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# REFRAMING SYSTEMS THINKING FOR SYSTEMS CHANGES: SCIENCING AND PHILOSOPHIZING FROM PRAGMATISM TOWARDS PROCESSES AS RHYTHMS

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**Abstract**
Systems thinking rose in 20th century industrial society largely from post-WWII research. Psychologists Eric L. Trist and Fred E. Emery were early in human relations, later turning towards sociology. Philosophers C. West Churchman and Russell L. Ackoff were cofounders of Operations Research, applying pragmatism to problem-solving of complex issues. The texture of Socio-Technical Systems (STS) and Socio-Ecological Systems (SES) perspectives interweaves with management science and inquiring systems.

In the 21st century, the Service Economy and Ecological Anthropocene followed advancement of the Internet and globalization through the 1990s. Resurfacing Trist-Emery and Churchman-Ackoff for a new generation not only revisits their sciencing, but also philosophizing.

Trist-Emery Socio-Psychological Systems (SPS) and STS perspectives extended the structuralist psychology of Gestalt, through Andras Angyal and Kurt Lewin. The SES perspective built on the pragmatist metaphilosophy of Stephen C. Pepper. Sciencing by Churchman-Ackoff encouraged Operations Research beyond mathematics towards collaborative decision-making. Postwar applied philosophizing built on the experimentalism of Edgar A. Singer Jr. This lineage traces from the Metaphysical Club circa 1890, through the 1980s.

Philosophizing in the 21st century provides new lenses for the systems sciences. Through ecological anthropology, Tim Ingold depicts the lives of lines, and texture in weaving. Through Classical Chinese Medicine, Keekok Lee distinguishes *yin qi* and *yang qi*. In post-colonial constructionist program of *Rethinking Systems Thinking*, principal concepts of (i) rhythm, (ii) texture, and (ii) propensity have become the core of *Systems Changes Learning* practices, theory, and methods.

A new world hypothesis of (con)textural-dyadicism is proposed, combining STS and SES features. The associated systems theory foregrounds time-space changes over the defining of space-time systems and boundaries. Philosophizing across Western and Classical Chinese traditions requires deeper inquiry and education.

**Keywords**
Systems change, philosophy of science, pragmatism, Chinese philosophy, socio-technical, socio-ecological

## 1 | Introduction: Sciencing systems from post-WWII into the 2020s sweeps in philosophizing

In the development of systems thinking from the 1950s through the 1990s, strands of an emerging science of systems coevolved with underlying philosophies of science. Collaborations spanned Anglo-American partnerships. In the American branch, C. West Churchman and Russell L. Ackoff led from philosophy into science. In the UK branch, via the Tavistock Institute, Eric L. Trist and Fred E. Emery led from the psychological and sociological sciences, towards philosophy. Collectively, the network was largely influenced by American Pragmatism dating back to the 1890s, extending those traditions.[1]

[1] Milestones in the development of systems thinking in the 1960s-1990s are reflected in published legacies. From 1969, an early expression of the Trist-Emery trajectory is collected in the foundational *Systems Thinking: Selected Readings* (Emery, 1969b, 1981). Through the 1990s, reflections of the Trist-Emery journey were collected into 3-volume *Tavistock Anthology* (Trist & Murray, 1990; Trist et al., 1993, 1997). Following the 1947 supervision by Churchman of Ackoff's doctoral dissertation, the coauthoring of *Methods of Inquiry: An Introduction to Philosophy and Scientific Method* (Churchman & Ackoff, 1950) serves as a commencement for later collective and individual works. Festscrifts by colleagues and former students honoured C. West

Branches of philosophy of science underlie practices in action learning, and theories in the systems sciences. Over decades, progress might be more explicitly recognized with verbs rather than nouns. *Sciencing* can be seen as an ongoing pursuit of better answers. *Philosophizing* can be seen as a pursuit of better questions. The two pursuits coevolve.

A call for *rethinking systems thinking* (Ing, 2013) encourages celebrating the history of the systems movement, while continuing scholarship in systems practices, systems theories and systems methods. Continuing advancement comes through sciencing as a process.

> Science is not merely a collection of facts and formulas. It is preeminently a way of dealing with experience. The word may be appropriately used as a verb: one *sciences*, i.e., deals with experience according to certain assumptions and with certain techniques. Science is one of two basic ways of dealing with experience. The other is art. And this word, too, may appropriately be used as a verb; one may *art* as well as science. The purpose of science is one: to render experience intelligible, i.e., to assist man to adjust himself to his environment in order that he may live (White, 1938, p. 369).

While the emphasis in this article is on sciencing, "arting" is acknowledged with a meaning from 17th century English of obtaining or gaining by art. Creativity associated with arting complements sciencing.[2] Open systems approaches to problematic situations (i.e. messes) may be resolved, solved or dissolved as insights as swept in through philosophizing, sciencing, and arting.[3]

In January 2019, a *Circle* of systems change practitioners and researchers formed as a collective slow contextural action learning program espoused as 10-year journey. The Circle proposed a three-word agglutinative neologism of *Systems Changes Learning*. This was a recasting and reifying of a distinct whole, rather than merely connecting "systems", "changes" and "learning" as parts (Ing, 2022). Over four years, presentations reviewed work-in-progress at monthly meetings of Systems Thinking Ontario, a biennial conference of the Canadian Society for Ecological Economics, an annual symposium on Relating Systems Thinking and Design, and workshops for Global Change Days. Foundational materials were shared in four lectures in the 2020 Systemic Design course of the master's program in Strategic Foresight & Innovation at OCADU. A pilot workshop was conducted for the Canadian Digital Service in the federal government in 2022, with materials released as open access. That success has led to a continuing advisory relationship with the Code for Canada not-for-profit organization with a mission of "technology and design" for good.

Deepening the rigour underlying practice, theory and methods, a multiparadigm inquiry was conducted applying an appreciative systems framework to surface (i) what are and are not systems changes; (ii) when, where, and for whom, systems changes are prioritized for attention; and (iii) how systems changes should be addressed (Ing, 2023). Philosophizing on (i) architectural design; (ii) ecological anthropology, (iii) Classical Chinese Medicine and (iv) rhythms, led a philosophy of systems rhythms more explicitly proposed as a foundation on which to approach systems changes.

In section 2 below, the history of sciencing in systems thinking is reviewed. The Trist-Emery post-WWII studies at the Tavistock Institute are foundational to contemporary organization science. The original research, on the Socio-Technical Systems (STS) perspective from 1951, and Socio-Ecological Systems (SES) perspectives from 1965, were commonly on MBA reading lists in the 1980s. In the shift to post-industrial organizations, the conventional wisdom on autonomous workgroups and work design have become footnotes in textbooks. The Churchman-Ackoff partnership started in philosophizing in pragmatism turned to Operations Research in active service in WWII. Subsequently, Churchman-Ackoff efforts transformed into a Social Systems Science at the heart of graduate academic programs. The shift from mathematical problem-solving towards qualitative and interpretive techniques echo in soft operations research and problem structuring methods.

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Churchman (Koenigsberg & van Gigch, 1994; McIntyre-Mills, 2006; Van Gigch & McIntyre-Mills, 2006) and Russell L. Ackoff (Choukroun & Snow, 1992b). These publications track the progress in the systems sciences in the 20th century.

[2] A progression from philosophizing to sciencing to arting may be present in creative problem solving. "The more philosophy and science I tried to bring to bear on problem solving, the more I came to realize that even together they can assure us no more than adequate solutions to problems. They cannot provide exciting solutions, ones that we call "beautiful." Only the kind of problem solving that involves art can do this. And art implies creativity (Ackoff, 1978, p. ix).

[3] Resolving is a *clinical* approach, relying on past experience, common sense and subjective judgments. "To *resolve* a problem is to select a course of action that yields an outcome that is good enough, that *satisfices* (satisfies and suffices)". Solving is a *research* approach based on observation and measurement, aspiring to objectivity. "To *solve* a problem is to select a course of action that is believed to yield the *best possible* outcome, that *optimizes*". Dissolving is a *design* approach that aims to synthesize a better state, through synthesis. "To *dissolve* a problem is to change the nature, and/or the environment, of the entity in which it is imbedded so as to remove the problem" (Ackoff, 1981b, pp. 20–21).

In the 21st century, social and ecological concerns have accelerated with globalization. At the 2012 annual meeting of the International Society for the Systems, two themes reflected a world that Trist-Emery and Churchman-Ackoff did not personally experience: (i) service systems associated with the rise of the Internet and globalization; and (ii) natural systems in the Anthropocene with resilience science (Ing, 2013). Since then, the world experienced an historic event in the Covid-19 pandemic disruption from winter 2020 to spring 2023. The Russian invasion of Ukraine in winter 2022 has been, unfortunately, an escalation that would have been more familiar to those who lived through WWII. Practitioners are called more frequently to engage on "systems change", with a predisposition towards innovation through systems thinking. The SES perspective has matured into Causal Texture Theory. The framing of systems as adapting through unfreeze-change-freeze modes may reflect 20th century pacing.[4] With structure continually undergoing change, a primacy on processes of systems leads towards philosophizing. Beyond science as a static body of knowledge, processual approaches towards situated action may come to the foreground.

In section 3 below, the history of philosophizing in systems thinking is related to pragmatism. The synthetic World Hypotheses of organicism and contextualism are root metaphors on which Trist-Emery built STS and SES. The root metaphor theory by Stephen C. Pepper may lead practitioners to re-examine their systems of interest as progress towards part-whole integration, or wholes alongside wholes in temporal textures. Nonrelativistic pragmatism is the Churchman-Ackoff extension of philosophy descending from the Metaphysical Club from 1890. Methods for systems practice that derive from this branch of pragmatism include (i) interactive planning, and (ii) strategic assumption surfacing and testing.

The Western intellectual tradition follows a cultural history of three major eras: the classical, the medieval, and the modern (Tarnas, 1991, p. ix).[5] The recognition of sciencing as distinct from philosophizing came with the rise of technology, beginning with Sir Isaac Newton in the late 17th century, and maturing with Immanuel Kant in the mid-18th century (Frank, 1952). In the early modern period, technology and science followed laws of motion in physics.[6] Processes philosophies with change in the foreground have generally had minor voice in the West. Around 500 BCE, Heraclitus developed a doctrine with the world constantly changing, in universal flux (Graham, 2021). In the 1920s, Alfred North Whitehead was looking beyond the reductionist notions of causality.

> Each actual entity is itself only describable as an organic process. It repeats in microcosm what the universe is in macrocosm. It is a process proceeding from phase to phase, each phase being the real basis from which its successor proceeds towards the completion of the thing in question (Whitehead, 1979, p. 215).

Organic processes characterize living systems, but not all process philosophies are organic. "Process philosophy is based on the premise that being is dynamic and that the dynamic nature of being should be the primary focus of any comprehensive philosophical account of reality and our place within it" (Seibt, 2012). In the systems movement, the ecological epistemology of Gregory Bateson has been extended into the ecological anthropology of Tim Ingold.

In the 21th century, the Internet has enabled easier access for scholars to non-English texts in translation. Recognition of views not based on the philosophies mainstream in the West has encouraged a movement towards post-colonial science. The science of Classical Chinese Medicine (CCM) is built on an alternative philosophy. These origins can be traced back to 1046 BCE, with the Pre-Qin and early Han periods.

> Modern Western philosophy may simplistically be summarized as follows: it is empiricist both in its metaphysics and its epistemology …. Its model of causation is Humean and linear -- the phenomenon to be explained, A, is related to one other phenomenon B, its effect, in terms of one cause and one effect, where the causal arrow moves in a straight line only from cause to effect ….

[4] Unfreeze-change-refreeze, known as "change in three steps", is often misattributed to Kurt Lewin in forensic examination. "At a time when research suggests that trends toward citing a greater volume of references with a shallower (i.e. more proximate to the present day) date-range, ... we advocate the opposite: looking back, looking deeper and reading articles like Lewin 1947 rather than just citing them" (Cummings et al., 2016, p. 22).

[5] From the times of Ancient Greece, Pythagoras and Euclid established mathematical foundations, while philosophical propositions by Plato and Aristotle became the groundwork for Western civilization. In a pre-scientific era, philosophizing sought to explain the cosmos by dissecting nature. That, in turn, led to the idea of "regularities" in the universe which are so stable that they can be expressed as Laws of Nature.

[6] Changes in the universe were understood as caused by forces acting on objects. Complex changes were explained from millions, or billions, or trillions of small, entangled forces creating changes simultaneously, or in succession. Newton's first law of motion can be stated as: "Every body continues in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it" (Crump, 2001, p. 121). That image of the universe underlies a mindset in which stability is normal, and change is the exception.

> In contrast, the ancient Chinese philosophy within which CCM was/is embedded may be said to imply process-ontology -- it considers events and processes to be foundational, rather than things. Furthermore, it implies complex causal relationships between events and processes which may be said to be multi-factorial and non-linear. Such a philosophy is Wholist in orientation— the universe and everything in it, including human beings, constitute Wholes which are different from the sum of their parts, and which in turn are related as well as inter-related with other Wholes (Lee, 2017a, p. 2).

Focusing on medicine in classical Chinese tradition draws attention to philosophy of science. There is a compatibility with the metaphysics of yinyang in *daojia*, while remaining outside of religious aspects of Daoist philosophy in *daojiao* (Littlejohn, 2022a).[7] Temporality is brought into the foreground, and the dyad of *qi*-in-dissipating mode occurs in phase with *qi*-in-concentrating mode. Sciencing follows from philosophizing in its cultural history.

In section 4 below, the STS and SES perspectives are inferred meta-analytically with organicist and contextualist world hypotheses that were implicit in the Trist-Emery philosophy. In contrast with a Western philosophical approach that separates dispersive and integrative manners, a (con)texturalist-dyadic world hypothesis dissolves that distinction. A root metaphor views the STS perspective as *yin*, and the SES perspective as *yang*, within the (con)texture of a greater yinyang. In a Chinese philosophy of body, a healthy yinyang is eurythmic (i) in rhythm (i.e. neither too fast nor too slow), (ii) in balance (neither too much or two little), and (iii) in transformation (i.e. neither changing too much or too little), relative to its contexture. This is a contrast to Western values pursuing ideals (e.g. plenty, truth, moral good, and freedom).

Concluding in section 5 below, the challenge of transitioning sciencing from the dominant English language Western philosophy is discussed. Classical Chinese philosophy may be embedded in the culture of modern China and the diaspora, but many technological advances are based on Western applied sciences. Accepting a reorienting of a systems approach from a space-time presumption to a time-space reification is a big leap.

> Chinese science in general and CCM in particular, were practised within a philosophical framework resting on process-ontology, a dynamic conception of Nature, Wholism, multi-factorial/non-linear causality which is totally incompatible with a one based on thing-ontology, a static conception of Nature, Reductionism, monofactorial/linear causality (Lee, 2017d, p. 339).

The universality of Western problem solving (e.g. the one best way) contrasts to a Classical Chinese (con)texturality (e.g. "it depends"). In dealing with systems changes, the Trist-Emery and Churchman-Ackoff legacy can be extended through sciencing and philosophizing from the dominant Western presumptions. Pragmatic systems thinkers advising on engagements with contingency approaches to problem-solving may be more likely to be accepting in applying such sciencing and philosophizing.

This article serves as an interim milestone contribution towards systems practices, theories and methods, on the journey of the Systems Changes Learning Circle. The rich history of sciencing on systems associated with philosophizing in Western pragmatism is recognized. An exploration of a new world hypothesis that sweeps in features of post-colonial sciencing and philosophizing is expected to continue for some years.

## 2 | Sciencing on organizations 1960s-1990s reflects post-WWII scholarship

Systems thinking in the late 20th century was founded on the progression of sciencing in the 1950s-1970s. As a prelude to Trist-Emery and Churchman-Ackoff contributions to science, an intertwining history of their trajectories reveals the intermingling of post-WWII scholars. An institutional timeline for the researchers is in Appendix 1. Churchman and Ackoff first met Trist at a meeting of The Institute for Management Sciences in Paris, 1959. This would later lead to the formalization of a relationship between the Tavistock Institute and the Operational Research Society in Britain (Friend, 1992, pp. 86–87).

The collective theorizing on social change and organization management continued across the Atlantic from the 1960s through to the 1990s. Trist-Emery have been more recognized in the UK, Australia and Canada. Churchman-Ackoff were centered in the USA, with some program graduates taking professorships abroad. Each duo has its own history, while ongoing progress central to much of the systems movement.

[7] "As an English term, Daoism corresponds to both Daojia ("Dao family" or "school of the Dao"), an early Han dynasty (c. 100s B.C.E.) term which describes so-called "philosophical" texts and thinkers such as Laozi and Zhuangzi, and Daojiao ("teaching of the Dao"), which describes various so-called "religious" movements dating from the late Han dynasty (c. 100s C.E.) onward. Thus, "Daoism" encompasses thought and practice that sometimes are viewed as "philosophical," as "religious," or as a combination of both" (Litlejohn, 2022).

**2.1 | The Socio-Psychological Systems perspective and Operations Research came from post-WWII sciencing**
While the British and Americans were allies in WWII, the military experiences of systems researchers set contrasting foundations for later collaborations. In Britain, social psychology focused initially on counseling officers and enlisted troops on their returns to peacetime, with later applicability with leaders in national public and commercial enterprises. In the USA, the operations research of managing military logistics would raise questions as to the degree that scope could be broadened to human social issues in large-scale businesses.

**2.1.1 |** Psychologists Trist and Emery were early in organizational development at the rise of industrialization
Trist and Emery are recognized as luminaries of the Tavistock Institute for Human Relations. The Institute was founded in 1946 with a grant from the Rockefeller Foundation as a "a group committed to undertaking, under conditions of peace, the kind of social psychiatry that had developed in the army under conditions of war" (Trist & Murray, 1997, p. 5). In 1948, Industrial Action Research was started with the British government concerned with a low-productivity economy, with "grants for research aiming to secure improved productivity through better use of human resources" (Trist & Murray, 1997, p. 8) for three years. At Christmas 1951, Emery came to the Tavistock Institute on a 6-month UNESCO fellowship. Emery was impressed by the recent publication of the Trist and Bamforth paper in *Human Relations*, October 1951, and joined the Bolsover coal study as a field officer. In May 1952, Emery was offered a position at the Tavistock Institute for summer 1953, but was unable to accept the offer. Emery returned to Australia and completed his Ph.D. (Trahair, 2015, pp. 148–151).

The Tavistock Institute went through three years of untied funding from 1951 to 1953, rebalancing towards consulting projects with Calico Mills in India, Unilever and advertising agencies. From 1954, for four years, socio-technical studies in the coal industry resumed through Marshall Plan funding jointly by the UK and USA. Towards the end of the 1950s, projects with Bristol Siddeley Engines, the National Farmers' Union and a Unilever subsidiary explored the changing contextual environment, leading to the socio-ecological perspective. Emery rejoined the Tavistock Institute in 1958 as a Principal Project Officer (Trahair, 2015, p. 150).

In 1966, Trist moved to the Graduate School of Business Administration at UCLA. This was an unhappy time for Trist, as the work with the Socio-Technical Systems perspective was not aligning well with the Quality of Working Life program (Trahair, 2015, pp. 226–231). Trist considered moving again, consulting Emery during his 1967-1968 visit to the Center for Advanced Studies in Behavioral Sciences at Stanford. On the invitation of Ackoff, encouraged by a parallel move by Howard Perlmutter, Trist joined the Wharton School at U. Pennsylvania in 1969, where he would teach until 1978. Emery returned to Australia in 1969, with fellowships at Australian National University extending to 1979.

**2.1.2 |** Philosopher Churchman led architect Ackoff towards philosophy, during WWII problem-solving
Churchman was appointed in 1939 as an assistant professor in philosophy at the University of Pennsylvania. In 1941, Ackoff received a bachelor's degree in architecture, at U. Pennsylvania, and accepted a teaching fellowship in philosophy for one year. Ackoff entered the Ph.D. program in September 1941 as Churchman's doctoral student, but was drafted into the U.S. Army in January 1942. Ackoff was first assigned to the headquarters of an armoured medical battalion, and then the engineering section of the Fourth Armoured Division. In 1943, Ackoff went to Officer Candidate School in Brisbane, and was active in the Pacific theatre through the invasion of the Philippines until 1946 (Kirby & Rosenhead, 2011, pp. 389–390). In 1942, Churchman took leave from the university to serve as a mathematical statistician at the Frankford Arsenal of the U.S. Army in Philadelphia, working on experimental methods of testing small arms ammunition (Assad, 2011, pp. 174–175). In 1945, Churchman was elected chairman of the philosophy department at University of Pennsylvania.

During the war, Ackoff continued to work on his thesis by correspondence.[8] The dissertation was completed in June 1947. Churchman and Ackoff tried to establish an Institute of Experimental Methods at Penn. This was not welcomed, and Ackoff's teaching appointment was not renewed. In 1947, Ackoff accepted an appointment as an assistant professor of philosophy and mathematics at Wayne State University in Detroit.[9] With

[8] The closeness of the relationship between Ph.D. supervisor Churchman and doctoral student Ackoff is remarkable.

