SET THEORY AS SELF-CONTRADICTORY

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Abstract

1. Background

This study presupposes a background, such as that set forth in my recent paper, “Can we Trust our Traditional Language?” In that document, I compare and contrast two collections of abstractions so extensive that we have no common word or standard phrase that captures their magnitude. For lack of a better term, I shall call them **frames of reference**.

As the newer contender, I hold up the **alternative frame of reference** which I have built on the explicit **non-aristotelian premises** proposed in 1941 by Alfred Korzybski (1879-1950).

As the older contender, I offer the traditional frame of reference based on the largely **tacit** and unrecognized presuppositions encoded in the generalized grammar which underlies the discursive and notational languages of the western Indo-European (WIE) family. Perhaps the phrase *the Western World-View* catches some of my intent here; but please recognize that I include not only tongues such as Danish, Dutch, English, … Latin, … Sanskrit, …, etc., but also the WIE logics, mathematics, sciences, philosophies, jurisprudences, religions, etc.

2. Hoppenbrouwers on “‘Freezing’ Language”

At least some WIE linguists have come to recognize human languaging as intrinsically dynamic. They have pointed out at least some of the ways in which, when we language, we alter the terms we use—change what we ‘mean’ by our terms.

In contrast, users of technical languages, rightly fearing the consequences of unrecognized ambiguity and other sources of misunderstanding, tend to develop specialized terminology—jargon—intending to “fix” what key terms ‘mean’. For example, when even the best Information Technology workers undertake to write what they call a *data structure*, they start by selecting key terms. Then they attempt to “fix” what these terms ‘mean’ by incorporating them into a *data definition dictionary*. Thereafter, they pretend that the 'meanings' of those key terms undergo no further changes. In other words, they tacitly assume it both possible and feasible to embalm human languaging, and arrogate to themselves the ability to do so.

I regard that supposition—that we can “fix” our key terms—consistent with the modern Logical Axiom of Identity, to the effect that

for all elements x that belong to the delimited domain D, $x \equiv x$.

In colloquial terms, that means that WIE workers hold that no term may differ from itself, and that mathematicians posit one and only one “logical level” for the mathematical theory of sets.

Hoppenbrouwers (2003a,b) calls this process—this pretense—“‘freezing’ language”. He and his colleagues have examined some of the difficulties which this pretended ‘freezing’ leads to. Further, they have begun to find ways to deal with some of these difficulties. For example, these workers bring together the various persons who have a stake in the shared project, and foster conversation amongst these stakeholders, intending to reach mutually-satisfactory agreements concerning how to proceed with the project. Where others may regard this as a strategy, arrived at mainly empirically, I contend that Hoppenbrouwers and his colleagues may have begun uncovering a novel way of ‘taking the observer into consideration’ in Information Technology. Further work along these lines may begin to provide ways to practice Information Technology without needing to pretend to ‘freeze’ human languaging.

In what follows, I intend to explore at least one way, little noticed until now, in which (as it seems to me) human languaging remains in principle incapable of becoming ‘frozen’. Having shown that (if I can and do), I shall explore some of the consequences which follow when WIE workers persist in what I regard as the delusion that they have ‘frozen’ their languaging.

3. Multiordinal

Korzybski's construct of *multiordinal* refers to a feature of human languaging which, if ignored, can lead (at the very least) to unanticipated ambiguities, or (at worst) to serious confusion—e.g., contradictions. Here, I shall first show how using multiordinal terms unawarely in discursive settings can lead humans into difficulties; then shall extend the topic into the domain of the structuring of WIE mathematics.

3.1. In Discursive Languaging

Before anyone can learn how to take multiordinal terms into account and use them awarely and effectively, s/he must have some way to detect them. In discursive languaging, the known and already well-recognized kinds of ambiguity arise mainly from the fact that many terms in a WIE language such as English have multiple, disparate meanings, or that terms of dissimilar origin (or spelling) sound alike. To avoid ambiguities from this source, this person must carefully restrict her/himself to one and only one of the “dictionary meanings” of whatever term s/he chooses to scrutinize. Then, to paraphrase Korzybski, in order for her/him to establish whether or not her/his chosen construct behaves as a multiordinal term, s/he must construct a series of logical levels, and a way of distinguishing among them. If s/he finds that using the term under scrutiny on one “logical level” in this series leads to an acceptable statement, and that using it on another (by convention, “higher level”) also leads to an acceptable statement, then this term has survived the test and s/he must designate it as *multiordinal*. (Korzybski, 1933, p. 433)

