

The Ontology of Legal Possibilities and Legal Potentialities

Pamela N. Gray

*Centre for Research into Complex Systems,
Charles Sturt University, Bathurst, Australia
pgray@csu.edu.au*

Abstract. Ontologies in a legal expert system must be processed to suit all possible user cases within the field of law of the system. From the logical premises of a deductive system of express rules of law, legal ontologies may be implied to encompass the combinatorial explosion of possible cases that may lack one or more of the express antecedents in the deductive rule system. Express ontologies in inductive and abductive premises that are associated with the deductive antecedents, may also be adjusted by implication to suit the combinatorial explosion of possible cases. Implied legal ontologies may be determined to suit the user's case and its legal consequences. The method of this determination and the processing of express black letter law accordingly, is considered by reference to the supplementation of ontology by logic and the supplementation of logic by ontology, in the legal domain; three bases of this method are discussed: law-making power, prior analytics, and the pillars of truth in science and law.

Firstly, law-making authority includes the power to determine the logical category of legal premises, and legal truth tables (c.f. Wittgenstein, 1918); law is laid down as legal ontologies with logic attributes or structures. Thus, three ontological posits of law-makers provide for the logical processing of legal information. Rules of law are Major deductive premises laid down, formally or informally, as conditional propositions which may be systematised for extended deductive reasoning. Material facts in a case are laid down as inductive instances that particularise or define antecedents in rules of law; they also may be used as Minor deductive premises to determine the outcome of the case. Reasons for rules are laid down as and for strong or weak abductive reasoning.

Secondly, legal knowledge engineering requires prior analytics (cf. Aristotle, 1952, originally c.335 BC) for the acquisition of the expertise; by prior analytics, premises are formalised and systematized for automation of their associated heuristics. Legal epistemology both determines and implements logical structures; through prior analytics it uses ontologies of legal possibilities and potentialities, to comprehensively predetermine premises for its three forms of legal logic: deduction, induction and abduction.

Thirdly, Lord Chancellor Bacon's (1620) reconstruction of legal epistemology as scientific method for expanding knowledge, systematizes the sources of truth in law and science. It is here developed as a method of prior analytics for constructing an ontology of legal possibilities and legal potentialities. Such ontological construction is essential for determining the heuristics of combinatorial explosion derived from express legal rules to meet the possible cases of users; while legal experts need only construct the relevant part of the combinatorial explosion, for a client's case, an expert system must be capable of constructing any relevant part to suit a user's case.

1. Ontology of Legal Possibilities and Legal Potentialities

In its meaning, a rule of law is concerned with what will happen if a situation or case exists; this is the nature of a rule because it has the form of a conditional proposition: 'if (antecedent(s)) then (consequent)'. The ontological situations that are explicit in law, might exist; law assumes an ontology of possibilities and potentialities. In the legal domain, reconfigurations of ontology in express rules of law, may produce a range of hypotheticals (cf. Rissland, 1985); the extent of the hypotheticals used by the legal profession is determined by what is the legal consequent if one or more of the antecedents in a rule of law do not exist, which is possible, or are given additions, which are realised potentialities.

2. Reconfiguration of Express Ontology

The reconfiguration of legal ontologies is a part of legal epistemology that was adapted for scientific method by Lord Chancellor Francis Bacon in the Second Book of his *Novum Organum* (1952, originally 1620). His system of four Tables, illustrated by the study of heat, allows consideration of (1) the attributes of heat through a range of instances of heat, (2) the attributes of a lack of heat through a range of instances of a lack of heat, (3) degrees or comparative instances of heat and lack of heat with causal observations on increasing and diminishing heat, then (4) the attributes of a lack of heat that are excluded from the attributes of heat. The pattern in the Tables is comparable to the pattern of pleadings in a court case; the *Novum Organum*, which was posed to replace Aristotle's work on ontology and logic, the *Organon*, was written just prior to Bacon's dismissal from office for taking bribes. He died a few years later from a chill suffered during his study of cold. Bacon explains his system as follows:

The investigation of the forms proceeds thus: a nature being given, we must first present to the understanding all the known instances which agree in the same nature, although the subject matter be considerably diversified. And this collection must be made as a mere history, and without any premature reflection, or too great degree of refinement....

