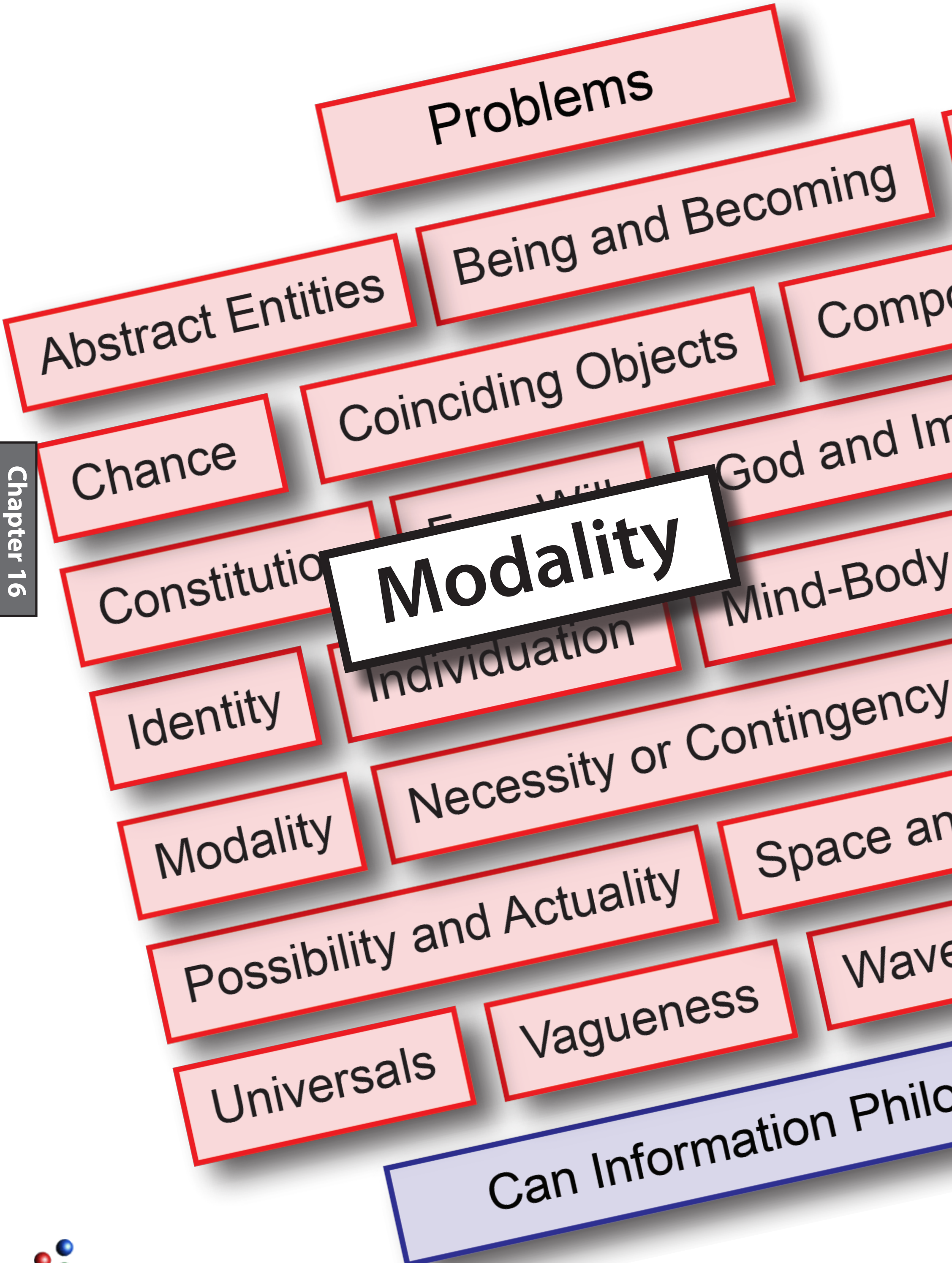
Problems
Abstract Entities
Being and Becoming
Chance
Coinciding Objects
Modality
Individuation
Identity
Modality
Necessity or Contingency
Possibility and Actuality
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Modality

Logic is an *abstract* human invention, a formal system of ideas much like mathematics, or purely theoretical physics. It is a kind of language, another human invention. Although we can see language as arguably the latest natural evolution of a biological communication system that uses arbitrary symbols for messages in and between all organisms, logic and mathematics are purely the products of rational human minds.

There is nothing material about logic. It is purely abstract and *immaterial* information. Its application to the material world is fraught with danger. A purely materialistic metaphysics cannot understand the fundamental nature of physical reality, cannot understand metaphysics, without including *immaterial* forms, the "Ideas" of Plato.

