The Logically Perfect Language on Words without Objects

by

Bonnie King Yee Chin

A thesis submitted to the Department of Philosophy

In conformity with the requirements for

the degree of Master of Arts

Queen's University

Kingston, Ontario, Canada

(September, 2018)

Abstract

Bertrand Russell's logical atomism holds that the world is made up of a body of structured facts composed of simple objects. A Logically Perfect Language (LPL) is constructed to reflect this hierarchy of facts—every sentence in a LPL corresponds to a fact, and how these sentences are related accurately reflects how their corresponding facts are related. This paper is divided into four parts. I will first explain Russell's conception and construction of a LPL. Then, I will explain Henry Laycock's modified account of a singular-general dichotomy; propositions about multiple objects and stuffs need to be taken into account. In the third part, I will focus on the difficulty of integrating propositions about the non-discrete liquid-stuff in an objectual language. In the fourth part, I will examine two problems, namely, the semantics-syntax discrepancy in a LPL and the problem of collective predication. Finally, after characterizing the individuation condition for liquid-stuffs, I will motivate individuating them as discrete portions for the purposes of particular predication. I will develop a new conception of what constitute a single instance of liquid-stuff, and use this new conception to characterize the preliminary works before the construction of a LPL for liquid-stuffs.

Table of Contents

Table I

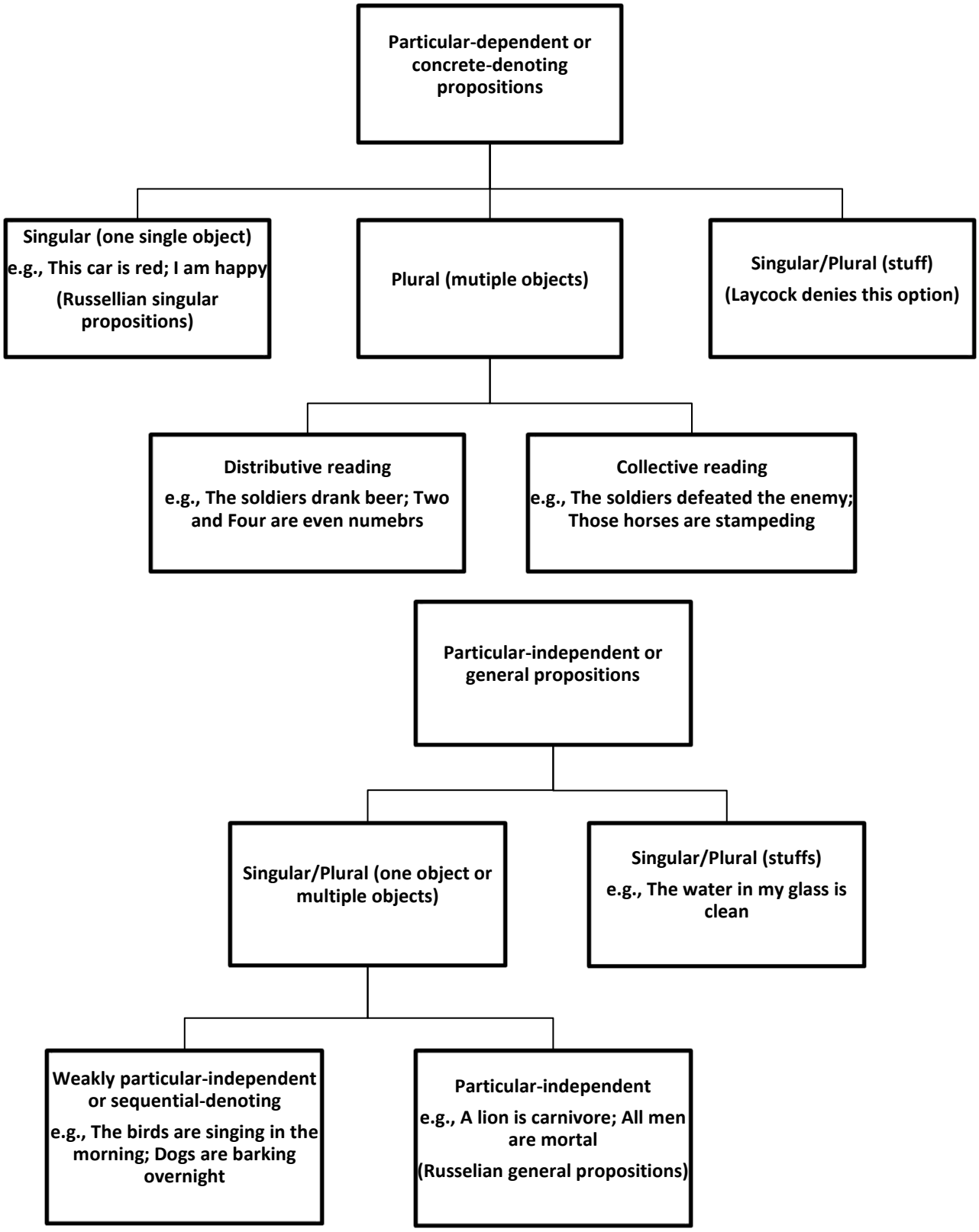
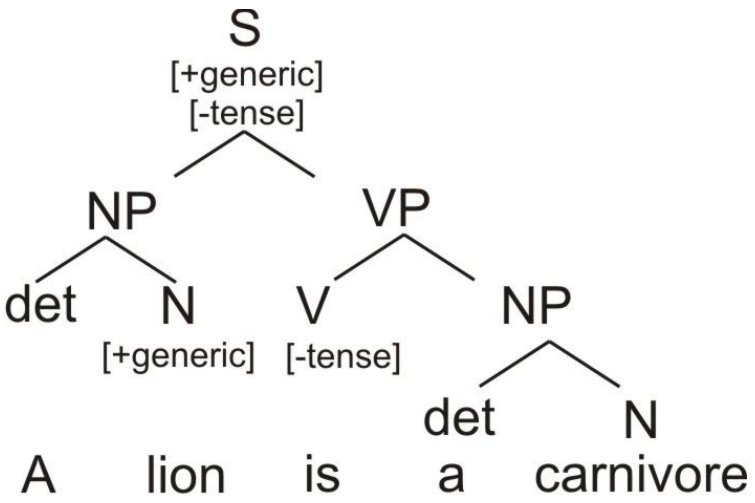
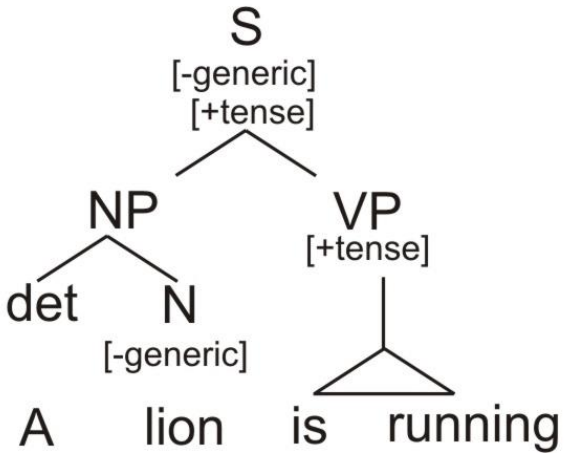

Particular-dependent or concrete-denoting propositions
Singular (one single object)
e.g., This car is red; I am happy
(Russellian singular propositions)
Plural (mutiple objects)
Singular/Plural (stuff)
(Laycock denies this option)
Distributive reading
e.g., The soldiers drank beer; Two and Four are even numebrs
Collective reading
e.g., The soldiers defeated the enemy; Those horses are stampeding
Particular-independent or general propositions
Singular/Plural (one object or multiple objects)
Singular/Plural (stuffs)
e.g., The water in my glass is clean
Weakly particular-independent or sequential-denoting
e.g., The birds are singing in the morning; Dogs are barking overnight
Particular-independent
e.g., A lion is carnivore; All men are mortal
(Russelian general propositions)

Table II


S
[+generic]
[-tense]
NP
VP
det
N
[+generic]
V
[-tense]
NP
det
N
A
lion
is
a
carnivore


S
[-generic]
[+tense]
NP
VP
[+tense]
det
N
[-generic]
A
lion
is
running

Chapter 1

Aristotle's Classification of Beings

Before presenting Russell's view on a LPL, I will first outline Aristotle's classification of beings as a precursor to the development of a LPL. The structure of LPL can be traced to the historical background of Aristotle's framework of *Category* of ontological dependence. For Aristotle, categories and their subjects are the basic kinds of things that exist, and their interrelations express different forms of being. Taken linguistically, categories are various kinds of words with different grammatical functions (e.g., subjects and predicates). Taken ontologically, categories are the most general classifications or characterizations of forms of beings—each category shows the different ways a thing is or can be (or indicates what kind of a thing it is or can be).

