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TAMBALACOQUE: for a Formal Account of the Gist of a Scholarly Argument

Nissan, E., Shimony, S.E.: *Tambalocoque: for a formal account of the gist of a scholarly argument*. Knowl.Org. 23(1996)No.3, p.135-146, 84 refs. Argumentation as reflected in a short communication from the published literature of botany and zoology is discussed. Trying to capture the logic structure of the argument, however imperfectly, is of interest to information science depending on a particular goal: namely, to potentially benefit the task of sketching the relation between bibliographic entries somewhat better than present-day bibliometric or scientometric practice does. This imposes tight limits on the depth of the analysis of the text. Even that way, the project of formalizing the analyzed paper's argument is ambitious.

(Authors)

Introduction

Scholarly and scientific texts are about inquiry¹, and ideally conform to principles of rational argument². The same applies to the discourse, or dialogue, of which these texts are part³.

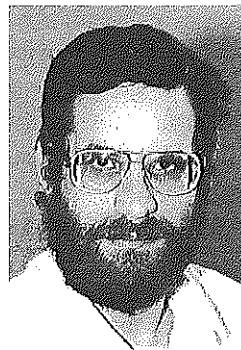
Out of the duo 'argumentation' (whose allegiance is to correct reasoning) and 'rhetoric' (whose allegiance is to persuasion⁴: of some second or third party⁵), it is usually admitted and assumed that scholarly texts and discourses owe allegiance to the former⁶. And that, because scholarly enterprises seek truth⁷, and owing to implicit assumptions to the effect that truth needs no embellishment, and that devices known to be prone to fallacies must be avoided⁸.

Nevertheless, making a point in a text cannot escape rhetoric: even ostensibly dry exposition, in papers in certain disciplines, is such to conform to a rhetoric precept of the genre⁹. It winks at insiders, and awes outsiders: both an effect of convincing, and one of persuading¹⁰ are the goals of exposition (as opposed to the inquiry itself). For statistical analysis itself, Abelson proposes a lawyer analogue¹¹. Bibliometrists are unlikely to naively assume that citation is just about intellectual indebtedness, and sociologists of science know well it's also about prestige¹²; appeal to authority is a typical device from rhetoric.

Apart from the bibliometric practice of scientometrics, the analysis of the deeper content of scientists' discourse¹³ is the other side of the coin of social studies of science. The analysis of this principally argumentative discourse spans well into the scopes of interest of disciplines other than sociology: into philosophy — the sociology of science is counterbalanced by an abstract philosophy of science¹⁴ —



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into logic, into linguistics and pragmatics, into literary and cultural studies, into cognitive studies, and into a variety of paradigms and branches of computation¹⁵.

Research into argumentation and rhetoric is undergoing a revival in, and across, several disciplines. Postmodern culture has been subjecting rational argument, too, to its critique¹⁶, but the current upsurge of interest in rhetoric comes in the aftermath of that critique. Law, the exact sciences, literary theory, or otherwise grand discourses — disciplines and practices with strong claims to bindingly truthful procedures, auratic or even hieratic — come to be viewed as narrative constructions. Each in turn, they are now reconceived and re-explained, in various intellectual quarters, as a cultural object, an object of critique instead of a context whose axioms are to be assumed unquestionably. A revival of inquiry into rhetoric is taking place among "posttheory" academics in literary studies¹⁷.

In the philosophy and history of science, narrative patterns in scientific discourse, historically considered¹⁸, are a fairly fashionable subject of analysis, in some relation to relativism¹⁹. A somewhat similar development can be observed for law: it's the "law as literature" movement²⁰, emerging along with other enterprises concerned with both domains²¹.

Furthermore — which leads us to our topic, scientific argumentation — here is one more parallel of law and science²². One area of research into argumentation is studies of argumentation in law²³. The mid Nineties are witnessing the bloom of AI models of legal argumentation²⁴ (which is about persuasion and adversary arguments²⁵; evidential reasoning is also involved in AI & law)²⁶.

As to *argumentation in scientific communication*, it is an active area of research, and our own TAMBALACOQUE project tries to involve information processing (or even AI) in this kind of endeavor. In this paper in

particular, we are going to propose a markup language for structuring a sequential online text in respect of arguments it makes.

We are interested, as a desideratum, in formal, possibly computational models capturing *some aspects* of scientific argumentation. It would be mission impossible, at least for the present generation, to develop an artificial agent simulating an integrated, all round proficiency in the several phenomena and sources of knowledge involved in scholarly debate even on a very narrow topic. What we are probing, instead, is the feasibility of a drastically restricted formalism, in view of a semi-automated capability relevant for bibliometrics or scientometric (possibly, beyond evaluative bibliometrics²⁷ or otherwise conceived models of research²⁸).

This paper will not yield a finished formalism. Discussing how to develop it, instead, will expose inadequacies and point at further desiderata.

If we are to try to envision a future front end for automated processing, then a tool is (only, barely) envisageable that would convert a simple pre-edited abstract into logic, and would subserve the manual definition of links among abstracts for either information retrieval, or scientometric use.

Kinds and Levels of Analysis

Our goal is the identification of the requirements instrumental for eventually enabling a semi-manual, semi-automated production of a sketch of the argumentation in a simple (or simplified) scholarly text, especially in relation to works it cites and discusses. Consider a citation network: a graph where every vertex is a bibliographic entry, and arcs are directed from it to the entries the text it stands for cites. Preliminary feasibility considerations suggest that:

The abstract of papers or the publisher's blurb of books may be available online, and is perhaps to be processed even in detail.

Sometimes the body of text is also available, typically in hardcopy, or, which is rare, online.

If the latter, in no case manual bibliographic or scientometric practice would admit more than just *browsing* a few sample texts.

The state of the art of artificial intelligence and natural-language processing (NLP) still does not enable a program to cope with large amounts of text for in-depth analysis.

Online texts, if available, can be *browsed* or *filtered* (sifted) automatically for some surface feature.²⁹ For our purposes, the specifications of a tool may include automated cursory browsing: e.g., by locating the citations, then analyzing the near context³⁰.

Otherwise — if computational linguistic analysis is ruled out — hypertext is an option, but it requires pre-editing the online text, and thus involves a manual preprocessing bottleneck.

A combination of the latter two items is an envisageable option.