Negatives, therefore, must be classed under the affirmatives, and the want of the given nature must be inquired into more particularly... (p.141)

In the third place we must exhibit to the understanding the instances in which that nature, which is the object of our inquiries, is present in a greater or less degree, either by comparing its increase and decrease in the same object, or its degree in different objects... no nature can be considered a real form which

does not uniformly diminish and increase with the given nature. (p.145)

For on an individual review of all the instances a nature is to be found... man...is only allowed to proceed first by negatives, and then to conclude with affirmatives, after every species of exclusion.

We must now offer an example of the exclusion or rejection of natures found by the tables of review, not to be of the form of heat; first premising that not only each table is sufficient for the rejection of any nature, but even in each single instance contained in them. For it is clear from what has been said that every contradictory instance destroys an hypothesis as to form. Still, however, for the sake of clearness, and in order to show more plainly the use of the tables, we redouble or repeat the exclusive. (p.149)

In the exclusive table are laid the foundations of true induction, which is not, however, completed until the affirmative be attained... And, indeed, in the interpretation of nature the mind is to be so prepared and formed, as to rest itself on proper degrees of certainty, and yet to remember (especially at first) that what is present depends much upon what remains behind. (p.150)

Bacon's father was also Lord Chancellor in his time, so Francis, who had studied at Cambridge University and at Gray's Inn, was well imbued with legal epistemology. At the outset of adapting legal method to science, Bacon observed:

Although there is a most intimate connection, and almost an identity between the ways of human power and human knowledge, yet, on account of the pernicious and inveterate habit of dwelling upon abstractions, it is by far the safest method to commence and build up the sciences from those foundations which bear a relation to the practical division, and to let them mark out and limit the theoretical. (p.137)

Bacon set out his method for science to 'superinduce' (p.137) knowledge. Scientific knowledge must look to its inductive instances as the source of truth that can be carried through to establish its Major deductive premises; whereas law looks to law-making power for the 'truth' of its Major deductive premises which then determine the scope of its inductive instances in cases (cf. Ashley, 1990).

A case is now pleaded in a variable Statement of Claim as one or more form(s) of action; this requires a statement of how the case facts of an action satisfy the relevant rules. The facts of the case must particularise the antecedents in the relevant rules and state the Final consequent of those rules in terms of the claim, as well as the orders that thereby are sought. Where several rules that are connected are relied on, the interim conclusions that connect the rules must be set out in the statement as matters that are particularised by the facts of the case. Where there are no rules to rely on, an action on the case may be pleaded, with facts suggesting new rules or a certain exercise of discretion by reference to relevant factors.

Issues of fact and law are resolved through the further pleadings, namely the Defence and Counterclaim, and Reply, if any. The defence will indicate which facts in the Statement of claim are denied and which rules or part of rules in a Statement of claim are joined in issue by the defendant; the defence relies on contradictions of the facts pleaded by the Plaintiff, and the rules that deal with such failures to establish a claim. The defence may plead further facts. If the further facts pleaded by the defendant amount to a claim against the plaintiff, then they must be pleaded as a Counterclaim, which is like a Statement of claim by the defendant. Only pleaded matters may be raised and relied on at the trial; the parties are confined to these matters and issues.

3. Legal Epistemology

Law-making authorities, who provide truth to the rules of law as Major premises for the modus ponens deductive syllogism, and truth to premises adopted for inductive and abductive support for the law, lay down law and its associated premises in ontological posits as legal ontologies with integral logic structures. These posits may be compared to the monads of Leibniz (1714), the a priori principles of Kant (1788, 1955), and the epistemes of Foucault (1969); the concept of a paradigm (Kuhn, 1970) also bears a fusion of ontology and epistemology. The fusion reconciles the jurisprudence of legal positivism and analytical jurisprudence. The ontological posits determine the sort of logical use that can be made of the premises in the posits; there are three sorts of ontological posits in the legal domain, where legal ontologies are laid down, namely:

1. deductive premises in the form of rules for use in extended deduction,
2. inductive premises which may be formalised as existential statements that are definitional, and are usually the material facts of cases for use in induction as instances of antecedents or instances of consequents in the deductive rules; inductive instances may be extended by common knowledge and dictionaries of synonyms and antonyms, and
3. abductive premises for use as reasons for rules or reasons for case decisions about rules. Abductive premises may provide strong or weak reasons; there may be abductive premises which are so strong that they displace or justify modification of a deductive rule.