> Over the next 4 years we worked as best we could by mail, even when I was in combat zones. We made slow but steady progress. Four years later, just a few days before the opening of the second semester of the 1945-1946 academic year, I was released from the service and returned home and to the university. I took up where I had left off.
>
> To maximize the amount of time we could work together, West and I, West's sister, and a friend of hers rented a small house near the university, where we spent long and hard hours at both work and fun. In the summer of 1946 we went to Cambridge and rented a room near Harvard, got use of its library, and finished my thesis, about 600 pages of single-spaced typing (Ackoff, 1988, pp. 352–353).

[9] Churchman was only 5 years older than Ackoff, yet he left a university department chair role to follow his student.

Churchman at Wayne State U. in 1948, the Institute for Experimental Methods was again proposed. This was rejected strongly by the faculty, leading to the decision to not renew Ackoff's 3-year appointment.

In 1951, the Case Institute of Technology offered appointments to Ackoff and Churchman to develop an operations research group. Between 1951 and 1957, the Case OR faculty increased 6 to 30 members. The first Ph.D. degree in OR was granted in 1957 (Assad, 2011, p. 177). Through the 1950s, Ackoff established relationships with many in the field, including British operational researchers bringing wartime technical experiences into peacetime (Choukroun & Snow, 1992a, p. xii). In 1961-1962, Ackoff held a visiting chair at University of Birmingham, where he brokered a relationship between the UK Operational Research Society and the Tavistock Institute for Human Relations to set up the Institution for Operational Research (Kirby & Rosenhead, 2011, p. 391).

In 1958, after Churchman had spent a year at University of California at Berkeley, he accepted an offer to found the Center for Research into Management Science in the Graduate School of Business Administration (Ackoff, 1988, p. 354; Assad, 2011, p. 179). In 1964, Ackoff moved all that remained of the Case faculty, students and projects to U. Pennsylvania into the Department of Statistics and Operations Research in the Wharton School (Choukroun & Snow, 1992a, p. xii).

In 1959 at Pennsylvania, Ackoff began an association with Anheuser-Busch for a 30-year relationship that began with capacity forecasting, and turned to corporate planning (Choukroun & Snow, 1992a, pp. xii–xiv).

In 1963 at Berkeley, Churchman was appointed associate director at the Space Sciences Laboratories, sponsored by NASA to study both the management and social impact of technology (Assad, 2011, p. 179). Churchman consulted for the U.S. Fish and Wildlife Service, the National Institutes of Health and the National Science Foundation. In 1970, he would server as the founding editor for the journal *Interfaces* for The Institute for Management Sciences (now INFORMS).

Beyond sciencing, Churchman and Ackoff were interested in "problems such as management, city planning and education" (Mason & Mitroff, 2015, p. 5). The pursuit of applied philosophizing in a rejected "Institute of Experimental Method" had led the pair in 1948 to Wayne State University, and then in 1951 to Case Institute of Technology. A driver for improved relevance comes through a philosophical approach.[10] A demonstration of the dedication to the pragmatism of Edgar A. Singer Jr. (1873-1954) is evident in the posthumous publishing of *Experience and Reflection* by Churchman in 1959.

**2.1.3 |** In the early 1970s, the Social Systems Science program brought scholars together into Pennsylvania

By 1973, Ackoff, with Hasan Ozbekhan and Eric Trist, believed that a systems approach should go beyond the methods mainstream with the Wharton faculty in operations research. They left the OR department and formed a new Social Systems Sciences program, with two parts. The Management and Behavioral Science Center, chaired by Trist, focused primarily on not-for-profit and public sector organizations. The Busch Center created research opportunities related to the academic program, emphasizing corporate strategic planning and organizational design (Choukroun & Snow, 1992a, pp. xiv–xv). The Social Systems Sciences program drew on distinguished visitors, including Churchman, Emery, Donald Schon and Stafford Beer.

In 1978, Trist became a professor emeritus from U. Pennsylvania. He moved on York University in Toronto until 1983. From 1982 to 1984, Emery was a professor of Social Systems Science at U. Pennsylvania (Bawden, 2022).

In 1981, Churchman retired from U.C. Berkeley, continuing to teach as professor emeritus in peace and conflict studies until 1996. In 1986, Ackoff became a professor emeritus, continuing consulting work as chairman for Interact, the Institute for Interactive Management through 2009.

The principal years of collective sciencing can be framed as from 1958 (Trist and Emery at Tavistock, Churchman Ackoff at Case) to 1982 (Ackoff and Emery at U. Pennsylvania, Trist at York U., and Churchman at Berkeley).

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West remained at Penn but arranged his courses so that he had to be in Philadelphia only Mondays and Tuesdays. He spent the rest of the week in Detroit with me, where we worked on our book, *Methods of Inquiry*. He came to know the members of the small department of which I was a part, and they were so taken with him that when I suggested he be brought to Wayne as a Visiting Professor, he was. At the end of his first semester there he was offered a full appointment, which he accepted (Ackoff, 1988, p. 353).

[10] The philosophy of science enriches science.

> … philosophy's contribution can take at least four forms: the clarification of scientific concepts, the critical assessment of scientific assumptions or methods, the formulation of new concepts and theories, and the fostering of dialogue between different sciences, as well as between science and society (Laplane et al., 2019).

**2.2 | Socio-Technical and Socio-Ecological Systems perspectives evolved to Causal Texture Theory**

From the Tavistock Institute, three research perspectives resulted contemporaneously from sciencing, with based on the engagements at hand at the time.

> ... the socio-psychological, the socio-technical and the socio-ecological perspectives ... emerged from each other in relation to changes taking place in the wider societal environment. One could not have been forecast from the others. Though interdependent, each has its own focus. Many of the more complex projects require all three perspectives (Trist & Murray, 1997, p. 30).

Following WWII, the Tavistock group was separated into two organizations. The Tavistock Clinic became part of the newly formed National Health Service, approaching the psycho-social with the social field directed by psychological forces. The Tavistock Institute focused on consulting with organizations, approaching the socio-psychological with the psychological forces directed towards the social field.

**2.2.1 |** Industrial mechanization led to the development of the Socio-Technical Systems perspective

The Socio-Technical Systems (STS) perspective was sparked by studies of the work system in Yorkshire coal mines, with the introduction of longwall machines (Trist & Bamforth, 1951). An edited republishing of the 1951 "Characteristics of Socio-Technical Systems" article coinciding with Emery's first arrival at Tavistock summarized the progress to date (Emery, 1993). A 1981 reflection (republished in 1993) highlights new thinking in organizing work:

> For several decades the prevailing direction had been to increase bureaucratization with each increase in scale and level of mechanization. The organizational model that fused Weber's description of bureaucracy with Frederick Taylor's concept of scientific management had become pervasive. [....]
>
> It was not true that the only way of designing work organizations must conform to Tayloristic and bureaucratic principles. There were other ways, which represented a discontinuity with the prevailing mode. The technological imperative could be disobeyed with positive economic as well as human results. [….]
>
> Conceptually, the new paradigm entailed a shift in the way work organizations were envisaged (Trist, 1981, pp. 8–10, 1993, pp. 37–38).

Sciencing on the STS perspective led to principles for the design of work organizations, clearly based on systems theories.[11]

Taylorism, or Scientific Management, was meant to be a direct application of Western scientific principles to the management of work processes in organizations. A Socio-Technical Systems perspective countered this with an approach meant to enable adaptiveness in purposeful organizations, towards improving reliability of the system. Two philosophies were described: (i) Design Principle 1 (DP1) based on *redundancy of parts*; and (ii) Design Principle 2 (DP2) based on *redundancy of functions*.[12] Machines are essentially designed according to DP1: when a

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[11] Reflections on the principles of STS design were summarized in 1981, and republished in 1993.

Some of the principles involved were as follows:

1) The *work system*, which comprised a set of activities that made up a functioning w hole, now became the basic unit rather than the single jobs into which it was decomposable.
2) Correspondingly, the *work group* became central rather than the individual jobholder.
3) *Internal regulation* of the system by the group was thus rendered possible rather than the external regulation of individuals by supervisors.
4) A design principle based on the *redundancy of functions* [*] rather than on the redundancy of parts (Emery, 1967) characterized the underlying organizational philosophy which tended to develop multiple skills in the individual and immensely increase the response repertoire of the group.
5) This principle valued the *discretionary* rather than the prescribed part of work roles (Jaques, 1956).
6) It treated the individual as *complementary* to the machine rather than as an extension of it (Jordan, 1963).
7) It was *variety-increasing* for both the individual and the organization rather than variety-decreasing in the bureaucratic mode (Trist, 1981, p. 9, 1993, p. 38).

[12] Mechanistic systems are designed with parts providing function to the whole, according to their structure. Social systems are composed of human beings, who can serve in multiple functions.

There are two basic ways that redundancy can be built in:

By adding redundant parts to the system. Each part is replaceable; as and when one part fails, another takes over.

By adding redundant functions to the parts. At any one time some of the functions of any part will be redundant to the role it is playing at the time; as and when a part fails in the function it is performing, other parts can assume the function; so

part fails, it is replaced with another having the same specification. DP1 is characterized as *subjective seriality* in which the governing relation is *asymmetrical dependence*. Human beings have the capability to be multifunctional, i.e. one person can serve multiple roles. A DP2 organization values teams where individuals have multiple skills, allowing autonomy in task taking and job rotation, and potentially producing superior outcomes. DP2 is characterized as *complementary seriality* in which the governing relation is *symmetrical dependence*.

**2.2.2 |** The increased speed of change around organizations led to the Socio-Ecological Systems perspective

The Socio-Ecological Systems (SES) perspective emerged from 1959 into the early 1960s, as the Tavistock Institute was engaged with large British organizations in aerospace, agriculture and consumer goods in international markets.[13]

In the publication of the "The Causal Texture of Organizational Environments", the open systems theory of the STS perspective based on the part-whole organicism following General Systems Theory was found insufficient. The SES perspective brought an ecological approach of wholes alongside wholes.

> ... though von Bertalanffy's formulation enables exchange processes between the organism, or organization, and elements in its environment to be dealt with in a new perspective, it does not deal at all with those processes in the environment itself that are among the determining conditions of the exchanges. To analyze these, an additional concept is needed -- the causal texture of the environment -- if we may reintroduce, at a social level of analysis, a term suggested by Tolman and Brunswik (1935) and drawn from S. C. Pepper (1934) (Emery & Trist, 1965, p. 22).

Four connections between the organization and its environment were presented as laws.[14] The STS perspective centers on $L_{11}$ inside an organization (i.e. within the system of interest), with $L_{12}$ (as planning, with the system of interest influencing the environment) and $L_{21}$ (as learning, by the system of interest about changes in the environment) recognized in open systems theory. The causal texture of $L_{22}$ (i.e. environmental wholes acting on other environment wholes) is outside the STS perspective. Metaphorically, "we may lawfully connect the actions of a javelin thrower in sighting and throwing a weapon; but we cannot describe in the same concepts the course of the javelin as this is affected by variables lawfully linked by meteorological and other systems" (Emery & Trist, 1965, p. 22).

Four ideal types of causal texture were described, as approximations of the world in which most organizations live.[15] The first three were considered well appreciated in disciplines. The fourth was new.

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> long as a part retains any of its functional capabilities (i.e., functional relative to system requirements) it is of some value to the system (Emery, 1977, p. 92, 1993b, p. 214).

[13] While the coal mining studies can be seen as national interests by the UK government, later consulting engagement included more commercial interests.

> ... we were dealing with cases where the broader environment -- the customers, labor force, legislators etc. -- was developing and changing the task environments. These broader environmental changes were acting to change the input/output equations as much as, if not sometimes more than, the systems themselves.
>
> More than that, it was possible to trace through these broad environmental changes and they appeared as knowable and as lawful as the changes occurring with systems or between systems and their dedicated task environments (Emery, 1997b, p. 38).

[14] Lawful connections between the organization and its environments are subscripted to emphasize directionality.

> With this addition, we may now state a general proposition: that a comprehensive understanding of organizational behavior requires some knowledge of each member of the following set, where L indicates some potentially lawful connection and the subscript 1 refers to the organization and the subscript 2 to the environment:
>
> $L_{11}, L_{12}$
> $L_{21}, L_{22}$
>
> $L_{11}$ here refers to processes within the organization, the area of internal interdependencies; $L_{12}$ and $L_{21}$ to exchanges between the organization and its environment, the area of transactional interdependencies, from either direction; and $L_{22}$ to processes through which parts of the environment become related to each other, that is, its causal texture, the area of interdependencies that belong within the environment itself (Emery & Trist, 1965, p. 22).

[15] Organization Development reflects roots is work psychology. Organization Design can be more associated with the rise of sociology.

> 1. In the simplest type, goals and noxiants are relatively unchanging in themselves and randomly distributed. This may be called the *placid, randomized environment*. A critical property from the organization's viewpoint is that there is no difference between tactics and strategy, and organizations can exist adaptively as single, and indeed quite small, units.

The first, simplest type was called the *placid, randomized environment*. For organizations, this required no need to distinguish between strategies and tactics. Small, individual units could adapt adequately. The second was the *placid, clustered environment*. Strategies became more important, and larger organizations with more centralized control and coordination were needed. Both of these types of environment were essentially static.

The third type was the *disturbed-reactive environment*, which was dynamic. Here, numerous organizations of the same type competed against each other, requiring more decentralized control, and strategies typical of military operations. The fourth type, called *turbulent fields*, was dynamic not only in competition between organizations (systems) themselves, but also at the level of the fields (the "ground") in which they existed.[16]

> The next generation of scholars who studied with Trist and Emery, have continued this work into the 21st century. "Causal texture is an emergent property of the whole field and concerns the behaviour of all systems within it. The causal texture of a field sets conditions on how these systems and shared environments transact" (Selsky et al., 2007, p. 74). Beyond organizational design within an enterprise as a system, they approach business networks as inter-organizational constellations under the label of Causal Texture Theory. The fluidity of coordinating across organizations contrasts with a presupposition of "strategy as plan" towards an end point. "CTT [Causal Texture Theory] deals with systems trying to survive and thrive in their environments in a sustainable way" (Ramirez et al., 2008, p. 18).[17]

One way of designing an inquiring system that sweeps in the complexities of causal texture into a strategic planning exercise is scenario planning.

The Trist-Emery partnership from 1951 to 1983 saw the development of the STS and SES perspectives. Some of the tradition was passed on to graduate students in the Faculty of Environment Studies at York University in Toronto, in the early 1980s (Morley, 1989). Trist had hoped that Calvin Pava might extend the work into the digital age, but Pava unfortunately passed away at the age of 39 in December 1992, shortly before Trist himself passed away in June 1993. Approaching the lawful links through negotiating order is another way to deal with a turbulent causal texture (Parhankangas et al., 2005).

### 2.3 | Operations Research evolved to Social Systems Science

Ackoff and Churchman were both founders of the Operations Research Society of America (ORSA) in 1952 (INFORMS, 2018a, 2018b). Ackoff was the fifth president of ORSA in 1956-1957. A subgroup of ORSA wanted a

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> 2. The next type is also static, but goals and noxiants are not randomly distributed; they hang together in certain ways. This may be called the *placid, clustered environment*. Now the need arises for strategy as distinct from tactics. Under these conditions, organizations grow in size, becoming multiple and tending towards centralized control and coordination.
> 3. The third type is dynamic rather than static. We call it the *disturbed-reactive environment*. It consists of a clustered environment in which there is more than one system of the same kind, that is, the objects of one organization are the same as or relevant to others like it. Such competitors seek to improve their own chances by hindering each other, each knowing the others are playing the same game. Between strategy and tactics there emerges an intermediate type of organizational response, what military theorists refer to as operations. Control becomes more decentralized to allow these to be conducted. On the other hand, stability may require a certain coming-to-terms between competitors.
> 4. The fourth type is dynamic in a second respect, the dynamic properties arising not simply from the interaction of identifiable component systems but from the field itself (the ''ground''). We call these environments *turbulent fields*. The turbulence results from the complexity and multiple character of the causal interconnections. Individual organizations, however large, cannot adapt successfully simply through their direct interactions. An examination is made of the enhanced importance of values, regarded as a basic response to persisting areas of relevant uncertainty, as providing a control mechanism, when commonly held by all members in a field. This raises the question of organizational forms based on the characteristics of a matrix (Emery & Trist, 1965, pp. 30–32 emphasis added).

[16] The Tupe IV causal texture might be associated (but not required) with the advent of the matrix organizational form in the 1960s. In the aerospace industry, a project manager would take primary line authority for completing a contract and assigning personnel, with corporate functional departments secondarily in a support relationship (Mee, 1964). It would be the late 1970s before the matrix form would become recognized in consulting, professional firms, multinational companies, banking, retail, hospitals and government (Davis & Lawrence, 1977; Hill & White, 1979).

[17] Practitioners with a stronger exposure to systems theory will better appreciate the language used with Causal Texture Theory.

> The inside (a system) and the outside (the environment of that system) 'co-evolve' in the sense that systems and their environments mutually and systematically influence each other, and they proceed into the future together (Selsky et al., 2007). System and environment both have links between variables that exist within them and links with each other. Several interacting systems, their shared environments and the links that connects them together are defined as a 'field'. (Ramirez et al., 2008, pp. 18–19).

more managerial orientation – Churchman wanted less of a military focus – and The Institute of Management Sciences was formed in 1953 (Horner, 2017). Churchman became the founding editor for the journal *Management Science*, as well as president of TIMS in 1962.

*Introduction to Operations Research* (Churchman et al., 1957), the acclaimed first textbook written on the subject, grew from the lectures materials from the course offered at Case Institute since 1952, one of the first academic programs on the subject. The core of the book from Part III focuses on "The Model": inventory models, allocation models, waiting-time models, replacement models, and competitive models. Part II on "The Problem" has chapters on "Analysis of the Organization", "Formulation of the Problem", and "Weighting Objectives". The Part I "Introduction" reflects an emerging systems approach with chapters on "The General Nature of Operations Research", "An Operations Research Study of a System as a Whole", and "Research Team Approach to an Inspection Operation".[18] A multidisciplinary "team approach" was not widely accepted across the Operations Research community. A review of this introductory section was described as "vulnerable" and "unfortunate", while the book may "have a profound influence upon the direction which OR takes in the future" (Jacobs, 1958, p. 474).

Churchman's dissatisfaction with the scope of Operations Research led to his sciencing into managerial decision-making.

> The problem is this: there is sufficient evidence to show that a manager may have perfect information "available" to him and yet not make the correct decision; what is the explanation of this phenomenon? Why don't managers act on the information stored in their environments? (Churchman, 1963, p. 30)

This issue would be explored at depth in two books. In the 1968 book *Challenge to Reason*, the criteria of rationality (e.g. expected utility) towards courses of action was questioned.[19] This initiated a thread that would later be described as a second wave of critical systems theory involving participation, laying groundwork for a third wave including emancipation (Midgley & Rajagopalan, 2020).[20] That book by Churchman would be distinguished by the American Academy of Management as one of the best books in management in 1968. The 1971 book *The Design of Inquiring Systems*, explored ways in which systems that might be improved through learning (i.e. inquiry, in a pragmatic epistemology) could be guaranteed.[21] This more philosophical work traced history from Leibniz, Locke, Kant and Hegel, and presented an operationalization continuing the lineage from Edgar A Singer, Jr. (Ulrich, 1988).

Ackoff, visiting at University of Birmingham in 1961, was invited to give an opening address for the national conference of the Operational Research Society of the UK. He chose to not give an "inspirational" address, but instead a provocation.[22] In retrospect, this could be seen as a call for what later might be called "Soft OR", or Problem Structuring Methods.

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[18] Churchman cautioned against Operations Research as a discipline dominated by mathematics:

> The overlap of methods, techniques, and tools between O.R. and other fields is largely due to the way in which O.R. was initially and is still carried on. It is research performed by teams of scientists whose individual members have been drawn from different scientific and engineering disciplines. One might find, for example, a mathematician, physicist, psychologist, and economist working together on a problem of optimizing capital expansion. The effectiveness of such inter-disciplinary teams in tackling the type of problem characterized as the subject matter of O.R. is not accidental (Churchman et al., 1957, p. 9).

[19] The title *Challenge to Reason* takes a systemic approach, recognizing *The Critique of Pure Reason* by Immanuel Kant: "

> How can we design improvement in large systems without understanding the whole system, and if the answer is that we cannot, how is it possible to understand the whole system? (Churchman, 1968, p. 3)

[20] The first wave of systems thinking included open systems theories of Angyal and von Bertalanffy, seeing models as representations of reality, rather than as aids on which intersubjective understandings across people could be developed:

> A second wave was born. In this new wave, systems were no longer seen as real-world entities, but as *constructs to aid understanding*. The emphasis was on dialogue, conflict resolution, mutual appreciation, and the intersubjective construction of meaning. Arguably, the authors best known for generating this paradigm shift are Churchman ([1979 *The Systems Approach*]), Ackoff (1981 [*Creating the Corporate Future*]), and Checkland (1981 [*Systems Thinking, Systems Practice*]). It is worth saying something about Churchman's contribution in particular, as his work was not only foundational for the second wave of systems thinking, but also influenced later third wave developments, including CST (Midgley & Rajagopalan, 2020, p. 112, embedded references extended).

[21] Inquiry, from pragmatism, was coupled with an action oriented by Churchman:

> In this essay, our interest lies in the creativity of science, i.e., in the actions that lead to new knowledge. We are interested in the extent to which man can design an inquiring system (Churchman, 1971, p. 4).

[22] Ackoff echoes Dewey's formulation that a problem well-put is half solved.