In NLP, syntactic and morphological analysis is usually not as problematic as the challenge of semantics and pragmatics. Analysis draws on all of these compartments, but the level at which sense is made, by a human reader, of the presentation of evidence and of the argumentation, falls heavily within the realm of pragmatics and of extra-linguistic knowledge. This involves common sense, both general and technical, and if the latter, then on body of knowledge — both of the discipline and of its practices — as shared by the practitioners of the discipline, as well as (at levels more and more specific) on the knowledge shared by the few specialists in the topic the argument addresses. The latter, in the setting of scholarly argumentation, are most often the audience of the argumentation, and actually make up potential allies or contenders. The proponent of the argument has knowledge of his or her goals, including the particular goal hierarchy of (and within) the instance of argumentation at hand.

Moreover, he or she has knowledge at a meta-epistemic level, i.e., about what the other parties know or believe. This concerns setting goals for exposition in respect of clarity, but it also concerns expectations about how is the argument going to be judged by a peer audience. Epistemic meta-knowledge (i.e., knowledge about knowledge) is intertwined with deontic factors: norms on professional duties or otherwise ethical, as well as norms in respect of perceived utility maximization (i.e., practical reasoning). Because of these epistemic and deontic factors, as well as because of temporal information, and because of approximation and uncertainty, internal representation in an AI model could usefully draw upon a panoply of extant logic-based models, and in particular on modal logics: epistemic, deontic logic, temporal logic, and modal probabilistic reasoning.

Because of dependence on technical knowledge about the topic of the inquiry, as well as about how to write a paper, there is much dependence on precedent and on skills at drawing analogies with precedents: i.e., case-based reasoning is clearly relevant, along with kinds of heuristic knowledge that could be expressed e.g. as rules. In this respect, one must recognize a parallel with findings³¹ of legal argumentation modelling endeavors as yielded by the discipline of AI & law. In turn, case-based reasoning as being a paradigm within AI, draws heavily upon indexing techniques³².

We are not going to address text analysis in the linguistic respect, and text presentation in respect of medium and layout, even though decisions and alternative allotments to both these poles — NLP and hypermedia — do play an important role in any attempt at tool specification, as seen above. Furthermore, space and forum scope reasons argue for leaving out of the present exposition such perspectives of our modelling effort that

would require delving into the taxonomy and details of AI techniques, paradigms from the philosophy of science, and even the extant body of knowledge on argumentation. Those aspects will hopefully find a place in future papers. Ultimately, both patterns of rational argument and rhetorical devices need to be encoded and matched on the lines of reasoning put in evidence in sample texts. Let us focus, instead, on a mainly informal or semi-formal discussion of the way a short sample scholarly text handles background evidence in an argumentative context, in the perspective of enhancing awareness of the rhetoric dimension as well.

Elsewhere, we sketched the preliminaries of an alternative formalism, but to the extent that we exemplified it, we confined ourselves to predicates in first-order logic, leaving out, e.g., modal operators, diagrammatic representations of arguments, and the like, even though these issues are central to the content of an AI-oriented model.

The present paper, in consideration of the intended audience, is concerned with proposing the very idea of upgrading bibliometric citation relations into richer information structures.

Dissecting a sample text

The sample text we analyze, reproduced by kind permission in Appendix A, is a paper in botany and zoology by John Iverson, an expert in world turtles. The original forum of publication was, in 1987, Vol.21, No.3 (p.229-230) of the *Journal of Herpetology*, of the Society for the Study of Amphibians and Reptiles. The topic is the reproduction of the tambalacoque tree from Mauritius. Its germination seems to necessitate facilitation by abrasion of its endocarp, and there the paper mainly contrasts two theories, both of them to the effect that this facilitating function was achieved by mutualism (symbiosis) with an animal no longer living in the island. The earlier theory has it that it was the extinct dodo which used to perform this task. Iverson, instead, argues it was a species of tortoise, and also points out that it may be that theories of obligatory mutualism for the tambalacoque to germinate may be after all wrong.

A basic assumption on our part is that the model we want is not going to be confronted with cited evidence beyond bibliographic citations present in the text. All the more so, no autonomous referential connection to the world is envisaged³³, which is necessary for direct access to the evidence. As to (representations of) evidence contained in the text itself, no statistics or tabulations are included in our sample: discussion is limited to transparent lines of reasoning. This is what makes this sample ideal, for our purposes at this stage.

This attitude towards evidence defines the boundaries of the compartment into which the model is to confine itself. Because of this, the typical kind of relation of the particular discipline to evidence is less crucial for the needs of devising the model. The paradigm of ecology and biology is as empirical sciences, neither as hard ones as

physics, nor as soft as politics, and moreover, as opposed to purely formal sciences (e.g., mathematics). Furthermore, the model has no say about such paradigm affiliations³⁴.

Considerations of more directly bibliometric import, that pertain to the sample, include:

- the fit between the scope of the journal (on reptilians) and the argument (preferring a reptilian species to the dodo, based on evidence appropriate to that forum);
- the length of the publication: two full columns of text of just one page, plus about 2/3 of a column of bibliographic references; thus, fitting into the kind 'short communication';
- the length of the bibliography, as a tentative indicator about the kind of relation between the text and its topic.

Consider the latter item. A general basic assumption is that authors of a scholarly text propose insights in a conventionally shaped text, to an audience. One kind of relation between these is in terms of novelty, there typically being expected incremental novelty, in a work with respect to works it cites. This expectation, however, is reversed when reference to superior competence on a topic is involved; all the more so, if it's a surveying concern that takes over, be it in a paragraph or in an entire paper. A very long bibliography makes the hypothesis warranted that classification as 'survey' is appropriate for at least part of the text. Which, in turn, does not preclude that a paper qualifying for 'survey' does not need to just introduce an audience to extant results. Among different structures of citation, the situation is frequent in which reference to superior competence co-occurs with an implicit or explicit statement of focus discrepancy with respect to the ongoing discussion. Structurally, such a citation sets a boundary, with respect to what is present and relevant in the cited text, *Y*, and is absent in the context of citation, *X*. Because of the incremental novelty assumption, to the extent that *X* does acknowledge the superior competence of *Y*, then two competing hypotheses are warranted: (h1) *X* is tutorially leading to *Y*; versus: (h2) *X* and *Y* have different topical foci.

