – you know that theory that has now become famous or I should say infamous in New Age beliefs – that the flapping of a butterfly's wings can influence far removed weather systems. What was meant by this statement is that small changes in a system can lead to large non-linear effects. This does not mean that these effects are random chaos or magical or esoteric. What it means is that they are NON LINEAR which means they don't fit into our old view of science as events unfolding in a nice straight line. It is a reminder to us that we can't reduce a phenomenon to small little parts to understand it and we cannot remove a phenomenon from being in the world.

SECTION 5

Trans-disciplinarity is about engaging in an ethical science

One of the key theorists to influence a complexity approach to trans-disciplinarity is Max-Neef. Max–Neef is a Chilean economist whose life work is to critique neoliberal economics and to reorientate development towards supporting local self-reliance and satisfying fundamental human needs (ref). He also advocates for a return to a human scale meaning that economic development should focus at the level of the community. With this background it is not surprising that Max-Neef's experiences led him to give a scathing critique of disciplines which he believed had become unethical. He particularly critiqued economics as having abandoned ethics but he did not stop at economics and included the sciences in his critique. His argument was that disciplines no longer serve society and are not driven by an ethical imperative to make a difference in the world but rather they help to uphold the status quo(M. Max-Neef, 2005). Now if you asked a scientist whether they were upholding the status quo they would probably argue that, of course not, their mission is to change society through generating new knowledge of the world. But for Max-Neef this was not enough. As he writes:

Economics, as it is still being taught in the Universities, is presumed to be a value-free science. In fact, the argument runs that the "intromission" of values distorts the economic process? This being so, it should not be surprising that, for example, efforts to overcome poverty tend to fail systematically. Contrary to such naive assumptions, it should instead be obvious that if ethical principles and values should conform a society oriented towards the common good, are not made explicit, no policies coherent with the challenge can successfully be designed. (A. Max-Neef, 2005, p. 9).

What he is saying is that there is no such thing as value free science. Values are present whether implicit or explicit. This is a bit like Freire saying that remaining neutral in response to oppression is siding with the oppressor (Freire, 2000).

Max-Neef's answer to addressing the need for a more ethical science is trans-disciplinarity. He is particularly considering trans-disciplinarity within the context of the University which is designed and choreographed according to disciplines. Now you can see that Max-Neef stepped onto the stage at the perfect time. The sciences were already questioning the way in which science gets to the answers of the Universe so cross and multi-disciplinary work was already on the cards. What Max-Neef from the great mountainous region of Chile brought to the table was that the problem was not only that the science needed to consider that the world was ordered differently to

what was originally supposed but also that the purpose of science is much broader than just bringing knowledge into the world. Science also has to change the world and change it not for some but for the common good. This, for Max-Neef meant that there needed to be an integration of all the disciplines in our quest to know the world. He set out, like others, to consider the role different disciplines would have in this collaborative quest. He came up with the idea of a pyramid with the knowledge (about the world): building sciences, such as physics forming the base and asking the question "What exists?"; the applied sciences, such as engineering, forming the next layer of the pyramid and asking the question "What are we capable of doing?"; certain social sciences, such as politics, asking the question "What is it we want to do?" and the ethical or value sciences, such as philosophy, asking the question "What should we do?" or "How should we do what we want to do?" He argues that as researchers we spend far too much effort on the bottom level of the pyramid without considering the most important level, the value or ethical level.

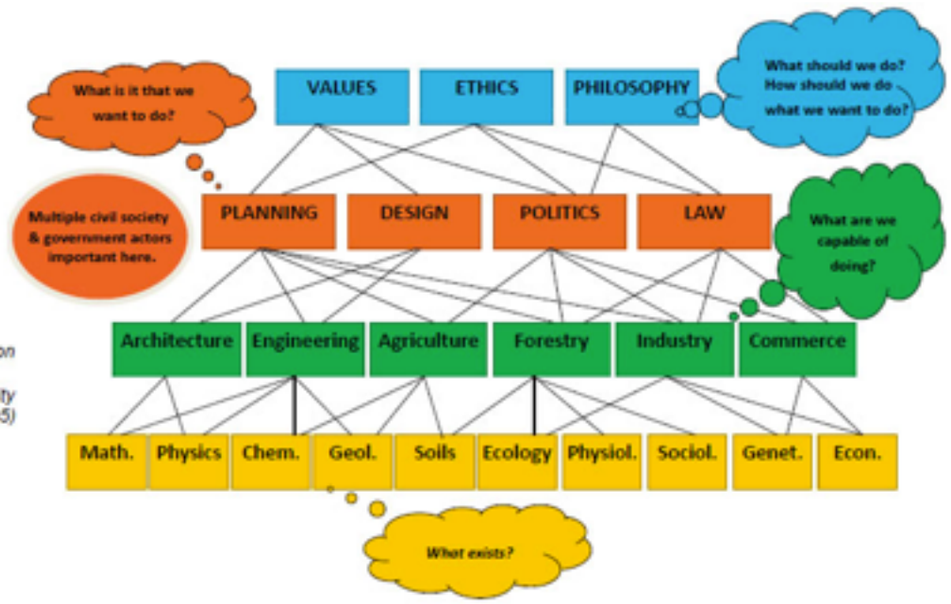


Figure 4 Max-Neef conceptualisation of 'weak' transdisciplinarity (Max-Neef, 2005)