> To be sure, a great deal of work is being done on the development of techniques of modelling and extracting solutions from models. Unfortunately, some of us have become so enchanted with these techniques that we identify operational research with their application, whether their application in a specific context is justified or not. To be successful, operational research must be problem-oriented, not technique-oriented. Relatively unsophisticated mathematics applied to the right

Ackoff was in the OR Department of the University of Pennsylvania from 1964 to 1973. Unable to effect radical change, he led a minority of the faculty to initiate the Social Systems Science ($S^3$) program, offering degrees 1975-1988. In 1979, he declared Operations Research in the USA as dead, with the possibility that Operational Research in the UK might not yet have died, or had experienced a renaissance. To be constructive, he prescribed for that the field of OR should see the larger scope of problem-solving:[23] At the University of Pennsylvania, the OR program became a fraction of its prior size, and no longer had a research center associated with it. Ackoff claims the Social Systems Sciences program would not have come about, if OR were able to change into a new paradigm, whereby:

> … the predict-and-prepare paradigm employed by OR be replaced by one directed at designing a desirable future and inventing ways of bringing it about, and that OR replace its problem-solving orientation by one that focuses on planning for and design of systems (Ackoff, 1979a, p. 189).

This systems research and education program addressed four major concerns: (i) developing and applying methodology for dealing holistically with systems of problems, messes; (ii) examining the design of social systems that can *learn* and *adapt* rapidly, towards coping more effectively with increasing complexity; (iii) humanizing ways to design, plan for and manage social systems to better serve purposes of their parts while promoting systemic objectives; and (iv) designing and managing systems towards better serving larger and other systems in its environment.

Ackoff became president of the Society for General Systems Research (SGSR) for 1987-1988. In 1988, the organization was renamed the International Society for the Systems Sciences (ISSS). Churchman became president of the ISSS for 1989-1990.

### 2.4 | After Internet and globalization, 2020s concerns included service economy and Anthropocene

More than 50 years have passed since the publishing of the 1965 "Causal Textures" article. The Internet has "flattened" the world (Friedman, 2005), with intelligent devices and ubiquitous communications enabling globalization of trade and cultures. The Trist-Emery and Churchman-Ackoff relationships advanced sciencing in social systems.[24] In business, the socio-ecological perspective saw re-expression as value constellations (Normann & Ramirez, 1993; Normann & Ramírez, 1994), innovation networks (Tuomi, 2002), and network economy (Shapiro

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problem is more likely to yield useful results than is sophisticated mathematics applied to a problem which has been distorted to receive it. This is not to say that sophisticated mathematics cannot serve us well. It can and does, but only if at least four conditions are satisfied: (1) if the problem is properly formulated, (2) if the appropriate techniques are applied, (3) if a proper measure of effectiveness is used, and (4) if the results are implementable (Ackoff, 1962, p. 2).

[23] The Social Systems Science program at University of Pennsylvania aspired beyond shortcomings in the OR Department.
First, there is a greater need for decision-making systems that can learn and adapt effectively than there is for optimizing systems that cannot.
Second, in decision making, account should be taken of aesthetic values-stylistic preferences and progress towards ideals-because they are relevant to quality of life.
Third, problems are abstracted from systems of problems, messes. Messes require holistic treatment. They cannot be treated effectively by decomposing them analytically into separate problems to which optimal solutions are sought.
Fourth, OR's analytic problem-solving paradigm, "predict and prepare," involves internal contradictions and should be replaced by a synthesizing planning paradigm such as "design a desirable future and invent ways of bringing it about."
Fifth, effective treatment of messes requires interaction of a wide variety of disciplines, a requirement that OR no longer meets.
Sixth and last, all those who can be affected by the output of decision making should either be involved in it so they can bring their interests to bear on it, or their interests should be well represented by researchers who serve as their advocates (Ackoff, 1979b, p. 103).

[24] The dominant modes of systems thinking can be seen as reflections of progressive eras.
In the 1950s–1960s, the rise of systems thinking correlates with advances in understanding physical systems. The foundational concepts of relations between parts were established, mostly in a mechanistic paradigm. Similes of computers as electronic brains and of athletes as locomotives illustrate the way that systems thinking was described.
In the 1970 and 1980s, systems thinking was challenged to recognize that that human systems do not behave like machines. The socio-psychological systems perspective describes human individuals in relation to groups and institutions; the socio-technological systems perspective describes human individuals and groups in relation to technologies; the socio-ecological systems perspective describes human individuals and groups in relation to rapid changes in society. With purposes in their parts and wholes, systems thinking developed a stronger appreciation of social systems thinking.
In the 1990s and 2000s, systems thinking was at the foundation of awareness about threats to the ecology. The natural world behaves neither as a machine nor as a social system. As environments in which living organisms change, some species have become stressed, whereas others are driven into extinction. Resilience thinking and panarchy emerged to describe cycles of growth and decline, as systems at varying scales coevolve (Ing, 2013, p. 536).

& Varian, 1999). Systems approaches centered first not on social systems but on ecosystems rose, from research into panarchy (Gunderson & Holling, 2002; Holling, 1973) into Social Ecological Systems (Berkes et al., 2002; Ostrom, 2009; Walker et al., 2004). Ten years ago, a call was made for renewing sciencing on systems.[25]

By 2023, these 21st century themes have continued, with some new labels. With the shift from personal computers to smartphones, the everyday use of social media has popularized commercial activity in the platform economy (Kenney & Zysman, 2016; Kiesling, 2018). The anticipation on climate change becoming regime shifts in ecosystems (Folke et al., 2004; Rocha et al., 2015) has been observed with the threat of firescapes (Bacciu et al., 2022; Thacker et al., 2023). The COVID-19 pandemic led to worldwide disruptions of societies and economies, from which we collectively may not have sufficiently learned to change behaviours. The rise of Generative Artificial Intelligence (AI) (e.g. ChatGPT) has been evolutionary to technologists, but governments and workers have been suddenly awakened to risks without strong precedents.

Rapid changes in sciencing are known as scientific revolutions (Kuhn, 1967). This leads us beyond normal sciencing towards discontinuous shifts in sciencing, better explored from philosophizing on sciencing.

## 3 | Philosophizing on science in the 1940s-1970s coincided with postwar recovery

There are practice patterns that develop through sciencing, as trial and error leading to adequacy for adoption, accepted as efficacious until superseded. The systems practices taken as conventional wisdom in the 1960s to 1990s by Trist-Emery and Churchman-Ackoff can be traced back into philosophizing on science from the 1940s to 1970s.

Trist was initially most influenced by Kurt Lewin, who had encountered Gestalt psychology while studying for his doctorate at University of Berlin, graduating in 1916 while serving in the German army. Lewin become a professor of philosophy and psychology at U. Berlin, until relocating to the United States in 1933 to escape worsening political conditions in 1933. While studying at Cambridge, Trist was attracted to the Gestalt ideas of Kurt Lewin, in a 1931 *Journal of General Psychology* article on how conceptual change might take place in modern psychology (Trahair, 2015, p. 28). In 1933, just before Trist was to leave for Saybrook College at Yale University under a Commonwealth Fellowship, he was called back to Cambridge for a tea with Lewin (Trahair, 2015, pp. 34–35). Lewin was on his way to Cornell University for a professorship as a displaced German scholar. Lewin toured the Cambridge campus guided by Trist for an hour. Trist would next see Lewin lecturing at Yale. After the Cornell appointment ran out, Lewin became a professor at University of Iowa 1935-1944, in the Child Welfare Research Station. In 1945, Lewin moved to MIT and founded the Research Center for Group Dynamics. In 1946, through a visit by Elliott Jaques, Lewin agreed to join the Tavistock Group in the publication of *Human Relations* (Trahair, 2015, p. 119). Two articles by Lewin were published in the first issue of *Human Relations* in 1947. Trist looked forward to meeting with Lewin to discuss how action research might be introduced into UK social science projects, but Lewin passed away in February 1947, before that conversation could take place.

In 1955, Trist was co-opted into the Management Committee of the Tavistock Institute, becoming Deputy Chairman (Trahair, 2015, pp. 163–167). Emery joined the Tavistock Institute in January 1958. With Trist, the two conducted studies on the STS perspective in Bristol prison, and the pilot Search Conference in a merger of Bristol Aero Engines with Armstrong-Siddeley Motors (Trahair, 2015, pp. 177–190). Trist took leave for research at the Centre for Advanced Studies in Palo Alto, from January 1960 to May 1961. In February 1961, acting chairman Ken Rice initiated an organizational split between consulting and research activities at the Institute (Trahair, 2015, pp. 195–199). In March 1961, influenced by the conflicts at Tavistock Institute, Emery wrote to Trist about a theory of organizational environments with human systems not as closed, but as open systems (Trahair, 2015, pp. 214–217). This thinking on organizational environments would lead to causal textures theory.[26] The 1965 article would reference works from two philosophers: “The Conceptual Framework of Tolman's Purposive Behaviorism” (Pepper, 1934) and *Methods of Inquiry* (Churchman & Ackoff, 1950).

[25] The theme for ISSS San Jose 2012 was on Service Systems (c.f. production systems) and Natural Systems (i.e. Anthropocene). Now, in the 2010s approaching the 2020s, systems thinking has the opportunity to contribute to the scientific understanding of issues in our world. Advances in two domains build on the traditions of systems thinking from the 20th century. Firstly, the shift of the developed world from manufacturing economies to service economies has opened up research into service systems science and service systems thinking. Secondly, the epoch of temperate climate enjoyed in the Holocene is transitioning into an Anthropocene where human activity has led to irreversible changes in the natural ecology. Are the traditions of systems thinking a foundation on which new knowledge is to be developed or an anchor where prior research becomes fundamentalist dogma? (Ing, 2013, p. 536)

[26] Socio-Technical Systems theory focused internally. Organizational environments are external to a system of interest. The notion of organizational choice took on entirely new dimensions; although previously organizational choice had referred to internal organizational arrangements of people and technology, it now included strategies taken by the organization to align or misalign itself with the environment (Pasmore & Khalsa, 1993, p. 1993).

Thus, from the 1960s, the philosophy of science under both Trist-Emery and Churchman Ackoff have roots in the lineage of American pragmatism. Stephen C. Pepper, a professor at U.C. Berkeley 1919-1953, was conferred a Ph.D. in 1916, supervised by Ralph Barton Perry. At Harvard University, Perry was a graduate student (1896-1899) and colleague (from 1902) of William James (retiring in 1907) who edited and posthumously published James' journal articles into *Essays in Radical Empiricism* in 1912. Churchman was a student and colleague of Edgar A. Singer Jr., who received a postgraduate fellowship to study and teach with William James in 1895. Churchman would edit and posthumously publish Singer's book on *Experience and Reflection* in 1959. The overlapping institutional affiliations are charted in Appendix 1.

Causal texture theory via Trist-Emery results from philosophizing on root metaphors in organicist and contextualist world hypotheses from Pepper. Social Systems Science via Ackoff results from philosophizing on nonrelativistic pragmatism from Churchman-Ackoff.

### 3.1 | Causal Texture Theory has root metaphors in organicism and contextualist world hypotheses

The philosophical turn in sciencing from biological to ecological by Trist-Emery occurred between 1963 and 1965, at which time the seminal article was published in *Human Relations*. To better appreciate the turn, writings by the social scientists lead back to philosophizing on pragmatism.

In developing the Socio-Psychological Systems perspective, Trist was deeply influenced by psychiatrist Andras Angyal.[27] Trist was not so concerned with General Systems Theory, focusing on organizations where "human systems are different", following the predisposition of Sir Geoffrey Vickers.[28]

To be explicit in a definition of systems, think of structure as an "arrangement in space", and process as an "arrangement in time" (Gharajedaghi, 2011, p. 93; Ing, 2013, p. 529). Trist extends Angyal's thinking from psychological systems to sociological systems, with a presumption that a human organization is integrative. Towards the open systems theory developed jointly by Emery and Trist, Angyal doesn't use the terms of "system" and "environment".

> In conceptualizing the interdependence between system and environment, Angyal made a novel contribution by making this interdependence his starting point. Instead of taking two terms "system" and "environment," which he must then relate in interactionist terms, he starts with one, the "universe," which includes them both. This he calls the "biosphere." For Angyal (1941), life takes place in the biosphere rather than inside the organism (or organization) (Trist, 1992, p. 116)

Trist saw this as a shift in root metaphor from "mechanism" to "contextualism". This may be incomplete (as discussed later in this section, below), as a jump in world hypotheses from analytic-integrative (mechanicist) to synthetic-dispersive (contextualist). In any case, Angyal sees a balance between autonomy (an organism attempting to extend control over its heteronomous environment) and homonomy (ways in which individuals relate to the larger world of which they are a part).

Trist expressed some reticence about teleology (i.e. goal-directed and ideal-seeking behaviour) that was not written by Angyal, but interpreted by Ackoff and Emery.[29] Emery was committed to purposiveness (i.e. goal-

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[27] In a general theory of systems, Trist cites von Bertalanffy, and then moves onto Angyal.

> Angyal, however, took a further step than these writers by formulating dynamic holism not only in systems terms but explicitly in terms of a theory of open systems. While the general idea of a system being open to its environment may be traced back to von Bertalanffy (1932) or Kohler (1938) -- and some may look for even earlier root -- no one before Angyal (1941) in his book *Foundations for a Science of Personality* (hereafter, FSP), which appeared in the early years of World War II, had stated the open systems concept in a way that showed its central relevance to the biological and social sciences as a whole (Trist, 1992, p. 111).

[28] Relations of structure and process are more difficult in discussing inseparable complexes, than with decomposable complications.

> Wholeness is not simple but represents, in Angyal's phrase, a *unitas multiplex* -- a system of interdependencies. It consists in complexity -- which expresses organization. Organization is the primary datum when nature -- physical, biological, or social -- is considered as a set of concrete whole objects. It is organization—and organizations -- one has to study if this is the perspective adopted. How far organizational forms may prove to be isomorphic has to be established empirically. Organization refers to both structure and process, concepts that have created much confusion and, in terms of one of which, to the exclusion of the other, many theories have been developed. Angyal's writings suggest that a structure is a process and that a process has structure. This double character of organization as structure and process seems to me to be demonstrable on the psychological level by the responses to the artificial creation of random fields .... (Trist, 1992, pp. 112–113).

[29] Anticipation towards the future may be seen as directional (i.e. movement), and not necessarily teleological (i.e. goal-oriented).

> Teleology was anathema in the scientific world of the 1940s and the stranglehold of the ateleological position has only gradually loosened since that time. That a man otherwise so in advance of his times should have avoided the teleological issue in the way he did exemplifies the force of the prevailing paradigm.

directed behaviour, ends within a period planned), less convinced than greater purposefulness (i.e. ideal-seeking behaviour, end unattainable over any period) espoused by Ackoff. From a non-anthropocentric living systems perspective, perhaps Trist might have been receptive to reorienting from teleology to the teleonomy of Ernst Mayr.[30] "*A teleonomic process or behavior is one which owes its goal-directedness to the operation of a program*. The term teleonomic implies goal direction. This, in turn, implies a dynamic process rather than a static condition, as represented by a system (Mayr, 1988, p. 45). In sciencing and philosophizing that involves evolution, teleonomy obviates issues whereby human beings exhibit will, in ways that other animals are believed to not do.

In the 1969 landmark publication of *Systems Thinking: Selected Readings*, arguments are made for a systems approach to the analysis of living phenomena. The interests were on managing social systems, rather than theorizing on systems in general.[31] Emery would seem to have been following the Ackoff movement away from Operations Research. The orientation of the reader would be primarily on the STS perspective.

In the "Precedents to Systems Theory" first part of the 1969 reader, the first chapter on "A logic of systems", excerpted from Angyal (1941) contrasts cause-effect thinking from systems thinking.

> In causal research, the task is to single out from a multiplicity of data, pairs of facts between which there is a necessary connection. In systems thinking the task is not to find direct relations between members but to find the superordinate system in which they are connected or to define the positional value of members relative to the superordinate system (Angyal, 1969, p. 24).

This is based on two different processes of knowing: (i) explanation refers to relational thinking, the direct connection between two objects; and (ii) understanding refers to complex relations with an unspecified number of components..

In 1968, Trist wrote to Ackoff that his intellectual trend was "pretty sure now . . . towards what I am starting to call organisational ecology" (Trahair, 2015, p. 230). This insight came through the reading of *Value Systems and Social Process* by Sir Geoffrey Vickers, published by the Tavistock Institute that year (Vickers, 1968). The third part of that book is titled "Beyond Descartes", describing "Appreciative Behaviour".

With the benefit of hindsight from decades later, the 1969 reader reflected the progress the researchers had made to date. Emery wrote that an ecological perspective was beyond the theories that had been built on Lewin and/or Angyal.

> Lewin was scuppered by philosophy, Angyal by the then state of the psychology of perception and motivation. It was only with the emergence of psychological ecology, on the back of Gibson's (1979) pathbreaking work in perception, that the program put forward by Lewin and pursued by Angyal once again found a foothold in the academic social sciences (Shaw and Turvey, 1981) (Emery, 1997b, p. 43).

From ecological psychology, the most familiar work is likely "The Theory of Affordances" in *The Ecological Approach to Visual Perception* (Gibson, 1979). Michael T. Turvey and Robert E. Shaw would build on Gibson's

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> Except for some very early work of Singer (1924), the search for a conceptual framework that would allow the inclusion of teleology in a language acceptable to science had scarcely begun when Angyal was writing FSP. This was well before the arrival of what Ackoff (1974) has called the "Systems Age." Apart from the contributions of cybernetics and information theory, those of Churchman and Ackoff (1950), Singer (1953) and Churchman (1961) opened up a path that might have been attractive to Angyal had he known of their work. A rigorous treatment of the teleological issue became available only after his death when the publication of *On Purposeful Systems* (Ackoff and Emery 1972) repunctuated the field.
> In my 1970 paper I had rested content with his notion of direction as a halfway house between an ateleological and a teleological position. Nor did I see any contradiction between talking about goals in their usual place in a psychology of motivation and denying purposefulness to the organism as a whole which represented the total biological process with which Angyal was so concerned (Trist, 1992, p. 123).

[30] As an alternative to an abstract goal outside of a biological system, Mayr described programming inside the system in 1961, but then modified his position in 1988.

> For the last 15 years or so the term *teleonomic* has been used increasingly often for goal-directed processes in organisms. I proposed in 1961 the following definition for this term: "It would seem useful to restrict the term teleonomic rigidly to systems operating on the basis of a program, a code of information" (Mayr 1961). Although I used the term *system* in this definition, I have since become convinced that it permits a better operational definition to consider certain activities, processes (like growth), and active behaviors as the most characteristic illustrations of teleonomic phenomena. I therefore modify my definition … (Mayr, 1988, p. 45).

[31] Emery outlined the focus of the selected readings in a footnote to the "Introduction":

> Throughout the volume we have kept to the strand of thought that runs from theorizing about biological systems in general to social systems. We have practically ignored the strand that arises from the design of complex engineering systems. Through such movements as operations research and cost-benefit analysis this influence is being strongly felt by management but its methods and language are so different as to require separate treatment (F. E. Emery, 1969a, p. 7).

research at the Center for the Ecological Study of Perception and Action, at the University of Connecticut.[32] This influenced a turn, extending the work from psychology to sociology: "In comparison to an information-processing characterization of *indirect* perception in Gestalt, an ecological characterization of *direct* perception is seen as a separate world hypothesis with its own root metaphor" (Cutting, 1982, pp. 202–203). This cross-appropriating of Gibson into social groups correlates with organizations become the systems of interest into the late 1960s.

In the 1969 reader, alongside the inclusion of Angyal (1941) work was a regret at the omission a reading on root metaphor theory from Stephen C. Pepper, most relevant to the socio-ecological perspective.[33] Pepper's credentials in metaphilosophy are supported by supervision of his doctorate in philosophy by Ralph Barton Perry, a student and then colleague of William James.[34]

In 1921, Perry described the movement from two 19th century philosophies: (i) positivism (as scientific philosophy, via David Hume (1711-1706)), and (ii) romanticism (as religious philosophy, via Immanual Kant (1724-1804)).[35] To *naturalism* and *idealism*, the early twentieth century added *pragmatism* derived "from the triumphs of science", and a new *realism* "from the loyalties and hopes of religion". Perry saw these two new tendencies as new revolts, with virility and capacity for growth to be tested by the next generation of philosophers.[36] Pragmatism is

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[32] The scope for Gibson was animal perception. Most psychologists are focused on human perception.

> As a revision of the ecological formulation of J.J. Gibson in psychology, the coalition model by Shaw and Turvey is an ecological reformulation with a more social science emphasis (Cutting, 1982, p. 200). As a coalition account of a honeybee ecosystem that might include all hive activities, the architectural behaviour of workers building combs (i.e. sheets of hexagonal cells) is described (Shaw & Turvey, 1981, pp. 396–397). (Cutting, 1982, pp. 202–203).

[33] The reference to Pepper (1950) should be more correctly cited as *World Hypotheses*, 1941.

> Only pressing problems of space precluded a selection from S. C. Pepper (1950). This is of particular importance because the 'root metaphors' he identifies and rigorously defines are all clearly operating in different systems theorists and account for much of the mutual incomprehension that exists among them. 'Contextualism' is the root metaphor which comes closest to our bias in selecting for this volume (Emery, 1969a, p. 15).