The option we adopt, in the present forum, for carrying out the analysis, is to just mark up the text, as rather frequent for linguistic analysis in online textual corpora. Ideally, a refinement of this markup would be processed by a graphic filter in a hypermedial environment, that would optionally put in evidence the structure of the evidence. Evidently, the disadvantages of this option consist in the amount of pre-processing necessary, and in the 'dumbness', *per se*, of the markup, which is not tantamount to the actual availability of an intelligent automated process exploiting the markup. These, however, are considerations valid also when deciding to edit a hypertext. A different option could rely, instead, on automated analysis capabilities to be integrated with ordinarily available capabilities from the current state of the art of natural-language processing.

The sample text of Appendix A is followed, in Appendix B, by about half that text as structured in respect of argumentation by means of the text markup language we propose. Syntax is omitted, and could be refined. The abundant exemplification should suffice to convey its conception. If and when processors are developed for this (type of) language, use could be made of it in computer interfaces. The kind of text markup language we propose, joins, on the shelf of conceptual devices, hypertextual markup for interfaces and telematics, formatting markup for typesetting, and morpho-syntactic markup for processing online text corpora in respect of computational linguistic analysis. That structuring in respect of argumentation—though with special consideration to citations—is warranted and deserves, e.g., markup, is not self-evident. After all, the introduction only hints at a panoramic view, but cannot span it. Therefore, the appendices are followed by copious endnotes, connected by a thread that takes up issues raised in the introduction. This will hopefully fill a gap, and while avoiding technicalities, raise awareness of topics that usually lay outside the horizon of, say, evaluative bibliometrists. Of course, scientometrics is aware of certain factors from the social studies of science as projected into scholarly texts, but the broader issue warrants many a perspective.

APPENDIX A: THE SAMPLE TEXT

Reproduced by kind permission. Unlike citations, references are omitted.

Tortoises, Not Dodos, and the Tambalacoque Tree

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It has been suggested (Temple, 1977) that an obligatory mutualism existed between the extinct dodo (*Raphus cucullatus*) and the endangered “tambalacoque” tree [*Calvaria major* according to Owadally (1979), but actually a composite of two species (*Sideroxylon sessiliflorum* and *S. grandiflorum*) according to Friedmann (1981)]. Although some of the evidence on which that hypothesis was based is disputed (Owadally, 1979; Temple, 1979), the apparent near absence of natural germination and the thickened structure of the endocarp of the seeds suggests that the tambalacoques (sensu lato) are very specialized plants, requiring some mechanism of endocarp abrasion to facilitate germination. Temple (1977) suggested that the dodo’s gizzard accomplished this, and that since that bird’s final extirpation in 1681, there has been no natural germination.

One test of Temple’s hypothesis would be an accurate aging of the remaining trees, especially since there is disagreement between Temple and Owadally as to the age

of those trees. They suggest the trees are 300 and 75-100 years old, respectively, even though their information apparently came from the same source. Friedmann (1981) has recently aged one specimen at between 30 and 50 years, and if other trees are significantly less than 300 years of age, any dodo-tambalacoque mutualism would at best have been facultative. However, the aspect of the Temple-Owadally debate that is most surprising to me is the total neglect of an even more logical group of organisms in response to which the thickened tambalacoque endocarp may have evolved. These are the testudinid tortoises of the genus *Cylindraspis* (Bour, 1984, 1985; *Geochelone*, according to some authors).

The significant enhancement of germination of the Galapagos tomato (*Lycopersicon esculentum*; Rick and Bowman, 1961) and the prickly pear (*Opuntia* sp.) by passage through the digestive tracts of the Galapagos tortoise (*Geochelone elephantopus*), and Berlandier’s tortoise (*Gopherus berlandieri*; Rose and Judd, 1982), respectively, have already been documented. In addition, seeds of many Aldabra Island plant species germinate readily after passing through the gut of the Aldabra tortoise [*Geochelone gigantea* (= *Dipsosaurus elephantina* according to Bour, 1984); Hnatiuk, 1978] and germination may even be enhanced in some (Stoddart and Savy, 1983). Further, tortoises were undoubtedly abundant herbivorous inhabitants of Mauritius through the Pleistocene (Bour, 1979, 1985; Pritchard, 1979) and until their extirpation in the early 19th century (Auffenberg, 1974; Pritchard, 1979). Closely related species on Rodrigues Island (now extinct) were even observed eating “apples”, “dates”, and “seeds from trees” 300 years ago (review in Bour, 1981).

There is, however, considerable difference of opinion as to how many tortoise species lived on Mauritius into Recent times. At least one species apparently went extinct on Mauritius shortly before humans arrived, and another shortly after (Auffenberg, 1974; Pritchard, 1979). In all, at least seven Pleistocene-Recent tortoise species have been described from Mauritius (Auffenberg, 1974), but it is currently believed that these were variants (primarily sexual and ontogenetic) of only two (or possibly three) species (Auffenberg, 1974; Bour, 1979, 1984).

Ecologically it is very interesting that two (or more) herbivorous tortoise species could coexist on Mauritius, an island of only 1865 km². They must have had very different habits as Arnold (1979) suggested was the case for the two closely related tortoise species living on nearby Reunion Island. Based on morphology he speculated that one species (more saddle-backed) occupied more open habitats and browsed higher than the other (more dome-shelled) species. Similar differences probably also characterized the species on Mauritius. It is therefore just as logical to suggest a tortoise-tambalacoque see coevolution as one involving the dodo. Experimentation with tambalacoque seed germination following mastication and passage through tortoise guts (for example, those from nearby Madagascar or the Aldabra islands in the Seychelles Archipelago) is clearly warranted. En-

hancement of germination in such experiments would argue strongly in favor of the natural existence of a tortoise-tambalacoque mutualism prior to the former's disappearance. It would also provide the Mauritius Forest Service with a more natural alternative to the mechanical seed abrasion now used to induce germination (Temple, 1979).

Finally, it should be mentioned that monkeys were also introduced to Mauritius in the 16th century and they may also have figured in the decline of the Mauritius tambalacoques (Bour, pers. comm.). However, neither they nor dodos occurred on Rodrigues, yet another tree of the same genus (*Sideroxylon galeatum*) is apparently vanishing on that island (Bour, pers. comm.; Friedmann, 1981). The historic presence of tortoises there argues against a mutualism involving dodos and in favor of one involving tortoises. The decline in other potential tortoise mutualists (especially the plams, as well as almost 300 other threatened plant species; Strahm, 1985) may well be linked to the disappearance of the tortoises as well as to direct human destruction. The near collapse of the natural ecology of the Mascarene Island due to human intervention makes it difficult to determine what (if any) organisms may have been involved mutualistically.