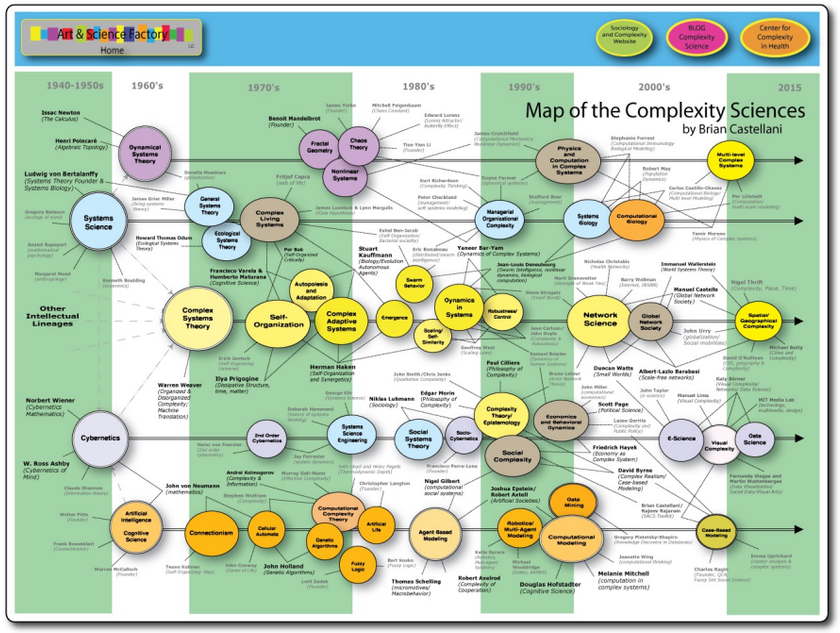
Max-Neef, drawing on the work of Nicolescu (Nicolescu, 1999), once again changed the game for scientists. Now 'science in the service of society' meant asking value questions about what we should do with the knowledge we generate and who should be involved in generating this knowledge and in the action that emerges from our new understandings.

By following the journey of science from 'science in service of knowing the world' to 'science in service of society' we can see how trans-disciplinarity becomes a next step in the evolution of scientific work in a complex world. This new way of thinking about the world and how we know the world (complexity thinking) is best served by adopting a trans-disciplinary approach. This has led to a series of meta-principles that we need to consider when doing the practice of research as scientists in service of society.

Contemplate this:

What do you think the principles of a complexity theory approach to trans-disciplinarity might be?

Complexity theory now takes on myriad different forms and has infiltrated almost every discipline.



It poses a set of key challenges to traditional science being:

1. The object of study has changed. Scientists are not only interested in 'the thing' itself but how things within a system relate;

2. How to bring about change is viewed differently. For example, a social–ecological system as not the central locus of control so we need to look for leverage points to change the system.

3. A scientist needs to track how different interactions and restrictions are contributing to the kind of behaviour that is emerging;

4. Context matters which means a scientist needs to know how different elements of a system will change when taken into a different context.

Why trans-disciplinarity addresses the philosophical mistakes of science?

Searching for an emancipatory science.

We will now leave the mountains of Chile and head across to the small and powerful island of England where we will meet a man who has one foot in analytical philosophy and the India. **Ram Roy Bhaskar** is the founder of a school of thought known as Critical Realism.

SECTION 1

Introducing Critical realism

CONTEMPLATE THIS

Read this section then consider: Why does the idea of an 'open system' lead to a trans-disciplinary approach?

Bhaskar embraced inter or trans-disciplinarity as the way forward for knowing our world and, more importantly for bringing change to it. He came to this position because of different reasons to the complexity theorists. The complexity theorists, as mentioned above, had to re-think the meaning of science in the world. To do this they needed to engage in new ways of doing science.

Bhaskar came to trans-disciplinarity from an even deeper place, the wonderful world of philosophy. Roy Bhaskar was half Indian, half British. He grew up in an England where people of Indian descent were treated like those classified as "non-white" in Apartheid South Africa. In every possible way they were second class citizens. At primary school Bhaskar dropped the 'Ram' from his name to avoid intense racist bullying. He describes his childhood as deeply unhappy.

At home the Bhaskar family followed a form of westernised Hinduism known as Theosophy which was also highly influenced by modern Buddhism. The goal of theosophy is to explore the origin of divinity, humanity and the world. It seeks to arrive at a coherent description of the origin and purpose of the universe. It is important to know about Bhaskar's past as well as his spiritual influences in order to understand the strong emancipatory drive in Critical Realism.

Bhaskar's father wanted him to be a doctor, like himself, but Bhaskar escaped this fatherly wish by winning a scholarship to Oxford where he studied Philosophy, Politics and Economics.

He then embarked on a PhD in economics that sought to explain why two-thirds of the world live in abject poverty. But he discovered, like Max-Neef, the inadequacies of the discipline of economics. He felt it had little to say on the matter. He began to understand that the defect in disciplines like economics and the sciences were because the very philosophy of science that underpinned these disciplines was inadequate. He was at Oxford at a time when most sciences including economics used a deductive mode of explanation and where Wittgenstein's theories still ruled. There was a distinct feeling that 'we are prisoners in the cave of our theories and discourses.' Bhaskar wanted to find a way out of this prison, which he saw limiting the emancipatory function of science. He abandoned his PhD in economics and began one on the philosophy of science (Bhaskar, 2008).