[34] Ralph Barton Perry would win a Pulitzer Prize in 1936 for a biography of William James. Perry was noted for clarifying the writings of James.

> By his appended summary of James's doctrines, Perry seems to me to have done a substantial service both to the reputation and influence of that master and to the study of contemporary philosophy. For James 's thought had a good deal more coherency, and the various parts of his reflection more of definite interconnectedness, than has commonly been recognized, more, indeed, than James himself ever paused to point out. Much of this Perry has exhibited in a highly illuminating manner; to not a few readers, I doubt not, this appendix will give a clearer and more correct understanding of James 's philosophical position than they have ever gained from reading James's own writings. This may seem a singular thing to say in the case of a writer so notable as James was for concreteness and effectiveness in exposition. But the truth is that James was by no means a good expounder of his own philosophy as a whole, except for such readers as had the patience to do what Perry has here done for them .... (Lovejoy, 1912, pp. 629–630)

[35] In the early 20th century,

> In positivism and romanticism the two motives of philosophy became sharply separated and opposed. Positivism is philosophy driven into the camp of science by loyalty to the standards of exact research; romanticism is philosophy merged into religion through its interest in the same ultimate questions. These two tendencies determined the course of philosophy in the nineteenth century: and they are represented today by naturalism and idealism respectively. In 'naturalism,' the positivistic tendency develops in the direction of a systematic materialism, or in the direction of a more refined criticism of scientific concepts. In 'idealism,' the romantic tendency amplifies and reinforces the theory of knowledge upon which it must rest its case the theory of the priority of the forms and ideals of the cognitive consciousness. But the difference between naturalism and idealism, like that between science and religion, with which they are respectively correlated, lies not so much in the disagreement of theory as in an opposition of attitude and method. The exponent of naturalism is governed by that reserve and apathy which belong to the scientist's code of honor; the idealist carries into his philosophy all the importunity and high aspiration of life (Perry, 1921, p. 38).

[36] With the Metaphysical Club of William James circa 1890 as a founding, pragmatism developed from the early 1900s.

> Pragmatism and realism are agreed in opposing both the narrowness of naturalism and the extravagance of idealism. Both seek to unite the empirical temper of the former with the latter's recognition of problems that lie outside the field of the positive sciences. They accept neither the finality of physical fact nor the validity of the ideal of the absolute. Their differences are scarcely less striking than their agreement, and may in the end drive them far apart. Pragmatism is primarily concerned to dispute the monistic and transcendental elements of idealism, and to construe life and thought in terms of that *human* life and thought that may be brought directly under observation, and studied without resort to dialectic. But life and thought remain the central topic of inquiry, and tend without sufficient warrant to usurp the centre of being. In short, pragmatism is never far removed from that dogmatic anthropomorphism, that instinctive or arbitrary adoption of the standpoint of practical belief, that is so central a motive in idealism. Realism, on the other hand, reacts not only against absolutism, but against anthropomorphism as well. Realism departs more radically from idealism than does pragmatism. Were the dilemma a real one, pragmatism would find more in common with idealism, and realism with naturalism. For

associated with the context of human lives, in material contexts; realism is associated with detachment from life, in idealized romanticism. In the next generation of philosophers following Perry was Pepper.[37]

In 1934, Pepper described a 1932 book on *Purposive Behavior in Animals and Men* by Edward C. Tolman as a "scientific revolution".[38] Tolman, having read William James while an undergraduate at MIT, turned to philosophy and psychology influenced by Gestalt proponents Kurt Lewin and Kurt Koffka. He completed his Ph.D. at Harvard in 1915. Tolman was a professor of psychology at U.C. Berkeley, 1918 to 1954. In period when the psychology was dominated under philosophical categories of mechanistic naturalism, Pepper saw Tolman confirming the philosophical stream of contextualism in pragmatism.[39] In comparison to the abstract philosophical descriptions of realism and pragmatism from Perry, Pepper provided a more useful way of describing metaphysical position as mechanism and contextualism (Duncan, 1980)

In 1935, Pepper extended the two metaphysical positions to describe "alternative world theories based on different root metaphors". A world theory is a metaphysics. Since Peirce (1968) built anti-skepticism into pragmatism (Legg & Hookway, 2021), world hypotheses builds on a theory of knowledge based in doubt.

> What I call the root metaphor theory is the theory that a world hypothesis to cover all facts is framed in the first instance on the basis of a rather small set of facts and then expanded in reference so as to cover all facts. The set of facts which inspired the hypothesis is the original root metaphor (Pepper, 1935, p. 369).

Many root metaphors fail due to inadequate evidence. Five "relatively fruitful root metaphors" were proposed:

> … similarity, which generates immanent realism; form and matter, which generates transcendent realism; push and pull, which generates mechanism; organic whole, which generates objective idealism; and temporal process, which generates contextualism (metaphysical pragmatism). None of these hypotheses is fully adequate (Pepper, 1935, p. 370).

This root metaphor theory, "whether the theory be correct in fact or not", was offered "as a useful instrument for the clarification of a confused field" in metaphysics. In a subsequent response to criticism, the root metaphor theory was defended as having "cognitive value", despite inadequacies (Pepper, 1936).

World theories can be placed between the extreme cognitive attitudes of an utter skeptic (i.e. "one who doubts all things") to a dogmatist (i.e. "one whose belief exceeds his cognitive grounds for belief"). In the moderate middle ground is partial skepticism, that is signified by world hypotheses, for which evidence can provide some certainty.

Six world hypotheses were reviewed, from which two were rejected as inadequate: "Animism is a world theory chiefly inadequate for the indeterminateness of its interpretations and lack of precision; mysticism, chiefly for its lack of scope and its lavish use of 'unreality'" (Pepper, 1942d, pp. 119–120). By the publication of the 1942 book, *World Hypotheses*, the first two root metaphors from 1935 would be combined, leaving four relatively adequate world hypotheses, as shown in Exhibit 1.

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> realism, like naturalism, detaches itself from life, and attempts to see things in their native colors through a transparent medium. But the dilemma is unnecessary. It proves possible to be both empirical and rigorous after the manner of science, and also emancipated from exclusive regard for physical fact (Perry, 1921, p. 39).

[37] Graduating with a Ph.D. in 1916, Pepper taught for a year at Wellesley College. After military service in WWI, Pepper joined U.C. Berkeley in 1919. He may have been more lauded in the field of aesthetics, as founder of the Department of Art Practice in 1923. Pepper was elected as chair of the Art Department from 1938 to 1952. He became chairman of the Philosophy Department with an endowed chair in 1938.

[38] Some philosophers see Pepper as influencing Thomas Kuhn. The book *The Structure of Scientific Revolutions* by Kuhn was started in 1947 as a graduate student at Harvard, finally published in 1962. After Kuhn failed to gain a promotion to a tenured position at Harvard in 1956, Pepper helped him secure a professorship as an assistant professor in the philosophy and history departments at Berkeley.

[39] A decade before World Hypotheses (1942), Pepper contrasted mechanism with contextualism.

> The main categories of mechanism are: first, a *spatio-temporal field*; second, *primary qualities* qualifying locations in that field; third, *natural laws* determining the configurations of locations qualified by *primary qualities*; fourth, *secondary qualities*; fifth, *laws determining the correlations* of secondary qualities with configurations of primary qualities; and, sixth, *laws determining* the sequences of *secondary qualities*. [….]
>
> The main categories of contextualism are: (i) *texture*, (2) in an *environment* of other textures, (3) analyzable into *strands* which extend into environmental textures, and (4) which have *references* (sense of direction) to or from environmental textures or (5) towards *consummations* yet to come, or (6) from *initiations* gone by. The (7) *quality* of a texture is a (8) *fusion* of its strands and there is no quality more fundamental than this felt or observed quality of the total texture (Pepper, 1934, p. 11).

**Exhibit 1.** Four relatively adequate world hypotheses [CC-BY David Ing]

| *World Hypothesis* | *Dispersive* | *Integrative* |
|---|---|---|
| *Analytic* | **Formism**<br>*Root metaphor:*<br>Similarity, are recurrence of recognizable features | **Mechanism**<br>*Root metaphor:*<br>Machine, where exerting force or energy produces predictable outcomes |
| *Synthetic* | **Contextualism**<br>*Root metaphor:*<br>Situation, as a historic event in its living actuality | **Organicism**<br>*Root metaphor:*<br>Constructive development, with orderliness of changes from stage to stage |

Pepper named four distinct world hypotheses with unfamiliar names, and coupled them loosely with prior philosophical schools. With each world theory, a root metaphor is induced.

- *Formism* is associated with *realism,* and the idealism of Plato and Aristotle. Its root metaphor is *similarity*.
- *Mechanism* is associated with *naturalism* or *materialism*, with philosophers such as Rene Descartes, John Locke, and David Hume. Its root metaphor is a *machine*.
- *Contextualism* is associated with pragmatism, and philosophers such as Charles S. Peirce, William James, Henri Bergson and John Dewey. Its root metaphor is a *situation* (described by Pepper as a historic event, or an act within a setting).
- *Organicism* is associated with *absolute idealism*, and philosophers such as George F. H. Hegel and Frances H. Bradley. Its root metaphor is *constructive development* (described by Pepper as integration, refinement towards an ideal).

Root metaphor theory builds on maxims, that can be taken as principles or rules on which knowledge is built. Each of the maxims outlined in 1942 are extended with post hoc inferences based on a contemporary appreciation of systems theories.

- *Maxim I: A world hypothesis is determined by its root metaphor*. In application, several systems theories could be based on a shared root metaphor.
- *Maxim II: Each world hypothesis is autonomous*. A systems theory should be independently judged on adequacy by the reliability in its corroboration of evidence within. A systems theory should stand on its own evidence, and not on the shortcomings of an alternative theory.
- *Maxim III: Eclecticism is confusing*. Systems theories are mutually exclusive from each other, based on different root metaphors. Mixing metaphors can introduce conflicting facts, leading to contradiction and a reduction of reliability.
- *Maxim, IV: Concepts which have lost contact with their root metaphors are empty abstractions*. A systems theory can grow old, so that associated abstractions get taken for granted. Rejuvenation comes through tracing evidence back to the root metaphor.

In essence, each world hypothesis is itself a system of knowledge, with a root metaphor at its core. Improving the reliability of multiple systems theories without contradiction is practical only if they share the same root metaphor.

The schema of Exhibit 1 above arranges ways for evidence to be recognized and interpreted. Pepper arranges the hypotheses depicted as polarities, as (i) analytic-deductive treatments, and (ii) dispersive-integrative treatments.

- The theoretical mode of reasoning can be analytic or synthetic.
    - With an *analytic* world theory,
        - *parts in relations* are presumed;
        - each whole comes inferred;
            - e.g. a world theory is reasoned by taking evidence apart; and
    - with a *synthetic* world theory,
        - *wholes* are presumed;
        - parts in relations come inferred;
            - e.g. a world theory is reasoned by putting evidence together.
- The theoretical mode for organizing evidence can be dispersive or analytic.
    - With a *dispersive* world theory,
        - *unpredictability* (non-determinism) is presumed;

        - determinate order is denied;
            - e.g. a world theory is organized through evidence that comes as scattered (fused through interpretation); and
    - with an *integrative* world theory,
        - *determinate order* is presumed;
        - unpredictability is denied;
            - e.g. a world theory is organized through evidence that fits properly (casting aside "unreal" facts).

The four world hypotheses are laid out in Exhibit 2 below, to underscore the distinctions.

**Exhibit 2.** Four relatively adequate world hypotheses [CC-BY David Ing]

| *World Hypothesis* | *Dispersive manner for organizing evidence* | *Integrative manner for organizing evidence* |
|---|---|---|
| *Analytic mode of reasoning* | **Formism**<br>• *Analytic*: parts in relations are presumed; each whole comes inferred;<br>• *Dispersive*: unpredictability (non-determinism) is presumed; determinate order is denied. | **Mechanism**<br>• *Analytic*: parts in relations are presumed; each whole comes inferred;<br>• *Integrative*: determinate order is presumed; unpredictability (non-determinism) is denied. |
| *Synthetic mode of reasoning* | **Contextualism**<br>• *Synthetic*: wholes are presumed; parts in relations come inferred;<br>• *Dispersive*: unpredictability (non-determinism) is presumed; determinate order is denied. | **Organicism**<br>• *Synthetic*: wholes are presumed; parts in relations come inferred;<br>• *Integrative*: determinate order is presumed; unpredictability (non-determinism) is denied. |

*Formism* is analytic and dispersive. The root metaphor of *similarity* reasons from parts into a whole, while the evidence arrives unpredictability for organizing.

*Mechanism* is analytic and integrative. The root metaphor of a *machine* reasons from parts into a whole, while evidence arrives in a determinate order.

*Contextualism* is synthetic and dispersive. The root metaphor of *situation* reasons from the whole into parts, while evidence arrives unpredictably for organizing.

*Organicism* is synthetic and integrative. The root metaphor of *constructive development* reasons from the whole into parts, while evidence arrives in a determinate order.

Systems thinking recognizes both synthesis and analysis. Working against reductionism, however, authentic systems thinking sequences reasoning through synthesis (i.e. wholes) before reasoning through analysis (parts) (Ackoff, 1981a, pp. 16–17; Ing, 2013, p. 529).

In organization theory, the Socio-Technical Systems perspective relates to organicism (Barton, 2009; Trist, 1981). The Socio-Ecological Systems perspective relates to contextualism.

A metaphor is a figure of speech that is used rhetorically to describe an object or idea by mentioning another. Root metaphor theory "is the theory that a world hypothesis to cover all facts is framed in the first instance on the basis of a rather small set of facts and then expanded in reference so as to cover all facts" (Pepper, 1935, p. 369). A root metaphor is a selected group of facts that expands an analysis to other facts, through which a metaphysical hypothesis can be derived. Each world hypothesis has its own theory of truth, and categories, summarized in Exhibit 3 below.

**Exhibit 3.** Root metaphors, theories of truth, categories, nature of time [CC-BY David Ing]

| *World Hypothesis* | *Dispersive manner for organizing evidence* | *Integrative manner for organizing evidence* |
|---|---|---|
| *Analytic mode of reasoning* | **Formism**<br>*Root metaphor*: Similarity, as recurrence of recognizable features<br><br>*Theory of truth*: Correspondence between (an) instance(s) and a likened ideal<br><br>*Categories*: Characterizations (of qualities and relations)<br><br>*Nature of time*: Universal or irrelevant. | **Mechanism**<br>*Root metaphor*: Machine, where exerting force or energy produces predictable outcomes<br><br>*Theory of truth*: Causal adjustment to a mature nominalism (i.e. named response to stimulus)<br><br>*Categories*: Primary qualities (effectual aspects) and secondary perception (symbols in the mind)<br><br>*Nature of time*: Schematic time as location (linear and dimensional) |
| *Synthetic mode of reasoning* | **Contextualism**<br>*Root metaphor*: Situation, as a historic event in its living actuality<br><br>*Theory of truth*: Operationalism, via qualitative confirmation of solving a specific problem<br><br>*Categories*: Strands, texture, quality, novelty<br><br>*Nature of time*: Qualitative duration, event relative to a specious present | **Organicism**<br>*Root metaphor*: Constructive development, with orderliness of changes from stage to stage<br><br>*Theory of truth*: Coherence, where fragments cohere with their nexus, free of contradiction<br><br>*Categories*: Progression (steps), final outcome (ideal)<br><br>*Nature of time*: Directional arrow, successive integrations |

The *theory of truth* for each world hypothesis is a logic of cognitive criticism. "A philosophically adequate base is one that leads to a large amount of corroboration in the handling of the totality of evidence; an inadequate base, one that fails to do this" (Pepper, 1943, p. 262). Dispersive theories are strong in scope in corroboration, but weak in precision (i.e. evidence is not well connected due to indeterminism or vagueness). Analytic theories are strong in precision in corroboration, but weak in scope (i.e. evidence that might be included is ignored or called "unreal").

*Categories* are "those concepts which most clearly and economically characterize a world theory, and differentiate it from other world theories" (Pepper, 1947, p. 555). Universal categories don't exist, because it is the distinctions between world theories that make them useful.

*The nature of time* is implicit with each root metaphor. Explicitly focusing on temporality in each of the four world hypotheses surfaces whether time comes to the foreground, or remains in the background.

*Formism*, as a world hypothesis, covers two ontologies: (i) immanent formism, where origin of being is contained in the world, and (ii) transcendental formism, where the origin of being is outside the world. The *root metaphor of similarity* could then either be between (i) two or more objects of the same type (e.g. sheets of papers), or two or more objects put into the same class (e.g. the sky and a bluejay are both blue). The *theory of truth is correspondence*, either between (i) two or more objects (e.g. likeness), or (ii) an object and a reference (e.g. a work of art, and the original subject). A general *category* that cover both ontologies is character, e.g. the qualities and relations in which the objects are similar. The *nature of* time can be either universal (i.e. the similarity between objects is eternal) or irrelevant (i.e. the object is compared to a reference.

Organizational systems theory based on formism would presume a universal ideal feature that instances would aim to emulate. Thus, an organization might eye the annual leave privileges in France of 36 to 48 days of vacation and public holidays, or parental leave in Finland of 320 days. From an analytical perspective, the isolated "best practices" don't necessarily have to add up.

*Mechanism*, has a *root metaphor* of a *machine* (i) like a watch, mechanical in matter, or (ii) a dynamo, in a electromechanical field. The *theory of truth* is *causal adjustment*, i.e. a machine in reality has a response to a

stimulus (e.g. an organism responds to a prick in reality), or correlates the prick with a corresponding symbol (such as the word "nail", or some other object that could prick). *Categories* include *primary qualities* (e.g. a real nail is sharp), or *secondary perception* (e.g. a object is pointy). The *nature of time* is *schematic*, e.g. a marked as an objectively regular clock in a place and time.

Organizational systems theory based on mechanism has been common with industrialization. The presumption that human beings can be programmed in the same way as machines is at the foundation of most employee incentive schemes.

*Contextualism* has a *root metaphor* of *situation*, where a historic event is embedded in the living actuality, not in the past and dead. In this pragmatic world hypothesis, the situation is often posed as a problem for which an act, at a point time, becomes solved. The *theory of truth* is operationalism, in a solution is confirmed to have solved a problem. *Categories* include *strands* (in time), *texture* (as weaves of strands), *quality* (of a texture), and *novelty* (as each solution is unique). The *nature of time* is a *qualitative duration*, e.g. the period over which the solving takes place.

Organizational systems theory based on contextualism closely relates to the Socio-Ecological Systems perspective. It would easily be recognized by individuals in business development roles. Closing a deal can be a historic event, where the months or years of relationship building and negotiations aren't obvious.

*Organicism* has the root metaphor of *constructive development*, where progress follows an order from stage to stage of synthesis and integration. The *theory of truth* is *coherence*, in that the whole doesn't contain contradictions in the parts that would frustrate the fusion. *Categories* include *progression* (i.e. steps of advancement over time), and *final outcome* (the ideal, in the whole that comes together). The *nature of time* is as a *directional arrow*, with successive integrations of parts into the whole.

Organizational systems theory based on organicism closely relates to the Socio-Technical Systems perspective. This is common in production and manufacturing predispositions, such as launching a new product. It's ready when it's ready. Rushing out an incomplete offering before its time can lead to a negative reputation by early adopters that inhibit acceptance when wider availability is attainable.

From these examples, it's clear that one root metaphor is not superior to another. A shock such as the pandemic disruption might cause an organization to change from one root metaphor to another. Heeding the maxim that eclecticism is confusing, if none of the four original world hypotheses was considered sufficient, a new one could be constructed.

Pepper originated root metaphor theory based on the metaphysics coming down the pragmatic tradition from William James, via Ralph Barton Perry. Branches of pragmatism coming down through different lineages have different emphases.

### 3.2 | Social Systems Science couples science with values, and progress towards ideals, from nonrelativistic pragmatism

The philosophy of pragmatism is expansive, reflecting the interests of a variety of esteemed figures. While William James was a professor at Harvard University (1873-1907), John Dewey was at University of Michigan (1884-1894) and University of Chicago (1894-1904).[40]

With James considered in the first cohort of pragmatists (graduating 1851-1869), Dewey and Singer are placed in the second cohort (1873-1898) and Churchman in the fourth cohort (1919-1939) (Pearce, 2020, pp. 9–16). (Perry would be considered late in the second cohort, with Princeton B.A. 1896. Pepper would be late in the fourth cohort, with Harvard B.A. 1913). The first cohort finished college around the appearance of Charles Darwin's *On the Origin of the Species* late in 1859. In the philosophy of science, the original members of the Metaphysical Club (1872) were influenced by the rejection of European metaphysics (much influenced by mathematics and physics), in favour of evolutionary ideas from biology.

Philosophizing in pragmatism by Churchman-Ackoff was not a turn, as for Trist-Emery. The induction and experimental methods of Churchman built on foundation established by Edgar A. Singer Jr. As a graduate student at U. Pennsylvania, Ackoff first studied the modern philosophy (i.e. Descartes through Kant) offered by Churchman

[40] William James can be seen as more radical in his philosophy, as compared to a more moderate John Dewey.