APPENDIX B: TEXT MARKUP STRUCTURING IN RESPECT OF ARGUMENTATION

We exemplify an added structure of argumentation, on top of the sample text, in intensive, sequential mark-up mode. This is just a possible option for analysis, for implementation (loosely) in the manner of editing a hypertext or marking up an online corpus. The additions (the keywords of the structure, identifiers of text segments, and bracketed strings) are introduced in one pass, when scrolling the file sequentially. Segments yielded would concatenate back into the original text:

$$T = \bigcirc_{i=1}^N T_i = T_1 \circ T_2 \circ \dots \circ T_N$$

Back-pointers from subsequent text may be added by scrolling up, and do not appear here. One more departure from sequential order does appear in the segmented sample: the markup syntax enables to single out a subsegment into a DETAIL substructure, for further elaboration. Syntax could be further refined; e.g., a provision has to be made for distinguishing such brackets that occur in the original text, such as in the segment labelled H1.ID1 below. We refrain from argumentation jargon, but the syntax has better to account for basic concepts (cf. DE RE vs. DE DICTO below).³⁵

(see p. 140-141)

Notes

The goal of *inquiry* is to prove a proposition that is not to be true (as opposed to *persuading* another party of its truth). Logic and evidence (with the role of the latter depending on the discipline) are central to scientific inquiry. However, logic is not enough for inventiveness. How are interesting propositions to be discovered in the first place? Models of creative thinking are necessary; subserviently, deduction and induction, as well as shifts of focus, can be handled by suitable logic models. Among the others, Blair and Johnson (1) denies that deductive logic is an adequate theory of argument criticism, as its "proper domain is implication, not argument. A new, dialectical theory of argument criticism is need[ed]" (1: p. 41). For models of inquiry, it is crucial to grasp conceptualization and idealization. There is more than argumentation, to making science. See Dilworth (2) on intelligibility in science, in respect of idealization in the perspective of the philosophy of science.

Here is a definition of rational argument, taken from a textbook in critical thinking (3): "In broad terms, an argument consists of three main elements: (1) a body of generalized experience, organized into the instruments required for dealing with the problem at hand; (2) a set of judgments, required for creating and applying that body of experience; and (3) a set of formal calculations or deductive inferences that link the generalized patterns of experience to particular cases. In that context, argument must fulfill three basic purposes. First, it must show that on the basis of experience, some set of general propositions should be accepted; they may be empirical or normative in content. Second, it must show that once those generalized propositions are accepted, it follows logically and necessarily that certain specific propositions must also be accepted. And third, it must show that the judgments made in the development and application of those instruments are justifiable or defensible or warranted. The parallel to justification within the analytic framework is exact; only the language, the concepts employed, is different" (p. 206-207).

Scholarship about scholarship is not only concerned with the published literature of a discipline. Interviews with scholars are also studied (4), as well as other kinds of information. However, even if we are to restrict ourselves to published texts (excluding transcriptions of interviews), for both inquiry and persuasion we may speak of discourse or of dialogue. To Walton (5), the discourse of inquiry is amenable indeed to dialogue. To Dascal ((6), cf. (7)), scientific controversies are quasi-dialogues. Dascal (7: p. 62) lists in a table, in chronological order from 1674 to 1709, the writings of Malebranche and Arnaud, directly relevant to their controversy. "At most, the[se] writings [...] might be viewed, on strictly formal grounds, as constituting the 'hard core' of controversy, in so far as the list includes only those writings that A and M have explicitly, directly, and publicly directed against each other's views. It deserves thus to be dubbed the controversy's 'primary text'. However, in order to be properly understood these writings must be supplemented by information contained in both their co-text (additional texts) and context (situational data). Potentially, any 'adjacent' text and any piece of historical information, no matter how remotely related to the primary text, is a candidate for the roles of co-text and context, respectively" (7: p. 63).

Don S. Levi (8) argues for rhetoric over logic. "From logic's point of view, only a limited number of questions about an argument can be raised. [...] They reflect a focus that pays closer attention to the argument than to the issues raised by it. [...] To the extent that its focus is on the persuasiveness of an argument, rhetoric's focus is just as narrow" (p.271), yet there is more to it than selling the argument. "[T]he criticism that rhetoric is concerned with the effectiveness of an argument rather than with its correctness depends on a much too narrow conception of an audience and on

HYPOTHESIS H1:

CITATION: It has been suggested (Temple, 1977) that
 CONTENT(H1): an obligatory mutualism existed
 between the extinct dodo (*Raphus cucullatus*)
 and the endangered "tambalacoque" tree

DETAIL: endangered
 ANALYST'S HYPOTHESIS H1.E1: [is it DE RE?]
 ANALYST'S HYPOTHESIS H1.E2: [is it DE DICTO?]
 ARGUMENT(FOR(H1.E2)): ['endangered' belongs in both the
 motivation and etiology of H1.]

DETAIL: "tambalacoque" tree:
 IDENTIFICATION: [in Linnean taxonomy:]
 HYPOTHESIS H1.ID1:
 CONTENT(H1.ID1):
 [Calvaria major
 CITATION (APPEAL TO AUTHORITY):
 according to Owadally (1979),
 HYPOTHESIS H1.ID2:
 CONTENT(H1.ID2):
 but actually a composite of two species
 (*Sideroxylon sessiliflorum*
 and *S. grandiflorum*)
 CITATION (APPEAL TO AUTHORITY):
 according to Friedmann (1981)].