Bhaskar writes in the tradition of analytical philosophy and his texts are dense and feel very inaccessible but luckily for us his work is being taken up by others and there are many texts out there that are easy to access.

The first dilemma that Bhaskar addressed was the philosophical mistakes of science, the first being what he called an embargo on ontology and a complete focus on epistemology. Ontology means the study of the world and epistemology means the study of knowledge. This is the prison that Bhaskar was trying to move science out of. What this means is that science was focused on the confirmation or falsification of theory, elaboration, explanation or prediction, processes that focused on knowledge and not the relationship between this knowledge and the world out there (Bhaskar, Dannermark, & Price, in press). So Bhaskar set out to reintroduce the importance of asking questions about the world. He also realised in this process, that science did make statements about the world (ontological statements) but these were implicit and not explicit. So science had an ontology but it was a secret ontology that no one spoke about and everyone just took for granted. He also argued that this implicit ontology was wrong and went about proving it.

Now for this tour we are not going to focus on his proof except to say that the crux of Bhaskar's argument is that the laws of nature function regardless of whether we know about them or not. They exist in an open system, not the closed system of a laboratory. Although the closed system of a laboratory helps us identify these laws, it does not mean that we need to see them in order for them to affect our world. It is the fact that these laws of nature function in an open system that leads Bhaskar to call for an interdisciplinary approach to research.

SECTION 2

The ontological depth is that we live and work in open systems.

CONTEMPLATE THIS

Read this section and then contemplate how researchers working in an open system can work with multiple causes for a phenomena?

Bhaskar's big critique of science is its lack of an explicit ontology and an ontology that identifies a world that exists free of what humankind knows of it (our epistemology). His great leap forward is to separate out what we know of the world and what the world is. This means that there is something underneath the events that science investigates when trying to understand causality. There are generative mechanisms that exist regardless of whether they lead to an identifiable event or not and it is these and not the events that are what cause things to become events (Bhaskar et al., in press).

So it is no wonder that when Bhaskar and his fellow critical realists turned their attention to theories of trans-disciplinarity that they discovered a similar problem. Most of the theories were entirely epistemological. Hardly any asked the philosophical question of what is it about the nature of the world that makes inter-disciplinarity possible and necessary. The answer that Critical Realism gives is that inter-disciplinarity is possible because the world and the universe is an open system. Consider this example given by some of the great writers around inter-disciplinarity and Critical Realism.

"*Consider how an experimental laboratory context is an artificial one. When scientists set up an experiment, they aim to isolate mechanisms from the influence of the open system. That is, they isolate mechanisms from potentially interacting and competing mechanisms and structures. Therefore, in an experiment, a scientist is studying the effect of a single mechanism working in isolation from the rest of nature. This is an artificial situation but it allows the scientist to generate a con-*

stant conjunction of events (empirical invariance) in a closed system. This kind of closed system context occurs in nature in a few situations. For example in an astronomical context, the solar system can be regarded as being effectively closed, but only if we look at the current time span, of perhaps a million years. If we want to go back 10 million years then the system is not closed. Therefore, ultimately, everything in nature is part of an open system. From the point of view of the context with which most of us are concerned, strictly closed systems are only found in laboratories. Outside the laboratory, there are more or less open systems in which mechanisms are always working alongside each other. To put this more simply: in open systems you are always working with a multiplicity of causes; in a laboratory set up you have a single cause and you describe it very precisely." (Bhaskar et al., in press)

What this means is that even though we can identify one cause in a laboratory situation as soon as we begin to understand situations in the open system of the world we are dealing with multiple causes all affecting and impacting on each other.

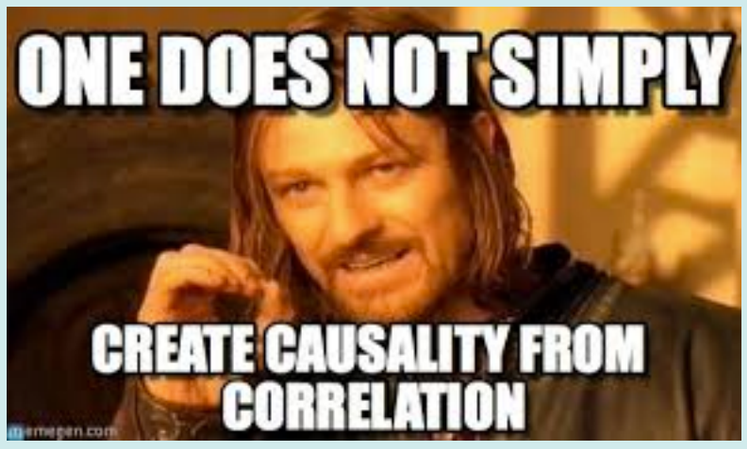
SECTION 3

There are many possible causes and so there must be many possible mecha-

CONTEMPLATE THIS

Read this section then consider the following:

Pick a problem or a research question and consider all the different levels of society that you need to consider to understand this phenomena. Now think of the disciplines that can contribute to understanding it. Remember you don't have to be an expert in all these disciplines but you need to be able to identify the kind of knowledge you need to understand your question and how to access this knowledge. This is why so much attention is given to 'trans-disciplinary' teams.



If we accept that causal laws function in the open system of the world regardless of whether we have isolated them in a laboratory or not, and that as soon as we start asking questions of the world itself and not just our knowledge of it we need to take into consideration the multiple causes that could lead to an event, then we also need to consider that there may be multiple mechanisms (reasons) for these events and causes.