Where symbols in ordinary language are notoriously ambiguous, logic is an attempt to formalize the allowed terms, the rules by which they are assembled into statements, and the principles for deductively reasoning from some statements (premises) to others (conclusions), such that true premises lead to true (valid) conclusions.

It was the vision of the great rationalist philosopher Gottfried Leibniz that we could develop an ambiguity-free language for logic and mathematics. That dream was pursued by Bertrand Russell, Ludwig Wittgenstein, Rudolf Carnap, and others.

Their logical truth-functional analyses are severely limited by the principle of bivalence, the excluded middle, that the only possible values are true and false. But the world is not limited to truth and falsity and attempts to develop three-valued or many-valued logics have largely failed.

Modal logic is the analysis and qualification of statements or propositions as asserting or denying necessity, possibility, impossibility, and, most problematic, *contingency*.

The use of "necessity" and "impossibility" to describe the physical world should be guarded and understood to describe events or "states of affairs" that have extremely high or low probability. The term certainty, when used about knowledge of the physical world, normally represents only extremely high probability.

Possibility and contingency are not easily constrained to the binary values of true and false. To begin with, possibility is normally understood to include necessity. If something is necessary, it is *a fortiori* possible. Contingency is then defined as the subset of possibility that excludes necessity.

The modal operators are a box '□' for necessity and a diamond '◊' for possibility. Impossibility is the negation of possibility, ¬◊, and contingency must negate necessity and also negate impossibility, so it is the logical conjunction of "not necessity" and "possibility" (¬□ ∧ ◊).

Mathematically, contingency is a continuum of values between impossibility and necessity, the open interval between 0 and 1 that represents all the probabilities (excluding the certainties). It is the negation of the logical disjunction of necessity and impossibility, neither necessary nor impossible. (¬ (□ ∨ ¬◊)).

But physically, contingency is the closed interval, including the endpoints of necessity (1) and impossibility (0). Theoretical physics today is often described as probabilistic and statistical, which is sometimes misunderstood to exclude perfect certainties like 0 and 1, but this is not the case. Even quantum physics, the basis of ontological chance in the universe, sometimes predicts certain outcomes, as explained by Paul Dirac.[1]

With its four modes, necessity, possibility, impossibility, and contingency, modal analyses simply contain more than can be confined to two-valued truth-functions, whether in logic, usually called *a priori* truths, or language analysis, usually called *analytic* truths, nor in supposed metaphysical truths.

Truth is a binary relation of ideas, true or false. Facts of the matter have a continuous value somewhere between 0 and 1, with plus or minus estimates of the standard deviation of probable errors around that value.

1 Dirac (1930) *The Principles of Quantum Mechanics,* chapter 1..

In analytic language philosophy, we need more than the "truth" of statements and propositions with their apparent claims about "necessary" facts in the world. The logical empiricists equate necessity in the first-order logic of their "object language" with analyticity in their higher-order "metalanguage" of propositional functions.

Although we distinguish the *a priori* truths of logic from the analytic truths of language philosophy, many such "truths" were discovered long before modern methods were invented to demonstrate their "proofs.' In that sense, knowledge is usually discovered *a posteriori* and ultimately all knowledge is synthetic in the Kantian sense.

All facts about the world are (necessarily?) empirical and *a posteriori*, and thus contingent, so it is best to restrict the use of the concept "truth" to logic and to analytic discourse about statements and propositions. Truth is an appropriate concept in "ideal" formal systems like philosophical logic and mathematics where the extremes of necessity and impossibility are defined parts of the system. But the world itself cannot be confined to a Procrustean bed of true and false.

We therefore conclude that the logical empiricist's idea that the laws of nature can be described with linguistic statements or logical propositions is simply wrong. This is particularly the case for the laws of modern physics, which are now irreducibly probabilistic in view of the indeterministic nature of quantum mechanics, the uncertainty principle, etc.

The "evidence" that "verifies" or validates a physical theory is gathered from a very large number of experiments. No single measurement can establish a fact in the way that a single valid argument can assert the "truth" of an analytic statement. The large number of measurements means that physical evidence is statistical. Indeed, physical theories make predictions that are probabilities. Theories are confirmed when the *a priori* probabilities match the *a posteriori* statistics.

Probability is a theory. Statistics are the results of experiments.

Information philosophy considers claims such as "If P, then P is true" to be redundant, adding no information to the (true) assertion of the statement or proposition "P." Further redundancies are equally vacuous, such as "If P is true, then P is necessarily true" and "If P is true, then P is necessarily true in all possible worlds."

Logically necessary and analytic statements are tautological and carry no new information. This is the *paradox of analyticity*. The statement "A is A" tells us nothing. The statement "A is B" is informative.