ARGUMENT(FOR+AGAINST(H1)):
 AGAINST: BY TEXTUAL MARGINALIZATION:
 Although some of the evidence on which
 that hypothesis was based is disputed
 CITATION (POINTER TO EVIDENCE, APPEAL TO AUTHORITY):
 (Owadally, 1979; Temple, 1979),
 FOR: BY EXPANSION INTO H2 ETC.:

HYPOTHESIS H2:

ARGUMENT(FOR(H2)): A1-H2 AND A2-H2:
 A1-H2: the apparent near absence of natural germination
 and
 A2-H2: the thickened structure of the endocarp of the seeds
 suggests that
 CONTENT(H2): the tambalacoques (sensu lato) are very specialized
 plants, requiring some mechanism of endocarp abrasion
 to facilitate germination.
 ARGUMENT(FOR(H2)): A3-H2:
 CITATION (APPEAL TO AUTHORITY): Temple (1977) suggested that
 CONTENT(A3-H2): [= HYPOTHESIS H3]

HYPOTHESIS H3: [= A3-H2]
 CONTENT(H3): H3.1 AND H3.2:
 H3.1: the dodo's gizzard accomplished this,
 and
 H3.2: that since that bird's final extirpation in 1681,
 there has been no natural germination.
 PLAN(FOR(ARGUMENT(FOR+AGAINST(H3)))): [= HYPOTHESIS H4]

HYPOTHESIS H4: [= PLAN(FOR(ARGUMENT(FOR+AGAINST(H3))))]
 CONTENT(H4): One test of Temple's hypothesis would be
 an accurate aging of the remaining trees,
 ARGUMENT(FOR(H4)): [= A4.a]
 NEED: DISAGREEING AUTHORITIES: = DIS1:
 especially since there is disagreement between
 Temple and Owadally
 as to the age of those trees.
 They suggest
 HYPOTHESES H4.1 (OF Temple), H4.2 (OF Owadally):
 the trees are 300 and 75-100 years old, respectively,
 ARGUMENT(AGAINST(DIS1)) [INVOLVES SOURCE=?]:
 even though their information apparently came
 from the same source.
 IMPLICATION(H4.2): ARGUMENT(AGAINST(H3.2)) [= A4.b]
 ARGUMENT(AGAINST(H3.2)), ARGUMENT(FOR(H4)): [= A4.c:]
 CONTENT(A4.c): H4.3 AND H4.4:
 HYPOTHESIS H4.3:
 CITATION (APPEAL TO AUTHORITY):
 Friedmann (1981) has recently
 CONTENT(H4.3): aged one specimen at between
 30 and 50 years,
 and
 HYPOTHESIS H4.4:

if other trees are significantly less than 300 years of age, any dodo-tambalacoque mutualism would at best have been facultative.

IS ARGUMENT (AGAINST (H3)).

HYPOTHESIS H5: = ARGUMENT (AGAINST (H3.1)):

APPEAL: {Herpetologist's appeal to Herpetologists' audience
in favor of Herpetology's evidence}

ATTITUDE: However, the aspect of the Temple-Owadally debate that
is most surprising to me is the total neglect of

CONTENT (H4): an even more logical group of organisms
in response to which the thickened
tambalacoque endocarp may have evolved.
These are the testudinid tortoises

DETAIL: of the genus:

IDENTIFICATION: [in Linnean taxonomy:]

HYPOTHESIS H5.ID1:

CONTENT (H5.ID1): *Cylindraspis*

CITATION (APPEAL TO AUTHORITY):

(Bour, 1984, 1985;

HYPOTHESIS H5.ID2:

CONTENT (H5.ID2): *Geochelone*,

CITATION (APPEAL TO AUTHORITY):

according to some authors).

ARGUMENT (FOR (H5)): [= A5.1 AND A5.2:]

[APPEAL TO ANALOGY:

PARAMETERS:

LOCALE: insular ecosystem,

PLANT MUTUALIST,

ANIMAL MUTUALIST]

CONTENT (A5.1):

The significant enhancement of germination

DETAIL D5.1.1: of the Galapagos tomato

(*Lycopersicon esculentum*;

CITATION (APPEAL TO AUTHORITY): [FOR DETAIL D5.1.1]

Rick and Bowman, 1961)

DETAIL D5.1.2: and the prickly pear (*Opuntia* sp.)

by passage through the digestive tracts of the Galapagos tortoise
(*Geochelone elephantopus*),

DETAIL D5.1.3: and Berlandier's tortoise (*Gopherus berlandieri*;

CITATION (APPEAL TO AUTHORITY): [FOR DETAIL D5.1.3]

Rose and Judd, 1982),

respectively, have already been documented.

CONTENT (A5.2):

In addition, seeds of many Aldabra Island plant species

DETAIL D5.2.1: germinate readily after passing through the gut

DETAIL D5.2.2: of the Aldabra tortoise

IDENTIFICATION: [in Linnean taxonomy:]

HYPOTHESIS H5.ID3:

CONTENT (H5.ID3): [*Geochelone gigantea*

CITATION (APPEAL TO AUTHORITY): [ANON. ENDORSEMENT]

HYPOTHESIS H5.ID4:

CONTENT (H5.ID4): (= *Dipsosaurus elephantina*

CITATION (APPEAL TO AUTHORITY):

according to Bour, 1984);

CITATION (APPEAL TO AUTHORITY): ARG (FOR D5.2.1):

Hnatiuk, 1978]

[REINFORCEMENT:]

DETAIL D5.2.3: and germination may even

be enhanced in some

CITATION (APPEAL TO AUTHORITY): ARG (FOR D5.2.3):

(Stoddart and Savy, 1983),

ARGUMENT (FOR (H5)): [= A5.3]

Further, tortoises were undoubtedly abundant herbivorous
inhabitants of Mauritius through the Pleistocene

.

a mistaken idea of what constitutes the effectiveness of an argument" (p.272). Rhetorics raises issues, and the audience responds, not necessarily by being persuaded. In inviting "rhetoricians to consider a different approach to argument correctness" (p.273), one whose analysis of arguments deemphasizes how "to reach a verdict on them" (p.274), Levi is more extreme than other rhetoricians, in respect of the concern with criteria of correctness (which to Perelman's 'New Rhetoric' (9), is through the concept of 'adherence' and 'convincing', whereas to Toulmin (10), is through context).

Also adversary arguments belong in persuasion. Indeed, parties A and B renounce persuading each other, but compete for C's verdict, so they each try to persuade C. Furthermore, persuasion is not just about having an audience come to believe a claim. It's possibly about generating skepticism: see (11). Arguably, scholarly exposition also resorts to persuasion devices, beyond its focus on argument correctness. Allegiance phenomena must not be ignored, and can be modelled variously (cf. (12) vs. Sec.3 in (13)).

