OWNERSHIP:
A CASE STUDY IN THE
REPRESENTATION OF LEGAL CONCEPTS †

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ABSTRACT

This paper is an exercise in computational jurisprudence. It seems clear that the field of AI and Law should draw upon the insights of legal philosophers, whenever possible. But can the computational perspective offer anything in return? We explore this question by focusing on the concept of OWNERSHIP, which has been debated in the jurisprudential literature for centuries. Although the intellectual currents here flow mostly in one direction -from legal philosophy to AI- we show that there are also some insights to be gained from a computational analysis of the OWNERSHIP relation.

In particular, the paper suggests a computational explanation for the emergence of abstract property rights, divorced from concrete material objects.

1. Introduction

I have struggled with the concept of OWNERSHIP for a number of years. In my earliest work on TAXMAN (McCarty, 1977), "own" was treated as a primitive predicate and the representation of corporate transactions was constructed almost entirely out of elementary changes in the ownership relation. In TAXMAN II (McCarty 1980, McCarty and Sridharan 1981, McCarty and Sridharan 1982), it became necessary to decompose the ownership relation further, at least for the ownership of corporate securities, and a more primitive representation in terms of the rights of stockholders and bondholders was proposed. This led to the development of a logic for reasoning about "permissions and obligations" (McCarty 1983, McCarty 1986), which then turned out to be of independent interest. More recently, the lessons learned in this earlier work have been applied in my *Language for Legal Discourse* (McCarty 1989). Although *LLD* is intended to be used in a number of applications, e.g., Schlobohm and McCarty (1989), it still bears the imprint of the initial problem that led to its development: the representation of the legal concept of ownership.

In all of this work, I have tried to make use of the insights of legal philosophers. The concept of ownership has been analyzed by every classical philosopher who wrote on the subject of law, from Locke and Bentham to Kant and Hegel. Likewise, in the twentieth century, interpretations of the concept of

ownership have run the gamut, from Wesley Hohfeld (1913, 1917) to Richard Posner (1973). Overall, the jurisprudential literature is rich and diverse. Can the computational perspective offer anything in return? I will explore this question in the present paper.

Section 2 summarizes the history of OWNERSHIP in Anglo-American law, and raises questions about the extent to which this history has been influenced by linguistic and cognitive factors. (I suspect that a similar story could be told about continental European law, but I will leave that to someone more familiar with the civil law tradition.) Section 3 reformulates these questions in computational terms, using the representational devices of *LLD*. Section 4 then supplements the computational model with an analysis drawn from conventional economic theory.

The main puzzle is this: The traditional and commonsense view is that ownership is a relation between a *person* and a *thing*, whereas the modern and sophisticated view is that ownership is a *bundle of rights*. These views coexist without difficulty when the thing owned is a concrete material object. But why do we talk about the *ownership* of *abstract objects*, such as "debts" and "stocks" and "bonds"? Here, it seems, there are rights and duties -and nothing more. Why do we pretend that there is also an abstract "thing" in these situations that is part of an ownership relation?

The paper suggests a computational answer to this question, in Section 3, and then speculates about the structure of these abstract property rights, in Section 4.

2. A Conceptual History

There are roughly three stages in the evolution of the concept of OWNERSHIP in Anglo-American law[1]:

At an early stage, the concept as we know it today did not exist. J.C. Smith points out that the word "owner" first appears in the English language in 1310, and the word "ownership" first appears in 1583 (Smith 1976, p. 214). The term describing the legal relationship between a person and a thing in early English law was "seisin", and it corresponded more closely to the concept of physical possession than the concept of ownership. If a person was "disseised" of his lands, he could maintain an action to recover possession, but in the meantime the "disseisor" could convey the lands to someone else or pass them on to his heirs as part of his estate. If a person was "disseised" of his goods, his rights were even more limited, since he had no action to recover possession of the goods but only an action for damages (Ames 1890). Such was the state of English law in the middle of the 13th century. At a later stage, the remedies against wrongful dispossession were substantially expanded, and the concept of seisin began to approach the modern concept of ownership. Honoré describes this development as follows:

> *To have worked out the notion of* having a right to *as distinct from merely* having, *or, if that is too subjective a way of putting it, of rules allocating things to people as opposed to rules merely forbidding forcible taking, was a major intellectual achievement. Without it society would have been impossible.* (Honoré 1961).

This evolutionary process reached its peak by the middle of the 18th century, when Blackstone could describe property as "that sole and despotic dominion which one man claims and exercises over the external things of the world, in total exclusion of the right of any other individual in the universe" (Blackstone 1791, vol. II., p. 2).

