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EXPERT SYSTEMS - THE NEED FOR THEORY

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Summary

In this contribution I shall compare two different approaches to the development of expert systems in law: the "law is rules" approach and the "semiotic view". The former is exemplified by some of the logic programmers (Kowalski, Sergot, Bench-Capon), the latter by a norm-based, information-systems methodology (Stamper). In looking at them from the point of view of a legal theorist, I shall be concerned more with their view of law than with the computational aspects of their work.

1. The logic lrogrammers (Kowalski, Sergot, Bench-Capon)

Some of those engaged in logic programming have been particularly influential in the area of legal applications, having made a clear decision to focus on law as a primary source of applications [Kowalski, 1990]. Although this approach was subjected to some fairly robust criticism some years ago [Leith, 1986] it is not entirely clear that the nature of the difficulty has yet been understood. It was said that the research would focus "almost exclusively" on systems which, when presented with a description of a situation, can determine the legal consequences which follow [Kowalski, 1990]. The researchers here had clearly been unsure about what they were doing. In the one article they could say that they "do not wish to get involved with problems of legal reasoning" (their concern is with the mechanistic application of rules to individual cases) and at the same time they could say that "the formalisation of legislation *and legal reasoning*" offers potential contributions to computing technology itself [Sergot et al., 1986a].

Yet it is clear from what follows that most of this work *has* involved important, but erroneous, assumptions *as to the nature of legal reasoning and law* - and this is what I would like to focus upon in this paper. Some of the points in this section have been further developed in [Moles, 1991]. This may well mean that this work has less to offer lawyers, and those who would develop *legal* expert systems, than we would have hoped for. What contribution it has made to "computing technology itself" is for others to assess. The technique has been to utilise logical models to represent statutes [Kowalski, 1990]. An automated theorem prover is then to be used to derive "useful consequences" and the law is then applied to facts by deduction [Sergot, 1990].

They say that there are no serious problems with knowledge acquisition - because the legislation is already written down [Sergot, 1990]. Clearly, these researchers do not distinguish between the *writing* (which is the legislation) and the *meaning* of that writing. The claims are also undermined by the extensive reformulations which researchers in this area engage in. This can be seen by the so-called, isomorphic approach.

1.1. Isomorphism

Bench-Capon has laid great emphasis on this need for isomorphism which, he claims, ensures similarity of structure between the knowledge base and source documents [Bench-Capon & Coenen, 1991]. Yet, if we look at what he says here, we find that we must treat this claim with considerable scepticism. The documentary sources comprise

legislation, delegated legislation, administrative guide-lines and precedents. The text is:

1. translated into computer readable form;
2. relevant sections are identified;
3. the sections are copied and summarised;
4. Entity, Attribute and Value triples are identified;
5. Class Hierarchies and Rule Bases are formed from the EAVs;
6. another program takes the Class Hierarchy and Rule Base and puts them through further compilation and translation procedures.

To claim that all this maintains the original structure is misleading. How does one know what sections are "relevant"? To what extent can a summary or translation maintain the integrity of the original? As Leith has pointed out, many of these researchers were unaware of the extent of the difficulties, because they had not included people with legal expertise as part of the research team. Bench-Capon acknowledges that a surprising factor of the research was that there were no practising or academic lawyers involved. Given the size and length of the project (65 researchers, 30 or more at any given time, working over some 5 years) and the fact that this was a feasibility study to explore the application of knowledge based systems *to law* - this was clearly inexcusable. This acknowledgment is similar to that made by Sergot and Kowalski, when they say that lack of legal expertise has meant that they have only structured a "layperson's" understanding.

The following assumptions would also appear naive to the lawyer.