As James saw right away, he and Dewey came to pragmatism from nearly opposite philosophical directions. James took his inspiration from (besides Charles Renouvier, a philosopher Dewey does not seem to have taken an interest in) the British empiricists -- John Locke, David Hume, and George Berkeley -- writers James thought had reduced philosophical terms like "matter" and "identity" to their cash value. James dedicated *Pragmatism* to John Stuart Mill, "whom my fancy likes to picture as our leader were he alive today." Mill and the British empiricists were, of course, the bane of the tradition in which Dewey had been trained -- just as Hegel, whose work Dewey said "left a permanent deposit in my thinking," was the particular bête noire of William James (Menand, 2001, p. 369).

in 1938. Ackoff was then encouraged to take the Analysis of Concepts course started by Singer around 1920 (Churchman, 1992, p. 27). Expanding from Singer's foundations, Ackoff's dissertation would contribute concepts on human personality, of individuals and of groups.

West Churchman earned a bachelor's and master's degree in philosophy at the University of Pennsylvania, completing his doctorate in 1938 with Singer as a teacher. Singer had attended University of Pennsylvania for a bachelor of science in engineering, completing a Ph.D. in philosophy in 1894. Following graduation, Singer received a postgraduate fellowship to study under William James at Harvard University before returning in 1896 to University of Pennsylvania. In a recommendation to the provost of the University of Pennsylvania, William James wrote that Singer was the best all-round man in philosophy – logical, metaphysical or experimental -- in his 30 years of giving instruction at Harvard (Mason & Mitroff, 2015, p. 39).

Philosopher Hilary Putnam also studied pragmatism as a student of Churchman. He described a "triple entanglement of theory, value, and fact".[41] The entanglement of facts and values by Singer-Churchman resembles a distinction between data and danda in *World Hypotheses*. Data is "something given, and purely given, entirely free from interpretation". Danda "are not pure observations, but loaded with interpretation" (Pepper, 1942c, p. 51). Data by Pepper aligns with "observational facts" from Putnam. Danda includes theory, and probably values.

The philosophizing of Churchman-Ackoff in early years may be most completely expressed in *Methods of Inquiry*, from 1950.[42] Ackoff would later speak of three ancient Greek ideals, (i) the true, (ii) the good, and (iii) the beautiful, and add a modern ideal of (iv) plenty (Ackoff & Emery, 1972, p. 243). Peace and war would be more top-of-mind for Singer, in the years following WWI. From 1923, Singer laid down two theses.

The first thesis summarizes Chapter VIII "Pragmatism", with Singer saying that human action isn't deterministic, and we have the possibility to shape reality.[43] This can be tied to later Churchman-Ackoff efforts towards establishing an applied philosophy.

While it seems that Singer (and Churchman and Ackoff) lean towards idealism, there's a recognition that there's something to be learned from realism.[44] In the strictest sense, an ideal causes time to "disappear". If we

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[41] The pragmatism of Hilary Putnam may be more influenced by Churchman's reading of Singer, than by Singer himself.

> Singer was retired by the time I came, I never met him, but I heard about him from West Churchman, and I read one of his books, a little book called *Modern Thinkers and Present Problems*. I was strongly influenced by Churchman in my undergraduate years. For me, the pragmatist theory of truth is not that important (in fact, I regard it as mistaken), and I don't think Churchman mentioned the pragmatist theory of truth, nor do I remember Singer's book talking about it. But what Churchman talked about was what I call the entanglement of fact and value.
>
> I quoted in one of my books E. A. Singer, saying four things (which were in turn quoted by Churchman in his lectures): 1) knowledge of facts presupposes knowledge of values; 2) knowledge of values presupposes knowledge of facts; 3) knowledge of theories presupposes knowledge of facts; and 4) knowledge of facts presupposes knowledge of theories. I think by "facts" Singer probably meant observational facts, and by "theories" he meant things beyond observational facts. So, the idea of a triple entanglement of theory, value, and fact is what I got from Churchman and Singer. Unfortunately, I forgot all about it for quite a few years, and had to rediscover it for myself (Bella et al., 2015, p. 1).

[42] The influence of Singer through *Modern Thinkers and Present Problems* (1923) lays out some of the heritage that Churchman and Ackoff were to honour. Jumping over 300-some pages of reviewing and criticizing other philosophical approaches, Singer concludes Chapter X "Retrospect and Prospect" with two theses.

> Thus it would seem that the philosophy which alone can bring to pass that gladness of the moment which comes not from its content, but from what there is mixed in it of fulfilment and of promise --- that philosophy must give validity to two theses:
>
> (1) Reality must in all its aspects be shown to be such a thing as human effort may make and mould.
>
> (2) This effort must set before itself an ideal in which are consistently included all that is genuine in the old ideals calling themselves Peace and War.
>
> If the first of these theses was the topic of the chapter on Pragmatism, the second was that which inspired the conception of Progress (Singer, 1923, pp. 314–315).

[43] The first thesis on reality in science is detailed in Chapter VIII. As a philosophy based on doubt, Singer positions pragmatism as swinging between realism and idealism,

> Now, confidence in our ability to tell what we have made from what we have found once shaken, there is no saying how far our questioning mind may carry us. No saying, I mean, in the case of any individual man — for it is easy enough to tell the general history of this doubt and uncertainty. It reaches all the way from those who think that back of all apparent creating by finite beings there is a Nature with its laws that was never made, but can only little by little be made out. Let us call those who think in this way "Realists." Historic uncertainty then reaches all the way from the realists to those who think that heaven, the earth, and all that in them is, have no reality save as they are the thought and work of finite minds. We will call these thinkers "Idealists." From realist to idealist and back again, through all intermediate phases, the dialectic of history swings; but it does not merely mark time therefore, it also measures progress (Singer, 1923, pp. 216–217).

[44] In discussing William James (1896) "The Will to Believe", Singer mocks realists who would prefer to take human beings out of science.

think of idealism in Platonic solids, a perfect cube is always a perfect cube. Yesterday and tomorrow don't change that idealism of perfection. Coming from realism, a perfect cube doesn't exist, but that doesn't mean that human beings don't aspire towards that perfection over time. A stronger exposition on progress is thus foreshadowed.

The second thesis from Chapter IX "Progress" sees Singer saying human effort should ideal-seeking (although the ideals are not specified here), with progress (that is measurable).[45] With a framing of World War I ending in 1918, and Singer publishing in 1923, defining progress as "man's cooperation with man" can be appreciated.[46] This is explicated and extended by Churchman in *The Design of Inquiring Systems*, and by Ackoff in *On Purposeful Systems*. From a 21st century perspective, "conquest of nature" may seem a little anthropocentric, yet technological breakthroughs are now occurring so rapidly that we worry about being overwhelmed by them.

In 1950, Churchman and Ackoff published *Methods of Inquiry: An Introduction to Philosophy and Scientific Methods*, as "designed to present to the elementary student some notion of man's thinking on the nature of scientific method or the logic of inquiry" (Churchman & Ackoff, 1950, p. 3).[47] In hindsight, it can be framed as the

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> There were, to begin with, the laboratory men. Now, a laboratory is a school of the most rigid discipline — a discipline whose first principle is "keep yourself out of your experiment." I think you will understand what I mean by this when I say that a scrupulous experimenter about to take conclusive readings in a matter that promises to be of some value to science will, if possible, get another observer ignorant of their import to take these readings for him, lest something of his own excitement and anxiety corrupt his very touch, sight and hearing, and warp his result to his will. [….]
> … James was saying — "For purposes of discovery… indifference is to be less highly recommended, and science would be far less advanced than she is if the passionate desires of individuals to get their own faiths confirmed had been kept out of the game. On the other hand, if you want an absolute duffer in an investigation, you must, after all, take the man who has no interest whatever in its results: he is the warranted incapable, the positive fool" (Singer, 1923, pp. 219–220)

This argument is continued by Singer, in the text that moves from criticizing realist science to criticizing realist history. Singer questions ways in which "historical facts" are separated and distinct from "non-historical facts".

[45] The second thesis on *progress towards ideals* is detailed in Chapter IX. In considering progress — from whence and towards wither — the thread flows from nature (possibility before technology, if we go back to the Garden of Eden), towards morality and science in collective human endeavours.

> … whatever could come of the lament for the good old days, the golden days, before science had done this or that to cloud our first innocence? No history written in such ancient times but that it can recall times still more ancient when things went better with the sons of the gods because then they knew less. [….]
> Wherefore, no less futile than regret for a past we cannot recover, is fear for a future we cannot avert. It is natural that certain conditions arising out of the progress of science should make gentle souls anxious for what is to come. Science is power, and as no man can commit the sins he is impotent to commit, there is a certain safeguard for innocence in ignorance. [….] Yet must man go on gathering unto himself knowledge with all its power for harm and no warning gesture of the fearful can stay him. Our only comfort can be that however great a power for harm science may bring, it ought to enhance in equal measure the power for good, did we but know what good and evil were (Singer, 1923, pp. 256–258). [Singer (1923), p. 257-258]

[46] Sciencing is certainly a human activity. Is it possible to separate the facts of (scientific) progress from the values of (scientific) progress? Singer continues with a discussion of good (and evil).

> Did we but know good and evil! In the suggestion that perhaps we do not, in the suspicion that this is just the knowledge to which science does not help us, — yes, in the fear that it is science itself which throws doubt on ethical standards — is, I conceive, a motive for deprecating the progress of science more serious than the others, and more sincere. Science is, indeed, endlessly critical; no authority of tradition or of general acceptance imposes upon it; nothing for it is finished, nothing fixed; and to those to whom all goodness is in danger the moment one asks, What is good? science may well seem a dangerous growth, — unhallowed in its origin, curiosity; damnable in its outcome, unrest. And yet if as we assume science must progress, stayed neither by regret for the past nor by fear for the future, then must its questioning spirit invade every realm of opinion, examine the most sacred of beliefs, look into the very meaning of good and evil. [….]
> In the beginning, Man was Nature's creature and her plaything. Sometimes she seems to have fondled her toy and been good to it, given it pleasant places to dwell in and let the light of her countenance shine upon it. [….]
> But need makes for perspicuity. Time passed, and some few caught a glimpse of the vision of science, caught it, widened it, brightened it and passed it on. Perhaps their lives were not very happy in a world where they were much alone; but it is easier to tell of their ostensible hardships than of their enthusiasms — who knows but that even they found here their compt? Time went on, and that Nature which had begun by being so cruel and capricious a mistress became through man's science more and more his slave. Human eyes were not so often turned to the gods in supplication. [….]
> *The measure of man's coöperation with man in the conquest of nature measures progress* (Singer, 1923, pp. 258–279).

[47] Singer, as a student of James, may have been more influenced by Dewey in the branch of pragmatism known as experimentalism.

> During those early years in the philosophy departments of Pennsylvania and Wayne Universities, Churchman also wrote his early masterpiece, *Theory of Experimental Inference* (1948), and co-authored with Russ Ackoff *Methods of Inquiry* (1950). *Theory of Experimental Inference*, especially, brought the young philosopher wide recognition in the philosophical community. It offered essential reflections on the experimental method, particularly concerning the importance and

milestone in a science of synthesis, when the dominant approach in philosophy was analytical. Philosophizing on science in the 1940s and 1950s would have seen *critical rationalism* as mainstream, following disenchantment with the Vienna Circle and *logical positivism* in the 1920s. The philosophical turn would alter come with Thomas Kuhn in 1970, with "the revelation that science is fundamentally a socio-cultural undertaking" (Matthews, 2006, p. 128).

In 1934 as a student, Churchman had met William Malisoff teaching at U. Pennsylvania. Churchman helped Malisoff him to become the founding editor of the *Philosophy of Science* journal, set up the Philosophy of Science Association, and affiliate with the American Association for the Advancement of Science. Graduating in 1938, Churchman published his first journal article in the *Journal of Symbolic Logic*, followed by a variety of mathematical and statistical articles based on his research from the Frankford Arsenal in WWII (Ulrich, 2002). In 1946, amongst Churchman's first publications in *Philosophy of Science* was a co-authored article with Ackoff. With the sudden passing of Malisoff in November 1947, Churchman stepped up become editor of *Philosophy of Science*, and worked with Philipp Frank to formally constitute the Association.

*Methods of Inquiry*, Part I – Analysis of Scientific Method concludes with Chapter VIII "Modern Synthesis (The pragmatic method)".[48] The chapter was written where "an effort would be made to develop a synthetic position which would attempt, in the eyes of its authors, to incorporate the strength of both the speculator and positivist, and eliminate their respective weaknesses" (Churchman & Ackoff, 1950, p. 93). This was not a claim of superiority, but a cementing of various prior ideas in the past into a distinctive and comprehensive theory of scientific method. Through William James, "Science is viewed as a means (an instrument) for obtaining objectives, and the various aspects of science are themselves viewed functionally as means for enabling science to work effectively in the task assigned to it" (Churchman & Ackoff, 1950, p. 196). Through John Dewey, science and common sense have a common pattern of inquiry, where "inquiry is the process of problem solving", where a problematic (indeterminate) situation is transformed "into a nonproblematic or determine one" (Churchman & Ackoff, 1950, p. 196). A successful inquiry leads to accomplishment of a purpose or goal, that leads to difficulties of which purposes should be made the criterion of truth.

Non-relativistic pragmatism, as the foundation for philosophy for Churchman-Ackoff, would rest on a theory of truth as "the communal scheme of values on which truth depends". This is compatible with the early roots of pragmatism.

> What does it mean to say we "know" something in a world in which things happen higgledy-piggledy? Virtually all of Charles Peirce's work—an enormous body of writing on logic, semiotics, mathematics, astronomy, metrology, physics, psychology, and philosophy, large portions of it unpublished or unfinished—was devoted to this question. [….]
>
> Peirce's conclusion was that knowledge must therefore be social. It was his most important contribution to American thought, and when he recalled, late in life, how he came to formulate it, he described it—fittingly—as the product of a group. This was the conversation society he formed with William James, Oliver Wendell Holmes, Jr., and a few others in Cambridge in 1872, the group known as the Metaphysical Club (Menand, 2001, pp. 199–200)

For Churchman-Ackoff, this would be reflected in two tenets that are at the foundation of their systems approach.[49]

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problems of metrology (the theory of measurement) and of statistical inference. It showed that there could be no single 'best' model of science -- an insight to which the analytical philosophers and critical rationalists of that time had hardly advanced.

Although acclaimed by the philosophical community, the book stood alone against the mainstream tendency toward analytical philosophy. The American philosophical community honoured it not by taking up its argument but (as mentioned above) by entrusting its author with the editorship of its prestigious journal, *Philosophy of Science*. (Ulrich, 2004, p. 210).

[48] The chapters of Part I of *Method of Inquiry* follow a history of scientific thought: II Rationalism (The role of reason in science); III Empiricism (The role of observation in science); IV Criticism (A synthesis of reason and observation); V Modern Rationalism (The speculative methods); VI Nineteenth Century Empiricism (The positivistic method); VII Twentieth Century Empiricism (The method of logical positivism); and VIII Modern Synthesis (The pragmatic method).

[49] The first thesis on reality in science in Singer (1923) lines up with the first tenet of science as necessarily integrated in Churchman & Ackoff (1950).

> … Singer, and to a lesser extent Dewey in some places, has argued that to obtain a coherent theory of truth, the purpose which defines truth must go beyond individuals or societies. This kind of pragmatism is called "non-relativistic. "
>
> This new pragmatic outlook on the philosophy of science can be characterized by two very general tenets that come out of the previous study of the history of philosophic thought.
>
> The first tenet is based on a theme the pragmatist claims has gradually appeared more and more forcibly in the history of modern science: *all problems of science are interrelated; there is no fundamental separation of the branches or aspects of scientific inquiry*. This says, in effect, that all the sciences are necessarily integrated. Science is not merely a series of

The first Churchman-Ackoff tenet, "all problems of science are interrelated; there is no fundamental separation of the branches or aspects of scientific inquiry" speaks to the multidisciplinary nature in systems thinking.

Philosophizing on science requires taking a position on whether facts are separable from values. The challenge of evaluation relates science with political and social decision processes. Two speculative, two positivistic and two pragmatic approaches are reviewed: (i) the good is simple and undefinable, independent of fact (i.e. non-naturalistic and beyond inquiry, via G. E. Moore); (ii) some aspects of the good are complex and definable (i.e. non-naturalistic and beyond inquiry, via A. C. Ewing); (iii) some evaluations are meaningless (non-sensical) with the remainder reducible to questions of scientific fact (i.e. positivistic via A. J. Ayer); (iv) all questions of value are meaningful and reducible to questions of fact (i.e. positivistic via G. A. Lundberg); (v) questions of value are translatable into psychological or social questions of fact, with questions of fact presupposing answering questions of value (i.e. naturalistic pragmatism via William James and John Dewey); and (vi) questions of value not translatable into questions of psychology or sociology, requiring a new science of value (i.e. non-relativistic experimental pragmatism).

A non-relativistic theory of value doesn't assume that one can discover what a person or society really wants. This new science of value instead rests on pursuing the possibility of improving intention towards ideals, that might or might not be efficiently measured.[50] The hypothesis is that *the Ideal* has four aspects: (i) the ideal of "plenty" (perfect production and distribution for each individual in any environment); (ii) the ideal of "truth" (perfect knowledge, in science and education); (iii) the ideal of "moral good" (perfect cooperation in the consistency of intentions of individuals, with removal of conflicts between parties), and (iv) the ideal of "freedom" (perfect regeneration in ideal pursuit, with recreation allowing an individual temporary relaxation for subsequent efficiency, and aesthetic activity through the arts motivating dissatisfaction with the way things are). These pursuits would later show up throughout the life work of Ackoff.

In the second Churchman-Ackoff tenet, "it is necessary to evaluate scientific efforts with respect to a criterion of progress that is not relative to particular individuals or societies" speaks to sciencing as a collective endeavour, not just the opinion of individuals. This second tenet lines up with the thesis on progress towards ideals in Singer (1920).

Part II – Applications of Methodological Analyses to Problems of Science of *Methods on Inquiry* included chapters on representative problems, with the pragmatic method having been established at the end of Part I.[51]

Churchman-Ackoff and Pepper (with later Trist) share a heritage in pragmatism. Churchman-Ackoff, through Singer's experimentalism, emphasized a theory of truth based on progress towards "*the Ideal*" with four aspects. Pepper eased the cognitive load towards world theories, with theories of truth each coherent with four root metaphors, with the possibility that other relatively adequate root metaphors might be developed.

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endeavors loosely knit by a common objective: science, for this type of pragmatism, is an integrated whole whose parts cannot operate effectively for long in isolation from one another. This tenet, then, is anti-hierarchical.

The second pragmatic tenet of scientific method is the one already mentioned, namely, that *it is necessary to evaluate scientific efforts with respect to a criterion of progress that is not relative to particular individuals or societie*s. If we incorporate the notion of progress into the description of science, then this type pragmatist means to imply that we can judge scientific effort from an "ethical" point of view. That is, we can make assertions about what the scientist *ought* to do, not merely what he, or the experts, actually do. The philosophy of science now becomes *in part* an evaluation of scientific effort on ethical or progressive grounds; the best scientific method does not depend merely on what the eminent scientists of our day are doing. It depends on notions of ultimate objectives of all scientific effort of all times. This progressive tenet has been late in developing chiefly because the scientist has feared the introduction of uncontrolled ethical prejudices in his field. But this simply means that we must find a way to characterize scientific method so that ethical judgements can be controlled as any scientific hypothesis is controlled. This is no easy task, but it is one the pragmatist believes to be necessary for an integrated science to face if it is to remain scientific at all (Churchman & Ackoff, 1950, pp. 205–206).

[50] While an ideal is defined as unattainable, progress towards the ideal is desirable.

The definition of *the Ideal*, according to this pragmatic development, offers the possibility of *experimentally* determining what is the ultimately valuable. This experimental investigation would entail in part an historical study of all mankind; it would be the most general of social investigations in the sense that it would study the most general social individual possible. But such an investigation would not differ from the search for the meaning of any scientific concept (Churchman & Ackoff, 1950, p. 538).

[51] In *Methods of Inquiry*, Part II – Applications of Methodological Analyses to Problems of Science, the chapters were titled: IX Formal Science (The nature of deduction); X Physical Science (The nature of causality); XI Statistics (The nature of probability); XII Biological Science (The nature of life); XIIII Psychological Science (The nature of mind); XIV Social Science (The nature of social groups); and XV Science of Value (The nature of ultimate value).

### 3.3 | Ecological anthropology temporalizes, yinyang synthesizes dyadic rhythms

If we, today, were able to continue sciencing and philosophizing with Trist-Emery and Churchman-Ackoff, rather than taking their 40-some years of collaboration as a snapshot, where might we go? Late in their careers, they provided some clues looking forward on (i) ecological thinking; and (ii) non-Western philosophy of science.

**3.3.1 |** Philosophizing on ecological systems has re-expressed strands as lines co-responding over time.

On ecological systems, Ackoff would seem to have maintained an organismic world hypothesis, in a part-whole relation. Emphasizing a containing whole, "social systems are parts of larger social and ecological systems. their environments" (Ackoff, 1979a, p. 197). More formally, three "basic types of systems and models of them" (i.e. deterministic, animated, and social) are described, with the ecological as a "meta-system". Ecological systems "serve the purposes of the organisms and social systems that are their parts, and provide necessary inputs to the survival of the non-animate biological systems (plants) that it contains" (Ackoff & Gharajedaghi, 1996, p. 17). This purely functionalist perspective is anthropocentric, and plays less well in a 21st century concerned with climate change and endangered species.

