New Paradigm Shifts in Literature through Poetry's Transcendence of Boundaries

New Paradigm Shifts in Literature through Poetry's Transcendence of Boundaries

By

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To the Souls of My Parents,
To My Wife and Children

"To err is human, to forgive divine"
—Alexander Pope

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INTRODUCTION

Let us swear an oath, and keep it with an equal mind,
In the hollow Lotos-land to live and lie reclined
On the hills like Gods together, careless of mankind. (Tennyson n.d.)

Unlike Tennyson's Lotos Eaters, the 20th century man cannot live isolated, unburdened by the unexpected events of daily life. Scientists and scholars had to deal with the vicissitudes of fortune despite a modernist ambiance of tedium, restlessness and self-seclusion. In the 21st century, sticking to a discipline's boundaries has not been effective; therefore, interdisciplinary studies have been practiced for long. In recent years, some scientists and scholars have suggested transdisciplinary studies as a solution for wicked problems that have become viral in every community.

As a young field, few references are found; however, efforts are exerted to support this field since it is necessary for solving wicked problems. Contrary to the Cartesian rule of clear distinct ideas, transdisciplinarity focusses on interconnected ideas for gathering information; therefore, it stands against fragmentation of knowledge. Transdisciplinary studies stress three key elements: breadth, integration, and transformation. The space beyond individual branches of knowledge is the main concern of transdisciplinarity, which creates a meta-language unlike interdisciplinarity or multidisciplinarity.

This book introduces four scientific genres—physics, biology, biochemistry, and pharmacology — which interact with poetry in particular and literature in general, highlighting possible transdisciplinary fields. Chapter one introduces transdisciplinarity, discusses its methodology, comparing between the transgressive and Zurich schools, and pointing out its shortcomings. Many challenges are set in the way, hindering setting a paradigm for different fields of research. Moreover, there is a lack of an adequate definition. Characteristics of transdisciplinarity/Transdisciplinarians are discussed. Transcendence, problem orientation and solving, and transgression are the most important characteristics of the field advocated by reviewers. Social, communication, and cognitive skills are required for a researcher to become a transdisciplinarian. As a young field it was languidly received by universities. Transdisciplinarity studies students suffer from being reluctantly accepted in the academic arena. However, the

field is characterized by flexibility and adaptability so much that any participant can be easily accommodated. Therefore, when there is enaction and interaction between arts and sciences, when scientific content is creatively transformed by means of forms of arts, transdisciplinarity fields are created and new knowledge-building practices are produced. Transdisciplinary research on poetry, on the one hand, and other sciences such as physics, pharmacology, and biochemistry on the other, are discussed in the following chapters. The last chapter shows that other genres of literature discuss scientific content and provide solutions to societal problems.

Chapter two discusses the relationship between poetry and physics. Poetry interacts with physics through quantum theory. Such interaction creates a common ground that proposes new interpretations of poetry supported by parallel universes derived from multi-verse theory or many-worlds-theory. Quantum theory provides a paradigm for a computation of probabilities for the outcomes of interpretations. However, if quantum concepts are misused, incorrect interpretations occur and quantum paradoxes are recognized. Quantum physics and literature has been investigated since 1920. Be it noted that the intersection of quantum physics and literature can help interpret a reality that is elusive. Such intersection results in transdisciplinary fields as quantum fiction which crystallizes modern man's experience of a new perception of material reality.

The relation between quantum physics and poetry lies at the heart of probability. Poetry is the vehicle through which physical facts can be translated from mathematical language into words, despite the Baconian proposition. Many poets developed the relations between poetry and physics. Eliot followed the wave model while pound followed the particle model. Newtonian and quantum functions can be traced in the relations among words in poems when poems are investigated through lenses of interaction and entanglement. Therefore, multi-dimensional interpretations are enriched by using quantum theory in poetry analysis.

Amy Catanzano's poetry is analyzed in light of quantum theory. Amy Catanzano developed a theory called "quantum poetics" in which poetry is viewed in parallel with particle physics, astrophysics, and quantum theory. Her poetry intersects with science. In Catanzano's viewpoint, the dark matter of poetry is reconciled with that of reality. She investigates the relation of the language of postmodern poetry and the representation of post-Newtonian physics. Catanzano wonders if there is a need for a poet to become a scientist. She discusses Christian Bök, proving that there is no

need for Bök's archive since imagination is a carrier and a reserve. Her poem "World Lines: A Quantum Supercomputer Poem, "choose-your-own-adventure" poem is a good example of quantum poetry, since it shows the idea of knotted entanglement as its best. It shows that reading a poem in a certain way is like observing a qubit; and rereading causes a change similar to the idea of a multiverse.

Catanzano's poem "Poetry in Superposition: An Essay-Poem in Quantum Poetics" is an example of how common grounds between poetry and science can be explored. Catanzano's second book *Multiversal* presents a theory of quantum poetry. In this book things are seen in poetic reimagining. The concept of spacetime, multiple orders, and multiple forms are depicted in Catanzano's poetic vision. Multiversal concludes with an undeniable fact: "nothing is fixed"; all expectations are probable, all interpretations are possible, and parallel universes may be found, a hyperspace.