1.2. Law is based on rules

There is a clear assumption in much of this work, that legislation is more a matter of rules than is case law. There is also an emphasis on separating the representation of the law from the inference mechanisms that apply this representation [Kowalski, 1990]. The insistence on this point probably reflects the use of shells to develop these systems [Sergot et al., 1986a]. Possible difficulties are that:

1. attempted application is integral to representation structuring - the consequentialist problem;
2. mechanistic application cannot account for the judgments necessary in moving to different levels of abstraction;
3. the perception (and manipulation) of rules as "atomistic" entities is erroneous and misleading.

It has recently been suggested, in defence of these views, that if the law is not a system of rules then many writers of legal texts will have been labouring in vain [Zeleznikow, 1992] and it has also been suggested that the theoretical issues are a priori and therefore irrelevant [Tyree, 1992]. The theorists must clearly try harder to make explicit the practical implications of their work. I would claim that the task of the writers of legal texts is not, and has not been, to elaborate a systematic exposition of rules, but to indicate the range of views found in judgements and to point to the tensions and contradictions which they contain. As Sir Anthony Mason, Chief Justice of the Australian High Court has said, it may be true that legal academics have not done all they should have done, for they have spent too much time spelling out where the judges have been - what they need to do more is to elaborate where the judges should be going in the future. They should look to developmental aspects. as well as the past - be normative as well as descritive. [Mason, 1991]

1.3. Consequentialism

This requires an evaluation of any potential outcome in a way which will have regard to its political, moral or social acceptability [MacCormick, 1978]. In legal cases, to the extent that such an outcome is not regarded as acceptable, it will lead to a reformulation of the law or rule so as to ensure that it does give rise to an acceptable outcome. In an extreme case it may well lead to the abandonment of the previous understanding (the "law" or "rule") alltogether [Moles, 1987, pp. 167-72 and 254-6]. Far from being an isolated or exceptional feature of legal decision-making, it is in fact pervasive It brings into clear focus the defeasibility of legal rules. If we do not understand that, then we do not understand their stability. This undermines the distinction commonly found in this area between "easy" and "hard" cases. The job of the advocate is often to develop a framework of argumentation which will turn the easy case into a hard one.

1.4. Rules may be applied deductively - mechanically

A legal theorist might want to say that working from the representation of law to the particular application does not involve any mechanism, inferential or otherwise. To be sure, it is, as Kowalski and Sergot emphasize: "this separation (...) (which) makes possible the use of logical models of the law in more ambitious systems" [Kowalski, 1990]. But if the use of logical models depends on this separation, and this separation is inimical to the nature of legal reasoning, then the proper conclusion might well be that the law is not a suitable application domain for the use of logical modelling - or if it is, it cannot be used in the way these authors suggest.

It would appear that the reason the logic programmers have pursued this line is because they were, before they started on law, already committed to the use of a particular computing tool, not to the understanding of law - "the goal of some of their projects was to represent legislation in PROLOG come what may" [Susskind, 1987]. It may well be, as we have suggested, that their concern is more with *computational* rather than with *legal* issues - "we believe that the formalisation of legislation and legal reasoning offers potential contributions to computing technology itself" and that "(...) the accumulated experience of managing complex systems of law may teach us something about the maintenance of large bodies of software" [Sergot et al., 1986a]. But how can they suggest that they are in fact managing "complex systems of law" unless they have some real understanding of the nature of legal dynamics?

The failure here involves a basic issue of epistemology and of the need to distinguish between the work of the legal scientist and a judge. The latter's role involves what may be called a "performative utterance" which is much more a matter of rule creation than it is of rule following. This would place the creative aspects of rule construction at the centre of both easy and hard cases, and is a factor which logical modelling cannot account for. These constructive aspects of knowledge modelling have, in recent years, been an important focus of attention for historians, sociologists, psychologists, and scientists. Unfortunately, they have been all but ignored by some of the logic programmers. The issue concerns the formalising of abstract rules from what are regarded as the source materials.To suggest that one can take textual materials and formalise them in this way, without accounting for the dynamics which direct that process is mistaken. "These rules are not of themselves to be found in any of these matererials". [Amsalek, 1991] The nearest human equivalent of expertise, without the ability to abstract, is in the case of the so-called "idiot-savant". This is regarded as expertise with a very low level of functionality [Treffert, 1990].