When a conditional proposition, stated formally or informally is said to be a law by a law-making authority, then this description means that it can be treated as true in a syllogistic application of its ontology as a Major premise for deductive application. Material facts of cases that satisfy an antecedent in a rule, are judicially asserted as inductive instances of an antecedent in a rule. If a premise is said to be a reason for a rule or for an accepted instance of an antecedent or consequent in a rule, then it is laid down as an abductive premise that strengthens the deductive or definitional necessity of the application of rules. A strong abductive premise that weakens a rule may break the deductive necessity of the rule and change the rule. What a judgment says of a premise, determines the logical nature of its ontological posit.

4. Systematic determination of ontology of legal possibilities

Four steps (cf. Bacon, 1620, 1952) are required to systematically ascertain the full extent of the ontology of legal possibilities: (1) the determination of the extended deductive order of deductive posits, (2) the determination of contradictories and uncertainties in extended deductive order, (3) the determination of inductive posits, their contradictories and uncertainties, and (4) the determination of abductive posits, their contradictories and uncertainties.

4.1. EXTENDED DEDUCTIVE ORDER

To establish the possible cases within the scope of the express black letter law, that are the extent of possible legal ontologies, the express legal ontologies of black letter law are initially formalised as the antecedents and/or consequents of the system of rules of law that permit extended deduction; every formalised rule is a Major deductive premise in an extended deductive order whereby rules become linked continuously. Susskind (1987, p.146), the champion of rule base systems, pointed out as crucial, the nature of this linking:

... the consequents of some rules function as the antecedents of others.

Thus, if a consequent of one rule is established when all its antecedents are established by the facts of a case, that consequent may be used as an established antecedent in a second rule, to establish, along with further facts of a case that establish any other antecedents in the second rule, the consequent of that second rule, and so on, in a sequence of extended deduction. This phenomenon produces rule hierarchies which *prima facie* have mixed components of law and fact that may raise issues of fact, issues of law or mixed issues of law and fact

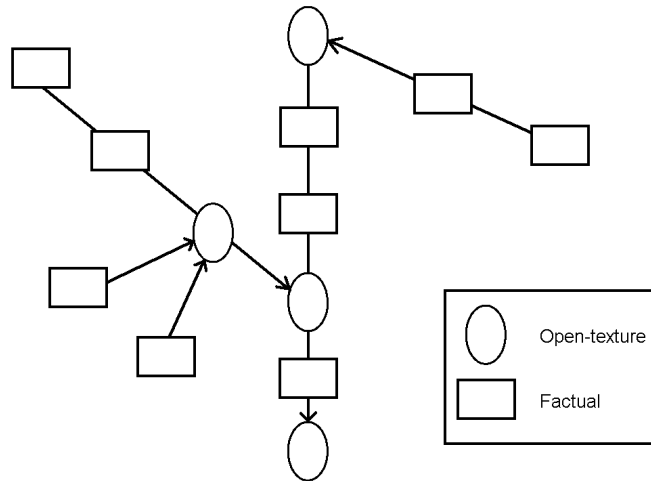


Figure 1. River of open texture ovals and factual nodes

in a particular case; the mix of components is evident in the directed acyclical graph of Popple (1996, p. 71), which is further developed in Figure 1, as an eGanges River of open-texture ovals and factual nodes. In this diagram, the oval nodes may raise issues of law and the rectangular nodes may raise issues of fact; in some cases, both an oval and a rectangle may be in issue as a mixed issue of law and fact.