A third stage, quite familiar today, involves the extension of the concept of ownership to abstract objects. Thus a "debt" can be viewed as a form of property, which can be bought and sold in the same way as an automobile or a house. Sophisticated extensions of this basic idea have produced the wide range of securities issued by modern corporations: "stocks" and "bonds" and "convertible subordinated debentures", to name just a few. Patent law and copyright law have extended the concept of ownership in another direction, treating various intellectual creations ("inventions" and "expressions") as if they, too, were physical objects. A parallel development in the modern era is a split between lawyers and nonlawyers about the nature of the concept itself. The commonsense concept of ownership today is still reminiscent of Blackstone, i.e., it is a relationship between a *person* and a *thing*. But to lawyers and other technical specialists, ownership is generally understood as a "bundle of rights". Each "stick" in the "bundle" is a distinct "right" in the ownership relation, which can be split off and transferred separately. Using the bundle-of-rights metaphor, of course, it does not make much difference whether the thing owned is a concrete physical object or an intangible abstraction, since the focus of attention is now on the "sticks".

To understand these modern developments, it is helpful to analyze the concept of ownership using Hohfeldian terminology (Hohfeld 1913, Hohfeld 1917, Lindahl, 1977).

Rights	*Correlatives*	*Opposites*
claim	duty	no-claim
liberty	no-claim	duty

power	liability	no-power
immunity	no-power	liability

Figure 1: Hohfeld's Fundamental Legal Conceptions

Wesley Hohfeld's "fundamental legal conceptions" are shown in Figure 1, with minor modifications[2]. The concepts in the first column are all "rights" in a general sense, i.e., they are legal relations between two persons viewed from the perspective of the person who is, in general, advantaged by the relationship. Thus

we say that *X* has a *claim* that *Y* either do or refrain from doing a particular action, or we say that *Y* is at *liberty* either to do or refrain from doing a particular action insofar as *X* is concerned. The column marked "Correlatives" expresses the same relationship from the perspective of the other person. For example, if *X* has a *claim* against *Y*, then *Y* has a *duty* to *X*, and vice versa. Roughly speaking, the column marked "Opposites" expresses the absence of the relationship in the column marked "Rights". This is obvious in the case of a *no-claim* between *X* and *Y*, which holds just in case there is no claim in existence between *X* and *Y* with respect to a particular action α. The opposite of a liberty must be stated more carefully, however. For example, the opposite of *Y*'s liberty to do a particular action α, insofar as *X* is concerned, is the existence of a duty on Y *not* to do the action α.

The last two rows of the table in Figure 1 represent a different kind of legal relation, in which the actions themselves involve changes in other relationships. Thus, we say that *X* has a *power* over *Y* if *X* is able to bring about a change in some legal relationship affecting *Y*. (Note that *Y* could be the same person as *X*, so that *X* could alter his or her own legal relationships.) The correlative of a power is a *liability*, i.e., a situation in which *Y*'s legal relationships are subject to change by *X*, and the opposite of a liability is an *immunity*. Thus we say that *X* has a power over *Y* with respect to a particular change in the relationship *R* if and only if *Y* has a liability to *X* with respect to this particular change in the relationship *R*, and if this is not the case then we say that *Y* has an immunity from such a change in *R* being brought about by *X*. Note that powers and immunities are generally advantageous, and are therefore loosely referred to as "rights", but liabilities are not always disadvantageous. For example, the beneficiary of a trust is subject to the *liability* of receiving money from the trustee.

Using this analytical vocabulary, we can now be more precise about the concept of ownership. Let us, for the moment, consider only the ownership of concrete physical objects. Then the *owner* of an *object* has the following Hohfeldian rights:

- A *claim* against other persons to exclusive physical control of the object, i.e., other persons would have a *duty* not to use the object in any way, or take any actions that would harm or destroy it.

- A *liberty* to use (or consume, or destroy) the object.

- A *power* to transfer all (or some) of these rights to another person.

- An immunity from the involuntary expropiation of these rights by other persons.

This is roughly the analysis of ownership proposed by Hohfeld in his original articles. Subsequent authors, such as Honoré (1961), have suggested a much longer list of the "incidents" of ownership, including such negative incidents as the *duty* that the object not be used to cause harm and the *liability* that the object might be seized to satisfy a judgment. But the preceding list is sufficient for our present purposes.

It is a matter of debate just how important Hohfeld's analysis was for the actual development of the law. Arthur Corbin, writing a foreword to the republication of

Hohfeld's articles in 1964, admits that Hohfeld's terminology did not catch on, but suggests that his analytical method had a subtle influence on legal thought (Hohfeld 1964). He tells the story of Williston, who drafted the American Law Institute's (First) *Restatement of the Law of Contracts*, checking to make sure that his analysis was consistent with Hohfeld's, and he points out that the first chapter of the American Law Institute's *Restatement of the Law of Property* was explicitly drafted in a Hohfeldian style. "That chapter must have had some influence on judicial and professorial thought", Corbin writes.

