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Using Contemporary Logic to Analyze Pre-Qin Logic*

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Abstract. The aim of this article is to sketch how some notions arising from notions or techniques mainly due to contemporary logic and some elements of the theory of argumentation may allow us to reach a better understanding of the logical contributions of the great thinkers of China's past. It is proposed to extend the usual notion of logic to include some elements of the theory of argumentation, hoping thus to create an open space where "Western logic" and "Chinese logic" may meet (sections 1 and 2). This is exemplified by a detailed study of some important pre-Qin contributions to logic. Sections 3 to 5 analyze some logical contributions in the traditional sense of "logic" : later Mohists and the basic laws of logic; definitions in theory and in practice; classification of names, interdefinability of quantifiers and contemporary explanations of the *mou* (侔) type of reasoning in the Mohist texts. Section 6 analyzes the phenomenon of sentence parallelism to show that it hides some partially formalizable elements of the theory of argumentation such as arguments by generalization, and that it contains some implicit but perfectly valid arguments. Section 7 presents a detailed analysis of examples of reasoning by analogy in the *Mencius* and suggests some formal ways of evaluating their strength.

The pre-Qin period is a very rich period for the development of logic in China. The Chinese society of the time undergoes a serious crisis. The feudal system is fading away, the Zhou (周) dynasty is losing its influence and a number of different states are fighting continuous wars in search for supremacy. It is precisely at that moment that some thinkers arise to solve the political and moral challenges of the changing society and one is struck by the similarity between that period and the situation of Greece at approximately the same moment. China and the Western world have known for a long time some of these thinkers, who have had a fundamental influence on the future of China: Confucius (Kongzi 孔子) and Mencius (Mengzi 孟子), considered as the founders of the Confucian school; Laozi (老子) and Zhuangzi (庄子), the supposed initiators of the Daoist movement. But it took more time for China and especially for the Western world to recognize the importance of other thinkers such as the confucianist Xunzi (荀子), or Shang Yang (商鞅), Shen Dao (慎到) and Han Feizi (韩非子), initiators of Legism and Mozi (墨子), founder of Mohism.

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Moreover, it is only very recently that philosophers, and in particular logicians, have understood the interest of the pre-Qin (先秦) period from the point of view of logic: the so-called School of Names and the Mohist Canons are the foremost examples of those contributions to the development of logic in China.

The aim of this article is to sketch how some notions arising from notions or techniques mainly due to contemporary logic and some elements of the theory of argumentation may allow us to reach a better understanding of the logical contributions of the great thinkers of China's past.

The first section will remind the reader of a few recent important moments marking the exchanges between Western logic and Chinese logic.

The second section discusses the notion of logic which is used here and contrasts it with other methods of studying the subject. An important distinction will be made between what thinkers have written about logical subjects and how they used logic in their writings. These are indeed two aspects which are often tied together, but which are in principle independent : the Later Mohists constitute an eminent example of thinkers who discussed logical notions using logical methods; strictly speaking, Gongsun Long (公孙龙)'s *Baimalun* (白马论) does not directly discuss logical notions in the same way as the Mohists, but proposes challenges using very clever arguments of a logical type; except for a few mentions of questions of language, Confucius' *Analects* (*Lunyu* 论语) do not discuss logical notions, but this does not mean that the *Analects* are devoid of argumentative techniques which are worth being studied; poetry would be a typical example of writings that do not in general[1] discuss logical themes and that do not in general use logical or argumentative methods.

The third section will be devoted to the example of the Mohists and the basic laws of logic.

The fourth section will discuss the theme of definitions in pre-Qin logic.

The fifth section will emphasize some contributions of Mohist Logic, which are important from the point of view of contemporary logic and analyze the example of their *mou* (侔) type of reasoning.

The sixth section will turn to logic in its argumentative use and present the example of parallel sentences, especially in Confucius' *Analects*.

The seventh section presents the case of analogical reasoning and studies some analogies used in the *Mencius*.

The last section presents some conclusions of this study.

Let me apologize for referring the reader to many of my previous publications, but the present article is intended as a summary of different uses of contemporary

[1] This qualification is necessary. Indeed, Gregor Paul rightly insists on the fact that ethical, pragmatical, empirical but also logical arguments are included in the *Shujing*, the "Classic of Documents", and even in the *Shijing*, the "Classic of Poetry". This is argued in detail in Chapter V of his forthcoming book [35].

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logic. I feel sometimes obliged to shorten the presentation but think it useful to refer the reader to texts containing complements and more detailed information.