For example, neurologists may be able to isolate the part of our brain that induces fear which means we know we can feel fear but what stimulates that part of the brain to feel fear is related to the context we find ourselves in and the kind of things we may be brought up to fear. The way we react to fear or cope with fear may also have to do with the support mechanisms we have access to and our ability to keep ourselves safe. So the fear stimulus in the brain emerges out of a feeling of being unsafe in the world. In order to understand the manifestation of fear we need to investigate multiple possible mechanisms which Critical Realist's call generative mechanisms that act as tendencies in open systems.

So we know that as a woman in South Africa you are unlikely to be as safe as your male counterpart because the mechanism and structures for protecting women are not in place. This is also due to the structure of patriarchy, which is a global structure, but has a particular manifestation in South Africa due to the history of our country. This does not mean that every woman in South Africa will be unsafe but rather there is a tendency for women to be unsafe because of the particular mecha-

nisms and structures in place in our country. This means that we can't reduce the fear that women feel to the stimulated mechanism in the brain but need to take into consideration all the socio-cultural mechanisms that make this feeling of fear possible.

This is where Bhaskar would see the role of multiple disciplines coming in. We need to draw on multiple explanations and then argue for the one that makes the most sense given the context that we are in knowing that this context could change at any time. For example, if Rhodes University was to change the process of reporting rape, which included adequate support for rape victims, then the social conditions that allow rape to continue may be altered slightly. This may not lead to a change in whether women feel safe at Rhodes and so we may have to alter our theory that one of the mechanisms that keeps the 'rape culture' at Rhodes (as per the recent protests) in place is the University's inadequate systems of dealing with rape.

Inter-disciplinarity is necessary because open systems consist of emergent levels of reality. It is our job as inter-disciplinary scientists to do the creative work of drawing on multiple disciplines to arrive at a new explanation for complex phenomena. This shows a difference between Max-Neef and Bhaskar. Max-Neef categorised disciplines according to different questions about reality and argued that we needed this trans-disciplinary approach as we needed to work at all levels of the problem. In some ways this is a bit like emergence as the knowledge we know of the world is necessary for us to consider how to apply this knowledge. We base our judgement on what we can do on what we know. Bhaskar on the other hand sees the purpose of drawing on different disciplines as an imperative for dealing with emergence and that the world itself is stratified and open. Rather than, in Max-Neef's case that our knowledge of the world is stratified and if we adopt this stratified approach to our knowledge we will better be able to deal with complex problems. This is a subtle but very important difference because it highlights the problem that Bhaskar sees in the sciences. Most trans-disciplinary approaches focus on epistemology. In other words how we know must change. This is why Max-Neef focuses on stratifying disciplines in his approach to trans-disciplinarity. On the other hand Bhaskar turns his attention to the world (ontology) and asks the question what is it about the world that needs a different way of knowing. He argues that the world is stratified and emergent and so an interdisciplinary approach is needed to understand this world.

This means that Bhaskar and his fellow critical realists do not stratify the disciplines as Max-Neef has done; they stratify the world by considering the different layers or laminations that make up social phenomena. The task of inter-disciplinarity research which then leads to a trans-disciplinary movement is to draw on multiple disciplines to explain the social phenomenon at each level of social life. This includes considering the relationships between different levels. You can see how we have done this in the example above on fear. To use the example at the level of the individual we can explain fear by draw-

ing on the research of neuroscientists. We can also draw on the theories of evolutionary psychologists. But if we are really going to understand the feeling of fear in women in South Africa we also have to consider the social conditions that women live in. For this we may draw on the theories of sociology or anthropology. We also need to understand the structures that are in place that allow women to feel fear, for example the laws that our country has and how these are implemented. Here we may draw on theories of politics or even organisational theory to explain why there is such a discrepancy between our laws and the functioning of society. Sociology will also be useful here. We may even want to draw on the work of statisticians who have studied the patterns of rape in South Africa which may tell us something about where rape is mostly happening or rather where rape is mostly being reported (depending on how you read the statistics). We also may need to draw on theories of post-colonialism that explain the big global movements of colonialism and the effects this has on societies and of course we will consult feminist writings on patriarchy, in a variety of disciplines, and the effects this has on society as a whole. From this stratified analysis we then need to consider an explanation that takes all this knowledge into consideration and best describes the phenomena of the fear felt by South African women. In other words what explanatory theory best describes the world.

SECTION 4

An approach that is committed to emancipation

SOME PRINCIPLES/ASPECTS OF A CRITICAL REALIST APPROACH TO TRANS-DISCIPLINARITY

1. Social-ecological phenomena are laminated: We draw on many and different disciplines to understand the different layers of a phenomena.
2. Social-ecological phenomena is emergent
3. The purpose of research is to be able to explain generative mechanisms that cause events and not just the events themselves.
4. Critical Realism distinguishes between ontology and epistemology. Traditional science on the other hand conflates reality with what we know about reality.
5. Trans-disciplinarity is the creative employment of models, analogies and insights to create a new understanding/ theory.
6. Explicit emancipatory agenda

Unlike other approaches to inter or trans-disciplinarity, critical Realism has an explicit commitment to emancipation. This means that the purpose of engaging in an inter or trans-disciplinary study would not only be to find leverage in a system but to seek out the emancipatory potential to change the system. This means that the explanation that we would come up with is an explanation that seeks to explain what mechanisms are in place that perpetuate a system of oppression or inequity and therefore argue for what we need to change to bring about a different kind of system.