Dascal (7: p.76) —see note 3 above— provides an example of polemic qualification (on the part of Malebranche) of a critique (Arnaud's against Malebranche) as consisting "in a display of rhetorical skill rather than in substantive arguments": To *M*, *A* is shifting the debate from the real issues to abstract ones, inaccessible to most of the audience, to win based on rhetorical skills and reputation. Claims about relevance are central to this line of defense: "Once he is satisfied with his demonstration of the irrelevance of *A*'s critique to 'the issue' at stake, is entitled to look for the 'real' meaning of *A*'s move. In doing so, he is assuming that the ostensive irrelevance of *A*'s attack is intentionally designed to lead the figure out its covert relevance" (7: p. 76). Arnaud then retorted, by reversing against Malebranche the charge of devious motives, as opposed to earnest inquiry into the real issues (7: p.77). This is but a detail of the controversy. Dascal's conclusions are that Arnaud and Malebranche differed also in their attitude to the value of controversies in general (7: p.90): to Malebranche, they just excite passions, and in his attitude, "it is a deep skepticism about language, communication, and especially the value of controversy that prevails" (7: p.88-89). For Arnaud, instead, "his conceptualism, coupled with his belief in the reliability of language, led to a positive attitude towards controversies" (7: p.90). Yet, "[i]t would be certainly an exaggeration (as well as perhaps an anachronism) to claim that *A* held a truly 'dialectical' view, which considers controversy and dialogue as the essential factors in the constitution of knowledge" (7: p. 90).

In the philosophy of science, see (14) on getting closer to the truth, and truthlikeness; cf. (15).

Distinguish false from faulty data, and both from fallacy in reasoning. To Walton (5), begging the question (*petitio principii*) is a tactic of argumentation indeed, and applies only in a dialogue (or discourse amenable to dialogue) either of persuasion, or of inquiry.

For example, Philippe Carrard (16) discusses the rhetorical devices employed by the late French historian Fernand Braudel, a prominent exponent of the New History school. Braudel was an advocate of quantifiable 'global history' as opposed to suspicious description of ancient 'mentalities'. He was, Carrard claims, a scholar that either consciously or not, supported the impression of objectivity conveyed by his own books, and the myth of objectivity in historiographical writing, by heavily resorting to quantitative data. Which, Carrard shows cogently, is not informative *per se*. Indeed, not always terms of comparison are clear. Rather, inclusion and exclusion have a non-informational, *phatic* role in writer/reader communication. (In spoken communication, an example of phatic role is when after greeting each other, we may get to speak about the weather.)

"Perelman and Olbrechts-Tyteca [(9: p.26-31)] distinguish between convincing and persuading in terms of the audience whose adherence is elicited. A convincing argument attracts the adherence of a universal audience, whereas a persuasive one attracts the adherence of a particular audience" (8: p.274, n.1).

Yale's Robert P. Abelson (well-known to cognitivists and, through Schank, to AI people) titled a recent textbook (17). *Statistics as Principled Argument*, whose blurb boldly proclaims: "Many students [think] of statistical practice as a medical regimen. [...] However, a completely formulaic approach to statistics is wrong-headed. Statements of conclusions from statistical analysis importantly involve narrative and rhetoric. To communicate results, a coherent story is required and preparation is needed for the criticism of these interpretations with convincing counterarguments. There is an analogue between the claims of a statistical analyst and those of a lawyer [...]" Contents include such titles as "Styles of Rhetoric", "Interestingness of Argument", and "Credibility of Argument". Two points about this must be realized: (a) Inquiry is meant, not advocacy or persuasion. (b) It's no invitation to misuse evidence, e.g., to produce doctored statistics, or to be selective about the evidence other than earnestly (cf. note 8 above, and cf. (18) on misconduct in science.) The risk of equivocation only subsists, if one fails to realize that 'lawyer' is used as a metaphor, and that no metaphor is a complete mapping, or totally felicitous. The point in Abelson's blurb is that students of statistics may conceive of the task as to one of argument criticism. It's as though it's the data-set that tries to persuade them, and they must be wary of following the wrong lead, and learn when to suspect something is fishy (one section is titled "On Suspecting Fishiness").

In his foreword to (19), Leszek Nowak extols Theo Kuiper's Groningen school in the philosophy of science (an abstract methodology, as opposed to social studies of science originating in Kuhn's paradigm). To Nowak, the Groningen people stand out for praise also in respect of their eclectic approach in terms of indebtedness: "The principle to make use of other approaches may appear to be quite obvious. Well, in the Third World it is. But what about the world in which we do philosophy of science? In this world, the simple speech act: 'What you have noticed is beyond the reach of my hitherto understanding of science, but it is of real importance and hence worth to be included in my theory' is encountered but rarely. If it happens at all, then only among 'equal in scientific prestige'. For in our world to quote somebody who has not (yet) gained an appropriate 'scientific position' is too often understood as diminishing the 'scientific position' of the quote. In contrast to this, the Groningen people make this simple speech act, explicitly or implicitly, every time they incorporate somebody else's understanding of science to their own, and quite independently of the scientific prestige of the discoverer" (19: p.16).

On scientific discourse at the meet of sociology and discourse analysis, see, e.g., Yearley's work on interaction and argumentation in scientific texts (20), on argumentation in science and law (21), and on causal explanatory discourse (22), as well as Gilbert and Mulkay (28, 29), Woolgar (30), etc. (Actually, (22) is devoted to what it calls "demotic logic", but there are, of course, shared cognitive patterns in science and common sense (19)). In prose studies, the contributors to Selzer (31) analyze the rhetorical structure of an often cited paper in evolutionary biology. Bazerman (32) and Sinclair (33) analyze, inter alia, the article that announced the double helix structure of DNA. The analysis depends on the order in which claims and arguments are presented in the text as written. In particular, a micro-analysis is conducted sentence by sentence, in the perspective of the pragmatics of written communication.