1.5. Rules as "atomistic" entities

The way in which the abstractive dynamic works, relates to a point which some of the logic programmers have not appreciated - the fact that statutes (and cases) are *interdependent*, for example, not *independent*. This raises fundamental difficulties in terms of representing statutes as systems of rules. An additional difficulty is that the factor which helps us to understand the relationship between these different pieces of legislation is only provided by an examination of the existing position at common law. Gower, in his discussion of the Companies Acts states: "behind the Acts is a general body of (common) law and equity applying to all companies irrespective of their nature, and it is there that most of the fundamental principles will be found" [Gower, 1979].
The fact that *most* of the *fundamental principles* will *not* be found in the statutes themselves, but in the reported decisions of cases, has immense implications for those who would work outwards, as it were, from the detailed wording of individual statutes. The extent to which this is a common problem with Codified European jurisdictions is a matter which requires further examination - there are, I suspect, underrated difficulties here.

The logic programmers, not only fail to appreciate the different dimensions of this external connectivity, but have also abandoned the *internal connectivity* of the statutes themselves. This is the assumption that a piece of legislation not only has a relatively autonomous existence, but that even sections of an Act may be regarded as relatively autonomous. This leads them to the surprising and misleading claim that if legislation is fairly recent, then it is free of the influence of case-law [Sergot et al., 1986a]. This is an assumption which no decent lawyer would make, as even a new piece of legislation will always involve some of the "fundamental principles" which we referred to earlier. The previous case-law will be of even more importance when we are dealing with legislation such as the British Nationality Act which has a long history in prior legislation. We need to have a better awareness of the theoretical aspects of the abstraction of knowledge and of the individualisation of rules [Moles, 1987, ch. 6]. This approach to law is rahter reminiscent of the Humean view in which our understanding is derived from certain "sense-data", being the neutral originals from which we develop ideas. Kant very wisely turned this idea on its head by pointing out the extent to which the knower participates in constructing that which is known - a factor which appears to be entirely ignored by the writers we are considering.

In a well-known book on statutory interpretation, it was said: "it is difficult to believe that the notion of construction in complete isolation was ever taken wholly seriously" [Cross, 1976, p.44]. He made it clear that meaning is an important function of the context of application. The example utilised by Cross is even more appropriate, given the fact that a major focus of the work of some of the logic programmers is on the British Nationality Act. That case dealt with the British Nationality Act 1948. It was clear from the speeches in the House of Lords, that in order to understand the 1948 Act, one also had to understand the previous legislation which was passed some 250 years earlier, and also the state of the common law at the time that the earlier legislation was passed. The court underlined the importance of context when they said that "It is the merest commonplace to say that words abstracted from context may be meaningless or misleading" [Jones, 1962, p. 56].

Some of the logic programmers presuppose in their approach that words can, and often do, have an unambiguous meaning [Bench-Capon & Sergot, 1985] [Kowalski, 1990]. In more recent work, some of the people at Imperial College have attempted to settle problems of ambiguity by use of a questionnaire. Such an approach indicates their serious lack of understanding of the nature of legal dynamics, of epistemology and of linguistics.