Popple (1996,p. 70-1), explains his directed acyclical graph in terms of his open-texture circles and square leaves:

The circles are parent nodes, representing open-textured concepts; the squares are leaf nodes, representing concepts which are considered to be fully

defined (i.e. answerable by the user). The top level parent node is called the root node.

When it comes to proving a case, law applies not just with the necessity of deduction, but, significantly, with the necessity of extended deduction based on the overlap of common components from different rules. The hierarchy of extended deduction produces the mix of potential issues in a case. Legal ontologies include both the open-textured and factual concepts of the epistemological hierarchy of the rules of law that constitute Major premises for extended deduction; the hierarchy is the epistemological structure that orders the ontology for extended deductive processing of its components by way of application to a client case.

The open texture of some antecedents in law makes extended deduction inevitable. Detailing of antecedents in some rules, with further rules, is the inherent structure of the hierarchy of rule systems in law. Material facts in cases remain the inductive instances of antecedents, as distinct from rules of finer granularity, even if finer rules have only one antecedent. Finer rules are an opportunity to require several antecedents, not just one, and to add a further hierarchy of requirements, not just deductive instances of a legal concept.

4.2. CONTRADICTIONARIES AND UNCERTAINTIES

To complete the ontology of deductive legal possibilities in a legal expert system, the extended deductive antecedents and consequents that are formalised from black letter law, are expanded by their contradictories and uncertainties, including the contradictories and uncertainties of open-textured ontologies; these additional antecedents and consequents are also structured as rules, further expanding the system of formalised rules that are within the scope of the black letter law. It is possible that a case may occur with the contradictory or uncertainty of an antecedent or consequent that is specified in a rule of law; the effect of this must be clarified, especially where black letter law disjunctions produce alternative rules with the same consequent.

In the legal domain, the contradictories in the ontology of legal possibilities are treated as ontologies, even if they ensure, not some antonym, but the absence of some fact or condition; since rules of law may require the absence of certain antecedents, such absence of an existence is treated as legal ontology. For instance, the absence of rejection of a contractual offer is one of the necessary and sufficient conditions to establish a valid contract. Uncertainties are given legal consequents, according to the rules of burden of proof, so they too are part of the ontology of legal possibilities used by legal experts, pending resolution of uncertainties

in a judgment.

The elements of ontological possibilities in the law are not completed by the deductive contradictories and uncertainties; however, these elements of ontological possibilities are contained in the epistemological structures of rules, as antecedents and/or consequents in an extended deductive structure. Combinatorial explosion of the alternative possible combinations of initial antecedents and consequents, their contradictories and uncertainties, determines the full scope of alternative, consistent, valid deductive legal arguments in the totality of the epistemological system of rules, and all possible case pathways through the full extent of the legal ontology of deductive antecedents and consequents.

Prior analytics, which is one of the six parts of Aristotle's work on logic, the *Organon* (Aristotle, 1952), deals systematically with the formalisation of premises for valid deductive inferences and the extent of necessary logical conclusions in syllogisms; invalid conclusions are also considered within the scheme of invalid inferencing and fallacies. A prior analytics of black letter law is posed in this paper as part of the first step in legal knowledge engineering methodology, namely the acquisition of the expert legal knowledge.

Acquisition of legal expert knowledge must take into account both the black letter law and the further rules to accommodate the contradictories and uncertainties of antecedents and consequents, as a matter of logical completeness; these further rules are the implied rules of contradictories and uncertainties that may be relied on by opponents in litigation. Prior analytics may formalise and shape rule hierarchies as continuous Major deductive premises for application by extended deduction to possible cases argued in litigation; the logical extension of the rules of law, and the hierarchies of Major deductive premises, are matters of legal epistemology.

Express law may state a mixture of rules for opposing parties, but extended deductive premises must be streamlined for one party or the other. It may be necessary to use a rule or its contradictory form to complete the streamlining for one side in litigation.