Aristotle classifies beings into categories according to their teleological nature, that is, a principle of constitution internal to a being which directs the changes and stability of the being. For example, the nature of an acorn is to bud and become an oak tree. Different forms of being are, according to their teleological natures, generalized into mutually exclusive and collectively exhaustive kinds of forms of being, which are ultimately classified under the irreducible and highest kind of Categories (Loux, p.21). Aristotle classifies beings into ten kinds of categories (or kinds of predicates): substances, quantities, qualities, relations, places, times, positions, states, actions, and affections (Metaphysics, 1b25–2a4). Substances are beings in the primary sense. All other categories are attributes of substance. Other things are considered beings only because they make some reference to substances—i.e., the fundamental beings in the primary

sense[1]. In the *Categories* (2a35-2b7), Aristotle explains the priority of substance in terms of the inherence and said-of relations[2].

Within a single category, each thing of a more general level stands in the *said-of relation* to things of a less general level (Cohen, §2). Being x is said-of being y if each particular in y must also be a member of x, because x is a more general classification of things than y within the same category. This generality of classification consists in x's being constituted by, or embodied in, an attribute of y. Everything in the category of substance is said-of another substance of a less general level, and ultimately, said-of a primary substance. For example, within the category substance, the genus plant is said-of the species tree, which in turn is said-of a particular oak tree, a particular apple tree, and so on. Likewise, within the category quality, the genus colour is said-of the species red, which in turn is said-of the red qualities of particular red things. Therefore, the said-of relation orders members within a single category (both universals and particulars) according to their level of generality and establishes an ontological hierarchy from the most generic universals at the top to particular individuals at the bottom.

The *inherence relation* is one of ontological dependence across categories (Cohen, §2). Being x inheres in being y if x depends for its existence on y. Particulars of non-substance

[1] "*So, too, there are many senses in which a thing is said to be, but all refer to one starting-point; some things are said to be because they are substances, others because they are affections of substance, others because they are a process towards substance, or destructions or privations or qualities of substance, or productive or generative of substance, or of things which are relative to substance, or negations of some of these things or of substance itself. It is for this reason that we say even of non-being that it is non-being*." (Metaphysics, 1003b5-11)

[2] In *Metaphysics* 1032a16-1034b33 and 1041a33-1042a2, Aristotle explains the ontological priority of substance in terms of an underlying *form-matter* analysis. The *matter* of an individual substance is what the individual is composed of. The *form* or essence is how that matter is put together to constitute an integrated whole performing the individual's characteristic functions. The cause of x's being a substance (i.e., what makes x's being the kind of thing that it is) is that its form is predicated of the matter of which it is composed. For example, Socrates is a man because the form of species human is present in a collection of flesh and bones, which constitute the substance Socrates. This form-matter composite jointly characterizes Socrates's essential nature as a rational being. The individual Socrates as a form-mater compound is fundamental (i.e., is an ontologically independent substance) because the compound is irreducible to its constituent matter (Cohen, §8).

categories cannot exist without a substance in which to inhere. Rational power and a colour shade are beings only because they exist in virtue of qualifying some substance, namely, an individual human soul and an individual coloured body respectively. Reason and colour cannot exist on their own.

Aristotle establishes a priority of existence of the category of substance over other non-substance categories: substance is the ultimate subject that underlies everything else, as other categories must be present in a substance. From this asymmetrical relation of dependence for existence, Aristotle further distinguishes between two kinds of substances within the category of substance: primary substances and secondary substances. In the *Categories*, the species of a particular is a *secondary substance* (Categories, 2b8-11, 2b28-30). First, a species inheres in its primary substance and not in anything else. For example, the species horse exists as the attribute of each individual horse. No non-horse individuals are required for the existence of the species horse. Second, a species is said-of its primary substance and not in anything else. The species horse fundamentally classifies each particular horse—i.e., the *only* lower level below the species horse—and does not qualify anything else. A *primary substance* is "what is neither in a subject nor said of a subject" (Categories, 3a10). That means a primary substance can exist on its own and does not depend for its existence on a less general thing. Whether an individual substance or its kind is more fundamental is difficult to decide. The two plausible interpretations are: (1) both are primary substances, neither one is more fundamental than the other; or (2) one is a primary substance in a primary sense, whereas the other is a primary substance in a derivative sense. In here, I will take both to be primary substances without determining which one is more fundamental.

Aristotle's classifications of beings into categories—in which substance serves as the fundamental being and everything else all derive their existence from substance—imposes an ontological hierarchy on all beings. Every subject, and every predicate term introduced in a predication corresponds to some term in one of the ten categories. Ordinary individuals serve as the fundamental subjects of predication. Such ontological hierarchy of beings can be represented in a chain of subject-predicate statements, both *vertically* and *horizontally*. An example of a horizontal chain of predications is: (1) "Socrates is a man", and (2a) "Socrates is a philosopher", (2b) "Socrates is a Greek", (2c) "Socrates lives in Athens". (1), (2a), (2b), and (2c) are examples of a horizontal chain of predications, each having Socrates serving as the fundamental subject of predication. (1) predicates a secondary substance of a primary substance, whereas (2a), (2b), and (2c) all predicate a non-substance of a primary substance. The qualities of being a philosopher, a Greek, and living in Athens are beings in a derivative sense: they exist only because they qualify some substance, such as Socrates. So predications of secondary substance (species or genus) to a primary substance are more basic than their corresponding non-substance predications (to the same primary substance). An example of a vertical chain of predications is: (3) white is a colour, (4) this paper is white, (5) this paper has a colour. Given that the genus colour is said-of the colour white, which in turn is said-of this individual white paper, (3), (4), and (5) are concerned with the existence (or embodiment) of the colour white in various levels of generality, with the whiteness of this paper at the ground level.

Therefore, Aristotle's division into categories depends on his ontology of classifications of beings. The various forms of being are characterized by Aristotle's analysis of predication in the form of subject-predicate discourses. Each true subject-predicate sentence would correspond to a fact—i.e., the fact that correctly represents the teleological nature of the relevant being.

Aristotle does not formulate a LPL in Russell's sense with a syntax expressed in modern symbolic logic, nor does he specify how individual subject-predicate discourses could be related (e.g., inferentially connected) to one another to accurately represent the structure of reality. However, Aristotle's marking of category divisions and structure of predication according to the classification of beings reflect the structure of ontology of the world, which heralds a significant metaphysical feature of the LPL subsequently developed centuries later.

Chapter 2

Russell's Construction of a LPL

In the second of his lectures on *The Philosophy of Logical Atomism*, Russell suggests that a LPL would tell us something about the ontology of the world (Russell, p.25). The world is made up of a plurality of independently existing objects standing in relation to each other. Facts are how these objects are related. Russell aims to determine a LPL which serves as a guide to reality: a LPL has a structure that precisely mirrors the structure of the world of facts. Given the identity of structure of a LPL and the facts, one would understand the nature of reality by understanding the true LPL-sentences.

In his work *Words without Objects*, Laycock holds that the LPL has to satisfy three criteria (Laycock, p.143): (1) syntax encodes semantics: semantically equivalent propositions will be syntactically equivalent; (2) semantics encodes ontology: there is a bijection between semantic categories and ontic categories; and (3) natural language serves as the standard of reference to determine the ontic categories. This latter criterion is problematic as it seems to presuppose that our natural language is already a LPL, since it claims that our natural language is already a guide to ontic categories. Evidently, natural language does not observe criteria (1) and (2)[3].

According to criteria (1) and (2), the difference between a LPL and a natural language is that a LPL is constructed to reflect reality accurately with a minimal vocabulary of simple

[3] A counterexample to criterion (1): "Tom is taller than Mary" and "Mary is shorter than Tom" are different in syntax yet express the same meaning. A counterexample to criterion (2): a dolphin would fall under both the semantic groups of "dolphins" and of "mammals"; however, only one dolphin exists in reality. One dolphin in the real world is mapped to two semantic groups. Hence, the one-one correspondence between semantics and ontology in natural language breaks down.

symbols. A LPL-proposition's structure is isomorphic to the structure of the fact it asserts. The logical form and the grammatical form of a LPL-sentence entirely coincide. LPL-sentences therefore better picture the structure of facts which ordinary sentences obscure. To correct the discrepancy between the grammatical form and the logical form of an ordinary sentence, Russell proposes using logical analysis (e.g., predicate logic and the theory of descriptions) to clarify how the constituents of the proposition expressed are truly put together.

For Russell, the bedrock of all facts is the simplest sort of facts—*atomic facts*—which state the configurations of the ontologically basic simple objects. Together, *particulars* (individual things) and *universals* (properties, relations, and stuffs) make up these simple objects.

A LPL would have a *perfectly transparent syntax* to satisfy criterion (1), and a *perfectly isomorphic vocabulary* to satisfy criterion (2). Perfect syntax would be given by classic predicate calculus with identity. Perfect vocabulary means that every term in a LPL names a simple object. Given that the world of facts is built out of atomic facts and that LPL-propositions consist precisely of the simple objects constituting these atomic facts, the limited vocabularies of LPL—the simple symbols representing these basic elements in the world—can in principle adequately capture all the simple facts.