To neglect the intrinsic ambiguity of multiordinal terms necessarily leads to serious confusion. To see this, take into account the fact that we humans can apply any multiordinal term to itself. When we do this, we find at least three main classes of second-order effects: With one grouping of multiordinal terms (ones which we might conventionally regard as referring to '*positive*' or '*desirable*' or ‘a*pproved-of’* activities), the ‘meanings’ of the second-order usages reinforce those of the first-order usages into designations for highly valuable activities, as in 'curiosity about curiosity', 'analysis of analysis', 'reasoning about reasoning', etc. With a second grouping (terms referring to conventionally '*negative*' or '*undesirable*' or '*disapproved-of* ' activities), the ‘meanings’ of the second-order usages reinforce those of the first-order usages and in the process convert them into designations for morbid activities, as in 'worry about worry', 'fear of fear', 'ignorance of ignorance', etc. With a third class of terms, the activities designated by the second-order usages reverse and annul the activities designated by the first-order usages, as in 'inhibition of inhibition', 'doubt of doubt', etc. (Korzybski, 1933, p. 440)

So when we use a multiordinal term in both a lower and a higher positioning in an ordering on abstracting, its meaning in the higher positioning differs from that in the lower positioning. More than that, from beforehand and in general, we cannot predict the nature — the “direction” — of this change in meaning.

Thus, as Korzybski puts it,

> The main point about all such multiordinal terms is that, *in general*, they are ambiguous, and that all arguments about them, 'in general', lead only to *identification of orders of abstraction and semantic disturbances* [please read these technical terms as meaning *serious confusion*]*, and nowhere else*. (ibid., p. 434)

To borrow two terms from WIE logic, a multiordinal term taken “in general”, not assigned to a definite “logical level”, resembles a **propositional function** (e.g. “All x ‘is’ black.”) rather than a **proposition** (“All snow ‘is’ black.”).
In other words:
we humans may not legitimately say or assume, in general, that

multiordinal $\text{term}_1 \equiv$ multiordinal term_1 . 1a

Or to move the negating from the meta-text into the notational expression, we must deem acceptable and valid the expression:

multiordinal term_1 multiordinal term_1 . 1b

3.2. Example:

An explicit example might make this construct more immediate. I’ll take the role of *designated observer* (or “she”), and provide a specific statement_1, a specific statement_2, and two terms, one of which she suspects as *multiordinal*, and the other she suspects as *non-multiordinal* (“uni-ordinal”?).

Our organism (or “he”) says to his friend (statement_1): “That beast, barring our way and barking at us, certainly has a hoarse voice.”
His friend replies (statement_2): “Noisy, wouldn’t you say? He looks to me like a Basset hound. They usually do have hoarse voices.”

As her supposedly “uni-ordinal” term, our designated observer takes the term **dog**, in the dictionary meaning of “a carnivorous domesticated mammal”; and as her supposedly multiordinal term, she takes the term **true**, in the dictionary meaning of “conformable to fact; correct; not erroneous, inaccurate or the like”.

It seems clear to our designated observer that she has framed $proposition_1$ so it describes certain "doings" or "happenings" which she could label as *a dog*; and that she has framed $proposition_2$ so it describes "doings" or "happenings" which she could label as *the act of 'classifying' the "doings" or "happenings" designated by* $proposition_1$. By her standards, she cannot legitimately label those "doings" or "happenings" which she calls *an act of classifying* with the noun-phrase *a dog*. Hence she finds that the term *dog*, by this test, does not satisfy the criteria as *multiordinal*. However, as long as she considers the "story-line" she has presented here accurate enough, she could legitimately label $proposition_1$ as *true* and could likewise label $proposition_2$ as also *true*. Hence, by her standards, the term *true*, by this test, does apply to both propositions and so does qualify as *multiordinal*.

3.3. WIE Mathematics as Multiordinal

Korzybski (1933, pp. 432-3) designates as *multiordinal* several terms from the vocabulary of WIE logics and mathematics, including *function* and *proposition*.

3.3.1. The Key Question

Does even one construct from the domains of the WIE logics and mathematics, taken in its proper context or contexts, "behave" like a multiordinal term?