In Chapters three and four poetry and biology intermingle through Dual Inheritance Theory to provide solutions to the problem of racial discrimination in the USA and Germany. Dual Inheritance Theory, or genetic-cultural coevolution, is an appropriate reading mechanism which highlights the role of jazz and blues in transmitting African American culture. There is a difference between the structure of cultural inheritance and that of genetic inheritance, since cultural parent or models can carry out the enculturation process more effectively than genetic parents. In fact, cultural and genetic evolutions hold mutual effect since they interact and impact each other. Moreover, changes caused by culture to the physical environment of genes highlight the presence and importance of coevolution of genes and culture. Cultural evolution mechanism can be used in reading African American literature and can yield important results. In Copacetic, in chapter three, a sense of commitment to soothe the pain of Komunyakaa's community is felt in his use of jazz and blues forms, themes, and idioms.

Chapter four focuses on the impact of Afro Americans on Afro Germans. It suggests that problems of racial discrimination, inequality, uprootedness, the inability of sharing common atavistic feelings, and inferiority complex can be solved when poetry and biology colluded, constituting a dual-force. The formative impact of cultural models on transmitting Afro Americans' and Afro Germans' reactions against racism is the focus of this chapter. Representing "prestige-biased oblique transmission", Audre Lorde has had a formative influence on Afro-German women writers and has really fulfilled the role of "a cultural parents" and "a cultural model". She has vertically, horizontally, and obliquely transmitted black American feminist

cultural practices of protest, different attitudes towards racial issues, social mobility, and even altruistic behavior to black Germans, especially Ayim. Lorde's impact on May Ayim has outlived both, which proves that cultural generation length may be longer than a biological one. Modes of expression highlight the role of cultural models. Jazz and blues have been developed and spread by G1s although Nazi leaders opposed it. Jaz dance was crystallized as a cultural identity, an escape from miserable conditions suffered by Afro Germans at that time.

Chapter five shows that poetry's subjectivity and science objectivity transcend their boundaries and meet at a transdisciplinary ground. The scientist's mind as well as the poet's imagination can echo what happens in nature. The aim of getting two isolated domains of research such as poetry and biochemistry is to create a transdisciplinary field of "literary genetics", DNA-based poetry/biopoetry supported by Christian Charles Bök and Stuart Kauffman, and other prominent figures such as Joe Davis, Pak Chung Wong, and Eduardo Kac. Biopoetry transcends the traditional ways of reading and writing so much that organisms are read into being. It is a blend of the Gutenbergian and the Darwinian as tissues can be written from cells. A biopoem passes by three stages, starting with writing the poem-genome, then injecting it into the bacterium, and the acceptance of the bacterium to host and respond to the poet's poem, which is the challenging step.

Kac's *Genesis* is based on the artist's gene hosted by E. coli bacterium, the mutation of which shows stunning results. Kac investigates the possible readings technopoetry can provide. Bök, who was influenced by Pak Chung Wong and Paul Davies, attempted to write an unkillable poem which asserts that boundaries separating bios and poetry are not fixed. He attempted to create an example of a living poem based on a chemical alphabet that would be implanted in Deinococcus radiodurans, which in turn would respond by creating a viable, benign protein. Bök succeeded in writing *The Xenotext: Book 1* which shows apocalyptic poetry and genetic and proteomic engineering.

Chapter six explains the relationship between poetry, pharmacology, and psychiatry, and shows how it helps retain pharmacological recipes. In the past, poetry solved the problem of oblivion since it facilitated the memorization of pharmacological recipes; moreover, it made up for the loss of pharmacological knowledge thanks to poetical meter. Poetry supports psychiatric treatment so much that poetry is as important to mental health as exercise is to the limbs. Poetic pills are served to save people from stress. While Deborah Alma is considered to be the founder of the poetry

pharmacy, William Sighart has greatly contributed to the field. People come to the poetry pharmacy, established by Alma, and undergo a cathartic experience in order to relieve stress and feel refreshed. It is the emergency poet, dressed as a doctor in an ambulance, who gets people attracted to poetry so much, so they interact and enjoy the moments they spend there. Alma's seminal book *The Emergency Poet An Anti-Stress Poetry Anthology* already contains test poems since they have already been prescribed for people at different places, people who see that verses can uplift their spirits, console, and help them. A representative poem from each of the ten sections has been selected. Together they illustrate the contribution of poetry in the form pharmaceutical prescriptions to solve problems resulting from stress.

The closing chapter discusses the interaction of other literary genres with chaos theory from an existentialist perspective in the hope of solving the wicked problem of living a chaotic purposeless life. Three works— Sartre's *Nausea*, Lawrence's *Sons and Lovers*, and Al Hakim's *The People of the Cave*—that represent three different cultures, viz., French, English, and Arabic, are analysed according to universal systemic characteristics of chaos theory. Three works highlight the developmental relationship between chaos and nothingness felt by the for-itself and order; a relationship similar to the change that happened to the concept of classical thermodynamics that saw heat transfer as a source of waste which later became a source of order.