Chapter 3

Russellian Singular or Particular-Dependent Propositions

Russellian singular propositions are divided into two types, atomic propositions and their truth-functional composites.

(1) Atomic propositions are of the form "α is F", where "F" stands for a universal and "α" is a logically proper name which takes a simple object as value. (We shall see later that this simple logic may need upgrading to accommodate Laycock's singular universals.) Depending on the number of constituent particulars (or Laycock's singular universals), an atomic proposition can represent either a simple particular (or singular universal) exhibiting a property, as in Fα, or multiple simple particulars (singular universals) standing in a relation, as in αRβ. The truth or falsity of a LPL-proposition depends entirely on its corresponding fact. Singular propositions of the form "α is F" and "αRβ" are *particular-dependent* because (1) the meaning of "α is F" and "αRβ" would change if the identity of the given particular(s)—i.e., α or β—changed, and (2) "α is F" is true if α has the property expressed by the predicate "… is F" (and false if α does not have property F), and "αRβ" is true if α stands in the R-relation to β (and false if α does not stand in the R-relation to β).

(2) Combining two or more atomic propositions with logical connectives would yield a variety of more complex propositions, such as "Fα & Fβ" and "Fα → Fβ". The truth-value of a complex proposition is a function of its constituent singular propositions and logical connectives. Therefore, the atomic propositions are metaphysically more basic than their complex counterparts.

The Acquaintance Principle

Russell's standard for simple objects is epistemological: simple objects are those objects with which one is acquainted, and a LPL consists ultimately only of those words standing for the entities of acquaintance (Hylton, Theory of Descriptions, p.226-227). *Knowledge by acquaintance* is a direct cognitive relation between the mind and certain objects. The scope of acquaintance is quite restrictive, limited to three kinds of entities: (1) sense data, (2) abstract universals, and (3) the Self. As such, simple symbols are the demonstratives "this" and "that" (as used to refer to the contents of one's mind), the pronoun "I" (as used to refer to one's Self), and the words for abstract entities.

Understanding a proposition consists of being acquainted with all of its constituent parts. This is Russell's *Acquaintance principle*. Propositions containing expressions that are beyond the scope of acquaintance are not singular but general.

Russellian general or particular-independent propositions

General propositions are not about individual things, but about how properties are related[4]. For example, "all bachelors are unmarried" says that the property "being a bachelor" is a subset of the property of being unmarried; "some students are hard-working" says that the intersection of the property of being a student and the property of being hard-working is non-

[4] Russell applies the notion of *propositional functions* (i.e., open sentences in first-order logic) in the analysis of general propositions. For Russell, general propositions state connections between propositional functions. For instance, to say that there are men is to say that the propositional function "x is a man" is sometimes true, the notion of "sometimes true" being taken as primitive for Russell.

empty. Russellian general propositions can be expressed in first-order logic with set theory and identity.

According to Russell, definite descriptions are not terms in any LPL because they do not stand for simple objects. Description propositions are not singular propositions in Russell's account[5]. Rather, they are general propositions.

"The F is G" expresses a general proposition

Russell proposes the *Theory of Descriptions* to show how the descriptive phrase in a description-sentence can be eliminated in favour of words designating simple objects. Logical analysis treats every word which designates things beyond the scope of acquaintance as an *incomplete symbol*. By this Russell means two things. First, a description as an incomplete symbol cannot be taken as a genuine referential expression. Second, a description has meaning only as used in the context of a proposition. The meaning of a descriptive phrase is provided by a rule—i.e., a *contextual definition*—for translating any sentence containing occurrences of the description into an equivalent sentence that does not contain the description. This description-free sentence is in turn analyzed and ultimately transformed into a fully analyzed sentence—i.e., a sentence in a LPL—which designates only the simple objects of acquaintance.

[5] There are cases where "the F" is not uniquely satisfied, including cases in which what the description describes does not exist (e.g., the Golden mountain), could not conceivably exist (e.g., the round square), or exists but not uniquely (e.g., the student at Queen's University). In the absence of a unique logical subject. Where Frege treats such sentences as defective because they fail in presupposition, Russell notes that these sentences nevertheless express propositions that convey meanings and carry truth-values. Therefore, "the F is G" cannot be a singular proposition of the form G[(ιx)(Fx)], which picks out a unique object—i.e., the unique x which is F.
The lack of referential function deprives definite descriptions of the status as words in a LPL—to regard definite descriptions as LPL-symbols is to admit a domain of unreal entities, a violation of criterion (2).

For Russell, a description-proposition “The F is G” as a whole is understood as equivalent to a conjunction of three quantified statements: (I) at least one entity is F, (II) at most one entity is F, and (III) whatever is F is also G. The corresponding symbolic representation is $(\exists x)((\forall y)(Fy \leftrightarrow y = x) \& Gx)$.

“The F is G” does not contain the object that is uniquely F as a constituent, but rather contains a definite description of that object as constituents. The role of “the F” is taken over by the existential quantifier “$(\exists x)$” and the variables it binds. As such, descriptive phrases of the form “the F” can be regarded as having only such ontological significance as being defined in terms of the basic symbols. Descriptions themselves are not terms in a LPL but are derived symbols built upon other terms in a LPL.

“The F is G” expresses a complex general proposition. The conjuncts (I), (II), and (III) all express *general* propositions whose identity depends only on the identity of the property of being F and that of the property of being G. None of the three conjuncts makes reference to the object that is uniquely F in particular. Hence, “the F is G” is particular-independent; it can still convey meaning and bear a truth-value even if “the F” is a non-denoting expression.

Chapter 4

Laycock's Account

According to Laycock, Russell's singular-general dichotomy overlooks two kinds of propositions: first, plural propositions about (countable) objects, and second, singular/plural[6] propositions about (uncountable) stuff (*stuff propositions* for short). Hence, Laycock divides Russell's particular-dependent propositions into two subtypes, as shown in Table I: (1) singular propositions about one single object, and (2) plural propositions about multiple objects. But in Laycock's view, stuff propositions containing mass nouns such as "water" and "gold" cannot be particular-dependent. This, we will see in Chapter 5, is because stuffs are singular universals, and whenever we designate some portion of that universal, there is no ontic reality to that which is designated.

General propositions also have to take both plural propositions and stuff propositions into account. Plural propositions are divided into two groups: weakly particular-independent and strongly particular-independent propositions. The latter are precisely Russellian general propositions.

Particular-dependent propositions

(1) Singular, particular-dependent propositions

[6] While Laycock favours classifying propositions about stuff as singular, I would not classify them so. It is a grammatical accident that should be of no metaphysical consequence that stuff propositions happen to be singular in English. This is not necessarily the case. For example, in Chinese, there is no syntactically-marked distinction between mass nouns and count nouns as there is in English.

Singular, particular-dependent propositions can be expressed in first-order logic as atomic propositions: Fα, where "α" stands for a logical atom and "F" stands for an abstract universal (a property or relation).

(2) Plural, particular-dependent propositions

Depending on the property being predicated, plural, particular-dependent propositions can be further divided into two kinds: distributive and collective predications.

A plural predicate is *distributive* when it applies to each and every object individually. "The soldiers drink beer" means that the predicate "drinking beer" applies to soldier 1, soldier 2, …, up to soldier n, where the extension of "the soldiers" is precisely those n soldiers. Therefore, distributive predication can be expressed in first-order logic as a conjunction of singular propositions.

A collective predicate applies to the collection of objects *as a whole*. "The soldiers defeated the enemy" says that the soldiers together as a collective whole defeated the enemy. The predicate "defeated the enemy" applies to the group, not to any individual soldier.

Particular-independent propositions

(1) Singular or Plural, weakly particular-independent propositions

Consider (p): "Birds sang in the morning". (p) is not particular-dependent because its truth does not depend on there being any specific birds singing throughout the morning. (p) is not strongly particular-independent either because the presence of some singing birds throughout the morning, though not necessarily the same group of birds over the time period, is required to

establish the truth of (p). So (p) is weakly particular-independent because it is referential but does not have a fixed reference over time. (p) can be expressed in first-order logic with tense—i.e., $\forall t \exists x$ (t is a moment in the morning & x is a bird & x sings at t).

(2) Singular or plural, strongly particular-independent propositions

Consider (q1): "The whale is a mammal" and (q2): "Whales are mammals". (q1) and (q2) are not particular-dependent because no particular whale or particular group of whales is denoted in either (q1) or (q2). Moreover, (q1) and (q2) are strongly particular-independent or non-referential in the sense that no particular whales, whether taken individually (as in Russellian singular propositions), collectively (as in plural, particular-dependent propositions), or sequentially (as in plural, weakly particular-independent propositions) are purported to be designated in (q1) or (q2). "The whale" and "whales" here are a generic reference—they refer to any things of the whale type.