4.3. INDUCTIVE POSITS

Further ontological possibilities in regard to selected black letter law arise from the inductive instances which particularise the deductive antecedents and consequents of the system of rules that is within the scope of the black letter law (cf. Popple, 1996, p.68); these are likely to be factual instances of open texture or factual antecedents, their contradictories and their uncertainties. Inductive instances, which are

existential or definitional in nature, may be iterative, or analogous to each other; they may be devised by reference to dictionary definition, synonyms, facts or dicta of precedent cases, expert evidence, common knowledge or common sense. Thus, further epistemological treatment of ontologies in rules, by induction, further expands the possible ontologies for legal argument or for the goal attainment of legal strategies. The instances are induced ontologies, to be applied through rules, and not directly to case facts. In the legal domain, rules of law are enforced, pursuant to the rule of law, not pursuant to a rule of inductive ontologies or a rule of the functional ontologies of Valente (1995). The contingent nature of rules acts as fair warning of enforcement to subjects of the law.

4.4. ABDUCTIVE POSITS

A final expansion of possible legal ontologies pertains to the ontologies to be found in abductive premises used in legal argument. These ontologies may also expand and contract as further circumstances come to hand and potentialities for legal invention or law-making, are realised. Abductive premises, their contradictories and uncertainties, may provide strong or weak support for rules of law. They are usually reasons for rules; they may be the deeply rooted customs of moral action referred to by Buchler (1961, p.159). In legislation and explanatory memoranda, abductive ontology may be available. Where case facts are brought to rules as the inductive instances of antecedents, or case dicta establish rules or parts of rules, as envisaged by Branting (1991), reasons for rules might also be given, abductively to the decision in the case (cf. Atkinson, Bench-Capon and McBurney, 2005). Abduction may be a meta-ratio for a *ratio decidendi*.

Abductive posits may have their own separate epistemology, some of which might be a *modus ponens* form of deduction in its own context. Historically, inductive and abductive annotations were made to codes of law as glosses; in modern times, margin notes are customary in statutes, but are treated as extraneous to the statutory law. A stratified appearance of the medieval glosses of the Jewish Code of Laws by Maimonides (1550), which might include his Aristotelian commentary, *ex facie* indicates an abductive epistemology. Figure 2 is a page in this work; other pages have similar but varied stratification. It would be difficult to provide Aristotelian commentary without retaining its logical structure; there may be transcendent *rationes* for *meta-rationes*. The Bologna glosses of the Roman Code of Laws, which began a century prior to Maimonides (1135-1204), include inductive and abductive annotations, confined to the four simple margins around the text; they

are not complex with stratification in reasoning around central ideas, as is Maimonides glossing.

Where induction and abduction are located, by reference to the components of extended deduction, their strands of annotative reasoning should be kept separate, like glosses, from the strands of extended deductive reasoning. Otherwise the sequence of reasoning may appear non-monotonic. Ontologies that are deemed by law-making authorities to apply to cases by necessity, should not be confused with abductive ontologies that play a different role in legal argument.

5. Semantic invalidity in logic

Ontological posits and informal truth tables of law-making authorities solve the problem of semantic invalidities in logical form. Semantic invalidation of a *modus ponens* syllogism which is used in applying law to a case, is described by Waller (1995, p.170), in his first year law text, in the following way:

Every sentence containing six words is true.

This sentence contains six words.

Therefore it is true.

Waller (1995, p.170-1) also points out that lawyers prefer conditional propositions or propositional calculus to predicate logic, which are interchangeable forms of deduction, as there is less to assert as true in the Major premise:

In any area where people use deduction they may employ one of two kinds of syllogism. They may begin, if the task is of a theoretical kind, by using the word "all". The ancient example is:

1. All men are mortal.
2. Socrates is a man.
3. Therefore Socrates is mortal.

This method is simple. If the first two propositions are correct, the conclusion is obvious. The first proposition is called the major premise, the second the minor premise. But, of course, you may want proof of either premise. "Is it true that all men are mortal? It is true that Socrates is a man?" In this example long experience shows plainly that both are correct. In any event, the logician would answer that he or she

3. Therefore Jane is guilty of these crimes.

The hypothetical method is often superior for use because it does not say “all”. It is another kind of assumption, not so hard to prove and likely to be correct....