To put that question more precisely, when I examine with tools which appear in principle competent to test this kind of supposition, do I find even one construct from the WIE logics and mathematics which shifts in meaning, in a fashion **similar in structuring** to what I have shown you for constructs such as *to analyze*, *to fear*, *to doubt*, etc.?

3.3.2. Criteria for Judging:

If I cannot or do not find even one term which shifts in meaning in that fashion, then by this chain of argument, I will have provided no grounds to criticize WIE set theory (or other WIE disciplines: logics, mathematics, etc.).

If I can and do find at least one term which shifts in meaning in that fashion, then by this chain of argument, I will have demonstrated that in the mathematical theory of sets, the fundamental construct of *identity* cannot and does not satisfy the generally agreed-on standards for *valid* held up by the contemporary WIE mathematical theory of sets. Such a finding (if any) would show that the construct of *identity* generates—in my opinion, unavoidably generates—a contradiction.

In order to test this question, I shall:

Examine a passage written in 1962 by W. Ross Ashby (1903-1972).

"Unpack" what Ashby says there, making the fundamental distinctions which my frame of reference requires, as if they made a difference.

Conclude by examining the results in light of the construct of *multiordinal*.

Ashby (1962) summarizes Bourbaki's contributions to set theory, putting them together as an algebraic set theory notation. In developing the notion of **mapping** (a fundamental construct related to, but broader than, the construct of **function**), Ashby makes an observation which I regard as revealing, crucial—and then at the end of his sentence, dismisses it. I consider and discuss this passage in some detail.

3.3.3 Ashby's Thesis, in His Words

In the passage under scrutiny, Ashby posits two sets, E and F, and defines a mapping μ from E to F as

> any correspondence, rule, method, diagram, indication, construction, process, algorithm, computation, machine, device, force, drive, reflex, instinct, command, or any other cause whose effect is that, given any element in E, *one and only one* element in F results.

After defining the constructs of *domain*, *range* and *values* in a standard way, Ashby continues by noting that

> … F is not necessarily different from E. At this point it should be noticed that whether the sets E and F are finite or infinite, ordered or not, discrete or continuous, with a metric or not, are all irrelevant.
>
> If the mapping μ, operating on e of E, gives f in F, we write $\mu(e) = f$. …

These remarks set the stage for his crucial observation.

> If A is a subset of E, and μ acts on each element of A, the set generated is some subset of F. Thus, given each subset of E, the action of μ on the elements generates *one and only one* subset of F. There is thus defined a mapping of the set of all subsets of E into the set of all subsets of F. Though essentially distinct from μ, experience has shown that the use of the same symbol μ to represent it is convenient and rarely a source of confusion. Thus, if $A = \{a_1, a_2, a_3, \ldots\}$, we have
>
> $$\mu(A) = \{ \mu(a_1), \mu(a_2), \mu(a_3),\ldots\}$$
>
> with the original μ on the right hand and the new μ on the left. (Ashby, 1962, 84b; underlinings, and small-capitals for emphasis, mine)

In my limited experience, I know of no set theorist—no logician or mathematician—who would refuse to accept as a well-formed formula an expression such as

$$\mu(A) = \{ \mu(a_1), \mu(a_2), \mu(a_3),\ldots\}$$

Furthermore, in that passage, I see Ashby as setting up a set-theoretic analog to a "single 'dictionary meaning'" for his articulated constructs: namely,

$\mu: E \rightarrow F$. (In words: the mapping *mu* maps the set E to the set F).

In this context, please remember that, in the mathematical theory of sets, we can express any set as a relation, and any relation as a set. Thus, I can express the mapping $\mu: E \rightarrow F$ as the Cartesian product space (set) $\mu = E \times F$. (In words: the set *mu* equals (consists of the same elements as) the Cartesian product (set) E cross F.)

In his text, I see Ashby as successfully adhering to that single 'dictionary meaning'. Then I see him as operating on—dealing with—at least three different, adjacent "logical levels". I write these out in the Bourbaki algebraic set theory notation which Ashby developed in the quoted paper, so as to make explicit what Ashby's English sentences say to me. In the process, I indicate "logical level" (or positioning in an ordering on abstracting) by means of a superscripted number which I write to the left of the term that I use it to modify, e.g., ${}^{0}\mu$, ${}^{1}A$, ${}^{2}B$, etc.