Corbin thus raises a question, in a narrow context, that actually has much broader scope: Does the way we think about legal concepts make a difference? Does it matter whether ownership is understood as a relation between a "person" and a "thing" or as an abstract "bundle-of-rights"? Do such conceptualizations have an impact on the development of the law? Or does the causal explanation go the other way?

These questions are also raised by two contemporary legal scholars, Thomas Grey and Charles Donahue, Jr., in their contributions to a *Nomos* symposium on *Property* in 1977. Grey writes about the disintegration of property in the modern world, arguing that the term "property" no longer denotes a coherent concept and suggesting that thus fact is politically significant. Part of Grey's analysis is simply the observation, noted above, that the concept of ownership had evolved from the time of Blackstone to the time of Hohfeld. This evolution was internal to the development of capitalism, Grey suggests. As the industrial economy matured, it became necessary to divide and rearrange the simple ownership of objects into more and more complex forms. But these new forms were primarily the constructions of lawyers, and their work was greatly facilitated by the analysis of property as a "bundle-of-rights".

> The "bundle-of-rights" conception of property appears in well-articulated form for the first time (insofar as I have discovered) in Wesley Hohfeld. "Some Fundamental Legal Conceptions as Applied in Judicial Reasoning", 23 Yale Law Journal 16 (1913). Thereafter, it became part of the conceptual stock-in-trade of the legal realist movement, often with the strong implication that "private" and "public" property were not as different as traditional property theory would suggest. (Grey 1980, p. 85, n. 40).

Ultimately, Grey argues, the Hohfeldian analysis subverted the concept of property itself, and weakened the moral foundations of capitalism[3].

Donahue's thesis is quite different, but it raises some of the same questions. Although Donahue acknowledges that "the concept of property itself is in trouble" (Donahue 1980, p. 28), he also notes an "agglomerative tendency" throughout history that cuts against the pressures for fragmentation. Thus, in both classical Roman law and medieval English law, Donahue observes a tendency to agglomerate the Hohfeldian rights in a single legal person, preferably the one currently in possession, and to treat the rights of other individuals as limited exceptions. This was true, Donahue claims, even before the rise of liberal political theory in the 18th century. Moreover, there is no obvious social explanation for the tendency.

Instead, Donahue proposes a conceptual explanation. The tendency began as an allocation of the burden of proof, he suggests. Then:

> *As the need for a category arose to describe the sum of the rights, powers, and privileges that an individual could have with respect to a thing, we chose the noun derived from the adjective that means "own". The category at once described the concept and also the tendency. As time went on, the tendency took on an independent life.* (Donahue 1980, p. 45).

Is this agglomerative tendency strong enough today to overcome the tendency toward disintegration noted by Grey? Donahue tries to answer this question by analyzing trends in the use of the word "property" by state appellate courts over a 20-year period, but his results are inconclusive.

From our perspective, the interesting point here is that Grey and Donahue (and also Corbin, to a lesser extent) are engaged in a debate about *cognitive phenomena*. They are seeking explanatory power from a study of the way lawyers use legal concepts in different historical periods. But explanations of this sort have always been greeted with skepticism. Would they be more persuasive if they were reformulated in computational terms? We will consider this question in the following section.

3. A Computational Reconstruction

I will assume that the reader is generally familiar with my *Language for Legal Discourse (LLD)*, as described in McCarty (1989) and applied in Schlobohm and McCarty (1989). However, several features of the language are needed for an understanding of the material in this section, and I will review these briefly.

At its most basic level, *LLD* provides a mechanism for the representation of *objects* and *relationships*, each of which can be arranged in a sort hiercachy. For example, we could have a sort 'Actor' with subsorts 'Person' and 'Corporation'. One important feature is the distinction between *count terms* and *mass terms*. Mass terms, e.g., 'Gasoline' and 'Cash', can have quantitative measures, e.g., 'Volume' and 'Value', attached to them. A quantitative measure expresses a relationship between (i) an individual mass; (ii) a reference mass; and (iii) a number, as in the following example:

```
(Value-
     {object (Cash 'C-I)}
     {unit (Dollar 'D-I)}
     {quantity (Number 1000)})})),
```

This syntax allows the arguments of a relation to be inverted, so that we can talk about "the Cash 'C-I which is the *objectof* a measure of Value with a reference mass of a Dollar and a quantity of 1000". In other words: one thousand dollars.