1 Logic between East and West

If one wants to avoid many misunderstandings, it is necessary to sketch what we mean here by "logic", especially in its relation with the exchanges between "Western logic" and "Chinese logic". The historical allusions given below are designed to give some precisions on the notion of logic used in this article and are in no way intended to be a history of the exchanges between Chinese logic and Western Logic, for which the reader can consult the very complete [16], which contains references in English, but also many references in Chinese.

Logic in its more traditional sense arose from the work of Aristotle and was technically explored during the Middle Ages. It remained dominant in the Western world for many centuries [39]. It was still the dominant model when Hu Shih wrote his pioneering thesis [14], emphasizing among others the work of the Later Mohists, Hui Shi (惠施) and Gongsun Long. Hu Shih had a rather inclusive conception of logic, to the point of including many epistemological considerations as well as discussions on the *Yijing*, Confucius' *Analects*, *Laozi* and *Zhuangzi*. But his conception of logic was also restricted, insofar as his technical tools of analysis were essentially confined to the notions of Aristotelian logic, more particularly to the theory of syllogisms. The advances of logical studies were at that moment mainly due to the work of mathematicians and were not yet well known by Western philosophers, let alone by Chinese philosophers.

Another significant step is given by Fung Yu-lan's work ([6]), whose translation [8] brought to the knowledge of the Western world the large domain of Chinese philosophical thinking. Fung's work is very impressive by its breadth, but from the philosophical and logical point of view, it remains very dependent from a neo-realist conception of philosophy: existence of universals, distinction between abstract concepts and their realization.

I consider that another important step is given by the foundation in 1973 of the *Journal of Chinese Philosophy*. This academic Journal, founded by Cheng Chung-Ying, has published in English numerous articles devoted to Chinese philosophy, with a considerable number of them studying the logical aspects of Chinese philosophy. The articles show a clear consciousness of the advances of logic in the Western world.

To finish with this brief presentation, I want to mention Christoph Harbsmeier's work ([13]), which is a part of Needham's encyclopedia ([34]). This is a very documented study of language and logic in Ancient China and it abundantly uses the concepts of contemporary logic, while carefully respecting the Chinese context of that logical thought.

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That too brief sketch should make it clear that we can in no way restrict Western logic to the theory of syllogisms, a position which was provocatively denounced by Russell in his [37]: "In most universities, the beginner in logic is still taught the doctrine of the syllogism, which is useless and complicated. If you wish to become a logician, there is one piece of advice which I cannot urge too strongly, and that is: Do NOT [capitals in the original text] learn the traditional formal logic." In this respect, it is important to mention the names of Henryk Greniewski and Olgierd Wojtasiewicz, who in a short paper published in 1956, appear to have been the first to apply logical instruments going beyond the theory of syllogisms to Gongsun Long's *Baimalun* ([11]). They were soon followed by Janusz Chmielewski, who in 1962 also used the theory of classes to explain part of the *Baimalun* and later published a number of studies devoted to early Chinese logic ([2, 3]). Since then, many other scholars have applied contemporary logical techniques to analyze pre-Qin logic; they are too numerous to be mentioned here, but the reader will find many of them mentioned in the bibliography of [13]. Our first task will now be to arrive at a notion of logic which encompasses enough to bring together Western and Chinese logic into a common space.

2 What is Logic? Questions of Method

There are many conceptions of logic, but I would like to start from an approximative definition which is neither too general nor too restricted: logic is the study of reasoning which is embedded in arguments and it tries to identify which arguments are acceptable.

There should not be too much disagreement about the notion of argument, the important point being that it gives rise to a sequence of propositions, from which one distinguishes the premises and the conclusion. It should not be *a priori* required that the argument be fully explicit: the vast majority of our arguments are indeed based on many implicit premises which are given by the context of their enunciation. One should also not require that the argument be formalized: the huge majority of arguments of real life or given in books, be they written by philosophers or scientists, is given in plain language. But, if we want to understand the structure of an argument, exhibiting its structure is important and formalization is in that respect a very useful tool. Although arguments are almost always used to express not yet recognized consequences of what we know, or to convince somebody, we should also not require that an argument gives us something really new: "it is cold and it is raining; hence it is cold" is a perfectly correct argument, but it can barely be said to bring "new knowledge".

If we understand "acceptable" in a very strict sense, we will soon reach the very common contemporaneous conception of formalized logic. According to that strict sense, an argument will be acceptable if it is correct or valid, that is, if the truth of the

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premises necessarily entails the truth of the conclusion. "Necessarily" means that an argument should not be declared valid on the sole truth of its conclusion, something which could be given by a happy concourse of circumstances. It should be declared valid if all arguments of the same form, when they have true premises, also have a true conclusion. A valid reasoning has thus a compelling force for every reasonable person. With such a definition, one is immediately led to a formalized conception of logic. In a very restricted sense, if we consider that genuine arguments are constituted by propositions which are either true or false, one is almost inevitably driven to accept only the so-called classical logic. But a more open conception, aided by purely formal studies, will admit the study of other types of logic such as intuitionistic logic, admitting propositions which are neither true nor false, or many-valued logic, admitting propositions having other truth values than true or false, or even paraconsistent logics, admitting propositions which are both true and false.