3.3.4 How I Translate This Into Notation

The basic tools of set theory provide me with access to everything I need to test my key question. As you will see, Ashby presents a basic construct of set theory, and then a familiar construction that rests on that construct, and then a perhaps less familiar construction which rests upon the more familiar one.

To start with, on the 'lowest' of these "logical levels", which I might call that of **element sets**, Ashby posits two sets, E and F , and a mapping μ from E to F . In a variant of the notation which Ashby develops, I shall write out the formulations which his English text describes.

3.3.4.1. Level 0: The level of what I might call **element sets** (a two-place relationing—the formulation leaves "room" to write in designations for two sets—which I indicate by $\ldots\in\ldots$, and read as "(*'something'*) *element of* (*'something else'*)"):

${}^{0}e \in E$, ${}^{0}f \in F$

$E = \{{}^{0}e_1, {}^{0}e_2, {}^{0}e_3, \ldots\}$, $F = \{{}^{0}f_1, {}^{0}f_2, {}^{0}f_3, \ldots\}$

${}^{0}\mu: E \rightarrow F$

${}^{0}\mu\,({}^{0}e) = {}^{0}f$

3.3.4.2. Level 1: The level of what I might call **subset-sets** (a two-place relationing which I indicate by $\ldots\subset, \ldots$, and read as "(*'something'*) subset of (*'something'*)"):

${}^{1}A \subset E$, ${}^{1}B \subset F$

${}^{1}\mu: {}^{1}A \rightarrow {}^{1}B$

${}^{1}\mu({}^{1}A) = \{{}^{0}\mu({}^{0}e_1), {}^{0}\mu({}^{0}e_2), {}^{0}\mu({}^{0}e_3), \ldots\} = \{{}^{0}f_1, {}^{0}f_2, {}^{0}f_3, \ldots\} = {}^{1}B$

3.3.4.3. Level 2: The level of what I might call **the family of all the subsets of any set S** , which I could call **the power-set of S** (and which I indicate by $\mathbf{2}^S$) (a two-place relationing which requires a **quantifier**, the relevant usage of which I express both in notation and in words below). In my version of Ashby's context, I express the key constructs as follows:

$\forall {}^{2}A_i \subset E: {}^{2}A_i \in \mathbf{2}^E$, $\forall\, {}^{2}B_i \subset F: {}^{2}B_i \in \mathbf{2}^F$

$({}^{2}A_i \subset E) \in \mathbf{2}^E$

${}^{2}\mu: \mathbf{2}^E \rightarrow \mathbf{2}^F$

${}^{2}\mu({}^{2}A_i) = {}^{2}\mu(\mathbf{2}^E) = \{{}^{1}\mu({}^{1}A_1), {}^{1}\mu({}^{1}A_2), {}^{1}\mu({}^{1}A_3), \ldots\} = \{{}^{1}B_1, {}^{1}B_2, {}^{1}B_3, \ldots\} = \mathbf{2}^F$

Here, the quantifier (upside-down A , to wit, $\forall$) means "For all …" or "For every…". Thus, I express that portion of the first line of this section which lies to the left of the first colon as "For all (2^{nd}-level) sets ${}^2A_i$ which form a subset of E" (where the subscript i takes in turn each of the values 1, 2, 3, …, so as to indicate "all of the possible sets ${}^2A$ (that form) subsets of E"). That makes that portion of the first line of this section which lies to the left of the first colon signify "the family of all the subsets of E". The colon signifies "such that"— "such that (each) ${}^2A_i$ *belongs to* (or *element of*) the power-set of E, $\mathbf{2}^E$ " Then I use the whole notational expression which lies to the left of the comma to mean "For the family composed of all the (second-level) subsets ${}^2A_i$ of the set E, every one of these subsets belongs to the power-set of E, $\mathbf{2}^E$."

3.4. Summarizing these set theory formulations:

These three usages of the mapping μ satisfy the "dictionary meaning" of that mapping, namely,

$\mu: E \rightarrow F$.

On the zeroth "logical level"—the one that I call *element-sets*— μ operates on elements of E to yield elements of F. Or, expressed as a set,

$\mu = E \times F$.