1.6. No need for legal expertise

Sergot and others made much of the point that most of the BNA was translated by a student, without any expert legal assistance [Sergot et al., 1986b]. Their constant references to the use of non-legal expertise is seen by them to be unproblematic, and to be a virtue rather than a vice. They assume that an expert will only contribute to the "accuracy" of the knowledge base and fail to appreciate that an expert may have a great many useful things to say about how one goes about the process of interpretation including the way in which the knowledge is structured. Even in their more recent article, they still seem not to appreciate the nature of the difficulty: They said: "Access to an expert might well have changed the exact form of the rules in our program, but it would not have changed the method we used to formulate and compute with those rules" [Kowalski, 1990].
Their claim would be more persuasive if it had been arrived at after considering what an expert does and what such an expert might have to say. These authors state that their approach was dictated by the factors of convenience and cost [Kowalski, 1990]. These factors do not justify such an important omission. Their hope that "expertise" can be brought in to "further develop" what they are doing, presupposes that they have been on the right track so far. Who would attempt to start building a house themselves - to avoid the cost of a bricklayer - in the hope that they could always bring one in later on to put things right? If the foundations are not laid properly, the only sound advice might be to clear the site and start again. In one respect, the ICG are refreshingly frank about the factors which motivated them to do as they did: We adopted this approach for purely practical reasons. It allowed us to delay addressing the more complex issues of knowledge representation until it became unavoidable to do so, and it enabled us to avoid considering how to represent the various commonsense knowledge needed to understand the legislation until we discovered what knowledge was required [Sergot et al., 1986a].
They have used logic programming to model the logical consequences of their own untutored assumptions as to how a statute, dealing with an area with which they have no experience, would be read and used by someone about whom they have no understanding.

1.7. Have we made any progress?

In their recent retrospective article, the logic programmers make the claim that there are no outstanding technical obstacles which need to be overcome to finish off a program in this way, but they will not actually do this because of the "extra programming effort" involved [Kowalski, 1990]. When we see that the final slog along the home straight is given as the reason for the *abandonment* of the program, in favour of taking up "more ambitious" projects, we may, perhaps, be forgiven for remaining a little sceptical.

2. Semiotics and the information systems methodology

The major factor which distinguishes the researchers which I will deal with in this section, and those of the previous section, is not so much the computational aspects of their system, but their overall relationship to, and understanding of, the application domain. The researchers in the previous section clearly had a certain mind-set or paradigm within which they wanted to work, and were looking for an information system to fit it. The researchers in this section are much more aware of the environment within which their computers have to operate. Even in their earlier work they pointed out for example, that whilst classical logic serves the mathematician pretty well it does so by simplifying problems - by putting the observer out of the picture. They also indicated early in their work, their awareness of the complementary relationship between statute law and case law in the sense that each provides a commentary on the other [Jacob, 1984]. They point to the creative aspects of categorisation - something which I see as an essential aspect of rule creation and application. They also acknowledged the fact that

deductive reasoning is entirely peripheral to the work of the judges - all of which is in stark contrast to the claims of the previous theorists we have looked at.

2.1. Semiotics - a serious engagement with theory

The most significant challenge provided from this perspective is upon the idea that words themselves can have meaning without reference to the social framework within which that meaning is developed [Stamper, 1987]. This is referred to as a naive assumption which begs all the important questions: "The semantic theories that rely upon the unwarranted metaphysical assumptions of mathematics can be superseded by a new approach better suited to the domain of information systems."

The view taken here, rightly emphasises that legal disputation is not a case of applying settled meanings, but of disputation and negotiation as to what those meanings should be. This is in accordance with the views of the legal theorist John Austin who suggested that rules are merely the shorthand way we try to explain the point at which a settlement to a dispute is either agreed or imposed. Rules may represent the point at which we end up, but cannot represent the means by which we get there or the point at which we start. Wherever there is a dispute, we have by definition alternative formulations of a rule - and the same applies for any other rule which we put forward in an attempt to resolve that dispute. Rules must always look beyond themselves for further and better particulars [Moles, 1987].

2.2. Rules as symbols

Rules may be the manifestation of a consensus, but even then they are only an abstract and symbolic shorthand for more complex reasoning - in that event they cannot be the *explanation* for that consensus. All of this accords with the view taken by Leith and with the very constructive use he makes of the views of Ludwig Fleck [Leith, 1990]. It also helps us to appriciate a neglected aspectnof Austin's work - unlike the legal theorists H.L.A. Hart who explained rules in terms of prior rules, Austin explained rules in terms of social attitudes and pressures [Moles, 1987] - some of the logic programmers have been misled by the Hartian, oversimplified legal philosophy. Whilst Leith is clearly correct in heis view that the logic programmers he looked at were engaged in a more simplified project than that of Stamper he did not really spell out in what way Stamper was trying to adapt to complexity. This is something which I would like to look at in the remainder of this paper.