However, we may understand "argument" and "acceptable" in a broader sense, which covers also part of what is called "argumentation" [2]. In that case, "acceptable" often takes the meaning of "convincing". Take for example the well known argument by analogy; it has no compelling force, but it may be very convincing. The comparison of the state and of its structure with the structure of the family is extremely frequent among pre-Qin thinkers and gives much light on their conceptions. This broader conception of arguments is thus extremely interesting, but it is unfortunate that they have misled many Western thinkers to very fuzzy conceptions of argumentation, relying on a vague notion of "informal logic". Fortunately, there are now more and more studies trying to explain the functioning of different types of argumentation by rigorous and quasi formal methods: non monotonic logic, default logic ([40]), logic of belief revision, learning theory ([12]), theories of analogical reasoning ([1]) and so on.

It seems well that there is a progressive transition from compelling types of reasoning to argumentation and less traditional logics. I agree with the idea that formalization is a precious instrument of analysis and that it could be applied also to some parts of the theory of argumentation (see similar assertions in [1]). Thus arguments by analogy have a certain formal structure which contains some premises and a conclusion which can be represented as this:

a is similar to a';
a' has property P;
hence, a has property P.

The following example gives a highly simplified illustration of that kind of ar-

[2] In this section, I am using rather freely terms such as "argument", "acceptable", "convincing", "informal logic", "rhetoric" and so on. The notions to which they correspond are dealt with in argumentation theory and it is well beyond the scope of this article to discuss them, even summarily. I can but refer the reader to the very complete *Handbook of Argumentation Theory* ([5]).

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gument:

the ruler is analogous to the father of the family;
the father of the family must be obeyed;
hence, the ruler must be obeyed.

It is well known that analogical arguments are not valid but this does not mean that a logical analysis is unable to bring information on their structure and value, as will hopefully be shown in section 7.

I will therefore propose here a rather large conception of logic, which covers what is traditionally included in logic, but also some parts of the theory of argumentation. However, I think that it is better to exclude arguments appealing more to the feelings than to reason, or designed to influence the audience by stylistic devices such as rhymes, alliterations, hyperboles, litotes, which have no direct impact on the truth value of the sentences involved in the argument and which should best remain under the heading of rhetorical devices. I want also to take here the precaution of warning readers that the word *luoji* (逻辑) has been imported in Chinese from Western languages and originally carries with it a very restricted conception of logic, especially in the studies of logic in the pre-Qin period. One often considers that "Western logic" is Aristotelian logic, or that it is exclusively a formalized and mathematized version of classical logic; it is then opposed to Chinese logic, which has indeed little to do with these two conceptions. It should be emphasized that mathematical logic has now become a reservoir of useful distinctions and technical instruments which has the same kind of neutrality as mathematics: as has already been alluded to, one studies systems which do not obey such fundamental principles as the excluded middle or even non-contradiction. Nothing can forbid us to use these instruments to study paradoxical formulations such as those proffered by Gongsun Long in his *Baimalun*. Moreover, that a word comes from outside and carries with it the traces of its origins does not mean that the concepts it covers are foreign to the importing culture. I am not thinking here of formulas or very elaborate theorems of mathematical logic but of basic concepts of logic. The relation name-object, the distinction between individual names, predicates and general names, the relation between quantifiers, the principles of non contradiction and of excluded middle, paradoxes, the idea of an organized system of definitions were all clearly a subject of preoccupation in the work of Later Mohists. And after all, Confucius, Mencius, Zhuangzi and many other thinkers did not have to learn arguments by induction or arguments by analogy to use them in a competent manner in their writings.

This being said, it is equally important to remind one that logic is not an omnipotent instrument. If I want to understand the logical structure of an ancient text, be it Chinese or Western, I will have to rely on a good philological analysis of the text, on historical and sociological studies describing the context of its production. This is absolutely necessary to restrain the potential interpretations and it will very often

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remain true that the use of logical instruments often suggests different possible interpretations, without being able to decide which one is better. It is also obvious that in general, as the saying goes, "one finds only what one is looking for". In other words, everyone has a certain preconception of the text he is trying to explain and he will choose his instruments in function of that preconception. However, this is common to all approaches of a text and should not exclude an approach using the contemporary techniques of logic.