So “If P then Q” is relevant as a guide – tautological though it may be. It remains the best and most common kind of inference for courts though they rarely use the actual terms: syllogism, major or minor premises. But they do constantly say, “If that is the law, then it follows that the plaintiff was entitled” or “the defendant is guilty”.

Of course Waller (1995, p.168), also recognised that precedent cases are inductive examples, even in the formulation of new antecedents or rules; some induction is determined by analogy and some by common sense or authoritative iteration. He also explored the logic used by lawyers that is outside the realms of deduction and induction, especially in keeping rules consistent and providing for new cases. A systems view of legal logic is maintained by Waller (1995, p.181), by reference to Wisdom (1973, p.195):

Professor Wisdom made a penetrating remark: he proposed that lawyers’ arguments “are like the legs of a chair, not like links in a chain”. Common sense, history, analogy and so on, support one another if the issue is at all complex. This is the type of logic that the ancients knew well and valued highly under the name of rhetoric. It was extensively used in medieval times for practical judgments. Only in the last three years did logic – in a vain effort to make thinking mechanical and perfect – come to include only formal logic. But throughout these centuries lawyers have gone ahead using rhetorical reasoning with excellent results. (“Rhetorical” here is not to be confused with fulsome oratory, unfair appeals to emotions and extravagant language.)

6. Limits of logical extensions of legal syllogisms

It is not logically valid to extend a rule of law to its adversarial form. Only the establishment of a contradictory ontology can provide the basis for an opponent’s argument in litigation. Thus if there is a rule ‘if a then c’, it is not thereby logically valid to assume ‘if not a then not c’. There may be ways other than a to establish c. However, if the rule ‘if not a then not c’ is established ontologically, then there is an adversarial provision that is part of the ontology of legal possibilities. The adversarial contradictory will be established from the meaning of the law-maker’s language in laying down the express rule; if the antecedents are referred to in terms that they must be established, then this will produce an adversarial contradictory.

Of course, law-making authorities may not lay down the adversarial contradictory rule; instead they may lay down a disjunction: 'if not a then c'. A disjunction of mutually exclusive contradictory antecedents occurs with some qualification in the Australian Spam Act 2004; a message which is not a commercial electronic message is not prohibited and a commercial electronic message which complies with certain conditions also is not prohibited. In legal epistemology, 'not a implies not c' may have ontological validity, even if it does not have logical validity as a derivation from 'a implies c'; epistemological rules may override the meta-rules of logic. Also, contradictories may be common points for both adversaries; it can not be assumed that the contradictory of one party's points is the same as a point for the opponent's case. Authoritative legal ontologies must be considered for each case.

Even though the ontology of the adversarial contradictory may be implied, and extended deduction justifies forward chaining in the direction indicated by the inference arrow that represents 'then' or 'implies' in the conditional proposition, this does not authorise backward inference; the conditional proposition that is a rule of law is only a material implication or an ontologic posit equivalent to the reversed C of Peano, if the law-maker designates it as such, and usually this does not happen unless there is a legal presumption. Prima facie, a consequent in a rule of law does not logically establish its antecedents; antecedents must be established, directly or indirectly, by evidence of material facts in order to establish their consequent.

7. Knowledge representation and ontology

In information science, ontology is used as a domain epistemology to acquire vocabulary with meaning mechanisms; Figure 3 is an embellished Porphyry tree (2005) which is an epistemological structure that was devised by Porphyry (c.232-304) to represent Aristotle's ontology of substance. It also locates inductive instances and the pattern of a taxonomy. The tree categorisation of ontology is useful in information science, as the meaning mechanisms of a Porphyry's tree representation founds the epistemology of predicate logic.