Through ecological psychology, Emery in 1981 would describe the emergence of a new paradigm of learning, in a shift from 200 years of industrial civilization based on empiricist epistemology, toward education practice based on perception in the work of J.J. Gibson. From the epistemological paradigm to a new educational paradigm, there would be a shift form (i) abstraction to extraction; (ii) generic concepts to serial-genetic concepts; (iii) permanence-change to relative persistence; and (iv) achieved by thinking and memory, to achieved by perceptual activity (Emery, 1997a, p. 147).

In ecological anthropology circa 2000, Tim Ingold crossed over from J.J. Gibson to Gregory Bateson, modifying a title on "Ecology of Mind" to a more integrated "Ecology of Life".[52]

> [An] 'ecology of life' ... all hinges on a particular answer to Bateson's question: what is this 'organism plus environment'? [….] A properly ecological approach, to the contrary, is one that would take, as its point of departure, the whole-organism-in-its-environment. In other words, 'organism plus environment' should denote not a compound of two things, but one indivisible totality. That totality is, in effect, a developmental system (cf. Oyama 1985), and an ecology of life -- in my terms -- is one that would deal with the dynamics of such systems (Ingold, 2000a, p. 19).

In contrast with cognitive psychology, ecological psychology proposes "that perceptual activity consists not in the operation of the mind upon the bodily data of sense, but in the intentional movement of the whole being (indissolubly body and mind) in its environment. The emphasis on movement is critical (Ingold, 2000b, p. 166). This view of life with the capacity for movement sees human beings as animals.[53] Human beings (and animals) live (dwell) on a landscape in a process that involves the passage of time, and landscape is formed where people have lived. Landscape is not "land", not "nature", nor "space". Landscape is "is the world as it is known to those who dwell therein, who inhabit its places and journey along the paths connecting them" (Ingold, 2000c, p. 193). Temporality is not chronology, nor history. Temporality in social life has rhythm, in a complex interweaving of other cycles, with forms coming into being through movement (Ingold, 2000c, pp. 196–197).

As a complement to the categories of change, strands, and textures philosophized in contextualism (Pepper, 1942b, pp. 242–252), movement, threads, and meshwork are anthropologized ecologically. "Wherever there is life there is movement" (Ingold, 2011a, p. 72). Two major classes of lines are defined: "A thread is a filament of some

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[52] Bateson's view denied the separation of a living system from its environment, into "organism plus environment":

> For conventional ecology, the 'plus' signifies a simple addition of one thing to another, both of which have their own integrity, quite independently of their mutual relations. Thus the organism is specified genotypically, prior to its entry into the environment; the environment is specified as a set of physical constraints, in advance of the organisms that arrive to fill it. Indeed the ecology of the textbooks could be regarded as profoundly *anti*-ecological, insofar as it sets up organism and environment as mutually exclusive entities (or collections of entities) which are only subsequently brought together and caused to interact. (Ingold, 2000a, p. 19).

[53] Anthropology studies man as a subtype of animal. Psychology studies human behaviour, without attention to other animals. … Gibson himself devoted scant attention to the specifically social and cultural dimensions of human life, preferring -- if anything -- to downplay the significance of the distinction between human beings and other animals. In developing his theory of affordances, Gibson did devote a brief section to 'other persons and animals' in the environment of the perceiver, noting that they have the peculiar capacity to 'act back' or, literally, to *interact* with the perceiver. Thus 'behavior affords behavior, and the whole subject matter of psychology and of the social sciences can be thought of as an elaboration of this basic fact' (Gibson 1979: 135) (Ingold, 2000b, p. 167).

kind, which may be entangled with other threads or suspended between points in three-dimensional space". "In our terms the trace is any enduring mark left in or on a solid surface by a continuous movement" (Ingold, 2007, pp. 41–43). "The movement of animate life, then, is held in the alternation between pushing out and pulling up, or in other words between anticipation and recollection" (Ingold, 2015a, p. 87). Rather than seeing the world as points intersecting, "what is commonly known as the 'web of life' is precisely that: not a network of connected points, but a meshwork of interwoven lines" (Ingold, 2011c, p. 63). "The life of lines is a process of correspondence" (Ingold, 2015c, p. 154), better expressed as a verb, in "co-responding".[54] Preferring the terms of Pepper, with the sense of Ingold, we can see individuals as strands (threads) with temporality alongside each other, occasionally coming together for some durations to form knots. Continuing knotting results in textures (meshworks) where traces may be recalled in history, and living rhythms may be anticipated.

**3.3.2 |** Philosophizing on metaphysics enables an appreciation of foundations in Chinese medical science

On non-Western philosophy of science, Churchman was interviewed circa 1993 as seeing merit to exploring Classical Chinese philosophy for sciencing on systems.

> In conversations with Churchman on the historical sources of systems thinking, he often identified the Chinese *I Ching* as the oldest systems approach. As an effort to model dynamic processes of changing relationships between different kinds of elements, the *I Ching* might be seen as a *systemic* approach, in contrast with the more *systematic* approach of rationalist Western thought, rooted in the work of Plato and Aristotle. The pre-Socratic philosophers were perhaps closer in spirit to the Eastern view than they were to the more orderly view of systems embodied in the later evolution of the Western tradition. This is particularly true of Heraclitus, whose inspiration is often cited in connection with the more progressive developments within the contemporary systems tradition. This contrast between systemic conceptions, which focus on interrelationships and dynamic processes, and the systematic conceptions, which are more concerned with classification and order, is critical in understanding the relationship between different views of systems in the twentieth century (Hammond, 2003, p. 13).,

This statement that a Chinese philosophy might be more *systemic*, while rationalist Western philosophy is more *systematic*, is striking. "Someone who pays particular attention to interconnections is said to be *systemic* … On the other hand, if I follow a recipe in a step-by step manner then I am being *systematic*" (Ison, 2008). Churchman found the 64 hexagrams of the *I Ching* (*Yi Jing*, 易經) superior to static models from operations research.[55] The 64 hexagrams of the Yi Jing are constructed as combinations of eight trigrams (*bagua*, 八卦), built up from the dyadic yinyang (陰陽).

**3.3.3 |** Reframed practices can result from expansive approaches to philosophizing and sciencing

Beginning in 2019, the Systems Changes Learning Circle began an exploration of ways in which the practices, theory and methods of systems changes might be extended from the foundations of systems thinking (Ing, 2023). Four years of research have led to a proposal to modify contextualism into an extended (or new) world hypothesis

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[54] The joining of (life)lines isn't passive, but an active engagement of co-responding in a larger meshwork.

> To describe the meshwork is to start from the premise that every living being is a line or, better, a bundle of lines. How, then, should we describe the interpenetration of lifelines in the mesh of social life? One possible way would be to think in terms of knots (Ingold 2015: 13-16). A knot is formed when a strand such as of string or yarn is interlaced with itself or another strand and tightened. I suggest that in a world where things are continually coming into being through processes of growth and movement -- that is, in a world of *life* -- knotting is the fundamental principle of coherence. It is the way in which contrary forces of tension and friction, as in pulling tight, are generative of forms (Ingold, 2017, p. 11).

[55] Reality based on a philosophy putting temporality in the foreground contrasts to the dominant Western viewpoint.

> On the whole, I find the *I Ching* to be an amazingly astute systems management document. Just consider what it does in modern systems terms. First of all, it assumes that the systems approach requires a comprehensive set of models of reality, Most contemporary attempts to apply the systems approach through models make just such an assumption. The fact that the *I Ching* contains a limited number of situational models certainly does not mitigate against its astuteness. [….]
> … in further dogged pursuance of the *I Ching*'s rationality, I believe that it created the idea of dynamic models, a really remarkably modern concept. In the early stages of operations research, in the 1950s, we had to confine ourselves to "static" models that described a single situation simply because we didn't have the theoretical power to describe situations that moved over time. Today with our increased capability for constructing large models, the time dimension is becoming more and more important. In the *I Ching* each model provides a way of determining how a situation will change (or not change at all). The changing situation is described both in terms of changing facts as well as of changing moods (Churchman, 1971, pp. 32–34).

called *contexturalism-dyadicism*. In an attempt to reduce confusion with contextualism, we will spell it as (con)texturalism-dyadicism.

While contexture might be an unfamiliar word, it has etymology tracing back to the 1600s, with a definition in the *Oxford English Dictionary* of "the action or process of weaving together or intertwining; the fact of being woven together; the manner in which this is done, texture". The label has been used for a branch of action research,

> Contextural action research ... focuses on the facilitation of participants as generators of change collaborating in a cooperative, self-learning venture. This style of research is less concerned with the intraorganizational expression of organizational change theory than with the change capacities of multi-organizational systems. Contextural action research engages participants from the range of interests associated with a particular metaproblem to *learn with and from each other* (Franklin, 1998, pp. 47–48).

The lineage of systems thinking in organization is an evolution of the *contextual action learning methods* influenced by Eric Trist with the *Action Learning Group* at York University in Toronto 1978-1983 (Carvajal et al., 1994; Morley, 1989) with the SES perspective.

(Con)texturalism aims to retain ties to historical 20th century development in the systems sciences, complemented with 21st century advanced in ecological anthropology (e.g. meshwork (Ingold, 2011c), contextual-dyadic thinking (Lee, 2017b), yinyang in Classical Chinese Medicine (Lee, 2017f; Maciocia, 2015), and Euro-Chinese philosophy (e.g. efficacy (Jullien, 1995)). While the temporality in process philosophy (e.g. Alfred North Whitehead), and rhythms of strategy (Omidvar et al., 2022), is acknowledged, consideration of living systems places rhythms in the foreground.

Dyadicism with (con)texturalism, through an implicit Chinese philosophy of science, can be contrasted to dualism in Western philosophy as context-free.[56] Science based on a Chinese implicit dyadic ontology defines the myriad (i.e. countless) happenings (i.e. *wanwu*, translated as ten thousand things) in contrast to Western philosophical distinctions of matter and energy. *Qi* is basic ontological category accounting for *wanwu* in life, in a processual view of the dyadic transformations of *yang* (as immaterial) from/to *yin* (as material). In an interpretation from the *Zhuangzi*:

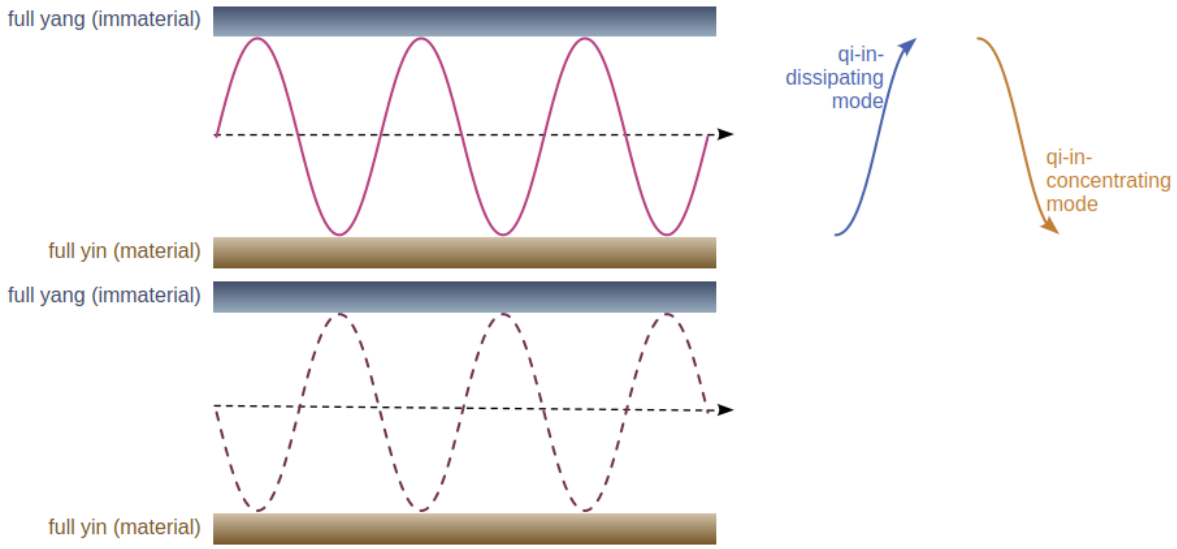
> *Qi* was capable of two modes of existence or being .... These two modes of being may be called: (a) *Qi*-in-concentrating-mode (*qi ju* / 气聚); (b) *Qi*-in-dissipating-mode (*qi san* / 气散). [....]
>
> These two modes of being are inter-related, inter-transformable. As already indicated, "inter-transformable" means that *Qi*-in-dissipating mode can become *Qi*-in-concentrating mode, and after a period of time, *Qi*-in-concentrating mode returns as *Qi*-in-dissipating mode, thereby setting up a cycle of sustainable exchange between the two modes (Lee, 2017c, pp. 42–43)

*Yin* and *yang* are inextricably entwined with each other, causally and ontologically, into a whole. In Exhibit 4, the inter-transformability is drawn with the dyads separated, on parallel timelines. As an example, let's take a living body over the course of the day as a system of interest, and express the process of *yang* (as a solid line) as waking (waxing), and of *yin* (as a dotted line) as sleeping (waning), in circadian rhythms.

[56] An inadequate expression of yinyang is a dualism without context.

> Dualism implies permanence, as it is context-independent -- hence, men are (in all contexts) superior to women, mind/soul is superior to body (or body to mind in Biomedicine), humans are superior to non-humans, and so on. Under dyadism, as it is context-dependent, men are superior to women in certain contexts such as, in general, possessing greater physical strength, while women, in general, are superior to men, for example, in grasping nuances in emotional relationships; women can bear children but men cannot, and in this sense, men may be said to be "inferior" to women. Inherent inferiority or inherent superiority is not part and parcel of dyadic but only of dualistic thinking (Lee, 2017a, pp. 224–225).

**Exhibit 4.** *Qi*-in-dissipating mode alongside *qi*-in-concentrating model [CC-BY David Ing]

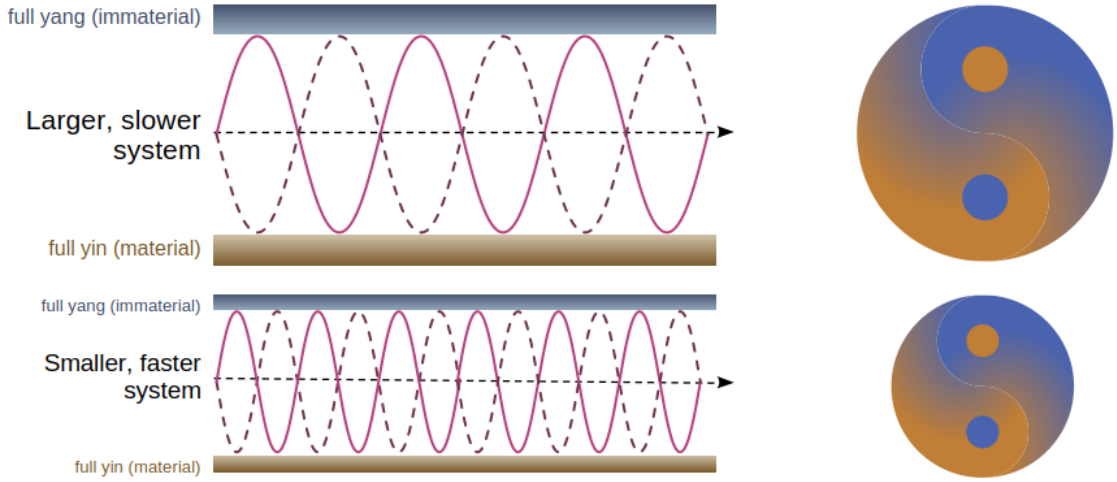



At dawn, *yang* (waking) and *yin* (sleeping) are at a pivot point: towards noontime, *yang* rises with *qi*-in-dissipating mode until maximum *yang* (maximum waking) is attained, complemented by *yin* descending with *qi*-in-concentrating mode until minimum *yin* (minimum sleeping) is attained. From noontime to midnight, *yang* descends with *qi*-in-dissipating mode to minimum *yang* (minimum waking), complemented by *yin* rising with *qi*-in-concentrating mode until maximum *yin* (maximum sleeping) is attained. This depiction represents a eurythmic living body, where waking and sleeping are not interrupted by contextural factors. Insomnia is a *yang* condition, with a majority of cases due to a *yin* disturbance resulting from an inadequate depth of sleep, or a shortened sleep time.

The illustration of Exhibit 4 could also characterize a tree in the four seasons of the year. At spring equinox, tree sap flows and buds shed their scales to produce new leaves and flowers. Summer solstice sees maximum photosynthesis, converting sunlight to sugar. Through the fall equinox, less energy is sent to the crown of the tree, and energy reserves are built up in roots. At the winter equinox, the tree is fully dormant.

The dyadism of *yin* and *yang* as mutually entwined into a whole is not well-represented in Exhibit 4. A better illustration appears in Exhibit 5, where the waxing and waning of *yang* (the solid line) with *yin* (the dotted line) is more clearly coupled.

**Exhibit 5.** A larger-slower dyadic alongside a smaller-faster dyadic [CC-BY David Ing]




A living system of interest is woven into a contexture. If we take a family as a smaller-faster system of interest, it can be placed as a strand in a larger-slower texture of a neighbourhood. The family responds to changes in the neighbourhood, and the neighbourhood responds to changes in the family. Alternatively, if we take a family as a larger-slower system of interest, multiple smaller-faster strands could be involved, e.g. a father, or a son. Systems live together in diachrony, as changes over time in one may influence the others.

More formally, the main features of a contextual-dyadic interpretation of the philosophy of Chinese thinking can be summarized:

1. *Qi* is the basic ontological category with two modes of existence -- *Qi*-in-dissipating mode and *Qi*-in-concentrating mode with the former transforming itself into the latter, the latter changing into the former in cyclic reversions.
2. *Qi* is divided into *yin qi* and *yang qi*; and the relationship between them is represented as *Yinyang*.
3. *Yin qi* and *yang qi* in reality do not and cannot exist in their respective pure states, but in varying degrees of *yin*-in-*yang* and *yang*-in-*yin*.
4. Reality is about change in the complex manner set out in 1 through 3 above (Lee, 2017b, p. 261).

*Yin qi* and *yang qi* are applicable to organisms, and to nature. A broader express of the philosophy extends beyond the science underlying Chinese Medicine, into cosmology.

In contrast to Western philosophy with mind-body dualism where epistemology and ontology are distinct, traditional Chinese philosophy is naturalistic and processual. A Western-based systems approach based on an organicist world philosophy defines function as "contribution of the part to the whole", structure as an "arrangement in space" and process as an "arrangement in time" (Ackoff, 1971; Gharajedaghi, 2011). A processual systems approach with an ecological perspective observes (i) changes in yinyang in a body, alongside (ii) changes in yinyang in the natural world. In the yinyang relationship in a living being:

> *Yin* is the structure (*ti* 體), and *yang* is the function (*yong* 用). *Ti* as *yin* refers to the tangible parts of the body .... *Yong* as *yang* refers to the abilities to act and transformational activities. Both structure and function are tied together to maximize different bodily capacities (Wang, 2012b, pp. 172–173).

Taking a processual systems orientation, *Qi*-in-dissipating mode is *functioning*, and *Qi*-in-concentrating mode is *structuring*. A living system co-responds with the natural world that itself is both functioning and structuring, with cycles of waxing and waning (e.g. waking and sleeping).

Hybridizing science across Chinese medicine and Western biomedicine is well-illustrated in the colonial and post-colonial history of Taiwan.[57] A post-colonial social science embracing a non-Eurocentric concept of propensity (*shì*, 勢) would not disfavour describing *things-in-themselves* in favour of *things-on-the-move*, and deprivilege *effectiveness* measured from the outside for *efficacy* (功 效) in courses of contexturally unfolding (Law & Lin, 2018, p. 12).

The study of Chinese philosophy from the west has been described as three paradigms: (i) exclusionist, (ii) comparative, and (iii) constructionist. (Littlejohn, 2022b). An exclusionist paradigm marginalized Chinese philosophy, leading to claims (e.g. in the 18th century by Kant and Hegel) that the Chinese did not actually "do philosophy". A comparative paradigm engaged Chinese philosophy as a corrective to Western programs (e.g. in the 20th century, A.C. Graham, David L. Hall and Roger T. Ames), positioning philosophical traditions from different cultures as incommensurable. A constructionist philosophy in the 21st century bends language and culture, exploiting and recreating a pluralist view of many texts and traditions. Sciencing and philosophizing on systems thinking in the 21st century can take the constructionist approach.

## 4 | Sciencing on systems changes leads to philosophizing on sciencing

The journey of Trist-Emery in the STS perspective first centered on an organization (i.e. workgroup) as a system of interest focused on homeostasis. The STS perspective emphasized the part-whole relations, of actors within workgroups. Rapid changes in the environment drew attention outside of the organization into influences, where external actors would shape the texture, beyond the control of the workgroup. The SES perspective therefore emphasized whole-whole relations of organizations alongside other organizations. The foundational sciences shifted from organicism with social psychology, towards contextualism with ecological psychology. The separation of STS and SES led to separation of perspectives. With one organization as a system of interest, the STS perspective prioritized looking inwards from whole to parts, while the SES perspective prioritized looking outwards to external organizations interacting with other external organizations.