It remains to be said that in this study of pre-Qin logic, one should also distinguish two different aspects. People like the Later Mohists or members of the so-called School of Names discussed and studied questions of language, they made them an explicit subject matter and used sometimes quasi formal methods of presenting them. Other people did not explicitly study those questions, but they used a number of perfectly reasonable arguments which are often put under the heading of argumentation, but which obey certain formal schemes; these arguments should also be studied and they are part of the broad conception of logic which I want to promote here. If we agree on such an enlarged conception of logic, we can find a common space where we can discuss the logic in pre-Qin texts as well as Aristotelian logic or Indian logic or many other types of logic.

In what follows, I want to give a few examples showing how the pre-Qin period discovered or used concepts which are genuinely logical in the broad sense which I described above. This will be done by using some basic tools of contemporary logic, but using a formal presentation only when I think that it is useful to clarify the discussion.

3 Later Mohists and the Basic Laws of Logic

Later Mohists are often credited with the discovery of the law of non-contradiction and of the law of excluded middle, to which we refer here as the basic laws of logic (thus omitting a discussion of the law of identity). The clearest assertion of these laws is given in Canons A74 and B35 which I recall here[3].

Canon A74.

经上：辩，争 (彼)* 仮也。辩胜，当也。

经说上：(辩)。或谓之“牛”，或谓之“非牛”，是争 (彼)* 仮也。是不俱当，不俱当，必或不当。(不若当“犬”)。

Canon. *Bian* (disputation) is contending over claims which are the converse of each other. Winning in disputation is fitting the fact.

Explanation. One calling it an "ox" and the other "non-ox" is "contending over claims which are the converse of each other". Such being

[3]In this article, the Chinese text, the references and the translations of the Mohist Canons, of the *Daqu* and of the *Xiaoqu* are those of [10].

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the case they do not both fit the fact; and if they do not both fit, necessarily one of them does not fit. (Not like fitting "dog").

Canon B35.

经下：谓辩无胜必不当，说在辩。

经说下：(谓)。所谓，非同也则异也。同则或谓之狗，其或谓之犬也，异则或谓之牛，(牛)* 其或谓之马也，俱无胜，是不辩也。"辩"也者，或谓之是，或谓之非，当者胜也。

Canon. To say that there is no winner in disputation necessarily does not fit the fact [*dang* 当]. Explained by : disputation.

Explanation. The things that something is called are either the same or different. In a case where they are the same, one man calling it a "whelp" and the other man a "dog", or where they are different one calling it an "ox" and the other a "horse", and neither winning, is failure to engage in disputation. In "disputation", one says it is this and the other that it is not, and the one who fits the facts [*dangzhe* 当者] is the winner.

It seems quite clear that the assertion "Such being the case they do not both fit the fact" expresses a law of non-contradiction and "to say that there is no winner in disputation necessarily does not fit the fact" expresses some law of excluded middle. This is fundamentally true, but after a second thought, we should be more critical of such assertions and explain more clearly in what way these canons express the basic laws of logic. First, what is the exact status of these laws of logic? Secondly, the Canon mainly deals with disputation; what is the relation between disputation and the basic laws of logic?

Concerning the first point, it is important to say that the so-called basic laws of logic appear in various guises and that they fully make sense only when they are considered in relation with the other laws of logic. Let us explain the point with the law of excluded middle. In a first sense, the law of excluded middle is a scheme which is represented by a formula such that $(p \vee \neg p)$, which is considered informally as a basic principle of thought, or is considered formally as a proposition which is provable in any reasonable formal system. However, as soon as you introduce some notion of meaning or truth in the study of your formal systems, you are led to consider semantic versions of that law:

(1) for every proposition p, $(p \vee \neg p)$ is true;
(2) for every proposition p, p is true or $\neg p$ is true;
(3) for every proposition p, p is true or p is not true;
(4) for every proposition p, p is true or p is false.

It is important to distinguish here our object language and our metalanguage. Indeed p, $\neg p$, $(p \vee \neg p)$, $\neg(p \wedge \neg p)$, q, $(p \wedge q)$, $(p \rightarrow q)$, $(p \leftrightarrow q)$ are in the object language, but when we say that p is true, e.g. "this is an ox" is true, we relate p

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with the facts, and we are in our metalanguage. Accordingly, one should distinguish the symbols "$\neg$", "$\wedge$", "$\vee$", "$\rightarrow$", "$\leftrightarrow$" and the corresponding "not", "and", "or", "implies" and "iff" (shorthand for "if and only if"); to avoid confusions, we do not introduce special symbols for our metalanguage, but sometimes use parentheses to clarify the scope of the connectives.