It was suggested by Valente that the modelling of functional ontologies would remedy the epistemological shortcomings of earlier legal knowledge engineering to be found in logic systems. Inevitable ontological 'commitments' embedded in logic formalisms were identified by Valente but he did not go on to find the ontology of legal possibilities implied by the express conditional propositions of law:

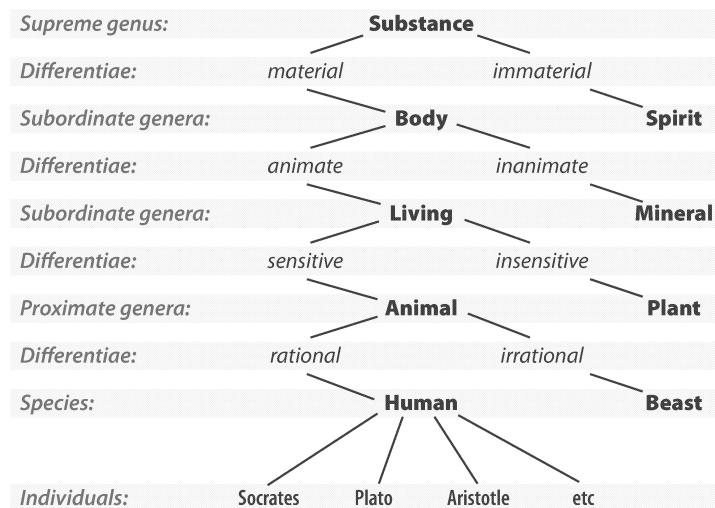


Figure 3. Horrocks' Porphyry tree (2005) See <http://www.epsg.org.uk/pub/needham2005/>

With regard to their role as a representation tool for legal knowledge, the basic problem is that most of the proposed formalisms (which means basically deontic logics) fail to keep track of the epistemological aspects they necessarily involve, i.e. of the (inevitable) ontological commitments embedded in the formalism. (Valente, 1995, p.17).

Certainly Aristotle's ontology of substance intended to capture all possible substance, but the distinction between contradictories that are non-existences and contradictories that are antonyms has not been considered in regard to the Porphyry tree epistemology and in the translation of predicate calculus to propositional calculus as suggested by

Waller. Use of an ontology requires logic; the use structure of ontology is required for selection of appropriate logic.

As a solution to the epistemological shortcomings of rule-based and case-based systems, Valente (1995) added ontology modelling to the repertoire of legal knowledge engineering methodology. He recognised that legal ontologies could be extracted from black letter law and modelled in various ways as functional ontologies for legal expert systems. His modelling of extracted ontologies was to be in accordance with models of legal practice ontologies that focussed on tasks, goals and methods. However, he did not consider that such modelling and models were, ipso facto, epistemological; nor did he consider the requirement that the functional ontology be in accordance with sound legal epistemology that had to be found in the legal practice ontologies. Sound legal epistemology plays a role in determining the ontology of legal possibilities for logical processing.

In his criticism of Valente's work, Aikenhead (1996) referred to the oft-quoted point made by Susskind (1987, p.20), in regard to legal expert systems:

It is beyond argument, however, that all expert systems must conform to some jurisprudential theory because all expert systems in law necessarily make assumptions about the nature of law and legal reasoning.

However, Valente's work filled an important gap in legal knowledge engineering methodology that was not appreciated by Aikenhead. The extraction of a legal ontology and its remodelling, explains the process of formalising rules of law as Major deductive premises; it is the process of prior analytics (cf. Aristotle, 1952 c 330BC) that is required if a deductive antecedent or consequent in a rule of law is varied in accordance with black letter law, for the sake of adversarial completeness. Valente illuminates precisely a step in the reasoning of legal practitioners, not before exposed.

Shannon and Golshani (1988) defined deep models as ones that model meaning and not just words. The meaning of law is adversarially complete with the ontology of legal possibilities and legal potentialities, with their implicit logic.

8. Conclusion

Legal knowledge engineering requires the development of its own Jurisprudence of Legal Knowledge Engineering. The use of ontology and epistemology in philosophy is a rich source for the development of legal knowledge engineering jurisprudence. A deep model of legal expertise for legal knowledge engineering may enhance legal practice and further

develop the jurisprudence of legal knowledge engineering. In order to program an epistemologically sound legal expert system, a legal knowledge engineer must acquire from a legal expert, a knowledge of the substance of express ontological posits that are deductive ontology, inductive ontology and abductive ontology, and then derive from these posits the ontology of legal possibilities. The process of derivation is an epistemological process, like the formulation of a truth table in logic; it provides for possible cases within the scope of the express black letter law and legal information, and the valid legal arguments that apply to those cases.