Some of the critiques of Critical Realism's approach are that the role of research, even emancipatory research is in the hands of the philosopher and researcher. It is only once an explanatory critique has been formulated that multiple groups of people are involved in deciding how to change the world. Science (which includes social sciences) is seen as the voice of the voiceless, which includes both vulnerable people and the environment but these people are not involved in developing the explanatory critique. This is seen as the work of the intellectual in service of society. This does not mean that Critical Realism does not support the engagement with different groups of people or that different groups of people can't engage in an explanatory critique; what it means is that Critical Realism does not provide the methods or approaches for doing so. We would need to find these techniques elsewhere which Critical Realist researcher-practitioners are doing. For example, some researchers are drawing on learning approaches and under labouring these with Critical Realism.

An example of this is the work of a fellow African, Mutizwa who used a learning approach called expansive learning to investigate small –scale farming practices with the farmers themselves. He underlaboured this with Critical Realism. He writes a fantastic papers that are worth reading if you want to gain an understanding of his approach. You can find these references in our reference list (Mukute,2009).

But remember Mutizwa is a skilled educator and a development practitioner. These skills can't be developed overnight. As a trans-disciplinary researcher you should work with your own skill set and rather draw on the skills of others to help you in your work or belong to research teams where you can engage in the research you know best and your work can be taken up by others who are more skilled in social change processes. There is a danger of one person doing everything badly rather than a group of people working towards a goal that is greater than one individual. This is sometimes difficult for us because the University structure rewards the individual rather than the collective. The modern university has emerged out of a very individualistic Western culture and a lot of us have grown up in very individualistic cultures where our rewards are seen as personal as are our failures. Breaking this down at a personal level means seeing our work as not for our personal gain but for society as a whole. For trans-disciplinarity to become common place in a University it means a radical shift away from the individualistic structures within the university which need to be broken down so that intellectuals can once again connect to working towards the common good. This means the praise they receive is to see a change in society and not brownie points for papers published in inaccessible journals. The difficulty of doing trans-disciplinarity in a University setting could be investigated in a Critical Realist trans-disciplinary explanatory critique, which aims to answer the question 'why is it difficult to do trans-disciplinary work in the modern University?

Why Trans-disciplinarity returns researchers to the real-world?

The global change sciences emerge out of Europe and have strong links to the Critical Theory which arose out of the Frankfurt School. The research methodology, action research, arose out of the Critical Theory.

The purpose of research is human emancipation not only the generation of new knowledge

Critical Theory critiqued the purpose of research as a process of knowledge production and argued that the purpose of research should be to liberate human beings from oppression. This was done through critiquing society and culture with a strong emphasis on reflexivity.

Critical theory was in direct opposition to positivism which saw the purpose of research as producing value-free knowledge through sensory observation. Most scientists were positivists and did not accept as knowledge the qualitative critiques of the critical theorists which looked beyond the gathering of information to how this information is used to perpetuate the status quo and how the structures that produce this information do the same. Critical Theory argued that there was no such thing as value free knowledge. They also argued that research should not be judged according to what knowledge it has generated but rather on how research has led to a change in the world for the common good. As you can see both Critical Realism and Critical theory have their roots in Marx although both have developed Marx's theories.

Critical theory engaged in a direct critique of positivism and was a key player in what is now referred to in research circles as the 'paradigm wars'. An aspect of the paradigm wars was the debate about what constitutes as valid evidence. In the sciences quantitative evidence was the holy grail whereas social scientists argued that quantitative evidence lacked the quality necessary to explain complex phenomena and argued for qualitative research methodologies as vital for understanding social processes.

Critical theory also began to question the role of the researcher as the only producer of knowledge and advocated for the process of research to be participatory and empowering. This led to the rise of methodologies such as participatory action research which was taken up by a lot of disciplines some being education with Paulo Freire with participatory action researchers being inspired by the critical pedagogy of Freire. This lead to a strong criticism for top-down development methodologies, which were seen to have failed to bring about any change in the livelihoods of the poor. Critical Theory and action research led to methodologies such as participatory rural appraisal and participatory learning and action.

In true critical theory style, the global sciences start with their journey to trans-disciplinarity with a critique of the rise of the discipline.

Because the Global change sciences have strong links to the critical theory it is not surprising that their arguments for trans-disciplinarity go way back to the Greeks. They trace and critique the changes and shifts in science as a social activity in the world and the effects that these changes in context and values had on the practice of science and knowledge generation. Notice they do not see science as a neutral activity but as a social activity. Bhaskar also argues that science, as an epistemology, is a social activity. He adds that the way the world is, is what allows us to do science rather than the way we do science defines the world. This is again why he argues for ontology because if there was not a world that existed separately from our ability to think about it, science would not be possible!

The critical analysis of the global sciences of the rise of trans-disciplinarity and the need for trans-disciplinarity is not a response to one major shift in meaning in the world, the meaning of science (as it is with the Complexity theorists), (rather their gaze goes further back to trace the many shifts of meaning in relation to epistemology that have happened through the short history of humankind. This history is documented beautifully in 'A handbook of Trans-disciplinarity' and is summarised below (Hadorn et al., 2008). They also do this for a particular reason: to argue that a fundamental flaw in our thinking about knowledge generation is the rise of the discipline and the effects this has had on research practice in the world. This is why there is a need for a new trans-disciplinary way of doing research. Their story identifies key moments in history where decisions were made about what constitutes

knowledge and the structures that upheld this. They talk about these moments as epochs of dominant thought and show how people were not only thinking about what kind of knowledge is being produced but how it is being produced AND and for what purposes it is being used.