This being recalled, observe that the four formulations of the law of excluded middle given above are not immediately equivalent! They depend on your semantics. Formulation (1) presupposes that you have a notion of truth. Formulation (2) is not the same as (1), because in (1) the symbol "$\vee$" is in the object language (the language you discuss) and in (2) the "or" is in your metalanguage (the language you are using to discuss the object language). Formulation (2) is equivalent to formulation (1) if you have an interpretation of "$\vee$" which satisfies: $(p \vee q)$ is true if and only if p is true or q is true (or both). Formulation (3) is not the same as (2), because in (1) the symbol "$\neg$" is in your object language while the "not" is in your metalanguage. Formulation (3) is equivalent to (2) if you have an interpretation of "$\neg$" which satisfies: $\neg p$ is true if and only if p is not true. And finally, (4) is equivalent to (3) if you accept in your metalanguage that "not true" is equivalent to "false". Formulations (3) and (4) are commonly accepted as semantic versions of the law of excluded middle.

Similar considerations apply to the law of non-contradiction and give semantic versions such as:

(1') for every proposition p, $\neg(p \wedge \neg p)$ is true;
(2') for every proposition p, it is not the case that $(p \wedge \neg p)$ is true;
(3') for every proposition p, it is not the case that (p is true and $\neg p$ is true);
(4') for every proposition p, it is not the case that (p is true and p is not true);
(5') for every proposition p, it is not the case that (p is true and p is false).

These are not idle distinctions, because some logicians have given good arguments to introduce special semantics and to reject, at least in some contexts, the law of excluded middle (intuitionism) or the law of non-contradiction (paraconsistent logics). We do not discuss this here, but we already note that the Mohists were quite far from our modern notion of formal system, so that we can certainly not credit them with a formal conception of the basic laws of logic. Their use of "当" suggests that they had in mind a certain notion of truth as a correspondence between propositions and facts; this is a semantic notion and their formulation is certainly akin to (3), (4), (4′) and (5′).

But moving to our second point, we can say that this is not yet enough if we want to understand their formulation in canons which explicitly discuss "disputation", *bian* (辩). We should be able to give a better connection between their formulation and our modern formulations of the law of excluded middle. I think that a bit of rigor can help us to situate their contribution with a maximum of precision.

The clue seems indeed to be their concept of disputation, which is clearly ex-

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plained in B35. The explanation of the canon shows that their notion of disputation relies on a staging of two persons, one person, say a, asserting proposition p, the other person, say b, asserting proposition q. Let us represent this situation by the metaformula Disc$(a, b; p, q)$, a discussion in which a asserts p and b asserts q. As the explanation makes it clear, this is not yet disputation. It is a disputation if one of the two persons, say b, asserts the negation of the assertion made by a, a situation which we may represent by the metaformula Disp$(a, b; p)$ and which the Mohists define like this, a formulation to which we will refer as (DISP) in the sequel:

(DISP) Disp$(a, b; p)$ if and only if (Disc$(a, b; p, q)$ and q is the negation of p).

Thus, as the examples show, if p and q are equivalent (here represented by *tong* (同)), like "this is a dog" and "this is a whelp", q is certainly not the negation of p and there is no disputation. Or if propositions p and q are incompatible but not contradictory (here represented by *yi* (异)) like "this is an ox" and "this is a horse", q is not equivalent to the negation of p, hence q is certainly not the negation of p and there is no disputation either. The typical disputation should be a discussion in which a asserts "this is an ox" and b asserts "this is not an ox" (see explanation of Canon A74)[4].

Now, both canons bring in two other notions: to win and to fit the facts. We could represent "x wins" by a metaformula such as Win(x). For "to fit the facts", we need a notion of truth, which we could express by True("p"). It is customary to represent that kind of situation with a predicate True which applies to terms designating propositions, so that we need a way of designating proposition p, something which will be done here by simply using the familar quotation marks, in agreement with their use in ordinary texts, as in the example:

proposition：this is an ox;
designation of the proposition："this is an ox".

Now, we are ready to represent the Mohist assertion of Canon A74 that "winning in disputation is fitting the fact", to which we will refer as (WIN) in the sequel:

(WIN) Disp$(a, b; p)$ implies ((Win(a) iff True("p")) and (Win(b) iff True("not p")).

Let us now consider the Mohist formulation "To say that there is no winner in disputation necessarily does not fit the fact" of Canon B35. It may be represented by

A. Disp$(a, b; p)$ implies not (not Win(a) and not Win(b)).

Consider also the assertion Canon A74 "Such being the case they do not both fit the fact", which may be represented by

[4]We base ourselves on the examples to give the strict analysis (1); a more liberal notion would be to allow Disp$(a, b; p)$ for q equivalent to the negation of p, but this is irrelevant for the main point of this section.