This book is but a step forward on the difficult road in which science and poetry in particular, and literature in general, merge. This choice makes all the difference:

> Two roads diverged in a wood, and I—
> I took the one less traveled by,
> And that has made all the difference. (Frost)

CHAPTER ONE

TRANSDISCIPLINARITY AS A YOUNG FIELD

Introduction

Transdisciplinarity emerged in 1970 and Jean Piaget coined the term that appeared in his essay in 1972 (Bernstein 2015, 2). Transdisciplinarity-net, initiated in 2003 by the Swiss Academies of Arts and Sciences, helped develop this young field (Pohl 2008). Although Transdisciplinarity is criticized for being vague when it comes to definition, its nature which is open to many interpretations refutes such criticism. In fact, "Transdisciplinarity concerns the space of research that is at the same time between different disciplines, across disciplines, and beyond each single discipline" (Minh 2021) . Transdisciplinarity combines both concepts of transgression and transcendence, with an ability to provide new responses (Burnard 2022, 169) to wicked problems offering creative solutions (Bernstein 2015, 1). It is a young field, so a relatively few references on the field can be listed. However, a reading list would be helpful.[1] Researchers' interest in Transdisciplinarity "stems from not only traditional focus on unity of knowledge but also new synthetic paradigms and theories in addition to trans-sector co-production of knowledge with stakeholders aimed at solving complex problems" (Klein 2022, 1). Transdisciplinarity organizes existing knowledge, collected through inquiries made by the researcher, with the strong assumption that ideas are interconnected. Information is gathered from different disciplines in order for a researcher to realize useful knowledge, which is contrary to the Cartesian rule of clear and distinct idea. "Transdisciplinary, thus, means not only going across but also going beyond disciplines" (Sneider 2020, 110). However, transdisciplinarity can be seen as self-contradictory:

> hybrid sub-disciplines have emerged is a testament to the need to break out of existing disciplinary boundaries. But we also have to recognize that in many cases the disciplinary boundaries of the new system are closed, and essentially a new closed disciplinary system is created… Women's Studies and Cultural Studies are examples of inherently inter- or multi-disciplinary areas of study that nevertheless, in the process of disciplinarization, risk

becoming isolated in their own sphere rather than having an impact on the wider discourse. (Montuori 2013, 48)

It is argued that transdisciplinary studies are topic-based rather than discipline-based (Leavy 9); however, they tend to form sub-disciplines with a specific nature that cannot be easily bounded. It is often argued that "breadth, integration and transformation are three key aspects of inter- and transdisciplinary research and their quality" (Vienni-Baptista 2023, 16).

It is noteworthy to differentiate between interdisciplinarity and transdisciplinarity specially in terms of popularity:

While interdisciplinarity is a somewhat familiar term, transdisciplinarity is a young term that remains unfamiliar in educational studies, having developed largely out of interactions between the natural sciences, sustainability studies and public health (Klein, 2004; Lawrence, 2015). (qtd. in Khoo 2019)

When a problem necessitates the presence of several disciplines for investigation, the study is a multidisciplinary one in which these disciplines contribute to solve the problem overflowing boundaries. But, at the same time, this approach is "limited to the framework of disciplinary research" (Nicolescu 2007). Interdisciplinarity involves at least two disciplines that equally collaborate to reach the findings in which case boundaries of each are crossed by the other(s). This does not mean that all disciplines involved become one, since each discipline keeps its specific base. However, new disciplines can be generated by interdisciplinarity. Transdisciplinarity is concerned with "the space across and beyond individual branches of knowledge" (Minh 2021). Unlike interdisciplinarity, it is capable of giving birth to a meta-language, creating a space where terms from different disciplines can be expressed.

When interdisciplinarity and multidisciplinarity fall short, transdisciplinarity provides a solution:

In an academic world characterized by a plethora of segmented disciplines, "integration" is the cardinal keyword to increase understanding. Neither multi-disciplinarity nor inter-disciplinarity meets this criterion. (Kim 1998, III)

Transdisciplinarity, which aims at necessary complementarity with disciplines, rather than a stark opposition to them, is based on integration and synergy which contribute to the co-production of thorough knowledge and to a better understanding of complex and wicked problems in order to improve future

choices. Therefore, transdisciplinarity stands against hyperspecialization, fragmentation of knowledge, and compartmentalization at the gnoseological level.

Transdisciplinarity can be seen as a co-production between science and different actors aiming at the good of society (Hesjedal 2022, 222). Therefore, the gap between policies and practice should be bridged by conducting empirical studies. The co-producing knowledge process should yield different kinds of knowledge.

> 'Systems knowledge' refers to analytical and descriptive knowledge about the actual state of the system. With 'target knowledge' we describe knowledge about desired future developments of the system. Finally, 'transformation knowledge' refers to the knowledge about how we can move from the actual state to the more desirable state. (Scnat Knoweldge n.d.)