The strongly particular-independent propositions are precisely Russellian general propositions. Since generic reference can be expressed as the universal of the genre, strongly particular-independent propositions can be expressed in a LPL in terms of relations of universals.

Chapter 5

The Problem of Stuff

For Laycock, the difficulty posed to a LPL by stuffs is that of representing stuff propositions such as “water is liquid” and “this ring is made of gold” in a LPL.

On one hand, stuff propositions seem not strongly particular-independent. Stuff is concrete and can be felt with the senses; say, one drinks water and swims in water. The mass nouns in stuff propositions seem to denote stuff with ontic reality, not just constructs of the mind. Consider “the liquid in my glass is the same as the liquid in your glass”. Such a comparison only makes sense if “the liquid in my glass” and “the liquid in your glass” are somehow referential and true if and only if the two terms denote the same kind of stuff.

On the other hand, stuff propositions seem strongly particular-independent or non-referential. Particulars are discrete entities that are distinct from each other, and therefore one can distinguish (the banana on the table), count (two bananas), and quantify (each banana) them. Although the stuff itself (the concrete singular universal) has conditions of individuation (i.e., water is H_2O), the water in my glass (the portion of the concrete singular universal that happens to be in my glass) has no intrinsic conditions of individuation to account for its numerical distinctness. There is no such discrete particular as the water in my glass, for the water molecules do not have an intrinsic condition of individuation by themselves, independent its container (Laycock, p.61). In other words, “the water in my glass” cannot be unqualifiedly counted as *one* (Steen, §3.1). Therefore, stuff propositions cannot be expressed in first-order logic, because the domain of quantification in first-order logic are discrete particulars—i.e., entities that are assumed to have already been individuated and therefore are to be designated by count nouns.

Therefore, "α = water" and "∃x (x is water)" which contain the mass term "water" referring to non-discrete H_2O stuff are ill-formed (at least as propositions about particulars) in first-order logic.

Stuff propositions can neither be expressed as particular-dependent singular propositions, nor as general propositions about the relation of concepts. Laycock therefore proposes a new logic variable denoting stuff, such as stuff of the water-kind or stuff of the gold-kind, as opposed to singular variables denoting objects. (Laycock, p.166).

We can conceive the real world as composed of objects or of the stuff constituting these objects. A Russellian language admitting only of objects and universals is incomplete because stuff propositions cannot be expressed in such language, as explained above. Likewise, a language admitting only stuff is incomplete because propositions about objects cannot be reduced to stuff propositions — "this lemon is sour" does not mean the same as "the lemon's chemical ingredients are sour".

In what follows, I will discuss two problems—the problem of the discrepancy between semantics and syntax, and the problem of collective predication—and explore possible resolutions.

Chapter 6

The Discrepancy between Semantics and Syntax

According to Laycock's first criterion for a LPL, the syntax of a LPL is isomorphic to its semantics. So two propositions in a LPL are syntactically equivalent (they have the same syntactic structure) if and only if they are semantically equivalent (they have the same truth-conditions). Consider (a) a lion is a carnivore and (b) a lion is running. The logical subjects of (a) and (b) are the lion-kind and a particular lion respectively, so (a) and (b) are not semantically equivalent. The translation of (a) in first-order logic is "$\forall$x (x is a lion $\rightarrow$ x is a carnivore)" while (b) is translated as "$\exists$x (x is a lion & x is running)". (a) and (b) are not syntactically equivalent. However, the English sentences (a) and (b) appear to have the same syntactic structure: a lion is such-and-such. This gives rise to a problem: By virtue of what is (a) translated into a universal proposition while (b) is translated into an existential proposition, given their same surface syntactic structure of a lion is such-and-such? But perhaps a deeper syntactic analysis would reveal differences between the syntactic trees of (a) and (b) that surface structures obscure (See Table II).

Another problem comes from the identical syntactic structure between the distributive reading and the collective reading: by virtue of what does a plural proposition have two readings, and how do we distinguish between the two readings? A more complete syntactic tree would not here determine which reading is to be chosen, for the two readings share the same syntactic structure. One possible answer might be found in the pragmatic Principle of Charity. We tend to interpret a proposition in the most charitable sense by giving the truest reading—i.e., the reading most likely to be the case as far as we know it. Therefore, "The soldiers drank beer" is

understood as an instance of distributive predication. Ascribing the predicate "having drunk beer" to the soldiers as a group would not yield a meaningful proposition. Similarly, "The soldiers defeated the enemy" would be given a collective reading. It is very unlikely that each of the soldiers defeated the enemy by himself or herself, or that the same enemy was defeated as many times as there are soldiers.

Nevertheless, this solution poses a problem for Laycock's third criterion of a LPL—i.e., natural language is the guide to the ontic categories, which in turn is the reference standard of semantics. For on the one hand, "The soldiers drank beer" is syntactically equivalent to "The soldiers defeated the enemy" in English. According to Laycock's third criterion, "the soldiers" in both statements denote the same ontic category. But on the other hand, the two propositions are syntactically inequivalent in a LPL, insofar as they have distinct logical forms, as expressed in the distributive and collective readings. How can one and same ontic group give rise to two distinct readings? How then can English consistently be the guide of a LPL's ontic categories, if the distributive and collective readings of the same ontic category can be distinctly represented in a LPL? The problem is that classical logic is designed to cope with discrete objects, not with the non-discrete collections. An individual soldier is unqualifiedly counted as one, there is only one non-ambiguous reading in each of "the soldier drank beer" and "the soldier defeated the enemy". A collection of particulars, on the other hand, cannot be counted as one without reference to a partitive term (e.g., a *group* of soldiers, or one *dozen* of eggs). The distributive and collective readings of the same "group of soldiers" show that a group of soldiers can be either counted as *one group of many individual* soldiers, or *each of the many individual* soldiers.

Chapter 5 explains that first-order logic cannot cope with the non-discrete stuffs. One possibility is to accept that stuffs are collections of discrete objects, and then accept collective predication over collections of objects. As such, stuffs can serve as the objects of particular predications. The alternative is to accept collective predication over collections of objects. The grounds for admitting plural variables denoting collections of objects into a LPL is epistemic. We do deliberate in terms of collections or groups *as if* they were ontically real. The human mind makes reference to groups for epistemic reason. In most cases, we know the facts but not the efficient causes of these facts. For example, one may know that the enemy is defeated, but not the series of military actions undertaken by each soldier and how each of these military actions contributes to the defeat of the enemy. Indeed, it is pragmatically more important to know that the enemy is defeated than to know the contribution of each soldier. If collections are psychologically real in this sense, it should follow from Laycock's third criterion for a LPL that collections of objects ought to be admitted into the set of ontic categories. Accordingly, plural variables should be legitimately introduced in a LPL in order to denote these ontically real collections.

The second half of my paper concerns the nature of particular predication ("b is F", where "b" and "F" are the subject term and predicate term respectively), the building block of a LPL. In particular, I will examine and explain how liquid-stuffs, with their constantly flowing molecules and ever-changing compositions, can serve as a subject entity in a particular predication. I will first present Quine's view on replacing proper names by bound variables in a particular predication. In what follows, "entity" is short for "physical entity"—i.e., concrete entities that exists in time and space. Social entities such as organizations and countries, mental entities such as emotions, and abstract entities such as concepts are excluded. Unless otherwise

specified, a particular predication can be understood as either an *ontic predication*—a property attributed to an object—or a *linguistic predication*—a predicate attributed to a subject term (a singular or general term).

Chapter 7

Quine on Particular Predication

In the traditional view, a singular linguistic predication is of the form "b is F," where "F" is a predicate and "b" is a singular name. "b is F" is the linguistic analogue of the ontic predication in the extra-linguistic world, where the property F is exemplified by the object b (Koskinen, p.341). Likewise, particular predications symbolized as "Fa," "Fb," and "Fc" are explained on the ontological ground that objects a, b, and c have property F in common.

This traditional view of linguistic predication requires the existence of two kinds of entities: universals and particulars. The linguistic expression "F-ness" serves as an abstract reference, a name for the kind of theoretical entity of being F. This assumption of the existence of universals is the ontological ground for linguistic predication.