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B. Disp$(a, b; p)$ implies not (True("p") and True("not p")).

In the presence of (WIN) and on the basis of a classical metatheory, we see that we have in A and B what we could qualify as a dialogical version of the excluded middle and of the non-contradiction law:

A_1 Disp$(a, b; p)$ implies (Win(a) or Win(b))
B_1 Disp$(a, b; p)$ implies not (Win(a) and Win(b)).

In the presence of (WIN), we could also present the Mohist A and B as

A_2 Disp$(a, b; p)$ implies (True("p") or True("not p"))
B_2 Disp$(a, b; p)$ implies not (True("p") and True("not p")).

Interestingly enough, this second formulation looks more like a semantic version of the two basic principles, because a and b do not appear in the consequent of the implication. Could it be that the Mohists basically had a semantic version of these principles? The answer lies in a context analysis of their use of disputation. It is clear that disputation here is not a trivial matter of analyzing the behavior of real disputers or of deciding whether this is really an ox or a horse or a dog. The Mohists had certainly in mind practical or moral purposes, but they were also very sensitive to questions of logic, and from that point of view, disputation is here just a theoretical setting which allows them to discuss the truth of sentences in general. That setting may be convoked for any sentence you want to consider. In other words, they would consider that any sentence p may be the subject of disputation, a principle which could be qualified of "disputation as a tribunal of truth" and which we abbreviate as (DTT):

(DTT) For all sentences p, there exist disputers a and b such that Disp$(a, b; p)$.

This being admitted, universal quantification of A_2 in a and b will give

for all a for all b (Disp$(a, b; p)$ implies (True("p") or True("not p")).

But because a and b do not appear in the consequent of the implication, this is classically equivalent to

(exists a exists b (Disp$(a, b; p)$) implies (True("p") or True("not p")).

But (DTT) tells us that the antecedent of this implication is true, so that A_2 entails

A_3 (True("p") or True("not p")).

Similar considerations for B_2 will give

B_3 not (True("p") and True("not p")).

A_3 is exactly the semantical version (3) of the law of excluded middle quoted above. Similarly B_3 is the semantical version (4′) of the law of non-contradiction.

There remains a question. What is missing to obtain the formalized version of these principles? A first element of answer is that, although the Mohist had some

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clear ideas and usages preparing formalization, they were quite normally still far from formal versions of logic. A complementary element of answer is that if you want to connect the semantic versions of the basic principles of the basic laws of logic with their formal expressions ($p \vee \neg p$) and $\neg(p \wedge \neg p)$, you need a theory of truth satisfying principles such as:

True("p") iff p (Tarski's convention T) ([42]);
True ("$(p \wedge q)$") iff True ("p") and True("q");
True ("$(p \vee q)$") iff True ("p") or True("q");
True (''$\neg p''$) iff not True("p").

If such is the case, then you can prove that A_3 and B_3 are equivalent to $(p \vee \neg p)$ and $\neg(p \wedge \neg p)$ respectively. But this element of answer leads us to the much discussed theories of truth which are indeed very far from the Mohists' theory and practice ([7]).

To summarize this discussion, we can say that a rigorous analysis of the Mohists' assertions shows us that they had dialogical versions of the basic laws of logic (versions A_1 and B_1, versions A_2 and B_2). The theoretically minded context of their use of *bian* validates (DTT) and shows us that they had in fact a semantic version of these laws (versions A_3 and B_3). On the other hand, we have no reasons to think that they had a formal version of them. It is worth noting that dialogical versions of logic were revived by Lorenzen's dialogues ([21]). Game theory may also be considered as a powerful extension of these dialogues[5].

4 Definitions in Pre-Qin Logic

There does not seem to be much theoretical reflection on the status of definitions in pre-Qin logic. However, one could consider that Xunzi in his chapters 18 *Zhenglun* (正论) and especially 22 *Zhengming* (正名) establishes the preliminary elements of a theory of definition. An important clue is given by his technical usage of *ming* (命), meaning "naming", "name", "term" and *qi* (期), meaning "alignment", "fixed period", but also "procuring agreement", which some authors ([15, 33]) do not hesitate to translate by "defining" or "definition".

Thus, 18.36[6] links together 言, 议, 期, 命 which Knoblock translates: "Thus, as a general rule discussions [*yan* 言] and deliberations [*yi* 议] on definitions [*qi* 期] and terms [*ming* 命] of right and wrong, take the sage kings as your teachers […]."