It follows from what we have just said, that the recognition of the abstract and symbolic nature of language and of the need for a theory of signs (semiotics) is important, in that it has correspondence with sociological insights whilst at the same time having theoretical depth which can serve to link jurisprudence with the theoretical contributions of other disciplines.

For some years now, Stamper has been critical of the theorists represented in the previous section . He argued then, as I have done now, that they assume too much and work within a formalism as if nothing existed beyond it, and that they take as primitive concepts, those which need to be explained. "For the analysis of business information, a semantic theory should explain such notions as truth, individuation, identity, time, space and so on, instead of adopting them as primitive concepts" [Stamper, 1985a]. What is essential to any prospect of success in this area is to have a better understanding of the relationship between any logical formalism and the "real" world. To understand this one needs to look at the way in which these classical logics define symbols which intrinsically have no meaning at all - if we see words as symbols then there is a stark contrast between this view and that which seeks the unambiguous meaning of a word. "One deficiency of these classical logics is that they are still capable of giving only a crude approximation to

the syntactic richness of natural language. A more serious criticism, as we explain, is that they do not handle satisfactorily the problems of semantics" [Stamper, 1985b].

The problem can, of course, be avoided by:

1. pretending that knowledge can be detached from its social context;
2. assuming that signs (or "rules") carry this expert substance;
3. and that the human process of interpreting signs is not essential to the knowledge represented.

The price to be paid is in the avoidance of responsibility, and hiding behind a false and misleading technicalism. If the role of the law is to establish boundaries and maintain them, even to allow them to move gradually in a controlled manner, then to assume that all kinds of boundaries are fixed, and fixed in an objective way, independently of any human agency, is to evade the central issues with which the law is concerned. Stamper uses the metaphors of bottling and transmitting knowledge as compared to the social construction of reality to which I have already referred [Stamper, 1991] and in support of which I have argued in detail elsewhere [Moles, 1987].

2.3. Rules as social constructs

Stamper clearly acknowledges the consequences of this line of thought. If we adopt it, then certain implications would seem to follow. First, we regard reality as subjective and constructed by users within their informal, culture-based information systems, knowledge of which is transmitted through abstract signs whose *meaning* can only be recognised by appreciating the purpose and context within which those abstractions are formulated. To speak of "meaning" raises the issue of semantics which many writers prefer to reduce to a problem within the technical platform. This may not be unreasonable, where boundaries reflect a well established consensus - but it fails when that consensus breaks down and negotiations are needed to re-draw or re-establish the boundaries. This is why we have to see the resolution of legal disputes as being in the nature of performative utterances - as creating the rule (the boundary). For use, a sign (or rule) must always have an intention imputed to it by its creator and interpreter and this can only be understood in its context: "signs used for action often have little syntax when taken out of context (...) without the token fitting into a resonant social context, it could not function fully as a sign" [Stamper, 1992]. This emphasizes the view that "context" means not just the relationship to other texts, but an understanding of the social framework within which those texts have meaning. It is this frame of reference, by its very nature, which is unexpressed or incompletely articulated within the texts themselves, yet which gives shape and meaning to them. "The frame of reference determines what you see and what remains invisible".

The analogy which is most appropriate to law is Stamper's use of the idea of information as "giving form" to something, as a potter informs the clay. The common view, especially prevalent in discussions concerning the law is that "the system" takes raw data and converts it into information. The information plumbing metaphor has no room for the people who give meaning and intention to the signs nor about the relationships between people which are created, sustained and exploited through signs. Technical questions, he claims, are secondary to the organisational needs and dynamics. The new power which our computers give us, to create and handle different kinds of signs, may be as important as the development of writing itself, but of itself, it does no more to create intelligence that did the creation of writing. The formal system must be correctly located within the necessarily more complex social system if to be of use.