Quine shifts the focus from objects in the world to the level of language (Koskinen, p.341). He proposes paraphrasing sentences of singular terms into existential quantifications in first-order predicate calculus with identity, which is explained as follows. On Quine's view, singular and general terms are ontologically insignificant and can be eliminated in the formal language of logic of existential quantifications. As such, bound variables are the only ontological connection between language and the world. Singular and general terms are referring insofar as their referents serve as the value of a bound variable. In Quine's words, "*to be is to be the value of a bound variable.*" (Quine, p.34)

Quine explains how proper names can be replaced by bound variables (Quine, p.25-28). Consider a particular predication containing a name and a predicate: "b is F." The first step is to convert the name into a description: (∃x) (Fx & b=x). Note that "=x" is taken as a monadic

predicate uniquely satisfied by object b. Quine converts a proper name into a description by replacing the "is" of predication with the "is" of identity. A proper name "b" is turned in a description of "=b"—i.e., being identical to object b. As such, each proper name is uniquely translated into one description, which applies solely to the object denoted by the proper name. For example, the description "being identical to Socrates" is satisfied by exactly one object, namely, the person Socrates. Quine's replacement of names with descriptions removes the existential import. In "b is F," the use of the name "b" presupposes the existence of the object b, and the existential assumption of the object b is implicit in the use of names such as "b". By contrast, Quine's $(\exists x)\ (b=x)$ carries no such existential import of object b. The singular term "b" is replaced by a quantifier, variable, and the identity predicate "being identical with object b."

For Quine, reality is identified and described in a sentence-based manner: ontological commitments do not depend on the referential relations between sub-sentential parts and their referents in the real world, such as names and objects, or predicates and universals (Koskinen, p.340). The value of a bound variable in a true sentence cannot by itself tell us what there is. The given sentence has to be justified—as a contributing part of an accepted scientific theory—in the first place. What there is (what is real) and what the world is like (what is true), for Quine, depends on what an accepted scientific theory says there is. All these true sentences containing bound variables, if they ever provide an accurate account of our world, must be built on the foundation of natural sciences. These bound variables of quantification specify the kinds of objective entities whose existence is guaranteed by a given scientific theory, formulated as a part of the enterprise of science as a whole (Hylton, Ideas of a Logically Perfect Language in Analytic Philosophy, p.916). In Quine's system, predicates are not bound variables and therefore are not names of real entities. However, Quine's theory leaves room for the existence of

universals. In particular, universals are to be replaced with classes, which can in turn be postulated as values of bound variables (Koskinen, p.345).

Accordingly, Quine's criterion of ontological commitment is conditional on our choice of scientific theories: one is ontologically committed to and only to those entities that are the values of the bound variables of the best available scientific theories (regimented into first-order logic and identity). We are justified in accepting the true sentences of a regimented theory as accurate representations of the fundamental structure of reality (and those which are negations of the regimented theories as false). We are also justified in accepting the entities of a given kind required for all sentences of a regimented theory to be true as real and existent (and those which are excluded from the regimented theories as not existing). In other words, Quine's ontology is naturalistic: our construction of scientific theories serves as the *only* legitimate guide to posit entities, nothing else can grant ontological significance to any entities. This is because, for Quine, there is no better alternative—other than science—to objectively and systemically organize empirical knowledge, taken as a whole (Hylton, Ideas of a Logically Perfect Language in Analytic Philosophy, p.917).

Chapter 8

The Metaphysical Range of a Predicate Term

With respect to predicates and properties, opinions roughly fall into two broad camps. On the one hand, trope theorists are committed to the idea of the existence of an abstract particular or a trope—i.e., a particular property instance occurring at a particular place and time, such as the whiteness of this page. The whiteness of this page and the whiteness of the next page are two distinct tropes. Tropes are qualitatively simple, as opposed to qualitatively complex objects, which can be conceived as bundles of tropes (MacLeod and Rubenstein, §3). On the other hand, universal realists postulate the existence of the universal—the common abstract characteristic property that many particulars share—such as the redness common to all red things and the appleness common to all apples (MacLeod and Rubenstein, §1). Qualitative identity and objective similarity among individuals are explained by the sharing of universals. To avoid the universal realism and trope nominalism controversy, in what follows, I use neutral terms such as "the metaphysical range of F-ness" or "the embodiment of property F in the world" to characterize either the multiple instantiation of the universal F or a number of qualitatively identical, but numerically distinct F-tropes, without reliance on the terms "universals" and "tropes."

The metaphysical range and linguistic range of a predicate can be understood in terms of predicate-token and predicate-type respectively. A predicate-token is the predicate term in an instance of predication, such as "is red" *in* "this apple is red". A predicate-type is an unsaturated predicate term such as "( ) is red", which can be multiply exemplified by the predicate-tokens in distinct particular predications. Removing all subject terms of a predication would yield the

predicate-type from the remaining predicate-token. Without a subject term to be predicated of, a predicate-type cannot stand for the subject entity's trope. However, a predicate-type F can denote an abstract universal—that is, the common characteristic or feature shared by all particulars falling under any predicate-token F. A possible candidate for an abstract universal is the Platonic Form—i.e., the ideal inner structure common to all particulars of the same kind, which makes the particulars what they are, and that exists in the abstract realm independently of its particulars. The Forms are the timeless, perfect, changeless abstract entities of which each particular "approximates" to an extent (Brennan, §2). A red thing is red because of its participation in the character of the Form of redness. A predicate-type, regardless of what it stands for, is associated with an embodiment scattered in the real world, if it is embodied at all. "( ) is red" is embodied by many red instances, and these discrete red parts of the world jointly constitute the embodiment of the predicate-type "( ) is red". Such a concrete embodiment constitutes the worldly range of the predicate-type, which can either be conceived as the exemplifications of a universal by many particulars at once, or as the spatio-temporal union of tropes of the same kind by a number of distinct entities. Whether the whiteness of this page and the whiteness of the next page are two qualitatively identical and numerically distinct entities, or whether they are a single universal exemplified by the two distinct pages, each with its separate spatial location, is an unsettled metaphysical dispute. For any predicate-type, trope nominalism and universal realism have the same embodiment. Any white trope would also be an instantiation of the universal "white"; a spatio-temporal part that is not occupied by any white trope would not be an instantiation of the universal "white".

The following is a note on notations. A subscript will be added for predicate-tokens to indicate their range of application. The predicate-token "F of b" stands for the F-ness specific to

object b, i.e., object b's F-ness, whereas the predicate-type "Fx" stands for the universal F-ness that is instantiated in all red things in general (sometimes noted λxFx). Consider (1) "Fb" where F-ness is specific to b, which says that the object b's F-ness is instantiated by object b itself (the predicate-token "F of b" is attributed to the subject term "b"); and (2) "Fb", which says that the universal Fx is instantiated by object b, where b is one of the many distinct entities instantiating the universal (the predicate-type "Fx" is attributed to the subject term "b").

Chapter 9

The Representations of Metaphysical Range: The Linguistic Range of a Predicate Term

The metaphysical range of a predicate-type is the embodiment of the associated property in the real world, which is given in advance of any linguistic characterization, as explained above. We can describe or characterize a property embodiment precisely and accurately in various locations[7]. This embodiment can be divided into parts, and each part is attributed to the predicate-token in question. As such, the metaphysical range of a predicate-type is jointly represented by a set of relevant particular (or token) predications. Each particular predication is in the form "b is F", where b is the linguistic range of the predicate-token F[8]. The linguistic range specifies the limit of application of the predicate-token in an instance of predication—i.e., the subject concept. Such a limit is a *linguistic* one, because the range of the predicate-token "F of b" is relative to the subject term "b" of the particular predication in which "F" serves as a predicate term.

Suppose there are n distinct entities instantiating the property F. The metaphysical range of F-ness can be naturally divided into n distinct instances of particular predications, one particular predication for each entity, all in the form "b is F." Here, there is an overlap between

[7] Suppose the world is comprised of only three objects: a red house, a red fire engine, and a red apple. In "this apple is red", the linguistic range of the predicate-token "red" is the redness that inheres in the apple. Each predicate-token is a particular instance of the associated predicate-type—the redness of the house, of the fire engine, of the apple, of various kinds and intensity of redness, all share a common colour characteristic.

[8] To describe the presence (or absence) of property F in distinct spatial parts of the world, the metaphysical range of F-ness must be divided into mutually exclusive sub-parts that jointly exhaust the metaphysical range of F-ness. Hence, a given metaphysical range of F-ness can be adequately segregated out and exhaustively characterized by a set of particular (or token) predications, where each of these predications specifies the F-ness in separate spatio-temporal locations. Together, these particular predications completely describe the range of F-ness, without missing out any part of the world that is F but not mentioned in the particular predications. For example, the embodiment of "redness" can be fully covered and characterized by n instances of predications: "b1 is red," "b2 is red," …. , up to "bn is red", where each distinct bi jointly exhausts the metaphysical range of redness.

the metaphysical range and the linguistic range: each particular predication ("b is F") stands for one particular fact (i.e., entity b instantiates F-ness).

In general, there are many different sets of particular predications, each equally providing a representation of the metaphysical range of the predicate-type in question so long as these particular predications jointly cover the metaphysical range. Consider a piece of homogeneously brown paper. The brownness of this paper can either be described by one particular predication, "this paper is brown," or by two particular predications on the two distinct parts, "the left half is brown" and "the right half is brown," or by four particular predications on "the top-left," "the top-right," "the bottom-left," and "the bottom-right." This one unified brownness, be it one brown trope of the paper or a single instantiation of the universal brown, can be divided into different sets of multiple particular predications. These sets of particular predications, be it one, two, or four distinct particular predications, all exhausts the metaphysical range of brownness of this paper. So, there are multiple ways to exhaust the metaphysical range of a predicate-type.