Methodology

After a long journey of research, Nicolescu (2007), representing the transgressive school, realized that there are three axioms:

i.   The ontological axiom: *There are different levels of Reality of the Object and, correspondingly, different levels of Reality of the Subject.*

ii. The logical axiom: *The passage from one level of Reality to another is insured by the logic of the included middle.*

iii. The epistemological axiom: *The structure of the totality of levels of Reality is a complex structure: every level is what it is because all the levels exist at the same time.*

Nicolescu's axioms are basically rooted in quantum physics. As Jay Bernstein (2015) maintains "Nicolescu's transdisciplinarity seems applicable to the integration of the humanities, including spiritual subjects such as religion, and philosophies of knowledge and education with physical science subjects such as those extant in laboratories and space observatories" (6). Unlike Nicolescu's school, "the Zurich school has led to work aimed at designing and implementing tangible solutions to "real world" problems" (Bernstein 2015, 7).

Moving to sustainability studies, transdisciplinarity research is characterized by three properties: address of research practices innovatively in order to create common understanding of situations and develop solutions; exchange between knowledge producers and knowledge recipients; and knowledge

integration. In order to "integrate scientific excellency, future orientation, practical relevance and social coherence", there should be a "modular approach for integrating transdisciplinary scientific knowledge into societal transformation discourses and democratic policymaking" (Renn 2021).

Other reviewers support another approach to transdisciplinarity studies characterized by focusing on crucial problems, having a cross-disciplinary competence and creating and integrating methods and knowledge.

> Transdisciplinarity is therefore conceived as "meta-methodology": a transdisciplinary approach takes as its object precisely the different methodologies of the various disciplines, in order to "transform" and to "transcend' them. (Lattanzi 1998, 37)

Be it noted that a transdisciplinary approach should have intrinsic transformative properties that should have an impact, not only on knowledge, but also on people.

It is worth noting that with the passage of time many shortcomings of transdisciplinarity have emerged such as:

> The relationship between transdisciplinary, interdisciplinary and disciplinary concepts remain vague and often confusing… The epistemic question of how to resolve conflicting truth claims between science, practical application and stakeholder interests remains unresolved in spite of many efforts to introduce reflexivity as a potentially integrating force… The tension between curiosity driven research and advocacy for a special cause… the potential conflicts between epistemic and democratic ideals… The clash of different rationalities between scientific and political thinking… . (Renn 2021)

Renn proposes a solution for the above-mentioned problems, viz., "develop a modular approach of transdisciplinarity as a combination of curiosity-driven, goal-oriented and catalytic research traditions." The proposed modular is based on three research traditions: the curiosity driven research concept, the goad-oriented concept, and the catalytic concept. These three concepts are "modules of a comprehensive transdisciplinary understanding of science" (Renn 2021). The synthesis of the three concepts is adavantegeous since it enables verification and provision of appropriate knowwldge; it helps develop strategies and achieve goals; it provides discourse promoting integration of diversity and resolving conflicts; and it helps improve planning processes.

In fact, defining a certain methodology for transdisciplinary studies is challenging since the field is young and still developing. Therefore, the best thing to do is to study theories, methods and relevant social, communication, and cognitive skills around which this new specialization revolves. It has not been that easy for transdisciplinary research to go on; rather, many challenges have been in the way, which makes creating paradigm shifts an excruciating task. Assuming that transdisciplinary research (TR) fits for "specific types of life-world problems", which can be disputable, Pohl and Hadorn (2008) define four problem fields in which TR can have:

> By transgressing disciplinary paradigms and surpassing the practical problem of single actors, transdisciplinary research is challenged by the following requirements: to grasp the complexity of the problems, to consider the diversity of scientific and societal views of the problems, to link abstract and case specific knowledge, and to constitute knowledge with a focus on problem-solving for what is perceived to be the common good. (G. H. Hadorn 2008, 19)

These challenges illustrate the need for transdisciplinary research in order to support new fields of knowledge by creating common ground between fields of research, and thus, setting paradigms.

Following Pohl's and Hadorn's assumption, TR should provide "descriptive, normative and practice-oriented knowledge" which necessitates the participation of actors of the life-world and the collaboration of researchers. Various knowledge bases provided by researchers from different disciplines are interrelated through the problem under study. This may result in a challenge:

> The transdisciplinary challenge with complexity of problems is that of interrelating the broad range of factors to come up with an integrated understanding of the problem and integrated suggestions for dealing with the problem. (Pohl 2008)

In order to face this challenge of integration, systems thinking is proposed. When hard systems thinking is applied to a problem, disciplines' contributions yield results that "can be integrated in a qualitative or quantitative model" (Pohl 2008). On the other hand, soft systems thinking is concerned with diverse disciplinary perspectives necessary for dealing with the complexity of a problem.

Grasping diverse aspects of a problem through mutual learning and integration is a challenge. According to Pohl and Hadorn, the methodological challenge of integration lies in "how to specify and combine means of integration with

forms of collaboration" (Pohl 2008). Scientific knowledge and everyday life situations must be related in order for TR to solve a specific problem field in a way that really serves the common good.