It is useful to distinguish two types of definitions in *LLD*, even though both are written in the same way. One type is the traditional definition *per genus et*

differentiam. For example, assume that we have the sort 'Corporation' and we want to define the subsort 'SmallBusinessCorporation'. We might encode this as follows:

```
(SmallBusinessCorporation C)    <=  (Corporation C)
                                    AND
                                    "C satisfies IRC Section 1371",
```

where we have simply abbreviated the conditions listed in §1371 of the Internal Revenue Code, assuming that they could, in fact, be written out in full. Notice that the variable 'C' appears here in both the *definiens* and the *definiendum*, and thus no new objects are created by this definition. The second type of definition does create a new object, or a new relationship. An example is the concept of "control" in §368(c) of the Internal Revenue Code. Assuming that the relations 'Own' and 'Issued' have already been defined, we could define a simplified version of the concept of 'Control' as follows:

```
(Control C1 {subject (Actor A)} {object (Corporation C)})}
     <==    (Own 01 {subject (Actor A)} {object (Stock S)})
            AND
            (Issued I1 {subject (Corporation C)} {object (Stock S)})
```

In this example, the variable 'C1' represents an instance of the relation 'Control', i.e., it is a new *relationship*. For a discussion of the problems involved in reasoning about such relationships, see McCarty and van der Meyden (1991).

The representation of objects and relationships only goes so far, however, and *LLD* also provides mechanisms for the representation of *events* and *actions*. Elementary events are represented by *statechanges*. For example:

```
(StateChange -
    {relation1
        (Own -
            {subject (Actor A1)}
            {object (Property P)})}
    {relation2
        (Own -
            {subject (Actor A2)}
            {object (Property P)})}
    {time1 (Time T1)}
    {time2 (Time T2)}).
```

Complex events are defined by Horn clauses similar to those defining complex relations, except that they presuppose a *linear order* on the underlying time points and allow order relations to appear as part of the definitions. For a discussion of the expressive power of this representation, and some of the techniques for reasoning about it, see McCarty and van der Meyden (1992). Finally, an *action* is a relationship between an actor and an event, which may be either elementary or complex.

In all of these examples, of course, we have been assuming that 'Own' (and 'Corporation' and 'Stock') are either primitive concepts, as in McCarty (1977), or concepts that have previously been defined. But for the present paper, this begs the question. The objective here is to define the concept of OWNERSHIP itself. The two types of definitions discussed above correspond roughly to the *terminological* component and the *assertional* component, respectively, in various other knowledge representation systems (?). Are these two components sufficient for the definition of OWNERSHIP? I will argue in Section 4 that additional modes of definition are required, but first we need to develop some additional machinery.

The basic strategy for a computational analysis of the ownership relation is: (1) to formalize Hohfeld's system in *LLD*; and (2) to write down the incidents of ownership in the formalized Hohfeldian language. To do this, we need to examine the modalities over actions that are available in *LLD*. The most prominent modalities are deontic: *permitted, forbidden, obligatory*. For expository purposes, we will write these in two ways. When a short form is needed, we will use (roughly) the notation in McCarty (1983): $\mathbf{P}<\phi \mid \alpha>$, $\mathbf{F}<\phi \mid \alpha>$, $\mathbf{O}<\phi \mid \alpha>$. For example, $\mathbf{O}<\phi\mid\alpha>$ means: "Under the condition ϕ the action α is obligatory". When we want to write out a complete representation of the conditions and actions, however, we will use *LLD* syntax:

```
(Permit  'PE-1
    {condition   ...}
    {action      ...})

(Forbid  'FO-1
    {condition   ...}
    {action      ...})

(Oblige  'OB-1
    {condition   ...}
    {action      ...})
```

Recall that $\mathbf{P}<\phi \mid \alpha>$ is a "free-choice" permission, meaning "under the condition ϕ, all ways of doing the action α are permitted". If we needed a weaker form of permission -"some way of doing the action α is permitted"- we would use the modality $\neg\mathbf{F}<\phi \mid \alpha>$. However, it turns out that we also need a modality over actions that is structurally similar to "not forbidden", but with an interpretation in terms of the agent's *ability* to perform the action rather than the *permissibility* of the action[4]. We call this the *enabled* modality, and write it as follows:

```
(Enable  'EA-1
    {condition   ...}
    {action      ...})
```

When a short form is needed, we will write it as $\mathbf{E}<\phi \mid \alpha>$[5].

This is all we need to represent Hohfeld's fundamental legal conceptions. Suppose $\alpha(Y, X)$ represents an action performable by Y that happens to benefit X.