References

- Aikenhead, M. (1996): Book review, A. Valente, Legal Knowledge Engineering, *International Review of Law, Computers and Technology*, Vol. 10, Issue 2, p351, Oct.
- Aristotle (1952): Organon, in R. M. Hutchins (ed.) *Great books of the Western World*, Vol 8, Encyclopaedia Britannica Inc., Chicago, USA.
- Ashley, K.D. (1990): *Modeling Legal Argument: Reasoning with Cases and Hypotheticals*, MIT Press, Cambridge, MA.
- Atkinson, K., Bench-Capon, T. and McBurney, P. (2005): Arguing about Cases as Practical Reasoning, in *Proceedings of the Tenth International Conference on Artificial Intelligence and Law*, ACM, New York, USA.
- Bacon, F., *Novum Organum* (1620, 1952), in R. M. Hutchins (ed.) *Great books of the Western World*, Vol 30, Encyclopaedia Britannica Inc., Chicago, USA.
- Branting, L. K. (1991): Reasoning with portions of precedents, in *Proceedings of the Third International Conference on Artificial Intelligence and Law*, Association for Computing Machinery, New York, USA.
- Buchler, J. (1961): *The Concept of Method*, Columbia University Press, New York, USA.
- Foucault, M. (1969, 1972): *The archaeology of knowledge*, English translation by A.M. Sheridan-Smith, Pantheon Books, New York, USA.
- Gray, P. N. (2005): eGanges: Epistemology and Case Reasoning, in P.E. Dunne and T. Bench-Capon (eds), *Argumentation in Artificial Intelligence and Law*, Wolf Legal Publishers, Nijmegen, Netherlands.
- Gray, P.N. and Gray, X. (2003): A Map-Based Expert-Friendly Shell, in D. Bourcier (ed.), *Legal Knowledge and Information Systems*, IOS Press, Amsterdam, Netherlands.
- Horrocks, I. (2005): Ontologies and the Semantic Web, http://www.epsg.org.uk/pub/needham2005/Horrocks_needham2005.pdf
- Kant, I. (1788, 1955): Critique of Practical Reason, in *Great Books of the Western World*, Vol 42, translated by J. M. D. Meiklejohn, T. K. Abbott and J. C. Meredith, Encyclopaedia Britannica Inc., Chicago, USA.
- Kuhn, T.S. (1970): *The Structure of Scientific Revolutions*, University of Chicago Press, Chicago, USA.
- Leibniz, G.W. Von, (1714, 1992): *Monadology*, translated and edited by N. Rescher, Routledge, London, England.

- Maimonides, M. (originally c. 1180, 1550): *Mishneh Thorah: Annotation of Jewish Code of Laws*, D. Pizzighettone and A. Dayyan (eds), C. Adelkind for M.A.Giustiniani, Venice, Italy.
- Popple, J. (1996): *A Pragmatic Legal Expert System*, Dartmouth Publishing Company Limited, Aldershot, England.
- Rissland, E. L.(1985): Argument Moves and Hypotheticals, in C. Walter, (ed.), *Computing Power and Legal Reasoning*, West Publishing Co, St Paul, USA.
- Shannon, D. T., and Golshani, F. (1988): On the automation of legal reasoning, *Jurimetrics Journal*, Vol 28, no. 3, p305, Spring.
- Susskind, R.E. (1987): *Expert Systems in Law: A Jurisprudential Inquiry*, Clarendon Press, Oxford, England.
- Valente, A. (1995): *Legal Knowledge Engineering: A Modelling Approach*, IOS Press, Amsterdam, Netherlands.
- Waller, L. (1995): *An Introduction to Law*, LBC Information Services, Sydney, Australia.
- Wisdom, J. (1951, 1973): Gods, in A. Flew, (ed.), *Logic and Language*, Basil Blackwell, Oxford, England.
- Wittgenstein, L. (1918, 1922): *Tractatus Logico – Philosophicus*, Routledge and Kegan Paul, London, England., Deontic Logic, *Mind*, Vol 60, p 1, 1951