There are four key aspects[2] of transdisciplinary research which can be integrated effectively, viz., "context dependencies, innovative formats, societal effects and scientific effects" (tdAcademy 2021 GAIA paper authors 2022). These key aspects can be evaluated through an integrative perspective with three approaches: "1-Explore and strengthen interconnections and synergies. 2-Further develop quality criteria as cross-cutting elements. 3-Capacity building and guidance for scientists and practitioners" (tdAcademy 2021 GAIA paper authors 2022). However, it should be notified that "[w]hile it is possible to make a distinction between different types of transdisciplinary research, it is not, however, possible to present a general paradigm" (G. H. Hadorn n.d.) This results in a lack of an adequate definition and a systematization of the research; hence, a typological organization of transdisciplinary approaches, viz., systematicity approaches, trade and negotiate approaches and learning approaches (G. H. Hadorn n.d.).

Suggested principles of the transdisciplinary process, which contains sub-principles, applied in a societal learning process for developing socially robust solutions, (Scholz 2020, 1039) can be summarized: Roles and independence including co-leadership, equal-footing, and accepting the otherness of the other; rules of mutuality based on mutual learning as a basic principle, and facilitation of the process; constraints reflected in precompetitive and not day-to-day politics and extended Chatham house rule; and outcomes realized in socially robust orientation.

Characteristics of Transdisciplinarity/Transdisciplinarians

Of the key characteristics of transdisciplinarity, three are most advocated by many reviewers:

(i) Transcendence (overcoming disciplinary boundaries and developing one's own transdisciplinary perspective and, if necessary, methodology); (ii) problem orientation and solving (problem recognition and developing of solution spaces with the support of relevant knowledge and competences); and (iii) transgression (the deliberate inclusion of idiosyncratic, contextual features and their interaction(s) with cross-case transferable or scalable experiences). (Renn 2021)

It is not easy for a researcher to become a transdisciplinarian (Klein 2022, 2). Researchers should have certain characteristics to "become inter-and transdisciplinary researchers (ITDRs)" (Guimarães 2019, 2). A would-be transdisciplinarian should be self-motivated, should have a real desire for serving community, should form a theoretical and practical vision bringing interest from different fields together. Above all, "ITDRs are willing to learn from other disciplines and adopt a humble attitude toward the immensity of knowledge" (Guimarães 2019, 3). For ITD project managers, the following set of skills are required:

> "a) social skills to build good working relationships with team members, b) communication skills to stimulate information flow and knowledge exchange, and c) cognitive skills to understand the theoretical and the methodological issues surrounding inter- and transdisciplinary research questions (Hollaender et al., 2008). (qtd. in Guimarães 2019, 5)

It must be noted that this young field attracts researchers and enables them to develop new skills:

> The possibilities of building bridges between unrelated areas, facilitating integration, and dealing with complexity and the "out of the box" nature of ITD are all identified as attractive features of ITD, capable of motivating scholars to engage in this type of research. This means that the aspects used to characterize the concepts of ITD also pull individuals into its practice. (Guimarães 2019, 13)

Broadly speaking ITDR skills can be grouped under operational and innate characteristics.

The history of universities participation and their impact on the field of transdisciplinarity has been investigated (Scholz 2020, 1033–1049) proving that "transdisciplinary research is a critical element of the university's research mission" (Scholz 2020, 1033), which stresses the fact that "universities are at a multiple crossroads with paths to different forms of doing science for and with society" (Scholz 2020, 1042). However, languid reception and reluctant acceptance are big problems faced by a young researcher/would-be transdisciplinarian since professors do not encourage them to engage in transdisciplinary studies instead of focusing on a specific academic project. Moreover, ITDRs face many stumbling blocks in the way for an advancement in their career since they are not (easily) allowed to be promoted or to have a tenure track position. Therefore, an ITDR should have an innate disposition toward working out of the box and should gain new competencies for achieving development in the field. They should encourage other researchers to collaborate with them to realize knowledge

beyond different disciplines. As Werner Heisenberg maintains "[a]ll true philosophy is situated on the threshold between science and poetry" (qtd. in Nicolescu 2007).

The issue of teaching students transdisciplinarity is much debated (Zinsstag 2023). It is argued that transdisciplinarity is important for students to study as it opens their eyes to a klaeidescopic vision of reality and enhance creativity. On the other hand, some see that it is not good to teach transdisciplinarity at the undergraduate level, preferring it to be part of MA and Ph.D programs. For early career faculty, it is important to work as a team and to have relevant skills:

> Being part of a transdisciplinary team requires not only disciplinary depth and expertise but also strong interpersonal, cross-disciplinary, communication, and collaborative skills, including the ability to give and receive challenges to customary ways of thinking about a particular problem and integrate new ways of thinking. (Moore M 2018)

Some early career faculty were reported to focus on the importance of have transdisciplinary skills in order to solve wicked problems. However, they lack the recquired experience in "enhanced methodological training, …writing scholarly papers, and obtaining grant funding" (Moore M 2018). A healthy work environment is essential for the success of any transdisciplinary training/work where young career academics feel supported.