On the first "logical level"—the one that I call *subset-sets*— μ operates on single subsets of E to yield single subsets of F. Or, expressed as a set,

$\mu = A \times B$.

On the second "logical level"—the one I call *power-sets*— μ operates on the family of all the subsets of E to yield the family of all the subsets of F . Or, expressed as a set,

$\mu = \mathbf{2}^E \times \mathbf{2}^F$.

I deem that the foregoing establishes that this mapping μ survives the test of 5.3.2—it satisfies the criteria as *multiordinal*—and so would any other mapping. When one or more humans engage in sequential abstracting, s/he/they generate a hierarchical ordering—or in more colloquial terms, a series of "logical levels". That means that, when we humans language, even in the allegedly "static" and "unchanging" terms of WIE spoken and/or written English or set theory, not only do we shift and change, but so do our symbol-systems. Like us, our symbolic environment appears intrinsically dynamic. Not even most WIE linguists have taken in the degree to which such shifting-and-changing occurs. No one, I infer, can successfully "freeze" symbol-systems such as human languaging.

Russell's Paradox (1902) showed that any mathematics based on Aristotle's "Laws of Thought" leads to a contradiction. Each version of the WIE mathematical theory of sets put forth since the publication of that paradox fends off Russell's paradox in one or more ways. As one component of how it does so, each has accepted the Logical Axiom of Identity as a presupposition (I would say, as its most fundamental presupposition). By the principle that says we may express any relation as a set, and any set as a relation, we may regard $\mu: E \rightarrow F$ as a set. When we accept the Logical Axiom of Identity as valid concerning the set μ, we constrain ourselves to write

$\mu \equiv \mu$,

and to regard it as 'true'. According to the Logical Axiom of Identity, we must constrain ourselves to hold that in no way may a term differ from itself.

4. Conclusions

However, in the present context, μ survives my test, which qualifies it as multiordinal. As Korzybski (1933, p. 434) points out, when we take a multiordinal term such as μ "in general" and do not assign it to a particular positioning in an ordering on abstracting (do not modify it, as by the left superscripted indexing which I used in the above discussion of levels 2 and 3), it cannot and does not satisfy the criteria as self-identical. We may not write, or believe, "$\mu \equiv \mu$". For nothing in that WFF, or anywhere else in the mathematical theory of sets, prevents having the μ to the left of the triple-bar identity-symbol from referring to the usage on one "logical level", while the μ on the right of that symbol refers to a usage on some other "logical level", and thus must differ in what it 'means'. Instead, we must write, and accept,

$$\mu \quad \mu \, .$$

This conclusion contradicts the Logical Axiom of Identity.

To say that in more formal language (which means, I shift from using the verb-phrase *contradicts* to using the noun-phrase *a contradiction*): Using this kind of scrutiny, I show that the presupposition known as the Logical Axiom of Identity leads to a contradiction.

At least some workers accept the WIE mathematical theory of sets as the general logical language, and say that today's workers can frame every currently-known branch of WIE mathematics in the terminology of set theory. Ashby states this proud claim as follows:

> The method described here is based on the work of the French school that writes under the pseudonym of N. Bourbaki. [T]heir great work has shown that all mathematics, and therefore all products of accurate thinking, can be based on set theory… (Ashby, 1962, p. 83a)

That suggests that this demonstration shows that every currently-known branch of WIE logic and mathematics leads to a contradiction—or in other words, appears unacceptable.

Ashby's blandishment concerning what I might call a *second- or third-order usage* of μ, to the effect that,

> Though essentially distinct from μ, experience has shown that the use of the same symbol μ to represent it is convenient and rarely a source of confusion,

violates the naming or **nouning** conventions of the mathematical theory of sets. Ashby's proposal does, however, satisfy the hidden assumption (corollary or consequence of tacit *identity*) that disallows any intrinsic hierarchical ordering. If widely accepted, this erroneous blandishment would "save the appearances" and allow mathematicians to continue writing, and believing, that "$\mu \equiv \mu$", despite the contrary evidence (and Ashby not only presents the contrary evidence, he even acknowledges it).

As I point out above, I designate as *delusional* any belief held despite undisputed contrary evidence. The following inference may sound like strong language, but from the standpoint of the present alternative frame of reference, the WIE "disciplines" share in this long-sustained delusional behaving-and-experiencing. Below, under the heading of Discussion, I shall briefly consider the survival-consequences of persisting in this delusional evaluating.