Then $\mathbf{O}<\phi \mid \alpha(Y, X)>$ represents the fact that Y has a duty to do $\alpha(Y, X)$, assuming ϕ is true, and this means that X has a (conditional) claim against Y for the performance of α. Suppose $\beta(Y, X)$ represents an action performable by Y that happens to be detrimental to X. Then $\mathbf{F}<\phi \mid \beta(Y, X)>$ represents the fact that Y has a duty *not* to do $\beta(Y, X)$, assuming ϕ is true, and this means that X has a (conditional) claim against Y that β *not* be performed. On the other hand, $\neg\mathbf{F}<\phi \mid \beta(Y, X)>$ tells us that Y is at liberty to perform β, and $\neg\mathbf{O}<\phi \mid \alpha(Y, X)>$ tells us that Y is at liberty not to perform α. For the remaining Hohfeldian categories, assume that $\Delta R(X, Y)$ represents an action in which X brings about a change in the legal relation R affecting Y. For example, such an action could be written using the *statechange* formalism illustrated above. Then $\mathbf{E}<\phi \mid \Delta(X, Y)>$ tells us that X has a power over Y with respect to ΔR, and $\neg\mathbf{E}<\phi \mid \Delta(X, Y)>$ tells us that Y has an immunity from X with respect to ΔR[6].

Let us now return to the concept of OWNERSHIP. We have just done the easy part: the representation of a "bundle of rights" in Hohfeldian terminology. The hard part is to represent particular objects, and the particular actions that can occur. Some of the distinctions here are legally significant -e.g., the distinction between realty and personalty, or between movables and immovables- and some of the distinctions are just plain matters of common sense. For example, consider the distinction between count terms and mass terms, mentioned earlier. For count terms, it is usually sufficient to consider actions that apply only to the object as a whole. But for mass terms, the most natural way of using the object might be to split off various parts of the mass, and to apply different actions to different parts. Our action language must be capable of representing this fact, and the distinction between count actions and mass actions will then percolate upwards into our representation of the Hohfeldian bundle of rights (this is still a simple example: imagine other objects...).

In general, the bundle of rights associated with *tangible* objects is at least as complex as the tangible world itself. On the other hand, the bundle of rights associated with *intangible* objects is often much simpler. Let us see how the ownership of intangible objects would be represented.

First, consider a specific obligation to deliver a specific quantity of goods on a specific date. For example, Armstrong might have a contractual obligation to deliver 5,000 bushels of wheat to Brubaker in Chicago on September 1, 1993. (For simplicity, we will assume that the purchase price for the wheat has already been paid in full.) This obligation might be represented as follows:

```
(Oblige 'OB-I
    {condition TRUE}
    {action
        (Deliver  -
            {agent (Person 'Armstrong)}
            {object (Wheat W1
                {objectof
                    (Volume  -
```

```
              {unit  (Bushel  'B-1)}
              {quantity  (Number  5000)})})}
      {recipient  (Person  'Brubaker)}
      {location  (City  'Chicago)}
      {time1  (Time  '1-September-1993)}
      {time2  (Time  '2-September-1993)})})})
```

The action 'Deliver' is tangible and complex, of course, and we will simply assume that it has been properly represented in *LLD*. Thus, Brubaker has a *claim* for the delivery of the wheat. In early English law, contract claims could not be assigned to third parties, but by the end of the 18th century these rules had changed. Today, for example, §2-210 of the Uniform Commercial Code explicitly allows the assignment of rights and the delegation of duties, with certain exceptions, none of which apply to Armstrong and Brubaker. Thus, Brubaker's claim is *assignable*. The right to assign a claim arising out of contract is a Hohfeldian *power*. The question is: How should such a power be represented?

The basic mechanisms are already available in *LLD*. We first create a 'StateChange' in which relation1 is the obligation 'OB-1' and *relation2* is the same as 'OB-1' but with the *recipient*, 'Brubaker', replaced by an anonymous actor, 'A'. We then stipulate that this is an action that Brubaker is able to perform, using the 'Enable' modality. Now, suppose Brubaker actually carries out this action, with A = Cadbury. The result will be a claim by Cadbury for the delivery of the wheat. However, we might now want to say that Cadbury has the power to assign the claim, to Dawkins, say, who would then have the power to assign the claim to Edelman, and so on. We cannot write this out, sequentially, for all finite sequences of assignments. Instead, we would like to find a representation in which the power to transfer is itself one of the rights transferred.