Transdisciplinarity: Pains and Gains

Transdisciplinarians face many hardships but enjoy fruits of their labor at the same time. Transdisciplinary work is not that easy since many hindrances are there in the way. The challenges and obstacles set in the way of transdisciplinary training and success are "ambivalence, challenges in engaging in transdisciplinary research, and obstacles to collaboration" (Moore M 2018). A researcher might be unable to step out of the boundaries of their discipline and create a more dynamic ambience with other members of the team as well as participants from the social network involved in the case study being undertaken. On the other hand, participants may be short of grasping the nature of transdisplinarity well; therefore, developing a discussion about a given issue is at risk. Cultural and social practices and old traditions may stand against the implementation of transdisciplinary procedures.

Many challenges face transdisciplinary research effects in the scientific field. There are "barriers to processing and disseminating insights from

TDR to the scientific community; different expectations regarding TDR's claim to contribute to solving societal problems and the need for reflexivity regarding the independence of science in TDR" (Marg 2023, 7).

Despite the above hindrances which make transdisciplinary practice painstaking, there are many positive points. First, a transdisciplinary field is characterized by flexibility and adaptability, which make acommadating any participant possible. Second, "transdisciplinary research contributes to scientific knowledge by changing the understanding of scientific problems… [Third] TDR changes the quality of scientific insights… [Fourth] TDR promotes a reflexive turn in science" (Marg 2023, 8-9).

Issues in Transdisciplinary Research

The Nicolescuians and the Zurichers transdisciplinarians have almost agreed on the importance of creativity, collaboration, and integration, something reflected in discussing and dealing with sustainability issues. Wicked problems such as "hunger, poverty, global climate change, the extinction of species, the exhaustion of natural resources, and the destruction of ecosystems as topics requiring a response from educators" (Bernstein 2015, 8). Other global issues that were focused on are: " a. Human aggression; b. Harmonious distribution of resources; c. Development of anthropocentric world views; d. Realization of human potential and empowerment through education" (Lattanzi 1998, 31). Experts from different cultural backgrounds are expected to contribute to solve these wicked problems, a contribution which is based on multidimensionality and combines transdisciplinarity and transectorality. Such contribution should work to new strategies of integration of knoweldge.

Few researchers have investigated "the scientific effects of transdisciplinary research" (Marg 2023, 1). However, three important effects can be noted, viz., "TDR changes the understanding of scientific problems and the quality of scientific insights. Furthermore, TDR promotes the reflexivity of the scientists involved" (Marg 2023, 3). It is argued that transdisciplinarity is " an advanced and specific research tool that can contribute to the new and necessary growth of knowledge in the fields of public health and the environment" (Annerstedt 2010, 2694). In this respect, researchers aim at finding a solution, through complex intervention, to the complex problem of disciplines' incommensurability; a solution that can be realized by following an approach of "*Inference to the Best Understanding*", seeing transdisciplinarity "as a specific research instrument", and for which implementation is a combination of "diverse disciplines, theories and meta-

theories" is necessary (Annerstedt 2010, 2698-99). Heterarchy is argued to be the best framework for transdisciplinarity in this respect. It is also argued that "joint problem defining" can result in "joint problem solution". Therefore, common ground viz. interactive factors, may be found among medical and ecological disciplines. One of the interactive factors is "human cooperative behaviour" (Annerstedt 2010, 2697), which is basically underpinned by dual-inheritance theory. For the transdisciplinary method to develop sucessfully, "it is of utmost importance to continue the search for interactive factors and to map inferences at all points along the research path" (Annerstedt 2010, 2700).

Transdisciplinary Enaction and interaction of Science and Arts

It is often argued that "arts and sciences are not separate or even separable endeavors" (Burnard 2022, 167). In the field of education, STEAM reflects synergistic endeavours for a transdisciplinary trajectory, combining arts and sciences. Science content is transferred creatively by means of various forms of arts:

> They range from the use of drama to model abstract processes (e.g., the four seasons; the digestive system) or the use of poems and songs to remember new or complex words to the integration of art-centric skills, such as visual thinking, recognizing and forming patterns, and the hand skills learned by using tools, or pens, as a means to further develop STEM inquiry abilities (Root-Bernstein & Root-Bernstein, 2011). (qtd. in Burnard 2022, 167-168)

The transdisciplinary process of transferring scientific content through arts is similar to that of diffraction, where knowledge can not be located within one discipline since boundaries are transcended and transegressed. The power of arts and sciences work transdisciplinarily diaectically " each one offering the opportunity for a different type of "attentionality," a way to "pay attention" and "to make sense" of the sensible" (Burnard 2022, 190).