In the opening section 22.1[7] of chapter 22, Xunzi repeats that names were instituted by the Sage Kings, which applied the various names to all things, following

[5] See [36] for a general presentation and [19] for an application to the Mohist argumentation.

[6] 故凡言议期命是非，以圣王为师。

[7] 后王之成名：刑名从商，爵名从周，文名从礼，散名之加于万物者，则从诸夏之成俗曲期，远方异俗之乡，则因之而为通。

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the established custom and that this allowed people from different villages to communicate. Thus, procuring agreement is essential in the use of names and this is in accord with the practical use of definitions; when people do not understand each other or disagree on a notion X, they will often ask "what do you mean by X?", "what is your definition of X?". When he speaks of "agreement", Xunzi has certainly in mind the practical aim of guaranteeing a stable and ordered society, but "procuring agreement" has also the logical function of fixing the reference of terms, so that we are bordering here a theory of definition. In this connection, sections 22.8[8] and 22.11[9] are especially important and we can recognize in them pure logical elements which must underlie a theory of definition, among which:

– names have no predetermined reference;
– the delimitation of their reference is given by (*qi* 期) [procuring agreement/fixing /defining];
– the agreement/definition fixes what counts as same (*tong* 同) and what counts as different (*yi* 异) and so classifies things into categories (*lei* 类);
– once the agreement is reached, people should keep to the fixed meaning;
– although the agreement/definition is somewhat arbitrary, there are good names, namely those who are straightforward, simple and nonambiguous;
– names can be combined to form compound terms having complex designations.

However, Xunzi is not fundamentally interested in logic and his embryonic theory of definition is essentially turned to the goal of reaching a harmonious society. Instead of looking for a theory of definitions in pre-Qin authors, we will have to turn to their practice to examine how they are using definitions.

Xunzi himself made an extensive use of definitions, very often signalled by the expressions *suowei* (所謂), *kewei* (可谓), *weizhi* (谓之) or *zhiwei* (之谓) which have been studied in great detail by Cua in his [4], chapter 3, pages 88-137, and it seems clear that definitions and distinctions constitute an essential element of his methodology. However, my opinion is that there are better practitioners[10] of definitions among

[8]名无固宜，约之以命，约定俗成谓之宜，异于约则谓之不宜。名无固实，约之以命实，约定俗成，谓之实名。名有固善，径易而不拂，谓之善名。

[9]实不喻，然后命，命不喻，然后期，期不喻，然后说，说不喻，然后辨。故期命辨说也者，用之大文也，而王业之始也。名闻而实喻，名之用也。累而成文，名之丽也。用丽俱得，谓之知名。名也者，所以期累实也。辞也者，兼异实之名以论一意也。辨说也者，不异实名以喻动静之道也。期命也者，辨说之用也。辨说也者，心之象道也。心也者，道之工宰也。道也者，治之经理也。心合于道，说合于心，辞合于说。正名而期，质请而喻，辨异而不过，推类而不悖。听则合文，辨则尽故。以正道而辨奸，犹引绳以持曲直。

[10]I would not like to minimize Xunzi's system of definitions or partial characterizations of notions, which is very rich from a philosophical point of view. However, from the formal point of view of the organization, it is rather complex and quite entangled. Thus, taking the well-known example of 22.2 ("散名之在人者：生之所以然者谓之性；性之和所生，精合感应，不事而自然谓之性。性之好、恶、喜、怒、哀、乐谓之情。情然而心为之择谓之虑。心虑而能为之动谓之伪；虑积焉，能习

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pre-Qin philosophers: as far as we can judge by the shortness of the texts, Hui Shi is a model of quasi-formal definitions; and judging by the formal organization of the upper part of their Canons, the Later Mohists were masters of definitional systems.

Hui Shi's first thesis "至大无外, 谓之大一; 至小无内, 谓之小一" is a model of quasi-formal, accurate and concise, almost mathematical definition. "What is ultimately great without outside is called Great One; what is ultimately small without inside is called Small One." In this translation, I refrain from putting definite articles as well as marks of singular or plural in front of "Great One" and of "Small One", first because they do not exist in Chinese, but mainly because Hui Shi had probably in mind the unique totality of all things for *dayi* (大一), but a diversity of small units, perhaps atoms, for *xiao yi* (小一). How do we account for this asymmetry, while the formulation of the text is so beautifully symmetric? The answer lies in an accurate analysis of Hui Shi's definition. The analysis makes sense as soon as we have an idea of "extremely great" and of "extremely small", for which we need a notion of comparison "is smaller than". The latter notion will normally obey the mathematical definition of a strict partial ordering on a set S of things. This strict partial ordering is a binary relation on the set S, usually denoted by the infix symbol "$<$", which is irreflexive and transitive; this means that "$<$" satisfies $\forall x \in S(\neg x < x)$ and $\forall x \in S \forall y \in S \forall z \in S((x < y \wedge y < z) \rightarrow x < z)$. We may think of S as being the set of all things and of the partial ordering as "is a part of".