Since the solution to this problem is familiar, I will present it first and ask questions about it later. Suppose we define a new kind of property -which might as well be called a 'Claim'- and then write an initial assertion that Brubaker owns a particular instance of this new kind of property. For example, we could write:

```
(State  'S-2
     {relation
         (Own -
             {subject  (Person  'Brubaker)}
             {object  (Claim  'C-34)})}
     {time  (Time  '15-June-1993)})
```

We now replace the unconditional obligation 'OB-1' with the following conditional obligation:

```
(Oblige  'OB-2
     {condition
         (Own -
             {subject  (Actor  A1)}
             {object  (Claim  'C-34)})}
```

```
{action
    (Deliver  -
            {agent (Person 'Armstrong)}
            {object (Wheat W1
                    {objectof
                        (Volume  -
                                {unit (Bushel 'B-1)}
                                {quantity (Number 5000)})})})}
            {recipient (Actor A1)}
            {location (City 'Chicago)}
            {time1 (Time '1-September-1993)}
            {time2 (Time '2-September-1993)})})
```

Clearly, if Brubaker's ownership of claim 'C-34' persists from June 15 to September 1, then 'OB-2' would have the same effect as 'OB-1'. However, we also have the following general rule governing the ownership of property:

```
(Enable 'EA-2
    {condition
        (Own  -
            {subject (Actor A1)}
            {object (Property P1)})}
    {action
        (Action  -
            {agent (Actor A1)}
            {event (StateChange  -
                    {relation1
                        (Own  -
                            {subject (Actor A1)}
                            {object (Property P1)})}
                    {relation2
                        (Own  -
                            {subject (Actor A2)}
                            {object (Property P1)})})})}
            {time1 (Time T1)}
            {time2 (Time T2)})})
```

Thus, Brubaker would be able to transfer his claim to Cadbury, who could transfer it to Dawkins, etc. Whoever ends up as the "owner" of 'C-34' on September 1, 1993, is the person to whom Armstrong is obligated to deliver the wheat.

This solution works because of the persistence of the object 'C-34' through time while the ownership relation for 'C-34' is allowed to change. Are there solutions that do not involve the creation of new objects? One possibility is to use the existing objects in the original obligation 'OB-1' to define a new relationship corresponding to the claim. For example, the English word "owe" could be used to describe this new relationship. (It is interesting to observe that "owe" and "own"

have a similar etymology.) We could thus say that "Armstrong owes 5,000 bushels of wheat to Brubaker deliverable in Chicago on September 1, 1993" just in case the obligation 'OB-1' holds. Now replace 'Brubaker' with a variable, and rewrite the enabled action as follows:

```
(Enable 'EA-3
    {condition
        "Armstrong owes 5,000 bushels of wheat to"
        A1
        "deliverable in Chicago on September 1, 1993"}
    {action
        (Action -
            {agent (Actor A1)}
            {event (StateChange -
                {relation1
                    "Armstrong owes 5,000 bushels of wheat to"
                    A1
                    "deliverable in Chicago on September 1, 1993"}
                {relation2
                    "Armstrong owes 5,000 bushels of wheat to"
                    A2
                    "deliverable in Chicago on September 1, 1993"}
            {time 1 (Time T1)}
            {time 2 (Time T2)})})
```

Finally, in the state corresponding to '15-June-1993', assert the proposition "Armstrong owes 5,000 bushels of wheat to Brubaker deliverable in Chicago on September 1, 1993". The net result is the same as before: Brubaker would be able to transfer his claim to Cadbury, who could transfer it to Dawkins, etc.

However, there are two problems with this representation:

1. We would have to write a separate 'Enable' statement for each particular instance of "owe". This is bad enough when each instance of "owe" has the same set of arguments: *agent, object, recipient, location, time.* But a different action inside 'OB-1' could lead to a completely different version of the "owe" relation, with a different set of arguments.

2. The instantiation of "owe" is individuated only by the objects it refers to: 'Armstrong', '5000-bushels-of-wheat', 'Chicago' and '1-September-1993'. If Armstrong happened to enter into a contract with someone else for the delivery of the same quantity of wheat in the same city on the same date, these obligations could easily become confused with one another. The 'Enable' statement would imply that both obligations were assignable, for example, but this might not have been the intention of the parties.

We can solve the second of these problems by using 'OB-1' itself as the persistent object. The basic idea is to *reify* the contractual obligation to deliver the wheat in Chicago on September 1, 1993, while treating the recipient as a free variable. We

could then write the 'Enable' statement with the obligation 'OB-1' lexically embedded inside it. With this representation, there could be no confusion in the analysis of the enabled action, since 'OB-1' would be distinct from every other obligation that happened to refer to the same objects. Essentially, 'OB-1' plays the same role here as 'C-34'. The only difference lies in the response to the first problem listed above. If, in fact, we needed to write special rules for the assignment of special obligations, then the use of a reified obligation 'OB-1' would be a good solution. However, for most purposes, the construction of a new object, 'C-34', provides a better level of abstraction. The persistent structure of the claim can be encoded in a conditional obligation such as 'OB-2', while the more transient identity of the claimant can be encoded in the ownership relation.