Adding "is true" and the like add no new information. They cannot change the fundamental nature of a statement. For example, they cannot change a contingent statement into a necessary one. Consider the statement "A is contingently B." Prepending the necessity operator, "Necessarily, A is contingently B," changes nothing.

We adopt Ludwig Wittgenstein's terminology from "The world is all that is the case." In fact, that is to say in the empirical world, any fact F is at best probably "the case," with the probability approaching certainty in cases that are adequately determined. And, in any case, any past F was contingent and could possibly have been *otherwise*. The idea of a "possible world" is best understood as a way this actual world might have been.

There is, "in fact," only one actual world, the one that is the case. The original purpose of the invention of the idea that there are "possible worlds" – abstract entities – was to provide metaphysicians with other ways of talking about possibilities unrealized in our actual world.[2]

The "sample space" of modern probability theory and the "phase space" of statistical physics are spaces for possible worlds. The 36 ways that two dice can be thrown, the 64 squares where a pawn can be located on a chessboard, the coarse-grained cells for gas particles in position-momentum space, and the minimum uncertainty volumes $\Delta p \, \Delta x = \hbar$ of quantum physics, all can be used to describe possible worlds, how worlds can be, and thus how our world might be.

2 Kripke (1981), *Naming and Necessity*, p.19.

Information philosophy maintains that ontologically real possibilities "exist" or subsist as ideas, as pure abstract information, at the present time, alongside "actual" material objects. The ontological or existential status of ideas has always been a controversial question in metaphysics. The exact status of their "existence", asymmetrical in the past and future, is controversial.

Actual Possibles and Possible Possibles

Possibilities in the past may be described as having been "actual possibles." Possibilities in the future are merely "possible possibles."

Possibilities in the past, for example the past alternatives for human actions or the past outcomes of experiments in probabilistic quantum physics, were mostly "roads not taken" and were condemned to "non-being," as the existentialists described it. But they were actual as possibilities in the more distant past that were never "really" actualized. Thus, we can say they were at one time, that they once "existed" as, "actual possibles."

The existence of alternative possibilities in the future raises the famous problem of future contingency, which, since Aristotle's *De Interpretatione*, has called into question the principle of bivalence (either P or not-P), since statements about the future may be (now) neither true nor false. P and not-P are (now) possible possibles about future actuals.

But what can be said about the existential status of these future alternative possibilities in the present time? What can "actual possibles" mean metaphysically? We shall show that possibilities are ideas, abstract entities, which from the time they are embodied in a physical system or in a human mind become "actual possibles." At later times, we are justified in describing them as past "actual possibles" that were never actualized.

Whenever one of many actual possibles is actualized, it does not mean that alternatives that existed as abstract entities at that moment are no longer possibly actualizable in the future. Unless they are forgotten, they remain as "actual possibles"for future use.

We can now describe the many possible worlds that exist within our actual world. They are ways our actual world may be.

If you see a connection between quantum chance and "free" human decisions, there is one, but it does not make our decisions random. Information philosophy provides two examples of future "possible possibles" that are transformed when one is actualized into past "actual possibles." One comes from the world of quantum physics (the source of ontological chance), the other from the human mind when evaluating alternatives and making a decision.

The Many Possible Worlds in Our Actual World

We distinguish three kinds of information structures and processes in our world, the physical, the biological, and the particularly human and mental. All such processing systems can have multiple possibilities for the next step in their processes. These possibilities are abstract bits of information ("ideas") that must be embodied physically to be available as "actual possibles."

At the physical level, quantum events that are amplified to the macroscopic world start new causal chains in "adequately determined" physical processes.

Biological possibilities include sexual selection, where chromosomes for the zygote are randomly selected from the sperm and egg, as a genuinely new individual is created and novel information enters the universe.

For human beings, possibilities are ideas in minds about what to do next. Many of these ideas are constantly available in the normal repertoire of behaviors. That one is chosen over others does not remove the others from future actualization. They remain as "actual possibles" unless they are forgotten. Human minds also create genuinely new information, like that created in biological evolution, when they mentally consider an idea never before thought as an "actual possible."

Although our metaphysically actual possibles are not as numerous as the plurality of worlds of David Lewis or the many worlds of Hugh Everett III, they are plentiful enough. With ten billion humans, millions of other species, some with trillions of individuals that have behavioral repertoires, the numbers of possibilities being actualized in the world each instant is truly vast.

There are many ways that our world may be. It is thus very strange that modal logicians, especially those who are necessitists, assume our actual world has only one way to be and all possibilities are found in worlds that are physically inaccessible, though modally accessible.