They identify three shifts from the Aristotolean view of science to today. Each one of these shifts changed the relationship of science with the 'life-world', which is a term used by the global science trans-disciplinary movement to mean the world in which we work and act rather than the world of knowledge production (Hadorn et al., 2008). One of the key arguments of the global sciences is that science has moved away from the 'life-world' and the purpose of 'trans-disciplinarity' is to bridge the gap between science and the world.

SECTION 3

The first shift: science divorces philosophy and marries economic and political power

First, the separation of the natural sciences from philosophy in the 17th century, the period known as the enlightenment. This shift replaced antiquities demonstration of causal laws through deductive reasoning with statistical methods developed in laboratories (the rise of the tyranny of quantitative methodologies). Natural science at this stage also became more closely linked with needs emerging from the life world as more technically equipped tools allowed for scientific discoveries to be of benefit for the production of commercial goods and technology. Science was no longer in the hands of the philosophers with the purpose of making truth claims about universal laws, rather the search for empirical laws became linked to the development of technological innovation and science and technology replaced the partnership of science and philosophy. This lead to science becoming a political and economic consideration and although not stated, embedded in the social world (Hirsch-Hadorn et al, 2008,pg 20 - 21). Francis Bacon explicitly stated this in the early 17th century where he argued for the collaboration of scientists to enhance scientific progress for the benefit of society. His viewpoint led to the establishment of The Royal Society in 1662. This shows that the idea of science in service of society is not very new. What the critical theorists asked is ‘who in society benefits?’

Although Bacon's argument for the benefit of science is honourable it led to the instrumental use of science knowledge for economic progress and the idea that the standard of living could be increased by increasing the quantities of goods avail-

able for humanity to consume. This dogma went unchallenged for decades and became accepted as common sense rather than a result of the separation of science from it's philosophical roots and the subsequent partnership that developed between science and a rising economic and political elite.

This is the disappointment that Max-Neef expresses when he critiques the discipline of economy in his paper (M. Max-Neef, 2005). Max-Neef is, whether consciously or not, trying to repair the rift that happened between science and philosophy in the 17th century both through his articulation of weak Transdisciplinarity and the categorisation of the disciplines according to their role in society (the pyramid of disciplines) and a search for a different kind of logic that would once again weave the relationship between knowledge generation, ethics and values.

SECTION 4

The second shift: the rise of the humanities and social sciences

Second, the rise of the humanities followed by the social sciences as separate specialised disciplines in the university in the 18th century (sentence doesn't quite make sense). This was catalysed by the industrial revolution and the social tensions that resulted during this time. It was at this point that modern science was criticised as a model for all the sciences. For example, Wilhelm Dilthey in the nineteenth century began working with hermeneutics to "achieve the understanding of cultural ideals and historical configurations, which constituted the identity of a cultural epoch in the history of mankind. He conceived of the humanities as hermeneutic sciences that rely on a method of understanding the meaning of life by interpreting its expressions in texts and other symbols" (Hadorn et al., 2008, p. 22).

This methodological division deepened with the social sciences in the late 19th century and early 20th century . At the time there were difficult societal problems that the world had never faced before that had arisen as a result of an industrialised world. Colonialism had also left its destructive mark on the world. This was the time of Karl Marx, Max Weber and Emile Durkheim. Research took on an edge. The aim: to solve societal problems. This led to an interest in human agency and structure (which includes institutions such as the state) and the interplay between the two. Suddenly the focus was not only on understanding the physical world but also the social world, which included the actions of individuals and institutions. This also brought to the fore again the debate around values and facts which still goes on today. There was also a

question of what could be considered to be rational, i.e. what can be counted as evidence and evidence of what?

SECTION 5

The third shift: the rise of trans-disciplinarity and the position of the global sciences

SOME PRINCIPLES/ASPECTS OF A GLOBAL SCIENCE APPROACH TO TRANS-DISCIPLINARITY

1. The research object is not ecology or social phenomena but the social-ecological.
2. A joint focus on real world problems *and* their solutions
3. There are different kinds of knowledge that help us move towards transformation.
4. A strong focus on participation between disciplines but also between groups and organisations outside of the academy.

The global scientists document, in their historical critique of the purpose of science, the rise of systems thinking as a key moment leading up to trans-disciplinarity. They document three key cognitive reasons for wanting to engage with other disciplines:

1. A wish for the unity of knowledge

2. A need to grasp the complexity of concrete issues

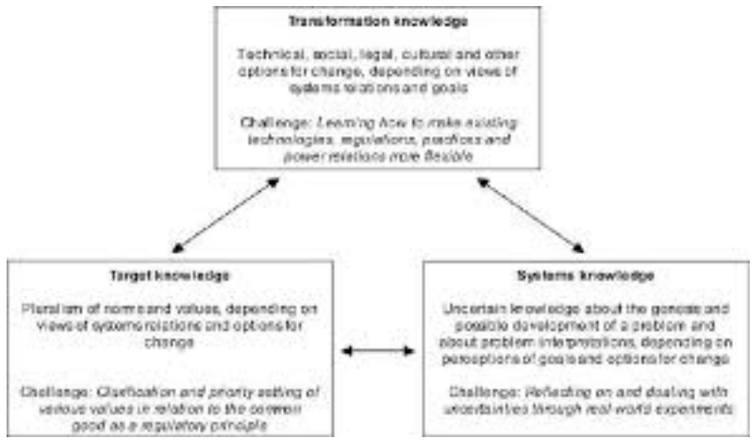
3. Innovation

As you probably know there are a variety of terms that highlight a crossing of disciplinary boundaries: cross-disciplinary, multi-disciplinary, inter-disciplinary, and intra-disciplinary. The global sciences differentiate trans-disciplinarity from all of these: trans-disciplinary is about developing an overarching epistemological framework for interdisciplinary work. Like Max-Neef they were interested in knowledge production and the kind of stages or questions that need to be asked to define the types of knowledge we should be investigating. The global sciences define typologies of knowledge, unlike Max-Neef, who splits knowledge into disciplines around certain questions. These typologies are:

1. Systems knowledge, which is knowledge about the current status

2. Target knowledge, which is knowledge about the target status

3. Transformation knowledge, which is knowledge about how to make the transition from the current status to the target status. (Hadorn et al., 2008, p. 30)

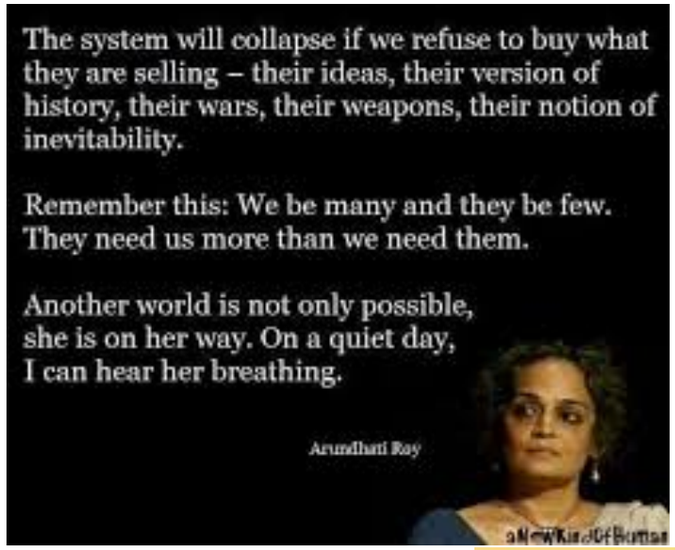


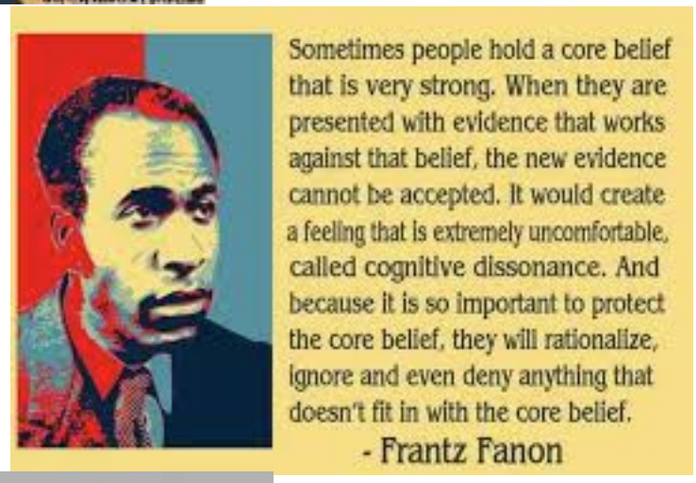
As with other approaches to trans-disciplinarity the key moment for the global sciences was to shift focus on what the object of research is and in the process ‘end the paradigm wars’. Trans-disciplinarity is seen as the bridge between the sciences and the social sciences. Before, as can be seen by the history above, there were two objects of research: the science object which sat in the positivist paradigm and the social object which sat in paradigm of hermeneutics and other social science research methodologies. What the global sciences did was re-think this divide and, at the turn of the 21st century, propose the social-ecological system as the object of research. This lead to the idea of ‘mixed-methods’ research and the challenge of using both quantitative and qualitative data to answer complex linked social-ecological phenomena (Lotz-Sisitka, 2015).

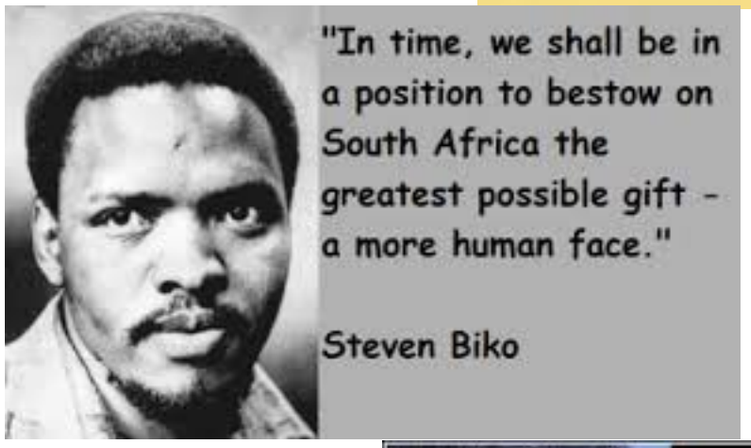
[quote: Science is not only a resource, but an ‘agent of change’ (Krohn and van den Daele, 1998): society is not only integrating scientific knowledge but adopting scientific research for societal problem-solving and innovation.(Hadorn et al., 2008, p. 27)