Let us go back to note 12 above, and to Nowak's foreword to (19). He points out that apart from its original contributions to the

philosophy of science, the Groningen school draws on a "variety of other orientations. Carnap's inductivism, Popper's falsificationism, Hintikka's synthesis of the two, Kuhn's theory of paradigms, Lakatos's theory of research programmes, Sneed-Balzer-Moulines's structuralism, Laudan's model of scientific success, the Starberg model of finalization, Millikan's teleofunctional theory of meaning, Reiter's theory of default reasoning, Musgrave's model of idealization, the idealizational approach to science, etc. are claimed to register something worthwhile to be noted in science" (19: p. 16). Quoting the list of approaches in the previous note is convenient for contrast with the social studies of science. Those debts of the Groningen philosophy of science are not quite homogeneous in respect of their discipline (Reiter's default reasoning is from artificial intelligence, and Kuhn is the *fontorigo* of the sociology of science). Yet, Nowak's list is a useful background when we get to citing, in contrast, such approaches to science that are, instead, oriented to sociology, discourse analysis, or both. One further pole beyond philosophy, discourse, and sociology, is computation: namely, 'machine learning' (ML) as a subdiscipline of artificial intelligence. One would rather associate it with models of cognition than with models of science, but it has on record claims (23) in that domain as well. How to construe concepts is a topic for epistemology; it is a daunting challenge for computation. Several ultimately small steps have been made, in ML, to grasp it, but these efforts only succeeded in handling it in very narrow domains: early conspicuous results published in the early 1980s were on the AM and EURISKO programs (24, 25). Meanwhile, ML evolved into a most often highly formal subdiscipline of AI, with several paradigms (possibly combined: cf. (26)). The least formalized paradigm of ML is 'case-based learning' within 'case-based reasoning', (27) that is about the selection and adaptation of indexed precedents to a problem at hand. Indexing is a major aspect, and is done *ad hoc*. 'Subsymbolic' computation — especially artificial neural networks — is a computational paradigm different from AI. It is already widely applied, notwithstanding certain important flaws.

Rowland (34) responds to the postmodern critique of argumentation theory. A recent bulky special issue of the *Argumentation* journal (35–36) is devoted to two topics at the meet of argumentation and postmodern culture.

In literary studies, a generation of academics qualified as practitioners of 'posttheory' is emerging, succeeding one professing allegiance to any of a number of vocally purported theories (37). Rhetorics is identified as an area of growing interest (38).

The contributors to Mali and Motzkin (39) "seek to show that scientific theories are constituted by plausible rhetorical narratives as well as by valid logical deductions. In so doing they seek not only to expose the narrative patterns that still persist in practically all the scientific disciplines but also to elaborate — so as to resolve — the tension between the narrative and the scientific modes of knowledge production. Their ultimate concern, then, is not solely with the narrative characteristics of 'scientific literature', which is fairly evident, but, more significantly, with the narrative characteristics of scientific practice" (39: p. 5).

Research in narrative patterns in scientific discourse developed on top of the acquired frame of mind 'social constructionism': a cultural-relativist approach that judges the scientific achievements of past generations of investigators against their own background, instead of with present-day afterwit. Ironically, social constructionists have been decrying, and dubbing 'Whiggery', the 'naive realism' of past generations of historians of science. Among historians of science, 'Whiggish' denotes a present-minded attitude towards the development of science, "a tendency to judge all past scientific activities by standards set by currently prevailing theories" (40: p. 60). That attitude is not necessarily overt or even

conscious. Nor is Whiggish editing of historical texts of science always wrong. "The scientist, active or retired, is likely to be impatient with what seem to be distractions or digressions on the progress towards truth, or anyway towards the present. And when reading a text of past science, he may well be most interested in what 'really happened', if some experiment or observation is in question, or how it can be set out in modern notation if it is a description in natural history or a piece of mathematics [...]. To write a modern chemical reaction for a nineteenth-century chemical test, or a genetic analysis of some work on selective breeding, is a dangerous business; well done, it may illuminate the text, but it can just be confusing" (41: p. 5).

Arguing for 'law as literature', Goodrich (42) claims: "The relation of literature to law is a question of genre. In the most immediate or contemporary of senses, the status of the legal genre is predicated upon a paradox. Law is a literature which denies its literary qualities. It is a play of words which asserts an absolute seriousness; it is a genre of rhetoric which represses its moments of invention or of fiction; it is a language which hides its indeterminacy in the justificatory discourse of judgment; it is a procedure based on analogy, metaphor, and repetition, and yet it lays claim to being a cold or disembodied prose, a science without either poetry or desire; it is a narrative which assumes the epic proportions of truth; it is, in short, a speech or writing which forgets the violence of the word and the terror or jurisdiction of the text. Law, conceived as a genre of literature and as a practice of poetics, can thus only be understood through the very act of forgetting, through the denial, the negation or the repression by means of which it institutes its identity, its life, its fictive forms" (42: p. 198); cf. (43). Norman Rosenberg (44), who is concerned himself with trials in films, discusses differences with respect to law in literature, and the latter's relation — as noted by Ward (1993) — to 'law as literature' (44: p. 343, n. 8): "Although what might be called the law and film enterprise bears some affinity to the more established law and literature venture, there are significant differences between the two projects. First, law and literature work generally focuses on canonized texts, [e.g., Kafka or Melville on trials]. Second, [...], the search for examples of 'law in literature' has generally been closely related to reading 'law as literature' — that is, to applying the techniques of literary criticism to traditional legal texts. [(45: 43, 44, 58–69)]. Finally, there are significant differences between 'reading' (or 'making meaning' of) printed and filmic texts. [...] For legal scholarship that addresses, from different theoretical perspectives, Hollywood film, see [(46, 47)]." As to 'law in literature', it's not just a courtroom setting, or detective stories or other 'whodunits'. Literature is sometimes constructed as to give fodder for the reader's evidential reasoning. Or, then, it is the narrator or a character that relates to the story as though it was an argument (To Unrue (48: p. 116–117), in Poe's 'The Fall of the House of Usher' "[t]he narrator of the story anticipates Melville's Ishmael [...], in that they witness the experiences of others and reach logical conclusions as if from the progress of an argument". But then, Poe is a Euclidean.)

Law and science also meet, of course, in the forensic sciences, and anyway with expert witnesses in legal argumentation. Actually Ghita Hohnström-Hintikka (49) applies to the role expert witnesses in litigation and trial, the interrogative model of inquiry developed by Jaakko Hintikka in the philosophy of science. This model adopts a game-theoretic conception of truth-seeking inquiry. It's a game against Nature, with one party being the Inquirer, and the other party ('Nature', or the 'Oracle') providing answers. In litigation, however, there are adversary parties, and the professional ethos of expert witnesses in current perceptions requires them to be unbiased. This is also the case of scientific investigators, notwithstanding the social and political dimension of science.