We now have to allow for, rather than ignore, those matters resonant of Leith's discussion of Fleck - the importance of informal tacit knowledge. Indeed, says Stamper, this informal system is not something to be minimised or dismissed - *it matters most*. It is

the concept of the norm which, he suggests, can be the link between the formal and informal systems. This requires us to map communication of the organisation in terms of its norms and responsible agents. The rules, or norms, being social constructs, must always be constructed by someone *for some purpose*. It follows then that there is no knowledge without a knower. The knowledge then, to be meaningful, has to be linked to those whose knowledge it is. This requires us to tie every item of knowledge to the agent responsible for it. Truth, then, is something which agents have to decide upon and the consequences for which they have to accept responsibility. Responsibility, here, plays the same role as truth in classical logic. Truth is not a primitive concept but a derived one, which is explained in term of agreement among agents [Stamper, 1992].

2.4. Ontological dependencies

If we accept this, then it appears that we may be able to map the relationships involved in this understanding. To do so we need to appreciate the ontological dependencies (the way in which one type of behaviour depends upon another), and the ontological antecedents (the way in which an invariant cannot be realised without its antecedent). If we can bring into the picture the issue of time constraints (when each of these operative factors begins and ends) and complications such as group agents and an agent with many parts or roles to play, then we are approaching a degree of complexity which may best be mapped by what Stamper calls an ontology chart.

3. Conclusion

If this represents an accurate portrayal of this approach, then it seems to me, as a legal theorist, that it presents us with much greater potential for a way forward. In essence, it appears that this perspective requires us to model the social understanding of a group, rather than to think that we can crank anything of significance out of a text - without this. Bringing this dimension - the aspects of conceptual modelling - into the picture, is in my view essential from a theoretical perspective. I would want to argue that theory and practice are not in tension or conflict - merely two different ways of looking at the same thing. Better theories will give us fresh insights and maybe raise issues which have to be seriously tackled if progress is to be made. Tyree has recently suggested that theoretical objections are *a priori* and irrelevant [Tyree, 1992]. His only concern is whether or not the system works. The evidence so far, from those pursuing the logic programming paradigm, is that their approach does *not* work within the legal domain - and they are no closer now to understanding why that is so than they were several years ago. From the perspective of legal theory, and epistomology in a wider sense, I would offer the opinion that this latter approach has real potential which is lacking the former. Whether it provides a strategy which is implementable, is something which I am not, as yet, qualified to judge - but I hope to be in a position to report further on that very soon.

4. Ackowledgement

Robert N. Moles is on leave from the Australian National University, Canberra, Australia, and Honorary Visiting Fellow at Edinburgh University.

5. References

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[Amselek, 1991] Amselek, P., Law in the Mind. In: Amselek, P. and N. MacCormick (eds), *Controversies About Law's Ontology*, Edinburgh University Press, 1991.

[Bench-Capon & Coenen, 1991] Bench-Capon, T. and F. Coenen, Exploiting Isomorphism: Development of a KBS to Support British Coal Insurance Claims. In: *Proceedings of the Third International Conference on AI and Law*, ACM Press, Oxford, 1991, pp. 62-68.

[Bench-Capon & Sergot, 1985] Bench-Capon, T. and M. Sergot, Towards a rule-based representation of open texture in Law. In: Walter (ed), *Computing Power and Legal Language*, Greenwood Press, 1985.

[Cross, 1979] Cross, Sir Rupert, *Statutory Interpretation Butterworths*, Gower, LCB Modern Company Law, 4th edn., 1979.

[Jacob & Stamper, 1985] Jacob, J. and R. Stamper, Lawyers: *The Meaning of Logic and the Logic of Meaning*, London School of Economics, 1985.

[Jones, 1962] Jones case, Jones v. Director of Public Prosecutions, A.C. 635, 1962.