The fact that data science emenates from computer science, mathematics, statestics and electrical engineering endorses the transdisciplinary nature of the field:

> the core principles of data science must be inherently transdisciplinary. In particular, the core principles of data science will need to draw on—and suitably integrate—a variety of principles from computer science, statistics, mathematics, and electrical engineering (from the latter, notably principles from information theory). (Agarwal 2020)

Transdisciplinarity and Literature

Some literary researchers use information technology in order to create scientific answers to problems raised by the research (Pop 2016). Disciplinary borders are constantly being shaken, expanded, and transformed as a result of the new research environment created by transdisciplinary research. "Transdisciplinary research practices transcend disciplinary borders and open up entirely new research pathways. Transdisciplinarity produces new knowledge-building practices" (Leavy 2011, 14).

As a transdisciplinary approach to literature, neurohermeneutics believes that the author and the reader are involved in creating the new vision of the work of art. Moreover, neurohermeneutics sees the text as "an anthropological cognitive device interacting with the imaginative, emotional and experiential background of the reader, giving rise to new cognitive avenues as a result of the aesthetics pleasure produced by this new counterfactual world" (Renata Gambino and Pulvirenti 2019, 186-187).

Poetry and Transdisciplinary Studies

> Poetic research is rhizomatic in nature it sets out roots and shoots that break and reform, reproduce and transform. The process may be broken at any point but at the point of rupture it can reconstitute itself to form connection again. It develops its future by looking for radical forms, breaks and lacunae in thinking. (Rosenberg 2000)

Poetry has rarely been intersecting with social sciences. For example, "concrete poetry in social sciences research is scarce, yet emerging" (Schoone 2021, 130). The following model has been used in investigating transdisciplinary research focusing on poetry and its relations with physics (quantum theory); biology (dual-inheritance theory); pharmacology & psychiatry (Poetry Pharmacy/Emergency Poet); and biochemistry (Experimental/(biological/DNA-based) Poetry).

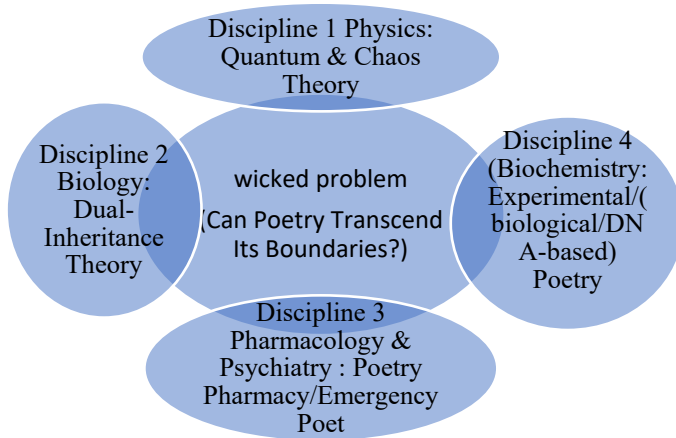## The Suggested Transdisciplinary Model Used in this Book

Fig 1.1: It shows how science and poetry enact and interact, which results in the creation of transdisciplinary fields and produces new knoweldge-building practices.

Conclusion

Transdisciplinarity organizes existing knowledge, collected through inquiries made by the researcher, with the strong assumption that ideas are interconnected. Information is gathered from different disciplines in order for a researcher to realize useful knowledge, which is contrary to the Cartesian rule of clear and distinct ideas. Transdisciplinary studies are topic-based rather than discipline-based; however, they tend to form sub-disciplines with specific nature that cannot be easily bounded. Poetry has rarely been intersecting with social sciences. However, discussing examples of transdisciplinary studies that include poetry and physics (chaos and quantum theories), poetry and biology (Dual Inheritance Theory), poetry and pharmacy (emergency poet), and poetry and biochemistry (experimental poetry), proves that poetry can transcend its boundaries. Here we show transdisciplinary fields and paradigm shifts can be created. We found that poetry can go beyond its boundaries and intersect with other sciences such as physics, biology, biochemistry, and pharmacology (& psychiatry), creating new transdisciplinary fields where poetry is based on (or at least tinctured with) quantum theory, dual-inheritance theory, DNA, and pharmaceuticals (& psychiatry). Our results show that transdisciplinary fields including humanities, social sciences, and pure sciences can be created.

CHAPTER TWO

POETRY AND PHYSICS: QUANTUM THEORY

Introduction

Modern physics is theoretically based on quantum theory which focuses on atomic and subatomic levels when explaining the nature of matter and energy, viz., quantum physics and quantum mechanics. Max Planck, Nobel Prize winner 1918, discovered that energy that exists in individual units is quantifiable. "The existence of these units became the first assumption of quantum theory" (Wigmore n.d.). Albert Einstein elaborated on Planck's discovery finding out that radiation is quantized in the same way. Later, in 1924, Louis de Broglie further investigated the makeup and behaviour of energy and matter and came up with the principle of wave-particle duality theory. In 1927, Werner Heisenberg reached the uncertainty principle theory.