Furthermore, once we have accepted the idea of treating an abstract claim like a concrete object, additional possibilities emerge. For example, since wheat is a mass term, we can "split" Armstrong's obligation to deliver 5,000 bushels of wheat into an obligation to deliver 2,000 bushels to Brubaker and 3,000 bushels to Cadbury. It would be cumbersome to write out all such possibilities, of course, for every obligation and for every conceivable action involving mass terms. Instead, we could treat claim 'C-34' as a mass term itself, and write a small number of general rules to enable a "split" in the ownership of a claim. The obligation 'OB-2' would be virtually unchanged, except for the fact that it would now include a measure of the mass of 'C-34' that would be correlated with the volume of wheat delivered. Once again, by factoring out the persistent structure of the claim from the transient (and "splittable") structure of the ownership relation, we have simplified our representation substantially.

The reader should recognize this strategy as the same strategy that led to the invention of corporate securities. Stocks and bonds are intangible mass terms, with relatively simple rules governing the split and the transfer of ownership. But the persistent structure of the Hohfeldian rights associated with stocks and bonds is very complex. The alternative solutions that we examined in the case of an obligation to deliver wheat -i.e., the use of the relation "owe", and the use of a reified obligation such as 'OB-1'- would not work here. The bilateral deontic relationships between particular stockholders and particular bondholders interact with each other in too many ways, and the only way to describe these interactions is to state the rules for the owners of securities from the perspective of another intangible object: the corporation itself.

Fortunately, the characteristics of intangible corporate mass terms are systematically related to the activities of the intangible corporate actors. These are primarily *economic* characteristics and activities, and they will be discussed in the following section.

4. The Conventional Economic Analysis

In the previous section, I suggested a partial explanation for the emergence of abstract property rights, in computational terms. Assume that we want to assert that an ordinary contract claim is freely assignable. There are several ways to do this, but the best way -computationally- is to create a new object and a new

ownership relation that carries with it the Hohfehldian power to transfer. We have thus identified a reason for the agglomerative tendency (noted by Donahue, 1980) to prevail over the disintegrative tendency (noted by Grey, 1980). A contract claim is a pure Hohfeldian bundle of rights, but it does not "disintegrate" because there are computational advantages in treating it as a persistent object.

However, this is only a partial explanation. It does not explain why we would want the contract claim to be freely assignable in the first place. The rest of the explanation is given by economic theory, and it is now a conventional part of the literature on law and economics (Demsetz 1967, Posner 1973, Ackerman 1975). The transferability of property rights insures that resources can be shifted from less productive uses to more productive uses through voluntary exchange, thus increasing "economic efficiency" overall[7]. This is true for concrete physical objects -land, buildings, machines- and it is also true for contract claims. For example, Cadbury might discover on August 15th that he could make a substantial profit in his mill if he had a guaranteed source of 5,000 bushels of wheat on September 1st, whereas Brubaker might discover on the same date that his mill was already running behind schedule and beyond capacity. Thus the contract claim would be worth more to Cadbury than to Brubaker, and it would be rational for Brubaker to sell it. Of course, Cadbury could always enter into a separate contract with Brubaker for the purchase of the wheat itself, as originally required under English law, but this is a cumbersome solution. It is much easier to assign the contract claim itself.

All of this is obvious. What is not quite so obvious is the fact that the contract claim -reified into a piece of "property" that is "owned" by Brubaker- acquires economic characteristics that are systematically related to Armstrong and his wheat. If the summer crop is poor, the value of the contract claim rises; if Armstrong becomes insolvent, the value of the contract claim fails; as the delivery date approaches, the value of the contract claim becomes more determinate. In principle, we can derive these characteristics directly from our representation of 'C-34' as an object embedded in a Hohfeldian "bundle-of-rights". Similarly, the economic characteristics of corporate securities are derivable from their underlying deontic representations. For example, the owner of common stock is subject to the *liability* of receiving periodic distributions of income from the corporation, and has the *power* (indirectly) to modify the corporation's dividend policy. On the other hand, the common stockholders' *claim* to corporate assets in a liquidation is given a very low priority. If we write these rules out explicitly in *LLD*, and make a number of simplifying assumptions about the economic environment, we can derive the fact that common stock has a relatively high expected rate of return and a relatively high level of risk[8]. In principle, we can carry out such derivations for any arbitrary corporate security.

Conventional economic analysis generates these inferences, too. The difference is that our analysis starts at a more fundamental level, with a formal representation of the bundle of rights that constitutes a financial asset. We are less interested in the economic analysis, *per se*, than we are in the contribution of this analysis to an understanding of the definitional structure of legal concepts.