Western science follows philosophy orienting towards monadism or dualism. Viewing a system through a monadic lens attributes oneness or singleness (e.g. an atom in chemistry, or a quark in physics). Viewing a system through a dualistic lens separates a whole into two distinct and separable parts (e.g. mind and body, good and evil). Coming instead through philosophical foundations of CCM, the STS and SES perspectives can be viewed as inter-related and inter-transformable, following a (con)textural-dyadic approach. Philosophically, this is presented as a new world hypothesis. A practical consequence of moving from the Western idealism-realism modal positions is adoption of the pursuit of eurhythmia.

### 4.1 | Contextural-dyadic thinking mutually unfolds Socio-Technical and Socio-Ecological

A (con)textural-dyadic approach to Trist-Emery and Churchman-Ackoff legacy is fundamentally synthetic. As an entry point into that approach, review of the STS and SES perspectives with contextualist and organicist World Hypotheses can be conducted meta-analytically. With systems of interests declared across human and non-human domains, the social engagement of social science can be recast into six perspectives, shown in Exhibit 6.

[57] The incorporation of CCM into medical practice in Taiwan contrasts to medical systems where the Western-trained institutions take a colonial stance on healthcare.

> In Taiwan, this started in the 1860s with Western missionaries, doctors and gunboats; biomedicine was institutionalized during Japanese colonialism after 1895, when CM was nearly eliminated. After 1945, the post-colonial republic created a biomedical health system that included CM. The project was chaotic and controversial. There were debates about the division of labour between CM pharmacist and doctors, the legality of using biomedical instruments in CM clinics, the need to rebuild the administration and regulation for certificating existing CM practitioners, and most important of all, what a modern institution for training new generations of CM doctors should be like. The process was slow, and it was not until 1958 that CM practitioners sought to revive their tradition by establishing the first CM institution, the Chinese Medical College .... Even so, CM needed to adapt to the administrative, epistemic and curricular practices of biomedicine ....
> From this we learn that in Taiwan, CM knowledge and diagnosis have been hybridized with modern science and technology; the traditions of clinical mentoring and reputation- based practice have been replaced by curricular education and exam-based certification; and CM medication has been transformed by biomedical analysis and located within the political and economic concerns of biotechnology .... (Lin & Law, 2014, p. 806).

**Exhibit 6.** Socio-Ecological + Socio-Technical perspectives, inferred systems of interest [CC-BY David Ing]

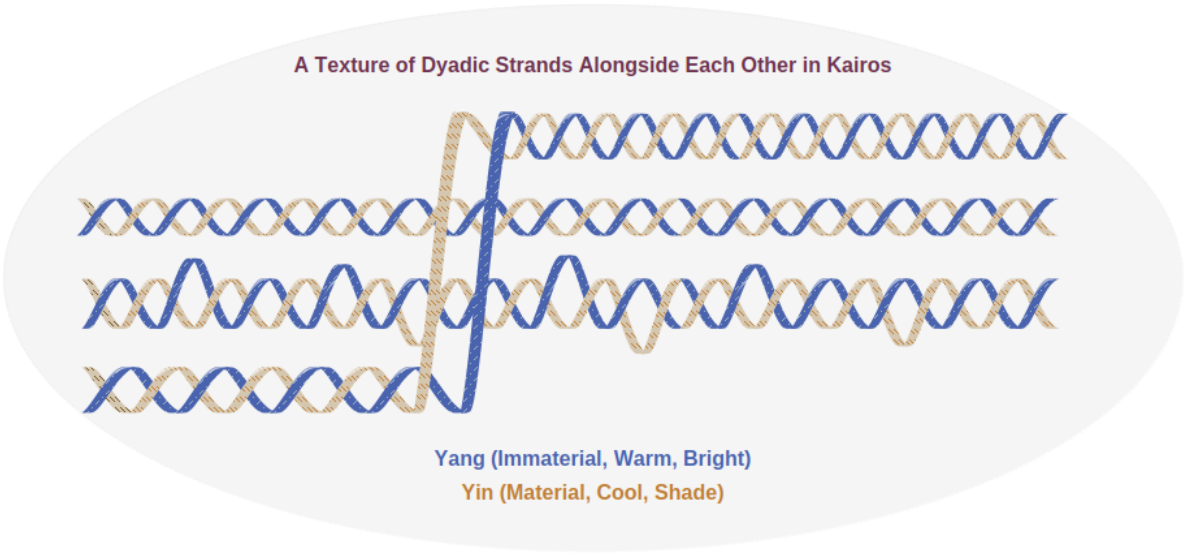
| | *Human* | | *Anthropocentric (or Non-Anthropocentric)* | | Non-Human |
|---|---|---|---|---|---|
| *Contextualist* | Eco-Cultural Systems perspective | → | Socio-Ecological Systems perspective | ← | Ecological Systems perspective |
| *Organicist* | Socio-Psychological Systems perspective | | Socio-Technical Systems perspective | | Technical Systems perspective |

In human systems, the Socio-Psychological Systems perspective was early in the work of the Tavistock Institute. In an organicist approach, soldiers returning from war were re-integrated into the nations that had sent them abroad to battle. A contextualist counterpart could be called an Eco-Cultural Systems perspective, as nations cooperated to rebuild their societies.

In non-human systems, a Technical Systems perspective can be inferred, as the other species and machines are framed in an organicist orientation, to serve functions as decided for human interests. An Ecological Systems perspective traces the lifelines of non-human wildlife and flora, that live largely unconnected to each other, with short periods where some may co-respond with others.

In a (con)texturalist-dyadic view, (i) a Socio-Ecological contexture has a Socio-Technical system of interest as one of its strands: (ii) a Socio-Ecological contexture is itself a dyadic relation; and (iii) the Socio-Technical system of interest is dyadic within its contexture. This is depicted in Exhibit 7.

**Exhibit 7.** A texture of dyadic strands alongside each other in kairos [CC-BY David Ing]




A primary system of interest is a strand in *kairos*, defining temporality as primordial. Each strand is dyadic with yinyang, with *qi*-in-dissipating mode and *qi*-in-concentrating mode not necessarily in perfect cyclic reversions. A strand (e.g. a family) lives alongside other strands (e.g. other families). Strands can co-respond with each other, forming knots for some periods over time (e.g. families related through marriage). Multiple co-responding strands form a texture (e.g. a clan). A texture itself is yinyang, so that textures can be woven together (e.g. clans into a community).

The STS and SES perspectives, as modes of systems thinking, remain definitionally coherent. Focusing attention on one perspective while denying the other is reductive. Intention (a teleological predisposition) in the Trist-Emery (and Churchman-Ackoff) viewpoints leads to questions about the goals of individuals relative to goals of the workgroup (STS) and goals of the workgroup relative to goals of external parties (SES). The workgroup is a subsystem of the ecosystem. The Western philosophical predisposition tends to order thinking first about structure (i.e. arrangement in space) and then secondly about process (i.e. arrangement in time). A (con)textural-dyadic approach reorders that predisposition to think first about process (i.e. arrangement in time), and then about structure (i.e. arrangement in space). Attention switches between STS and SES perspectives, depending on the

circumstances. Skills are transferred from masters to novices, from the experienced to inexperienced, through an "education of attention".

> The idea of showing is an important one. To show something to somebody is to cause it to be seen or otherwise experienced -- whether by touch, taste, smell or hearing -- by that other person. It is, as it were, to lift a veil off some aspect or component of the environment so that it can be apprehended directly. In that way, truths that are inherent in the world are, bit by bit, revealed or disclosed to the novice. What each generation contributes to the next, in this process, is an *education of attention* (Gibson 1979: 254). Placed in specific situations, novices are instructed to feel this, taste that, or watch out for the other thing. Through this fine-tuning of perceptual skills, meanings immanent in the environment – that is in the relational contexts of the perceiver's involvement in the world – are not so much constructed as discovered (Ingold, 2000a, pp. 21–22).

Attention trumps intention. Going out for a walk, when we are either transporting our bodies or wayfaring to take in the journey, we have to be mindful to not trip on uneven pavement. Managing an organization switches attention back and forth from internal concerns (a STS perspective) to external influences (a SES perspective). Some people are better at multitasking than others. Emphasizing temporality invokes gauging periodicity and duration, as actions may be performed immediately or deferred, and effects may be seen sooner or later. The announcement of a key employee leaving the company draws attention to the STS perspective. A new competitive entrant in the marketplace draws attention to the SES perspective. STS and SES are perspectives on a system of interest.

Organismic thinking tends to place social systems and technical systems inside ecological systems. Contextualist thinking, with temporality in the foreground, puts social systems alongside technical systems alongside ecological systems, all changing over time.

**4.2 | Socio-Technical as *yin* alongside Socio-Ecological as *yang* is a new world hypothesis**

Maxims of world hypotheses include "each world hypothesis is autonomous", and "eclecticism is confusing" (Pepper, 1942f, pp. 98–113). With the STS perspective related to organicism and SES perspective to contextualism, the (con)texturalist-dyadic view is offered as a new world hypothesis on a different root metaphor. Pepper himself introduced a new world hypothesis of selectivism (although he was unsure whether it might actually be a variant of contextualism) (Boyle, 1982; Reck, 1981). Finding selectivism inadequate, neoselectivism has been proposed as a adequate world hypothesis (Hoeflin, 1987). Pepper suggested that the systems philosophy of Ervin Laszlo, with the root metaphor of a "dynamic self-regulating system" be regarded as world hypothesis (Pepper, 1972).

(Con)texturalism-dyadicism follows a synthetic mode of reasoning, while dissolving the distinction between dispersive and integrative manners for organizing evidence is dissolved, in Exhibit 8.

**Exhibit 8.** Contextualism and organicism compared with (con)texturalism-dyadicism [CC-BY David Ing]

| | *Synthetic mode of reasoning* | *Synthetic mode of reasoning* | |
|---|---|---|---|
| *Dispersive manner for organizing evidence* | **Contextualism**<br>*Root metaphor*: Situation, as a historic event in its living actuality<br><br>*Theory of truth*: Operationalism, via qualitative confirmation of solving a specific problem<br><br>*Categories*: Strands, texture, quality, novelty<br><br>*Nature of time*: Qualitative duration, event relative to a specious present | **(Con)texturalism - Dyadicism**<br><br>*Root metaphor*: Yinyang dancing through [eight] seasons, as ((*yin qi*) ∝ 1/(*yang qi*)) wayfaring in unfolding *wanwu* [concentrating ⇌ dissipating] textures<br><br>*Theory of truth*: Entailment, traceability back through history, with anticipated outcomes indetermined<br><br>*Categories*: Rhythmic shifts, (con)texture, propensity<br><br>*Nature of time*: Kairotic, with propitious periods and inopportune periods | *Dispersive + integrative manner for organizing evidence* |
| *Integrative manner for organizing evidence* | **Organicism**<br>*Root metaphor*: Constructive development, with orderliness of changes from stage to stage<br><br>*Theory of truth*: Coherence, where fragments cohere with their nexus, free of contradiction<br><br>*Categories*: Progression (steps), final outcome(ideal)<br><br>*Nature of time*: Directional arrow, successive integrations | | |

A *root metaphor* of yinyang dancing through [eight] seasons expresses the complexity of (con)textualism-dyadicism.

- The dyadicism of "yinyang dancing" is expressed as "((*yin qi*) ∝ 1/(*yang qi*)) wayfaring". The mathematical symbol ∝ is not an alpha, and should be read as "is proportional". *Yin qi* and *yang qi* are inversely proportional, i.e. *yin qi* increases as *yang qi* decreases, and vice versa. Wayfaring sees *yin* and *yang* as *kairotic*, yet not deterministic. A simile for yinyang dancing is a couple engaged in ballroom dancing.
- The (con)textualism of "[eight] seasons" is expressed an "unfolding *wanwu* [concentrating ⇌ dissipating] texture. The right-left harpoon arrows (⇌), normally used to denote equilibrium in chemistry, is borrowed for the feature of reversibility of concentrating alongside dissipating. The textures are composed of myriad (countless) temporal strands, and are rhythmically cyclical.

While the seasons of the year are commonly expressed as four (i.e. winter, spring, summer, autumn), the binary dyadic taken to the third power counts to eight seasons.[58] In the *I Ching* (*YiJing*), trigrams composed of three *yao* (i.e. broken *yin yao* lines and unbroken *yang yao* lines) result in a permutation of eight. Unfolding, as an adjective, can be defined as disclosing or developing. *Wanwu* is the mutual transformation between *qi*-in-concentrating mode and *qi*-in-dissipating mode; materializing and immaterializing; birthing and dying; or originating and decaying.[59]

[58] The eight seasons can be expressed as winter, spring beginning (li chun 立春), spring, summer beginning (li xia 立夏), summer, autumn beginning (li qiu 立秋), autumn, winter beginning (li dong 立冬) (Lee, 2017d, p. 113).

[59] Wanwu is often expressed as the "myriad things" or (worse) literally as ten thousand things. From the *Zhuangzi*, the process of life and death is an illustration.

> The beginning of life is but *Qi*-in-dissipating mode transforming itself into *Qi*-in-concentrating mode while death is but Qi-in-concentrating mode transforming itself back into *Qi*-in-dissipating mode -- these phases of change mark the birth and death of an organism. But the cycle starts afresh again, with *Qi*-in-dissipating mode transforming itself into *Qi*-in-concentrating mode, in another organism -- such a cycle carries on sustainably during the entire evolution of life on Earth (in our Solar system). It is important to note that this unchanging mutual transformation of the two modes of Qi occurs not only in the biotic but also abiotic domain -- for instance, planets such as Earth did not originally exist as Matter/*Qi*-in-concentrating mode, but as *Qi*-in-dissipating mode.
>
> It should, therefore, be pointed out that the term *Wanwu* can have two meanings -- a narrower meaning which refers to organisms but also a broader meaning, referring to entities in both the biotic and the abiotic domains. It is natural to talk

The lining up of natural rhythms in (con)texturalism recognizes irregularities and the specious present in contextualism. The constructive development in dyadicism is orderliness in changes, in the synchrony of successively progressing towards a complete journey.

The *nature of time* in (con)texturalism-dyadicism is *kairotic*, rather than chronotic, with propitious times and inopportune times. Simply, *kairos* is qualitative duration as felt time; *chronos* is clock time. More formally: "Chronos is 'the chronological, serial time of succession, ... time measured by the chronometer not by purpose". *Kairos* is the 'the human and living time of intentions and goals ... the time not of measurement but of human activity, of opportunity" (Orlikowski & Yates, 2002, p. 686). In these world hypotheses, both are eventful moments or durations of time. (Con)texturalism places an event in its specious present of rhythms. Dyadicism sees propitious periods and inopportune periods coming and going in a directional arrow of time, potentially.

The t*heory of truth* of *(con)texturalism-dyadicism* is *entailment*, a traceability back through history, with anticipated outcomes indetermined.

> "Entails" can be a synonym for "could lead to". Entailment and causality are linked concepts, the difference being that causality is "what does happen" and entailment refers to "what COULD happen". Nothing can happen that isn't entailed (Rosen, 2016).

(Con)texturalism allows tracing an outcome back through entailments, without forward-looking causality, e.g. the existence of a child entails parents, but a couple marrying doesn't necessarily cause children. A general systems predisposition appreciates teleonomy in biology (Mayr, 1988), as an alternative to teleology. Dyadicism has a coherence in continuing processual eurhythmia, where living systems are able to overcome temporary periods of incoherence, as arrhythmia.

*Categories* for *(con)texturalism-dyadicism* include rhythmic shifts, (con)texture and propensity. The categories of contextualism have parallel expressions in contemporary research: strands extending over time might be called lines (lifelines), threads or traces (Ingold, 2007). texture might be associated with meshworks, knots and co-respondences (correspondences) (Ingold, 2011c, 2015b, 2017). (Con)texturalism recasts the temporality of significant events as rhythmic shifts in living systems. Dyadicism weaves pair of strands together into texture; and texture can be interwoven with other textures as contexture to the strands. The dyadic understanding of *yin* with *yang* in Chinese philosophy can be contrasted with dualist philosophies of the west (e.g. Hegel). Propensity is a predisposition related to the arrangement of things, in a non-causal way (Jullien, 2004a, 2015). (Con)texturalism-dyadicism appreciates propensity when novel circumstances can come together, and progression towards eurhythmia or arrhythmia, rather than idealism.

(Con)texturalism-dyadicism is a world hypothesis related to both contextualism and organicism, but with its own distinctions. The rhythms in (con)texturalism add a dimension to the processual nature of contextualism.

Rhythms as the dyadicism of *yin* with *yang* are conventionally only discussed in living systems when attention is paid to unhealthy imbalances between the dyads.[60] In a systemic sense, the STS perspective brings absolute idealism suggesting wholeness, as a progression towards a unity. Organicism has an integrative manner, where determinate order is presumed, and unpredictability (non-determinism) is denied. Rhythm does have a determinate order. As human beings, we know that we are mortal, so that death is natural end. However, unanticipated rhythmic shifts are an unpredictability that is problematic if denied. We don't like to think about

---

about birth and death in the former, less so in the latter. However, the abiotic also has its analogues of birth and death -- one can speak of the origin/coming into being of a mountain (orology) and eventually of its decay until the mountain no longer exists and all that is left are some stumps. The Himalayas are so high for the simple reason that in geological terms they are considered to be very young mountains. But eventually they, too, would wear down primarily through weathering, but conceivably even by movements from the center of Earth, changing the crust formation on its surface. Mountains, as high and as big as the Himalayas or the Alps, would eventually be transformed from their *Qi*-in-concentrating mode to become *Qi*-in-dissipating mode. The abiotic as much as the biotic are part of *Wanwu*, of *xingerxia*, and therefore are subject to the same processes of change as the biotic according to the ancient Chinese (Lee, 2017d, pp. 43–44).

[60] Mainstream western metaphysics don't put balance into the foreground, and tend to express life as progression towards ideals. Organicism is commonly called "absolute (or, objective) idealism." It is associated with Schelling, Hegel, Green, Bradley, Bosanquet, Royce (Pepper, 1942a, pp. 141–142).

> The organicist believes that every actual event in the world is a more or less concealed organic process. He believes, therefore, that a careful scrutiny of any actual process in the world would exhibit its organic structure, though some of the processes with which we are generally familiar reveal the structure more clearly and openly than others. The categories of organicism consist, on the one hand, in noting the steps involved in the organic process, and, on the other hand, in noting the principal features in the organic structure ultimately achieved or realized. The structure achieved or realized is always the ideal aimed at by the progressive steps of the process (Pepper, 1942e, p. 282).

accidents or injuries that would irreversibly change the course of our lives. This leads us to look to changes in the (con)texture.

Rhythms in the texture may or may not influence a system of interest, when we consider the grander temporality. The timing of evolutionary transitions suggests intelligent life is rare. "It took approximately 4.5 billion years for a series of evolutionary transitions resulting in intelligent life to unfold on Earth. In another billion years, the increasing luminosity of the Sun will make Earth uninhabitable for complex life" (Snyder-Beattie et al., 2021). This is the context of the general consensus that the Universe is 13.8 billion years old. So, the probability of any human mortal on the planet Earth to be alive at the same time as an intelligent being on another planet seems small.

Living systems, in contextualism, make the ongoing process of continual change the norm, with a (weak) denial of order. Movement can be associated with change, so that strands as wholes might occasionally coincide and tie a knot.

> ... disorder is a categorial feature of contextualism, and so radically so that it must not even exclude order. [....]
>
> Change in this radical sense is denied by all other world theories. If such radical change is not a feature of the world, if there are unchangeable structures in nature like the forms of formism or the space-time structure of mechanism, then contextualism is false. Contextualism is constantly threatened with evidences for permanent structures in nature. It is constantly on the verge of falling back upon underlying mechanistic structures, or of resolving into the overarching implicit integrations of organicism. Its recourse in these emergencies is always to hurry back to the given event, and to emphasize the change and novelty that is immediately felt there (Pepper, 1942b, pp. 234–235),

The SES perspective based on contextualism views wholes living alongside other wholes. The rhythms of strands within the texture may pace slower or faster relative to each other. The sun takes about 365 days for a cycle, the moon takes about 28 days. There are rare occasions when some stars align, or a planetary body goes into an eclipse.

The history of Western philosophy has led to the separation of world hypotheses based on integrative or dispersive manners of organizing. (Con)textualism-dyadicism dissolves that distinction.

**4.3 | Eurhythmatizing dyads in contextures replaces idealizing towards steady states**

In the original Tavistock Institute research, the SES and STS perspectives were premised on action by purposive, goal-seeking agents.

> For our analysis of the changing causal textures of organizational environments we chose Chein's dimensions of goals and noxiants. These dimensions encapsulate the concept of motivation and the question of the sufficient conditions of behavior. This theoretical choice made it possible for us to make the main point of our version of socio-ecology; namely, that these conditions are in continuous flux between the individual and the social field. Sometimes the individual is freely choosing goals, purposes or ideals and the means to pursue them. At other times individuals can be seen to choose means and ends because the social fabric has left them little choice. Either way it is the individual in the social field that is choosing (Emery, 1997b, p. 39).

In an ecological approach, there are alternatives to purposive behavior towards idealism. In an appreciative systems approach (as favoured by Trist), situations converge on standards regulated across reality judgments, value judgments and instrumental judgments (Vickers, 1995). In an anthropological approach, wayfaring (in contrast to transporting) acquires knowledge by going around in an environment, and following trails through a meshwork (Ingold, 2011b).