As classical logic is designed to cope with the discrete objects, the non-discrete stuffs cannot serve as the objects of particular predications. What would be the value of non-discrete x in "x is F"? Moreover, what are properties of non-discrete x properties *of*? I will explain that a legitimate division of a metaphysical range into a set of linguistic ranges requires that the object of the predication to be discrete—i.e., to be unqualifiedly countable as *one* (Steen, §3.1). The following section explores the requirements and constraints on dividing a metaphysical range into distinct particular predications about discrete objects.

Chapter 10

The Discrete Unity Condition

A metaphysical range can be correctly represented in various ways by different sets of predications. Which particular set of predications is to be chosen? Would the choice of the set of predications be arbitrary? In what follows, I will show that the linguistic range of any particular predication has to satisfy *the discrete unity condition*—i.e., the subject entity in a particular predication constitutes *one unified whole*, connected and extended in time and space, as opposed to scattering into various disconnected spatial locations or temporal moments. That is, in a particular predication, the subject entity has to be discrete or unqualifiedly countable as one, so that the linguistic range of the predicate applies to this *one* subject entity and not to anything else.

In a particular predication "b is F," "F" applies to "b" as a whole. *An entity as a whole* is not simply a mere sum of all of its constituent parts, where these parts are mutually exclusive and exhaustively constitute the entity. What is true of an entity as a whole does not have to be true of each of its parts.[9] For example, a car painted in red is *red*, despite its four black wheels. A patient who is terminally ill with lung cancer can still have a fully-functioning liver and pancreas. A couch is soft even though its four metal legs are hard.

A theoretical conception of *entity b as a whole* would be a bundle of properties of b, each of which is a function of every (mutually exclusive and jointly exhaustive) part of b, and how these parts are related. More precisely, *entity b as a whole* is a set of all its properties, such as its texture, shape, colour, size, weight, temperature, and so on that are related to one another. For

[9] The converse relation does not hold either. What applies to each part of an entity may not apply to the entity as a whole. Each puzzle piece is small, but all pieces together can constitute a big puzzle.

example, the colour of b *as a whole* would depend on the colour of each part and on how the colours of these parts are related to one another; the shape of b *as a whole* would depend on the shape of each part and how the shapes of these parts are related to one another. The last condition of part relatedness cannot be omitted, for the property of one part may change the property of another part. These interrelations are relevant to determining what the whole entity would be like. For example, the bone structure of the left thigh bone would affect the right thigh bone in a human body, given that both thighs have to support body weight together.

Unified wholeness or oneness requires continuity in time and space. A metaphysical range scattered in various locations cannot be represented by a single particular predication, as if the metaphysical range is instantiated by one single entity. This is because, all the scattered entities do not constitute *one* entity as a whole. Each scattered entity has to be characterized by distinct instances of predications: one particular predication for each entity.

Now that I have clarified the concept of the unified oneness of an entity. What it means for a linguistic predicate "F" to ascribe a property to an object, say b, "b is F" can be characterized as follows: (1) there is one and only one b and there is everything else (call these "*others*"), such that (2) the predicate-token "F" in "b is F" applies and only applies to b and *not* to anything else. The first clause says that everything that exists is to be divided *linguistically* by "b is F" into two mutually exclusive groups: (i) the one and only b (of which "F"-token applies), and (ii) everything else or others (of which "F"-token does not apply). In other words, the proposition "b is F" is about entity b, the uniquely one entity b, and not about anything else. "Fb" linguistically separates what counts as the subject entity b and what does not. The second clause simply says that the linguistic range of "Fx" is "b"—the predicate-token "F" is attributed to and only attributed to entity b.

"b is F" fixes entity b as being in the linguistic range of the predicate-token "F" and everything else as outside it—that is, the predicate-token "F" is predicated of b and of nothing else. Being outside the linguistic range of the predicate-token "Fx of b" means that the predicate-token itself does not apply (does not attribute anything) to this everything else.[10] The others are in opposition to b. Accordingly, the particular predication "b is F" *by itself* neither specifies whether these others are F or not, nor are possibly F or not. Another instance of predication, say "r is F," is needed (assuming r is distinct from b) to represent that either r has property F or not.

In summary, in a particular predication, the range of application of the predicate—i.e., its linguistic range—is limited to the subject entity, which in turn has to satisfy the discrete unity condition of individuation.

[10] This *everything else*, or *the others*, is conceptually dependent on entity b: the spatial boundary of entity b determines what counts as the constituent parts of b and what does not; x is part of b if it is interior to b's spatial boundary, otherwise, x belongs to everything else. Therefore, the conception of *everything else* is derived from a conception of entity b.

Chapter 11

The Ground of the Discrete Unity Condition

The discrete unity condition is grounded in the physical fact that properties apply to a *unified whole*. This unified wholeness or oneness of the subject entity is constituted by connected interior parts and bounded by a physical boundary, being considered as a whole.

Such unity consists in extension in time and space. I will first address spatial connectedness. Disconnected parts do not constitute a single unified entity, and therefore cannot serve as the subject concept in a particular predication. The following example shows that two spatially-disconnected sets of molecules cannot come to form a single entity. Consider an imagined "bucket" consisting of the upper part of one plastic bucket and the bottom part of another bucket, where the upper part is spatially disconnected from the bottom part. The linguistic range of the predicate term in "this bucket is blue" simply doesn't exist, for "this bucket" only specifies a non-entity, not a discrete bucket that can be unqualifiedly counted as one. By contrast, the linguistic range of "is blue" in "the top half of a bucket is blue" and "the bottom half of a bucket is blue" are simply the two halves of buckets. Both the top half and the bottom half constitute a subject entity on their own, connected in time and space, and therefore satisfy the discrete unity condition.

Two spatially-disconnected sets of molecules cannot be taken as a single entity—there is no such entity as a conjunction of two distinct entities (refer to the imagined "bucket" example above). By the same reasoning, the predication of the conjunction of *two* distinct objects as if they constitute *one* single object — (b and d, taken as a whole) is F — is ill-formed while the conjunction of two distinct particular predications — (b is F) and (d is F) — is well-formed.

But a discrete unity condition based on spatial connectedness (or spatial extension) alone is inadequate to address changes in molecular structure of an entity. Temporal connectedness is also needed. We must naturally distinguish between objects and their properties. The (linguistic) *predication to an entity* is simply the ascription of any predicate terms that truly apply to the entity. *The entity being predicated of* is a full-blown object, composed of a physical boundary encompassing its interior parts, persisting over a period of time, showing a variety of real and vivid characteristics, etc. Only a real object can be a legitimate subject entity of a particular predication.

A full-blown entity can be characterized as a *narrative video* of the lifespan of an entity. In "this banana is yellow," being yellow is predicated of the banana as a full-blown object, timing back to its budding on a banana tree up to the present moment of utterance. According to the discrete unity condition, being yellow is attributed to the banana as a whole, within the banana's full lifespan history, not only of the banana at the present moment, nor only of any past moments. This explains why "this banana is yellow" is true of a banana that was green on the tree and yellow at the moment of the utterance. Indeed, there is no such thing as "a banana at time t0," i.e., a banana that exists at t0 *only* and not at any other moments. Such a fleeting banana, which lasts only for an instant at t0, can only be represented by a photo image captured at a particular instant, but never as an actual object in reality.

To conclude, the extended discrete unity condition imposes two limitations on the subject entity of a particular predication: a spatial limit and a temporal limit. The spatial limit is given by a physical boundary, which singles out the constituent body of the subject entity from its background environment. The temporal limit is the persistence or duration of the subject entity, marked by the creation (the starting point) and decomposition (the endpoint) of an object. The

subject entity in a predication is whatever satisfies the extended unity condition, i.e., any entity with a definite spatial-temporal existence, as given by a physical boundary along a specific time interval. The extended discrete unity condition requires a four-dimensional entity to serve as the object of predication. What counts as the object of predication is a collection of molecules connected in time and space.

Chapter 12

Liquid-Stuffs are Not Spatially Connected

The extended discrete unity condition states that the subject entity has to be a unified whole over time and space in order to be correctly attributed a predicate-token in a particular predication. This oneness requires the subject entity to extend in space and time, and to be bounded by a physical boundary which separates the entity itself and the rest of the world during its existence. Liquid-stuffs, which do not have fixed or definite boundaries (neither spatially nor temporally) pose a problem to the discrete unity condition. An entity satisfies the extended discrete unity condition if it expresses a unified whole, i.e., being composed of spatially connected parts during its lifespan. An object like a banana keeps "in one whole piece" over its lifespan. Liquid-stuff instances of various kinds, on the other hand, scatter in separate locations. The water on Earth fills a variety of objects, such as a bottle of lemonade, a fish tank, a swimming pool, and an ocean. Stuff kinds fail to satisfy the discrete unity condition because they neither persist in time, nor extend in space as one and the same collection of stuff molecules.