Elsewhere (   ) I pointed out that, as judged by my version of the criterion of generality, my alternative frame of reference (including its non-standard notation) appears more general than do WIE logics and mathematics (or any other "disciplines" (sub-languages) based on the generalized WIE grammar). That means that this alternative frame of reference includes the WIE sub-languages as "special cases".

Here, that 'including' bites.

Let me compare and contrast my languaging here to that generated to express the way a famous dispute within physics got resolved: In briefest summary, measurements made during the 1919 total eclipse of the sun did disconfirm the predictions based on inferences from the Newtonian theory of gravitation (which posits an inverse-square "force of attraction" which acts at-a-distance, and "causes" or "impels" two massive bodies to move towards each other). These measurements failed to disconfirm the predictions based on inferences from the general theory of relativity (which explains gravitation as a manifestation of the curvature of space-time). From that critical experiment, physicists concluded that Newtonian physics "no longer forms the cutting edge of scientific investigation." Subsequently, physicists demoted Newtonian theory, declaring it "still useful, perhaps, for solving 'practical' problems".

The present study similarly addresses a fundamental dispute. As I indicated above, I use the term *frame of reference* to refer to these two ponderous contenders.

As their keystone presupposition, practitioners of the traditional Western frame of reference regard-and-treat the logical construct of *identity* as valid. But they do not do so in a fashion that satisfies the standards of the **social institution of science**: As far as I can tell, virtually no one holds the construct of *identity*, or her/his accepting of *identity*, in a tentative or provisional manner—as a testable assumption, in principle disconfirmable. Instead, most workers appear to me to regard their accepting of *identity* as "a manifestation of the way things really 'are'"—a phrase which, to me, begs the question, for the phrase itself signifies that they have already accepted *identity*, specifically in the guise of *'map'-'territory' identity,* as valid.

In turn, as their keystone presupposition, practitioners of my alternative frame of reference accept Korzybski's suggestion that, in a Cosmos that harbors living organisms, including humans, we regard-and-treat *identity* as not-valid. Framed as a hypothesis, that becomes the prediction that No usage of the logical construct of *identity* will survive competent scrutiny.

For the purposes of this study, I proposed the following chain of abstracting:

- Hoppenbrouwers (2003a,b) points out a practice—as the initial step in generating a *data structure*, creating a *data definition dictionary* in order to "fix" the key terms of the Information Technology project. I pointed out that that practice implies-and-assumes the modern logical axiom of identity.
- Korzybski's construct of *multiordinal terms* provides a criterion by which a worker can partition the lexicons of WIE languages into "terms which we could perhaps fix" and "terms which, in principle, we cannot fix—terms not subject to the logical axiom of identity".

  I apply this criterion to a key construct from the mathematical theory of sets—that of *mapping*.

- I show that the set theorists have provided convincing evidence that the construct of *mapping* satisfies the criterion as a multiordinal term. We may not set any multiordinal term identical with itself. Therefore the logical axiom of identity does not apply to the construct of *mapping*. Multiordinal terms unavoidably differ from themselves.
- In other words, in the mathematical theory of sets, the presence of the logical construct of *identity*, which leads us to expect no term (noun-phrase) to differ from itself, leads to an unavoidable contradiction.

5. Scope of These Conclusions

I remind you that we construct theories out of symbols.

Further, I must point out that the premises of the special and general theories of relativity, of quantum theory, and Newtonian mechanics, along with the WIE logics and mathematics, etc., conjointly agree in relying on the construct of *identity* as valid.

I hold that the presupposition of accepting *identity* as valid amounts to a special restricted and restrictive assumption which these "less general" theories share. For in a (symbolic) Cosmos that harbors (symbolic) living organisms, including humans, the assumption of *identity* seems to me so restrictive that it holds under no circumstances whatsoever. In other words, it appears **untenable**.

I predict that any competently-framed attempt to test this untenable presupposition will disconfirm it. The whole collection of "special cases"—the entire grouping of the WIE "disciplines"—thus appears self-contradictory, and therefore unacceptable as primary tools for exploring our-relationing-with-ourselves-and-our-various-environments.

I must allow that the Western "disciplines" might still prove useful for solving certain types of 'practical' problems—but not to guide us towards long-term survival.

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