While teleology is one way to understand the behaviour of social systems, living systems in biology and ecology are not necessarily so rational. "In the Chinese holistic tradition epistemology is inseparable from ontology", so the philosophy is based on an onto-epistemology (Rošker, 2021). For an alternative to the metaphysics descended from the ancient Greeks, let's approach from the philosophy underlying the *Huangdi Neijing*, the ancient Chinese medical text. A concise English language interpretation of *yinyang* provides a foundation.

> All internal bodily functions are the work of yinyang, according to at least three variables:
>
> (1) the rhythm of yinyang (*jiezou* 節奏): either yang or yin is too fast or too slow;
>
> (2) the balance of yinyang (*pingheng* 平衡): too much or too little yang or yin; and

> (3) the transformation of yinyang (*bianhua* 變化): yang or yin changing too much or too little (Wang, 2012a, p. 22).

A stronger interpretation of *bianhua* (變化) as change (*bian* 變) combined with transformation (*hua* 化) requires "you renew yourself entirely from within" rather than just adapting or modifying a response to a situation (Jullien, 2004b, p. 178).

Causal texture theory, following a western philosophical tradition, retains more of its organicist predisposition, as Trist-Emery moved towards contextualism. The lawful link $L_{11}$ is a Socio-Technical perspective. Link $L_{22}$ is a Socio-Ecological perspective. Link $L_{21}$ is the Socio-Ecological affecting the Socio-Technical. Link $L_{12}$ is the Socio-Technical affecting the Socio-Ecological.

For a (con)texturalist-dyadic approach, the three conditions for a healthy system can be generalized, working from (con)textures towards the dyads (detailed in Appendix 2):

- constructive rhythmic pacing of a dyadic strand, as influenced by its (con)texture (as connection $L_{21}$);
- dyadic balancing within a strand, with neither an excess nor deficiency of yin or yang (as connection $L_{11}$ and $L_{22}$);
- transformative reifying, as progressive functioning and structuring of a dyadic strand into its (con)texture (as connection $L_{12}$).

A dyadic strand, as a body, is presumed to be a living, self-regulating system that is mostly capable of dealing with ailments. Treatment in Classical Chinese Medicine is based on "certain methodological rules derived from theory such as when *qi* is blocked, it causes pain / 不通则痛 / *bu tong ze tong*; and that treatments such as acupuncture, *tuina*, and decoction can eliminate a blockage and thereby the pain" (Lee, 2018b, p. 45). Self-healing of the system via internal adjustments is preferred over invasive interventions (e.g. surgery) initiated externally.

Synthesis as "putting things together" is more complicated with dyadicism in living systems. *Yang* and *yin* are not just two phases of cyclical movement (i.e. *yang* as brightness and activity; *yin* as shade and rest), but also two states in the density of matter (i.e. *yang* as more immaterial and rarifed; *yin* as material and dense). Traditional Chinese philosophy comes with an ontology of body that is gendered.

> According to [ZHANG, Zailin 張再林], the bodily emphasis in the perception of the world naturally leads to constructions of gender. Gender is the mechanism for the process of the universe. Take an example from the *Zhouyi*, "The Dao of *qian* 乾 (heaven) completes the male; the Dao of *kun* 坤 (earth) completes the female" (9). It is because of the interaction between heaven and earth, male and female, that the myriad things are generated and transformed. Body obviously falls into a gender field: the body is seen as either male or female. This necessity of gender naturally leads to a living force and generative process through intercourse (Wang, 2009, p. 114).

Gender as *yang* (male) and *yin* (female) does not suggest a superiority or inferiority that descends from "Descartes in the seventeenth century".

> Very briefly summarized, their difference lies crucially in this -- dyadism simply notes their contrastive character, which from the naturalistic perspective, can also at the same time be regarded to complement each other -- in other words, there is not only co-existence but they are also capable of mutually helping each other to achieve a certain effect or outcome. Together they form a Whole whereas dualism, on the other hand, reads into these polar contrasting terms, the notion of superiority or inferiority, one member of the pair being privileged over the other (Lee, 2017e, p. 125).

Yinyang is thoroughly synthetic in its thinking. Splitting *yin* from *yang* is analytical, and antithetical to Chinese thought. This can present challenges coming from contemporary Western presumptions of inferior-superior relations.[61] Progression towards an ideal in dyadic thinking is therefore not towards superiority, but instead

[61] Western philosophy descending from The Enlightenment emphasizes "oneness" over dyadism.

> It is Reductionist thinking -- the inferior member of the pair is but an appendage, a mere shadow of the superior member. In the case of humans, the latter enjoys the status of being the epistemological/methodological authority, laying down criteria for what constitutes a "proper" / "good" specimen of the former. Feminism complains bitterly on these two fronts.(6) Historically, in the Mind/Soul and Body pairing, the former was privileged over the latter; this held true in Christian theology; in Descartes's view, this remained true, thereby releasing the Body as inert matter, fit for scientific investigation while retaining the Soul/Mind for higher things beyond, thereby escaping empirical/scientific probing. However, after Descartes, Materialism as the new metaphysics began to undermine this version of the Cartesian accommodation, turning the relationship upside down, with Body as Matter becoming the superior category while Mind was/is to be reduced to Matter. In Modern Medicine/Biomedicine, the human being is even conceived as machine, as artefact, no longer a naturally-

eurhythmia between yang and yin, not only within the system of interest, but between the system of interest and the contexture.

Under the philosophy of Classical Chinese Medicine is a timespace framework resting on process ontology. A person in good health has a balance between *yinqi* (i.e. *yin qi*) and *yangqi* (i.e. *yang qi*) in the person-body. In a systemic approach, the person-body is not independent of the contexture. A medical practitioner diagnoses *mai* 嬥 ("translated as pulse, but best left untranslated as it is not the pulse of Biomedicine") in profiling the patient, taking the season of the year into consideration.[62] The preferred treatments in Chinese medicine are to encourage to body to return to its own natural yinyang condition. Personalized medicine appreciates a changing individual in his or her changing (con)texture. A "magic bullet" or panacea that can be decontextualized is incompatible with this science and philosophy.

A rhythm of yinyang should be seen within a contexture of yinyang. With a system of interest conceived as dyadic, the texture with which that system is related is also dyadic. This is not, however, a hierarchical relation of organicism where a system of interest is seen as within a containing whole. The system of interest is a whole, alongside other wholes in textures of temporality.

## 5 | Conclusion: Textures can be systems; not all systems are textures

The history of sciencing on systems in the 1950s to 1990s was based on philosophizing from the 1920s to the 1950s. Churchman-Ackoff came from philosophizing into sciencing, following the pragmatic tradition through the rise of psychology, operations research and sociology. Trist-Emery came from sciencing into philosophizing, from the socio-technical to the socio-ecological. Sciencing in Chinese medicine has a much longer history, with constructivist philosophizing on that sciencing in the English language a recent 21st century endeavour.

When most people speak of "context", the temporality of texture from Trist-Emery coming from Pepper is not obvious. Branches of systems thinking portrayed with only the integrative manners in root metaphors of mechanism and organicism omit the possibility of the dispersive manners in formism and contextualism. For those authentically interested in systems changes, the temporality of texture presents categories different from the integrative categories. Defining a "system" and a "boundary" doesn't make sense in world hypotheses with a dispersive manner.

The dyadicism foundational in yinyang will be difficult for the majority of people who didn't have Chinese grandmothers who were raised with that conventional wisdom.[63] Perhaps those more advanced in studies of science from a Western foundation will have greater cognitive dissonance with Chinese philosophy.

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occurring organism.(7) Dualism in this sense is the rival of Monism which may take the form of either Materialism (when Mind is reduced to Body) or Idealism (Body/Matter is reduced to Mind) (Lee, 2017b, p. 223).

[62] The seasons, or mutually transforming wanwu texture, are ever-present in the background of yinyang.

> … an illness is not a disease entity, but the misbalance between *yinqi* and *yangqi* in the person-body, leading to the malfunctioning of the *Wuzang-liufu*. […] Ascertaining] the *mai* is nothing but ascertaining the balance between *yinqi* and *yangqi* in the person-body, and that when the *mai* of a patient is an unseasonal *mai*, this portends trouble, unless the patient takes an appropriate prescription/treatment to redress the unseasonal *mai* …. The **Summer** *mai* seasonably is vigorous and large/洪脉. The **Winter** *mai* is seasonably quiet. Why should this be so? Under *Tianren-xiangying*, in **Winter**, *yangqi* is on the retreat with *yinqi* at its maximum; *yang* stands for motion/activity, while *yin* stands for rest/tranquillity/stillness. It follows that the seasonable **Winter** *mai* would be quiet, while the seasonable **Summer** *mai* would be robust. Should a patient display the **Summer** *mai* in **Winter**, the physician would predict trouble, as the patient's person-body is already suffering in **Winter** from an excess of *yangqi*. Just think what would happen when Summer arrives -- this excess of *yangqi* would overpower the person-body; to that *yangqi* would be added the heat/*yangqi* of the external environment, which is reaching its peak during that season. This aggravation could result in killing the patient. Hence, medicinals and/or other treatments must be prescribed to return the person-body to the state-of-normality-for-the-season (Lee, 2018a, pp. 251–252).

[63] Metaphysics are foundational in a culture, so that a belief that "obvious" amongst the Chinese are not so obvious, or counter-intuitive to those trained in the West.

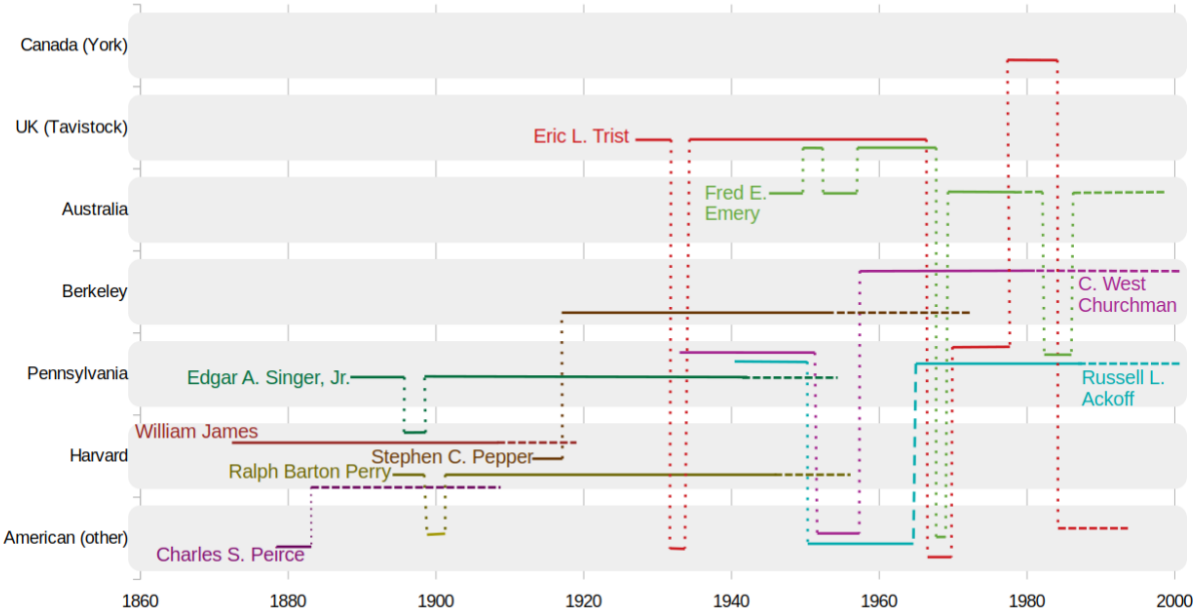
> Taking our cue from Chinese medicine as a practical application of this cosmology, we have to avoid the formalism that comes with a doctrine of external relations by acknowledging the inseparability of physiology and anatomy, of function and structure. Indeed, it is because traditional Chinese medicine has a dynamic, symbiotic understanding of the coterminous relationship between structure and function often captured in the expression "forming and functioning" (*tiyong* 體 用 )—or perhaps more simply, as "trans-*form*-ing"—that it can provide us with a significantly different way of understanding the myriad "things" that Mencius finds to be "all implicated here in me." As medical anthropologist Judith Farquhar observes in her attempt to make sense of what we might call this Chinese *qi* cosmology: "*Qi* is both structural and functional, a unification of material and temporal forms that loses all coherence when reduced to one or the other 'aspect'" (Farquhar 1994, 34) (Ames, 2015, p. 1`75).

A subtlety in the research into (con)textural-dyadic thinking is that the focus has been on a philosophy of science (i.e. Classical Chinese Medicine, as *daojia*), with the exclusion of the spiritual (*daojiao*). The religion of Daoism presumes yinyang, while the science of Chinese medicine recognizes *qi* without having to mention *dao*. Pragmatist John Dewey visited China in 1919-1921 as a teacher and a learner, having repudiated his evangelical Christian upbringing in favour of humanism. It's easy to get the philosophy of science confused with philosophical metaphysics when trying to trace a history of pragmatism with Chinese philosophy.[64] The aim of this research article has not necessarily to align (con)textural-dyadic thinking with the pragmatism of the Metaphysical Club, but instead with sciencing in the mid 20th century. This follows a pragmatic style in the design of an inquiring system, but not limited to the Western philosophical traditions. This sciencing and philosophizing itself takes a (con)textural-dyadic style, open tor additional strands of thought to go wayfaring together.

## 6 | Appendix 1: Philosophical lineages from 1890 into 20th century systems thinking

Tracing the institutional alignments, from the beginning of universities studies through to emeritus roles.

**Exhibit A1.** Institutional associations of some philosophers and scientists in the systems movement



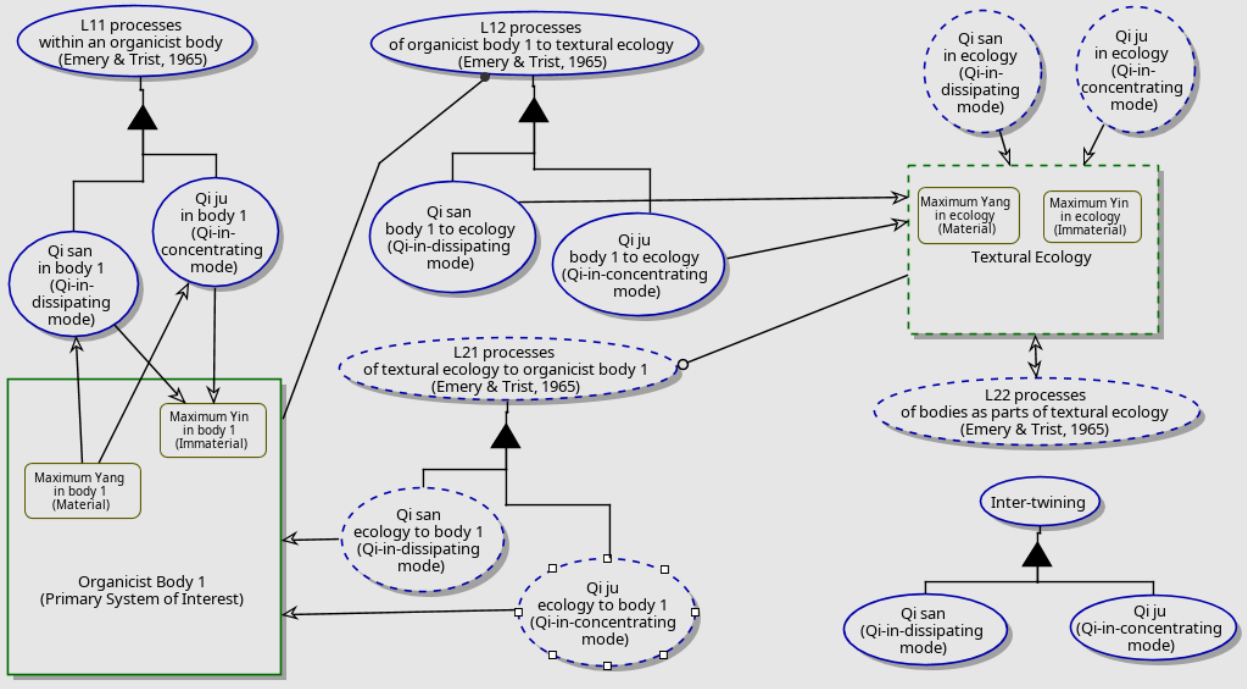

[64] Religion and philosophy preceded science. Yinyang excluding Daoism may be as challenging as separating pragmatism from Christianity with the Metaphysical Club of the 1890s.

> If we want to invoke Chinese cosmological language to restate what Dewey and James are saying here, it would be to recognize that *dao* ( 道) is the unbounded field of experience always construed from one perspective as opposed to another, and *de* (德) is the insistent particular that construes the field of experience from this perspective or that. In other words, *dao* as the continuous field of experience and the unsummed totality of *de* as "everything that is happening" (*wanwu* 萬物 or *wanyou* 萬有) are simply two ways of expressing the same phenomenon save with a different emphasis on either the continuity of, or the multiplicity, perspectivity, and particularity in, the content of experience. Every unique "thing" or event has implicated within it the continuous totality of all things, and the totality of all things is always construed from some particular insistent perspective. When we are able to achieve resolve—that is, commitment and focus in our own lives—we are best able to transform the full content of our experience in its most meaningful way (Ames, 2015, p. 180).

## 7 | Appendix 2: Object Process Modeling of Causal Textures Theory with Contextual Dyadic Thinking

Object Process Methodology is an approach to conceptually modeling systems, standardized as an ISO/PAS 19450 specification. The OPCAT software platform is bimodal tool that simultenously generates Object Process Diagrams (OPDs) and Object Process Language (OPL).

**Exhibit A2.** Object Process Diagram, Causal Texture Theory with Contextual Dyadic Thinking




Here's the Object Process Language.

Organicist Body 1 (Primary System of Interest) is physical.
Organicist Body 1 (Primary System of Interest) can be Maximum Yin in body 1 (Immaterial) or Maximum Yang in body 1 (Material).
Organicist Body 1 (Primary System of Interest) handles L12 processes of organicist body 1 to textural ecology (Emery & Trist, 1965).
Textural Ecology is environmental and physical.
Textural Ecology can be Maximum Yang in ecology (Material) or Maximum Yin in ecology (Immaterial).
L11 processes within an organicist body (Emery & Trist, 1965) is physical.
L11 processes within an organicist body (Emery & Trist, 1965) consists of Qi ju in body 1 (Qi-in- concentrating mode) and Qi san in body 1 (Qi-in- dissipating mode).
Qi ju in body 1 (Qi-in- concentrating mode) is physical.
Qi ju in body 1 (Qi-in- concentrating mode) changes Organicist Body 1 (Primary System of Interest) from Maximum Yang in body 1 (Material) to Maximum Yin in body 1 (Immaterial).
Qi san in body 1 (Qi-in- dissipating mode) is physical.
Qi san in body 1 (Qi-in- dissipating mode) changes Organicist Body 1 (Primary System of Interest) from Maximum Yang in body 1 (Material) to Maximum Yin in body 1 (Immaterial).
Qi san in ecology (Qi-in- dissipating mode) is environmental and physical.
Qi san in ecology (Qi-in- dissipating mode) yields Textural Ecology.
Qi ju in ecology (Qi-in- concentrating mode) is environmental and physical.
Qi ju in ecology (Qi-in- concentrating mode) yields Textural Ecology.
L12 processes of organicist body 1 to textural ecology (Emery & Trist, 1965) is physical.
L12 processes of organicist body 1 to textural ecology (Emery & Trist, 1965) consists of Qi san body 1 to ecology (Qi-in-dissipating mode) and Qi ju body 1 to ecology (Qi-in-concentrating mode).

Qi san body 1 to ecology (Qi-in-dissipating mode) is physical.
Qi san body 1 to ecology (Qi-in-dissipating mode) yields Textural Ecology.
Qi ju body 1 to ecology (Qi-in-concentrating mode) is physical.
Qi ju body 1 to ecology (Qi-in-concentrating mode) yields Textural Ecology.
L21 processes of textural ecology to organicist body 1 (Emery & Trist, 1965) is environmental and physical.
L21 processes of textural ecology to organicist body 1 (Emery & Trist, 1965) consists of Qi san ecology to body 1 (Qi-in-dissipating mode) and Qi ju ecology to body 1 (Qi-in-concentrating mode).
Qi san ecology to body 1 (Qi-in-dissipating mode) is environmental and physical.
Qi san ecology to body 1 (Qi-in-dissipating mode) yields Organicist Body 1 (Primary System of Interest).
Qi ju ecology to body 1 (Qi-in-concentrating mode) is environmental and physical.
Qi ju ecology to body 1 (Qi-in-concentrating mode) yields Organicist Body 1 (Primary System of Interest).
L21 processes of textural ecology to organicist body 1 (Emery & Trist, 1965) requires Textural Ecology.
L22 processes of bodies as parts of textural ecology (Emery & Trist, 1965) is environmental and physical.
L22 processes of bodies as parts of textural ecology (Emery & Trist, 1965) affects Textural Ecology.
Inter-twining is physical.
Inter-twining consists of Qi san (Qi-in-dissipating mode) and Qi ju (Qi-in-concentrating mode).
Qi san (Qi-in-dissipating mode) is physical.
Qi ju (Qi-in-concentrating mode) is physical.

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