Before showing how to adapt the discrete unity condition to liquid-stuffs, I will first explain the differences in nature between physical boundaries (spatial connectedness) of objects and liquid-stuffs. Most physical objects (or parts of objects) have a relatively clear-cut physical boundary, singling out the object from the rest of the world. There are two kinds of common boundaries of an object; both of which satisfy the extended discrete unity condition.

(1) *A whole object*

Suppose b is any object with a definite physical boundary, and "b is F" is true of b. Consider "this book is blue." This book has a definite spatial-temporal extension which is the linguistic range of the predicate-token "is blue."

(2) *Parts of objects*

Suppose b is any part of an object with a definite physical boundary, and "b is F" is true of b. Typical examples of parts of an object are handle of a door, lid of a cup, zipper of a jacket, wood patterns of a log, and leg of a chair. Constituted by a unified spatial-temporal extension, these parts can be distinguished from the rest of the object by their distinctive features such as colour, texture, or functional features. For example, in "my hand is warm," my hand constitutes a set of spatially-temporally connected molecules, and therefore satisfies the discrete unity condition.

Parts of objects can also be singled out from the rest of the object by a *stipulated* physical boundary, such as "the top-left corner of this paper," and "south-east of London." Certainly a paper does not build into its molecular structure a physical boundary dividing its top-left corner from the rest of the sheet. However, "the top-left corner of this paper" denotes a specific connected part of a paper, and linguistically separates this part from the rest of the paper, thereby satisfying the discrete unity condition. The predicate term "is blue" can then be successfully ascribed to the subject term to yield "the top-left corner of this paper is blue."

(3) *Portions of stuffs*

Unlike objects, stuffs have adaptable spatial boundaries. The definite boundary of a solid object is due to its molecular structure, closely packed together[11] in a fixed definite shape. In a liquid stuff, on the other hand, molecules are loosely connected—space between stuff molecules provides room for each molecule's flowing to another position. A loosely connected molecular structure explains why stuffs adapt their shapes to the liquid containers.

Any collection of structurally—connected stuff molecules (or a mixture of structurally-connected molecules of several kinds of stuffs) constitutes one instance of the stuff. This conception of *unity of stuff* matches our ordinary intuitions: two spring water bottles would contain two distinct instances of spring water stuffs. Pouring half of the water from a kettle would yield two distinct instances of water: water in glass (a collection of structurally-connected water molecules inside the glass) and water in kettle (a collection of structurally-connected water molecules inside the kettle).

Intuitively, the subject entity b in "b is F" is any stuff instance satisfying the discrete unity condition, namely, the stuff molecules which are structurally connected into one unified stuff body. However, this generalized unity condition poses some difficulty for the fluid or flowing nature of stuff molecules. "The water at the lake bottom" does not denote a fixed collection of water molecules connected in space. This is because stuffs, unlike objects, do not have a relatively stable internal molecular structure over time. Water molecules keep on flowing within the lake body. "The water at the lake bottom" does not stand for a fixed collection of H_2O

[11] A closely connected structure between molecules does not mean that each particle tends to stay at the same position over time. In a living organism, old cells are constantly replaced by new ones. Yet the same kind of new cells would occupy the same position as the old cells. For example, skin cells are closely packed with one another after each replacement.

molecules, and therefore cannot serve as the proper object in a particular predication. Consider another example: “the water of Niagara Falls,” which denotes a fixed collection of water molecules at a particular instant, yet the term does not denote the same collection of water molecules over time.

Chapter 13

Liquid-Stuffs are Not Temporally Connected

Liquid-stuffs neither have definite spatial boundaries, nor definite temporal boundaries. The following example illustrates the problem of identifying the persistence of stuffs (due to the lack of a definite temporal limit). Consider "this lemonade is sweet." Given the full persistence history of water stuff as H_2O molecules, some portion of water would become an ingredient of this lemonade. Being sweet is therefore, according to the extended discrete unity condition, predicated of the water stuff *as a whole*, of which some relevant part constitutes this lemonade. The *same collection of water molecules* would be involved in "the pool of water," of which some relevant part of the water stuff fills the pool. However, the pool of water and this lemonade, despite both having H_2O molecules as ingredients, are different *kinds* of stuffs. A stuff as a mixture of liquids and chemicals can at once share a common origin, and diverge into different paths of mixing with different components and become various kinds of stuffs. The temporal limit has to be refined to draw a distinction between this common history (e.g., both stuffs contain H_2O molecules) and the individual paths of forming stuffs of different kinds (e.g., along their different paths of history, some of H_2O molecules becomes lake water, whereas others become river water).

One may suggest that a stuff comes into existence when the relevant ingredients are combined together, and cease to exist when the ingredients change. This reasoning violates the spatial connectedness of an entity, as required by the discrete unity condition. A stuff does not have a natural boundary built into itself. Stuffs in a container, such as a glass of lemonade or water in a lake are not a single object, but one object (e.g., the glass) and one stuff (e.g., the

lemonade liquid) existing side by side. The lemonade's molecules are structurally disconnected with the glass molecules. Glass molecules constitute one single collection of molecules, and the lemonade molecules constitute another collection[12].

In what follows, I will examine and explain the differences in persistence conditions between an object and a stuff. Then I will show the way to accommodate the instable nature of stuffs in the discrete unity condition.

[12] This definition of unity or oneness in terms of structural connection has some interesting implications. First, a pair of wired earbuds is one single object, whereas a wireless model of the same earbuds is two distinct objects. The wired earbuds are structurally connected: any physical (e.g., pressure) or chemical (e.g., water damage) changes in the left earbud would much more likely generate corresponding changes in the right earbud in the wired than the wireless model, ceteris paribus. The wireless pair, which is connected by Bluetooth technology, can be considered as a system of two objects (earbuds) working together for some function. A pair of shoes is another example of a system of two objects.

Chapter 14

A Historical Conception of Liquid-Stuffs

Discreteness of an entity consists in its individuation—i.e., its being unqualifiedly countable as one. Such oneness of entity is specified by the discrete unity condition: only those entities that persist in time (in terms of clear-cut creation and decomposition points), and extend in space with clear boundaries can serve as proper subject entities. Unlike objects, stuffs have adaptable spatial boundaries and a constant changing composition. This lack of relatively fixed and determinable spatial and temporal boundaries renders stuffs non-discrete and poses difficulty for stuffs to serve as the subject concepts in predications of classical logic, as mentioned in Chapter 12-13. In what follows, I will introduce *portions* of stuff as the discrete units of the objects of particular predications.

Instead of identifying the spatial-temporal limits and fixing a particular collection of stuff molecules satisfying the discrete unity condition, I propose to relax the discrete unity condition itself to cover the borderline cases of liquid-stuffs. That is, instead of restricting the referent of "this lemonade" to a collection of lemonade molecules connected in time and space, with specific spatial and temporal limits (i.e., definite spatial extension and persistent conditions), the unity condition can be further relaxed to accommodate the special natures of liquid-stuffs. The unity or oneness of "this lemonade" can be traced back to a long history of its coming into existence, involving all of its ingredient stuffs. Consider a long history of the origin of the water stuff. A typically imaginative one is as follows, details omitted for brevity. A collection of H_2O molecules travels a long journey: formed as vapours, stored in a reservoir, sanitized in a water plant, transported through water pipes in the city, stored in a water tank, released in a household

faucet, filling an empty jar, and mixed with syrup and lemon juice. In each step, a certain portion of the water stuff is omitted for irrelevance (these portions are irrelevant to the making of *this* lemonade, such as some H_2O molecules that evaporate in the reservoir, or those being used to make another bottle of lemonade), and only the relevant portion of stuff is counted as a component under the name "this lemonade." A similar history can be outlined for the other two ingredients of "this lemonade", i.e., syrup and lemon juice.

According to the discrete unity condition for liquid-stuff, "this lemonade" denotes the stuff mixture (syrup, lemon juice, and water) which has traveled a long journey and finally constitutes the lemonade molecules, as specified above. "This lemonade" can be taken as *the relevant portion* of all the water there is, the one and only portion of lemon juice, and the one and only portion syrup, each of which has traveled a long journey and finally become constituent parts of "this lemonade." According to this new unity condition for stuff, "this lemonade is sweet" means that it is of this *portion* that sweetness is predicated. In other words, the linguistic range of "sweet" is this portion of lemonade. More generally, "this lemonade is so-and-so" is no longer about this particular instance of lemonade stuff, but about certain relevant mixture of the water, lemon juice, and syrup stuffs, each of which have their own history, all contributing to the making of this instance of lemonade.