The Copenhagen interpretation, proposed by Niels Bohr, opposed objective reality and supported the superposition principle which refers to the proposition of the undecidability of the state of an unmeasured object, something that can be supported by Schrodinger's Cat hypothesis. "If quantum mechanics applied to the cat, it would be described by a 'wavefunction' in a superposition of 'alive' and 'dead'" (Chen 2023, 514). Stephen Hawking and Richard Feynman supported the many-worlds theory or multiverse theory:

> as soon as a potential exists for any object to be in any state, the universe of that object transmutes into a series of parallel universes equal to the number of possible states in which that the object can exist, with each universe containing a unique single possible state of that object. Furthermore, there is a mechanism for interaction between these universes that somehow permits all states to be accessible in some way and for all possible states to be affected in some manner. (Wigmore n.d.)

According to quantum theory, the state of potential existence of an object may cause existence of possible states of the same object that can similarly

be accessed and affected simultaneously. Therefore, it may be argued that "*[i]n a strict sense, quantum theory is a set of rules allowing the computation of* **probabilities** *for the outcomes of tests which follow specified preparations*" (Peres 2002, 13).

Chen (2023, 513) discusses the idea of determinism of a quantum universe, stressing the fact that a quantum universe determines the shape of the universe, despite the uncertainties it contains. For Chen, the determinism of the universe, if any, will "depend on the final theory that bridges the divide between quantum physics and relativity — and that remains a far-off prospect" (Chen 2023, 515). The theory of everything is at perpetual retrieve since it seems impossible for gravity to come under quantum theory (Webb n.d.). When quantum concepts are misused, incorrect interpretations occur, and quantum paradoxes are recognized (Peres 2002, 5).

Quantum Theory and Literature

> While some research focuses on a quantum consciousness in postmodern literature or asserts a shared paradigm between quantum mechanics and the literatures of Modernism and postmodernism, there lacks research that specifically focuses on how contemporary writers mine the new physics for its metaphysical and philosophical import. (Morrison 2015)

In the second half of the 1920s, some researchers investigated the relationship between quantum physics, especially the wave-particle duality, and literature. They noted that: "quantum physicists were attempting to resolve the wave-particle duality, leading to Niels Bohr's complementarity. This parallel has been noted by researchers as relevant to the novel, as it too displays a general binary that can be read as wave-particle-like" (Cousin 2022). However, Xavier Cousin, in his PhD dissertation, "UnQuantum Woolf: The Many Intellectual Contexts of *To the Lighthouse*'s Metaphorical Wave-Particle Binary", which adopts a sceptical approach, claims that studies of novels through the lens of quantum theory do not help in better understanding the novel. Moreover, Cousin sees that studying quantum physics and literature relationships has not been proved, yet, to be "academically productive; historically valid; scientifically accurate; interpretatively precise; and leading to demonstrable conclusions" (2). Cousin proceeds to prove that science and literature stand on equal footing, denying that influence comes from science to literature (1-18) and not fully discussing the transdisciplinary knots that can be created from such an entanglement. In fact, the intersection of quantum physics and literature can help interpret a reality that is elusive (Oppermann 2015, 87).

Quantum fiction, a term coined by novelist Vanna Bonta, author of *Flight: A Quantum Fiction Novel*, 1996, bridges the gap between the quantum nature of reality and everyday life, taking elements of quantum physics as a device for storytelling. The genre includes life since it can be seen as a realm of all possibilities.

> The genre reflects modern man's experience of a new perception of material reality influenced by quantum physics that transcends the mechanical model of science, elements of the imagination, and human perception as the building blocks of reality. (Academic Accelerator n.d.)

Defiance of the laws of machine physics is a characteristic element of this genre; and the observer/character and observer/reader dualities are perceived as active participants. The theme of quantum fiction is not necessarily restricted to science fiction; it can be anything. Other distinguishing characteristics are: "Adventures with life as synchronicity, multidimensional reality, interactive metaverse, parallel worlds, or multiverses" (Academic Accelerator n.d.).

The impact of quantum awareness on fiction can be crystallized in using multiple and flexible narrative structures, and by dealing with ordinary people and events yielding a many-worlds interpretation underpinned by a wave-particle duality. Quantum fiction is an explanation of a mutual mimicry of life and art. In fact, the two fields of physics and literature, separate as they may appear, interact, and affect each other (Oppermann 2015, 95-102).

Some scientists have tended to use poetic expression when rendering physics facts into a language understandable by ordinary people. Moreover, "poetry broadly conceived has been a prominent feature of popular physics writing for the last century or so" (Matlack 2017). Using poetic language as a vehicle for expression of the world of physics both endorses the importance of poetry and the need for a real connection between poetry and science, in order for physical facts to be translated from mathematical language into words, despite the Baconian proposition of parable-argument/poetic-images scientific description development of language that generally elevates scientific language over poetic one.

It is noteworthy that many examples of the creative and poetic terms of art occur in the field of physics, such as "dark energy, antimatter, strings, loops, spin foam, big bang, big bounce" (Matlack 2017). These examples illustrate the underpinning props behind poetry-physics relations. Moreover, be it