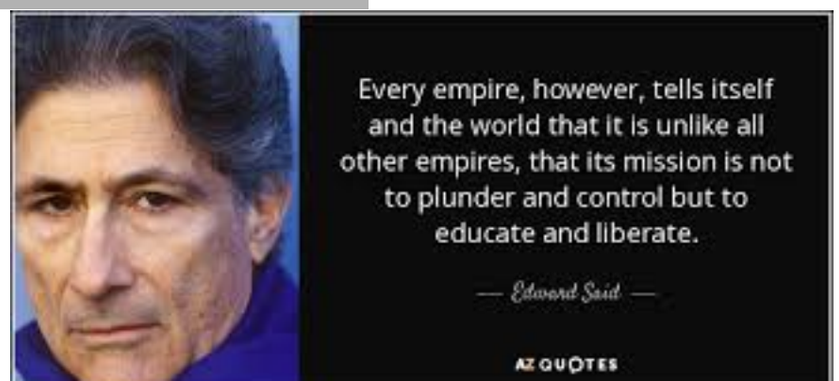
Another important contribution of the global sciences is the emphasis on participation and that knowledge is held in many different places, not only in the Universities. This comes out of the action research history of scientists and social scientists engaged in development and livelihood research and practice and is clearly emphasised as a core principle of trans-disciplinary research

A brief note of post-colonial movements and cognitive justice.









Critical theorists, post-colonial theorists and researchers who are generally sick of the dominance of Western thought bring a lot to bear to trans-disciplinarity even though they don't directly call their work trans-disciplinary.

In a way the work of these theorists is not from the position of making science more valuable to the world as if science stands outside the world but more from the position of the most vulnerable whose knowledge, knowing and thus Being is denied in the wave of knowledge generation and production. As Arundhati Roy writes:

"I think of globalization like a light which shines brighter and brighter on a few people and the rest are in darkness, wiped out. They simply can't be seen. Once you get used to not seeing something, then, slowly, it's no longer possible to see it." (Arundhati Roy quoted in Nixon, 2011)

In this way, ground-up work has always had to be transdisciplinary because the core questions of this work is not just about making the dominant forms of western knowledge more applicable to the 'life-world' but for the ignored knowledge, knowing and thus being to find a voice in the world.

Visvanathan argues that knowledge and knowing are linked to the landscapes through which we move and are held in the relationships we have. He critiques traditional science by challenging the idea that the production of knowledge can be separated from culture and context and argues that science today still separates the world into the consumers of knowledge (society) and the inventors of knowledge (scientists). He sees this as a violence on the part of science and a cognitive injustice. What he brings to the fore here is that injustice does not only need to take the form of harm to the body and oppression of the body but also the oppression of the mind by ignoring, silencing and making unseen the diverse 'knowledges of the world' (Visvanathan, 2006). What Visvanathan calls for is a non-violent science. It is the ultimate call for scientists and those that propose to be the inventors of knowledge to do a self-inventory on 'science as social activity in the world' and whether this activity has truly been in the service of society or in service of a small part of society. So much innovation, so much intelligence but who actually gets to benefit from these great innovations? Science may be a shining light of reason and a shining light of knowledge but who does it shine with, who benefits and at what cost to all the other knowing Beings in the world?

Your journey

Now it is time for you to leave us and start journeying with others .. we wish you luck and many fascinating discoveries along the way that will not only benefit you but all Beings.

References

Bhaskar, R. (2008). *A Realist Theory of Science*. Routledge.

Bhaskar, R., Dannermark, B., & Price, L. (n.d.). Part II: A Critical Realist General Theory of Interdisciplinarity. In *Interdisciplinarity and Well-Being*. Oxon: Routledge.

Freire, P. (2000). *Pedagogy of the oppressed*. Bloomsbury Publishing.

Hadorn, G. H., Hoffmann-Riem, H., Biber-Klemm, S., Grossenbacher-Mansuy, W., Joye, D., Pohl, C., … Zemp, E. (2008). *Handbook of transdisciplinary research*. Springer.

Lotz-sisitka, H. (2015). Transdisciplinarity. Presentation to the Rhodes Trans-disciplinary group. 2015

Manson, S. M. (2001). Simplifying complexity: A review of complexity theory. *Geoforum*, *32*(3), 405–414. doi:10.1016/S0016-7185(00)00035-X

Makute, M, & Africa, S (2009). Cultural Historical Activity Theory, Expansive learning and agency in Permaculture work places. Southern African Journal of Environmental Education. Vol 26. Pages 150-166

Max-Neef, A. (2005). Foundations of transdisciplinarity. *Ecological Economics*, *53*, 5–16. doi:10.1016/j.ecolecon.2005.01.014

Nicolescu, B. (2002). Manifesto of transdisciplinarity. Suny Press.

Nixon, R. (n.d.). *Slow violence and the environmentalism of the poor*. Cambridge, Massachusetts: Harvard University Press. doi:10.1017/CBO9781107415324.004

Visvanathan, S. (2006). Alternative Science. *Theory, Culture & Society*, *23*(2-3), 164–169. doi:10.1177/0263276406023002226