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Let us see how economic analysis plays a role in the definition of "stocks" and "bonds". The definition of a corporate security does not fit into either of the patterns discussed in Section 3. It is not a definition *per genus et differentiam*. That is, we cannot simply say: "A stock is an X for which ...". We might try: "A stock is a kind of property for which ...", but we would then be forced to fill in the sentence: "A property is an X for which ...". This does not seem possible. Terms like "stock" and "bond" and "property" are syntactically primitive, even though they are semantically very complex. Nor does it help to expand the definitional level to the relation "own". We cannot simply say: "An actor A owns a stock S if ...". However, the meaning of "stock" is not all that mysterious if we study carefully the construction of claim 'C-34' in the example in Section 3. There are two important mechanisms:

1. Claim 'C-34' is defined contextually. It always appears inside the instantiation of an ownership relation, which in turn appears inside a particular set of modalities over actions. The *context* of the claim is the persistent structure of Hohfeldian rights associated with it.

2. A particular corporate security, 'S-27', would be defined in the same way, except that the context would be more complex. Suppose we wanted to create subcategories for "stocks" and "bonds" and various hybrid securities. The main idea is to focus on the context, i.e., the Hohfeldian "bundle-of-rights", and then to derive the economic characteristics outlined above. This gives us an *economic space* in which to construct the subcategories.

The definition of "stocks" and "bonds" can now take several forms, but it is natural to write such definitions using *prototypes* and *deformations* in the derived economic space (McCarty and Sridharan 1981).

In my earlier work on prototypes and deformations, I wrote about "projecting" the description of a "stock" onto the space of "Expected-Distribution-of-Earnings" (McCarty and Sridharan 1981, p. 251). The current account is both more flexible and more constrained. It is more constrained, first, because of the stratification of *LLD* into distinct sublanguages: a language for objects and relationships, a language for events and actions, and a language for modalities over actions. It is more flexible because it allows, in principle, the use of an arbitrary modal context in the derivation of the economic characteristics of a corporate security. Finally, it is more constrained because of the constraints imposed by economic theory itself. These latter constraints need to be studied more carefully. This will require, I believe, a combination of traditional economic analysis with the computational analysis set forth in the present paper.

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Notes

[1] In writing this abreviated history, I have relied upon: Honoré (1961), Smith (1976), Donahue (1980), Grey (1980), Munzer (1990).

[2] Commentators on Hohfeld's system have often proposed minor variations in terminology, and I have adopted some of these variations here: (1) Hohfeld used the words "right" and "no-right" in place of the words "claim" and "no-claim" in Figure 1, since he considered the correlative of a duty to be a "right" in the strict sense. However, he also suggested that the word "claim" would be a reasonable synonym. (2) Hohfeld used the word "privilege" for the opposite of a duty, although he suggested "liberty" as a possible synonym. One problem with the word "privilege", as Hohfeld noted, is that it also connotes a special legal advantage. (3) Hohfeld used the word "disability" for the opposite of a power, but I have substituted the word "no-power" to emphasize the structural similarity to the concept of a "no-claim".

[3] For a sharp critique of Grey's conclusions on this point, see Munzer (1990, pp. 31-36).

[4] Formally, this modality is defined using a Grand Permitted Set, exactly as in McCarty (1983). The only difference is that the subworlds in the Grand Permitted Set are now interpreted as actions that the agent ia *able* to do, and the agent's actual actions are constrained to lie within this set.

[5] The dual of $E< \phi \mid \alpha>$ is also interesting. Define $C< \phi \mid \alpha \equiv \neg E< \phi \mid \neg \alpha>$ and interpret it as a *causal* modality. This modality is useful in a number of contexts, but will not be used in the present paper.

[6] In a previous paper (Schlobohm and McCarty, 1989), I represented a legal power as a weak permission, so that X would have the power to bring about a change in the relation R just in case X's action to change R was not forbidden. Although this purely deontic representation seems adequate for encoding the powers of a trustee, which was the primary application in Schlobohm and McCarty (1989), Layman Allen has pointed out to me that it does not correspond to Hohfeld's original conception of a power. I have therefore replaced the modality $\neg F$ with the structurally similar modality E. This new representation allows us to say that X has a power over Y with respect to ΔR, but that X is nevertheless forbidden to exercise that power. An even finer grained representation would distinguish between physical acts and legal acts, and encode a power as the ability to perform a particular physical act (e.g., reciting a sentence, signing a document) which is then causally linked to a change in a legal relationship. However, for present purposes, this finer grain does not seem to be necessary.

[7] I will not discuss here the various elaborations and qualifications of this principle that are necessary to apply it to even mildly realistic situations. See, e.g., Michelman (1982), Demsetz (1982).

[8] An outline of this derivation appears in McCarty and Sridharan (1982), but without the benefit of a formal deontic representation. I will present a more detailed derivation in a future paper.

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