Liquid-stuffs, unlike objects, have molecular changes that are closely related to their ingredient stuffs, which can be represented and predicted by the relevant laws of nature. When water, lemon juice, and syrup are mixed, lemonade is created. The lemonade's molecular structure is entirely causally determined by its ingredient stuffs. Given the molecular structure of all its ingredient stuffs, theoretically, the set of properties applicable to the lemonade can be correctly determined—lemonade composed of water, lemon juice, and syrup would be liquid-

like, lemon-sour, and sweet. But this is irrelevant, for the discrete objects of predication (e.g. in "this is too sweet") are not molecules, but portions of stuff.

Chapter 15

A Sketch of a LPL for Liquid-Stuffs

A hybrid language taking account of both objects and stuff is needed to mirror the structure of reality. I will try to sketch such a language, L′, in terms of the persistence histories of objects and stuffs, as follows.

First, the existence of stuff is granted in L′, say, the existence of gold with so-and-so properties and the existence of water with such-and-such properties, all included in their persistence histories. The next step is to apply the theory of descriptions to the various kinds of stuffs individually: "water has such-and-such properties" means that "there is one and only water and this water has all relevant properties". One of the infinitely many properties of water is that it can be divided into portions of homogenous properties. As such, stuff propositions such as "water is liquid" and "there is water in my glass" can be represented in L′.

Second, a particular predication "b is F" can be represented in L′ by the *difference* between entity b's persistence history and a relevant possible persistence history of b—that is, the difference between (1) the persistence history of b (assuming b is F), and (2) the persistence history of b except that b is not-F. As such, atomic propositions in L′ would not take the subject-predicate form. This would avoid the undesirable consequence of turning many widely-regarded synthetic propositions into analytic propositions. Otherwise, given the extended conception of an entity as its long course of history, the subject concept "this lemonade" alone would contain predicate concepts such as "being made in a beverage factory" and "being mixed with spring water". As such, "this lemonade is made in a beverage factory" and "this lemonade is mixed with spring water" are rendered true by definition.

Third, an *object-formation principle* is granted in L′: the principle states that a certain variety of stuff combines together and forms an object. Once an object is formed, two results follow: (1) the stuff constituting the object no longer belong to the portions of stuff. Rather, they become parts of the objects; and (2) propositions about that object can be expressed in L′. The introduction of (1) is to avoid double counting—the stuff constituting an object does not have existence independent of the object. According to (1), talks about stuffs constituting an object require the object-formation principle. “The water in the cup is clean” is expressed in L′ as “some portion of water and the cup form an object—i.e., the cup of water” and “this portion of water is clean”.

Fourth, an object-decomposition principle is granted in L′: the principle reverses the object-formation principle and describes how an object is decomposed into the relevant stuffs.

These two principles are introduced to smooth the transition between an objectual language and a stuff language, as mirroring the constant transformation between objects and stuffs in reality.

Chapter 16

Conclusion

A LPL has a structure that precisely mirrors the structure of the world of facts. Russell pursues a bottom-up approach to construct a LPL, wherein all facts can be adequately represented by the basic true atomic propositions in the sense that the more complex true propositions are built upon from these atomic propositions. In this paper, I have suggested how a particular predication can be represented by the persistence history of an entity (either an object or a liquid-stuff) in a LPL for stuffs. Whether more complex propositions such as relations between entities and general propositions can be represented by logical operations on the persistence histories of the relevant entities have not been covered. A full LPL for liquid-stuffs with a syntax of a vocabulary and formation rules; and a semantic specifying the meanings of the atomic elements and the complex elements is yet to be developed. Moreover, how our inferential practices can be correctly captured by the relations between persistence histories and how the nature of the world can be determined by the truths expressed in the LPL for liquid-stuffs are yet to be explored. But I hope to have motivated a plausible account of what the objects of stuff-predications are: portions.

References

Aristotle, “Categories”. Trans. S. Marc Cohen, Gareth B. Mathews. In S. Marc Cohen, Patricia Curd, C.D.C. Reeve. (Eds.), *Readings in ancient Greek philosophy: from Thales to Aristotle* (pp.694-700). Indianapolis: Hackett Publishing Company.

Aristotle, “Metaphysics”. Trans. W. D. Ross. In Barnes, Jonathan (Eds.), *Aristotle: The Complete Works*, (pp.1552-1728). Princeton: Princeton University Press.

Beaney, Michael, (2012). “Logic and Metaphysics in early philosophy”. In Leila Haaparanta & Heikki Koskinen (Eds.), *Categories of Being: Essays on Metaphysics and Logic*, (pp.257-292). New York: Oxford University Press.

Beaney, Michael, “Analysis”, *The Stanford Encyclopedia of Philosophy* (Summer 2016 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/sum2016/entries/analysis/>

Brennan, T. (2002). Forms, Platonic. *The Routledge Encyclopedia of Philosophy*. Taylor and Francis. Retrieved 3 April. 2018, from <https://www.rep.routledge.com/articles/thematic/forms-platonic/v-1> doi:10.4324/9780415249126-A131-1

Cohen, S. Marc, "Aristotle's Metaphysics", *The Stanford Encyclopedia of Philosophy* (Winter 2016 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/win2016/entries/aristotle-metaphysics/>

Groarke, Louis F., “Aristotle: Logic”, *The Internet Encyclopedia of Philosophy*, ISSN 2161-0002, URL = <http://www.iep.utm.edu/aris-log/>

Hylton, P. (2003). “Theory of Descriptions”, In Griffin, Nicholas (Eds.), *The Cambridge Companion to Bertrand Russell*, (pp.202-235). New York: Cambridge University Press.

Hylton, Peter, “Ideas of a Logically Perfect Language in Analytic Philosophy”, In Beaney, Michael (Eds.), *The Oxford Handbook of the History of Analytic Philosophy*, (pp.906-925). New York: Oxford University Press.

Juhl, Cory, & Loomis, Eric, (2012). “Analytic Truth”, In Fara, Delia Graff, & Russell, Gillian (Eds), *Routledge Companion to Philosophy of Language* (pp.231-241). New York: Routledge

Klement, Kevin, “Russell's Logical Atomism”, *The Stanford Encyclopedia of Philosophy* (Spring 2016 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/spr2016/entries/logical-atomism/>

Koskinen, Heikki J., (2012). “Quine, Predication, and the Categories of Beings”. In Leila Haaparanta & Heikki Koskinen (Eds.), *Categories of Being: Essays on Metaphysics and Logic* (pp.338-357). New York: Oxford University Press.

Laycock, Henry, (2006) “The Ideal Language Project and the Non-discrete”, *Words without Objects: Semantics, Ontology, and Logic for Non-Singularity* (pp.141-167). New York: Oxford University Press.

Loux, Michael J., (2012). “Being, Categories, and Universal Reference in Aristotle”. In Leila Haaparanta & Heikki Koskinen (Eds.), *Categories of Being: Essays on Metaphysics and Logic* (pp.257-292). New York: Oxford University Press.

Ludlow, Peter, “Descriptions”, *The Stanford Encyclopedia of Philosophy* (Fall 2013 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/fall2013/entries/descriptions/>

MacLeod, Mary C., & Rubenstein, Eric M., “Universals”, *The Internet Encyclopedia of Philosophy*, ISSN 2161-0002, URL = <http://www.iep.utm.edu/universa/>

Pelletier, Jeffry. “Semantics and ontology of mass terms. Mass terms”, 1998, *Routledge Encyclopedia of Philosophy*, Taylor and Francis, URL = < https://www.rep.routledge.com/articles/thematic/mass-terms/v-1/sections/semantics-and-ontology-of-mass-terms>

Quine, W.V.O., “On what there is”; *Review of Metaphysics*, Vol. 2 (1948/1949), pp.21-38.

Sainsbury, Mark, (1991). “The Project of Formalization”. In Mark Sainsbury, *Logical Forms: An Introduction to Philosophical Logic* (pp.339-389). Malden, MA, Blackwell Publishers.

Russell, Bertrand, (2010). “Facts and Propositions”, “Particulars, Predicates, and Relations”, “Atomic and Molecular Propositions”, “Propositions and Facts with More than One Verb, Beliefs, Etc.”, “General Propositions and Existence”, “Descriptions and Incomplete Symbols”. In *The Philosophy of Logical Atomism* (pp.1-77). New York: Routledge

Shields, Christopher, “Aristotle”, *The Stanford Encyclopedia of Philosophy* (Winter 2016 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/win2016/entries/aristotle/>

Smith, Robin, "Aristotle's Logic", *The Stanford Encyclopedia of Philosophy* (Spring 2018 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/spr2018/entries/aristotle-logic/>

Steen, Mark, "The Metaphysics of Mass Expressions", *The Stanford Encyclopedia of Philosophy* (Winter 2016 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/win2016/entries/metaphysics-massexpress/>