Necessity of Identity and the Limits of Necessitism

David Wiggins and Saul Kripke claimed that the proof of the necessity of identity appeared to make contingent identity impossible. Wiggins also argued against Peter Geach's idea of *relative identity*.

An information analysis of identity limits perfect and total identity to cases of self-identity, which includes an object's intrinsic internal information and the extrinsic information in dispositional relations of one object to others and to space and time. We can say that any object is absolutely identical to itself. We can also say that some objects are relatively identical if their "identity" is limited to their intrinsic internal information. We then discover a large number of relatively identical objects, both concrete and abstract, including some of those claimed as "natural kinds" by Kripke and Hilary Putnam, for example, atoms of gold and molecules of water (H_2O)

Kripke claims that things which we describe as informationally intrinsically identical, are metaphysically *necessary a posteriori*. The domain of things that are intrinsic information identicals is much larger, including both natural and artifactual "digital clones," whether embodied or so-called "non-existent" abstract entities.

It was the claim for the necessity of identity that led to the leading modal systems including a "rule of necessitation," that if P, then necessarily P. ($P \supset \Box P$) We should examine this claim carefully. If correct, it may only be a tautological or analytical statement about a universe of discourse, with no significance for the physical world. By contrast, our claim for intrinsic information identicals is a metaphysical and ontological claim about the fundamental nature of reality as including digital clones.

The first proof of the necessity of identity, by Ruth Barcan Marcus, was little more than the substitutivity of identicals, which may be seen as begging the question of that identity! It is best seen in the simple proof by her thesis adviser, Frederic B. Fitch,

23.4

(1) a = b,

(2) □ [a = a],

then (3) □ [a = b], by identity elimination.[3]

Clearly this is mathematically and logically sound. Fitch substitutes b from (1), for a in the modal context of (2). This would be fine if these are just equations. But substitutivity in statements also requires that the substitution is intensionally meaningful. In the sense that b is actually just a, substituting b is equivalent to keeping a there, as a tautology, something with no new information. To be informative and prove the necessary truth of the new statement, we must know more about b, for example, that its intrinsic information is identical to that of a.

Most earlier identity claims showed only that a and b were references (names) for the same thing, Frege's Morning Star and Evening Star for example. But this is a new claim, that numerically distinct things are identical – in some respect.

Those earlier claims often referred to Leibniz's Law, the *Identity of Indiscernibles*. Marcus in 1961, Wiggins in 1965, and Kripke in 1971 all added Leibniz's Law, usually without specifically mentioning Leibniz. But none of these changed the fact that contingent identities are merely possible, that substitution of b for a is valid if and only if you already know that a and b are intrinsic information identicals, and that such knowledge, gained *a posteriori*, is in no way made metaphysically necessary by substituting into the modal context of necessity. Wiggins offered a definitive argument,

> "If a and b refer to the same object, it is already a perfect and absolute self-identity. Calling the identity necessary adds nothing more than "is true" or "necessarily true in all possible worlds." [4]

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3 Fitch (1952) *Symbolic Logic*, p.164

4 Wiggins (1980) *Sameness and Substance*, p.21

Modal Realism and Possible Worlds

It is critical to note that the metaphysicians proposing possible worlds are for the most part materialists and determinists who do not believe in the existence of ontological possibilities in our world.

They are mostly actualists who say that the only 'possibilities' have always been whatever it was that has actually happened. This is Daniel Dennett's position, for example, not far from the original actualist, Diodorus Cronus.

Moreover, their infinite numbers of worlds, e.g., David Lewis's modal realism and possible worlds, are governed by deterministic laws of nature. This means that there are also no real possibilities in any of their possible worlds, only actualities there as well.

Now this is quite ironic, since the invention of possible worlds was proposed as a superior way of talking about counterfactual possibilities in our world.

Since information philosophy defends the existence of alternative possibilities leading to different futures, we can adopt a form of modal discourse to describe these possibilities as possible future worlds for our to-be-actualized world.

Saul Kripke recommended that his "possible worlds" are best regarded as "possible states (or histories) of the world," or just "counterfactual situations," or simply "ways the world might have been."

Kripke appears to endorse the idea of alternative possibilities, that things could have been otherwise.

But there are Lewisian worlds in which your "counterpart" is a butcher, baker, candlestick maker, and every other known occupation. There are possible worlds in which your counterpart eats every possible breakfast food, drives every possible car, and lives in every block on every street in every city or town in the entire word.

This extravagance is of course part of Lewis's appeal. It makes Hugh Everett III's "many worlds" of quantum mechanics (which split the universe in two when a physicist makes a quantum measurement) minuscule, indeed quite parsimonious, by comparison.