[Kowalski & Sergot, 1990] Kowalski, R. and M. J. Sergot, The use of Logical Models in Legal Problem Solving. In: *Ratio Juris*, vol. 3, 1990, no. 2, pp. 201-218.

[Leith, 1986] Leith, P., Fundamental Errors in Legal Logic Programming. In: *The Computer Journal*, vol. 29, 1986, no. 6.

[Leith, 1990] Leith, P., *Formalism in AI and Computer Science*, Ellis Horwood, 1990.

[MacCormick, 1978] MacCormick, N., *Legal Reasoning and Legal Theory*, Oxford University Press, 1978.

[Mason, 1991] Mason, the Honourable Sir Anthony, A.C., K.B.E., Chief Justice Of Australia, *The address at the Inauguration of the Faculty of Law*, University of Wollongong, Australia, 19 February 1991.

[McCarty, 1977] McCarty, T., Reflections on Taxman: An experiment in artificial intelligence and legal reasoning. In: *Harvard Law Review*, 1977, no. 5.

[McCarty, 1990] McCarty, T., Artificial Intelligence and Law: How to Get There from Here. In: *Ratio Juris*, vol. 3, 1990, no. 2.

[Moles, 1987] Moles, R., *Definition and Rule in Legal Theory*, Blackwell, Oxford, 1987.

[Moles, 1991] Moles, R., Logic Programming - An Assessment of its Potential for Artificial Intelligence Applications in Law. In: *Journal of Law and Information Science*, Tasmania, vol. 2, 1991, no. 2.

[Sergot, 1990] Sergot, M. J., The Representation of Law in Computer Programs. In: Bench-Capon, T.J.M. (ed)., *Knowledge Based Systems and Legal Applications*, Academic Press, 1990, pp. 3-67.

[Sergot et al., 1986a] Sergot, M. J., F. Sadri, R. A. Kowalski, F. Kriwaczek, P. Hammond and H.T. Cory, The British Nationality Act As A Logic Program. In: *Communications of the ACM*, vol. 29, 1986, no. 5, pp. 370-386.

[Sergot et al., 1986b] Sergot M., H. T. Cory, P. Hammond, R. Kowalski, F. Kriwaczek and M. J. F. Sadri, Formalisation of the British Nationality Act. In: *Yearbook of Law, Computers and Technology*, vol. 2, 1986, pp. 40-52 at p. 41.

[Stamper, 1985a] Stamper, R., *A Logic of Social Norms and Individual Affordances*, Complex Series no. 8/85, Norwegian Centre for Computers and Law, Oslo University, 1985.

[Stamper, 1985b] Stamper, R., The Logic of Meaning and the Meaning of Logic in the Context of a Lawyer's Work. In: *Proceedings of The Council of Europe*, Conference on Computers in Legal Education, Rome, 1985.

[Stamper, 1987] Stamper, R., Semantics. In: Boland & Hirscheim (eds), *Critical Issues in Information Systems Research*, 1987.

[Stamper, 1991] Stamper, R., Expert Systems Lawyers Beware. In: Nagel, S. (ed), *Law, Decision-Making and Microcomputers*, Quorum Books, New York, 1991.

[Stamper, 1992] Stamper, R., *Signs Organisations and Norms*, Keynote Address: Australian National Information Systems, Conference, 1992.

[Susskind, 1987] Susskind, R., *Expert Systems in Law*, Oxford University Press, 1987.

[Treffert, 1990] Treffert, D., *Extraordinary People*, Black Swan, 1990.

[Tyree, 1992] Tyree, A.L., The Logic Programming Debate. In: *Journal of Law and Information Science*, Tasmania, vol. 3, 1992, no. 1.

[Zeleznikow & Hunter, 1992] Zeleznikow, J. and D. Hunter, Rationales for the continued development of legal expert systems. In: *Journal of Law and Information Science*, Tasmania, vol. 2, 1992, no. 1.