In an overview of the recent literature of argumentation in Germany and Austria, Kienpointner (50), whose own affiliation is with classical philology, takes issue with rhetoricians, speech and communication, rhetoric and literary criticism, linguistic studies, and philosophy. He then "turn[s] to *studies of argumentation in law*. They can be characterized as being influenced either by logical and normative schools of thought or by rhetorical and relativistic approaches. The first branch takes up the work done in deontic logic and normative models like the one of Habermas or the Erlangen school; the second follows the tradition of ancient topics (dialectic) and rhetoric" (p. 133). Geography aside, overviewing is a daunting task, with implications for librarians. Enos (51), asked by the editors of *Philosophy and Rhetoric* to assess the emergence of journals in rhetoric in relation to the rhetoricians' academic community, lists several journals, but glaringly omits both Kluwer's *Argumentation*, and the Canadian forum of Kienpointner, *Informal Logic*, let alone the German forum he mentions, *Rhetoric. Ein internationales Jahrbuch*.

Reviewing the Fifth International Conference on Artificial Intelligence and Law (52), Trevor Bench-Capon (53) points out: "The main theme to emerge this year was the use of argumentation and dialogue. This topic has been around for many years, notably in the work of Edwina Rissland and Kevin Ashley [cf. e.g. (54 - 56)], and had been foreshadowed at the previous conference in Amsterdam by Tom Gordon's excellent work on the Pleadings Game [cf. (57)] but at this conference almost a third of the papers touched on the topic in one way or another" (cf. (58 - 64)). Bench-Capon identifies four distinct uses being made of argument in AI & Law: (a) to handle conflicting norms, (b) to do without a specifically non-monotonic logic, (c) for modelling dialogue, and (d) for result presentation.

ABDULILANA is an AI program that simulates the generation of adversary arguments on an international conflict (65).

Åqvist provides an AI model of evidential strength for law (66). We applied kappa calculus and probabilistic reasoning to his model (67). Temporal constraints are involved in evidence (69).

See Narin (70) on evaluative bibliometrics. Cf. Schubert and Glänzel (71) on models and indicators, and Snizek et al. (72) on further possible indicators.

The late Maria Nowakowska ((73), cf. (74)) combined bibliometrics, cognitive science and artificial intelligence, in her models of research and researchers, and of the structure of knowledge. Instead, in the philosophy of science, Izabella Nowakowa's (75) theory of the dialectical correspondence of scientific theories is relevant for our concerns.

Information filtering matches profiles to an incoming stream of objects (76).

By 'near context', we don't necessarily mean quite the same as corpus-oriented computational linguistics currently does. As to first locating citations and then trying to analyze what is found around, in the text, this instantiates island-driven analysis (as opposed to sequential analysis). Analysis being expanded from islands (island-driven word-hypothesizing), is one of the traditional paradigms in automated speech recognition (77). One of the present author adopted it in an epistemological model in a different, text-based domain ((78), cf. (13)).

See especially (56), in the literature of AI & law on case-based and rule-based reasoning for legal argumentation (cf. note 24 above). See in note 15 above, on case-based reasoning (CBR) and case-based learning (CBL) in AI. Consider the following, on the use this paradigm makes of indexing and of *ad hoc*, informal design solutions (as opposed to neat theories): "There has always been something of an intellectual rivalry in the AI world between the 'scruffies' and the 'neats,'" states Wood (79: p.29) in a populari-

zation paper on CBR, starting a section titled "The last refuge of the 'scruffies'?" This, in turn, is motivated by the rather informal criteria of "adaptation, index selection, and to some extent case representation". These considerations on the role and modes of indexing are particularly apt for the present readership: there is a lesson to be learned by CBR from this discipline.

"Biology and ecology are not as hard as physics but hopefully not as soft as politics. Empirical data, necessarily external to any scientific publication, are important. An article brilliantly written by a known scientist may persuade the reader of the truth of its statements (truth may be a controversial concept but we must use it at least as the opposite of what can be refuted [...]) but it is true only if the external evidence is OK" (O. Sechser, pers. comm.). This remark finds a gloss in Smith's (80) critique of Lenat and Feigenbaum's CYC project of encoding in a knowledge representation the knowledge of a desk encyclopedia. "Like logic, L&F neither address nor imagine their system possessing anything like the wherewithal to give its frames and slots autonomous referential connection with the world. In fact something quite else suggests itself. Given the paucity of inference they imagine, the heavy demands on indexing schemes, and the apparent restriction of interaction to console events, L&F's system is liable to resemble nothing as much as an electric encyclopedia. No wonder its semantics will be derivative" (80: p.282). Smith suggested that the English text of the entries of the encyclopedia used as a source for CYC, be retained instead of discarded once they are encoded in the data structure. "Forget intelligence completely, in other words; take the project as one of constructing the world's largest hypertext system, with CYC functioning as a radically improved (and active) counterpart for the Dewey decimal system" (80: p.282). This attitude brings us back to our discussion of the contrast between AI capabilities and 'dumb' hypertext (cf. (81)).

Attempts are made, sometimes, at intra-discipline shift to another type of inquiry vis-à-vis its attitude to evidence. The claimed policy of the *Journal of Experimental & Theoretical Artificial Intelligence* to promote the adoption of a rigorous methodology of empirical experimentation in AI (82). Its editor recollects anti-AI taunts on the part of theorists, e.g., "He would say 'those AI people claim the program is the theory' (usually followed by derisive laughter)", and retorts, by an admittedly belated realization: "the taunt was exactly wrong. It's precisely because some among the AI community understand the relationship between theory and programs that AI [...] has the capacity to become a hard science". However, whereas "most computer scientists (including many AI researchers), believes that mathematics is the one that CS should profess to be", claims that AI should "lay claim to the mantle of experimental science", like biochemistry: thus, recognizing the dignity of properly tested implementation. An opposite trend is exhibited by discursive psychology defining and propugating itself by repudiating that mantle, which is mainstream in psychology publications. So starts the blurb on the cover of a paper collection (cf. its introduction (83)): "In the last decade many diverse streams of thought have come together in an international movement to reject the traditional view that a 'scientific' psychology must rely on an experimental methodology".

35. "In general, the distinction between a *de dicto* and a *de re* report of S's belief that N is F lies in the characterization of N that appears in the report. If the characterization is one with which we agree, then the report is *de re*. If it is one with which S agrees, then the report is *de dicto*. S would not necessarily agree with the characterization of N that appears in a *de re* report, and we would not necessarily agree with the characterization of N that appears in a *de dicto* report" (84: p.1407).

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