In that case, if we understand the definition of Great One as "nothing is outside it" or "everything is inside it", it is exactly the mathematical definition of greatest element for the relation $<$: an element G of S is greatest element of S if and only if G is greater than all the other elements of S. In formulas: $\forall x \in S(x \neq G \rightarrow x < G)$.

焉，而后成谓之伪。正利而为谓之事。正义而为谓之行。所以知之在人者谓之知；知有所合谓之智。所以能之在人者谓之能；能有所合谓之能。性伤谓之病。节遇谓之命：是散名之在人者也，是后王之成名也。"), we have there definitions of 性, 情, 虑, 伪, 事, 行, 知, 智, 能, 命 and 病. There are two definitions of 性, the second one defining 性 in terms of 性; there are two definitions of 伪; there are also two definitions of 能, each one in terms of 能. It is generally accepted that these double definitions correspond to two different senses attached to the character. However, a more serious complication is that 性 and 伪 are redefined in 23.4 ("不可学，不可事，而在人者，谓之性；可学而能，可事而成之在人者，谓之伪。") This sets the problem of comparing or combining the definitions. On the other hand, it is quite clear that the definitions given in 22.2 are interdependent, for example, 伪 is defined in both cases in terms of 虑; 虑 is defined in terms of 情, which is itself defined in terms of 性 but also in terms of quite a number of other concepts (好、恶、喜、怒、哀、乐) qualifying 性; 恶 is defined in 23.12 ("凡古今天下之所谓善者，正理平治也；所谓恶者，偏险悖乱也：是善恶之分也矣。"). The interdependence of these concepts remains to be carefully studied from a formal point of view, but, pending further investigation, they seem to be not as transparent as the interdependence of concepts in the Mohist *Jingshang*. On the other hand, it must be said that the system of definitions given in the *Jingshang* is philosophically rather obscure and often more difficult to interpret than Xunzi's system. In the study of Xunzi's definitions, a special place should also be given to his consummate art of distinctions such as the celebrated two kinds of honor and disgrace given in 18.37 ("有义荣者，有势荣者；有义辱者，有势辱者。").

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A partially ordered set does not necessarily have a greatest element (think of the set of positive integers), but if it has, it is unique; otherwise, we would have two elements G and G' satisfying $G < G'$ and $G' < G$, from which $G < G$ would follow by transitivity; but this contradicts the irreflexivity of the strict partial ordering $<$.

On the other hand, if we understand the definition of Small One as "nothing is inside it", it is exactly the mathematical definition of minimal element for the relation $<$: an element m of S is minimal if and only if there is no x in S such that $x < m$. In formulas: $\neg\exists x \in S(x < m)$. A partially ordered set does not necessarily have minimal elements (think of the set of negative integers), and if it does, these elements need not be unique. A very simple example of that situation is given by the set of all subsets of a set and the ordering relation "is strictly included in" : the minimal elements are the singletons which are different from one another and are abundant as soon as the set has more than one element.

For people worried about the formal asymmetry of greatest element and minimal element, we note that to these notions correspond formally symmetric notions of smallest element and of maximal elements, but these notions have no relevance here.

I will not repeat here the formal analysis of Hui Shi's fifth thesis, which I have proposed elsewhere [22] and partially repeated in [29], but let me say that it agrees very well with an interpretation of Hui Shi's theses as an attempt at proving that the "Universe is One" (Hui Shi's thesis 10).

Let us now turn to the upper part of the Mohist Canons *Jingshang* (经上). This is an organized system of 75 extremely short sentences, which have the undeniable characteristics of definitions, as is shown by the repetition of the formula "X is Y" (X, Y, *ye* (也)). As already said with respect to Xunzi's theory of definition, one may object that these were certainly not intended as a formal system, but as a (not always clear) summary of the main Mohist notions dealing with logic, geometry, ethics, space, time, action, etc. The objection is perfectly valid, but this does not exclude a study of the organization of the *Jingshang* and a formal study is in this respect a very interesting tool: one does not concentrate on the content, but on the relation between the different sentences. And here, the formal features of the Mohist system are remarkable. I repeat here some of the main results, which have been published elsewhere ([25, 29]).

(1) A definition has in general the form "X is Y", where X is the term to be defined (*definiendum*) and Y is the term defining it (*definiens*). In practical situations, definitions appear when someone does not understand the meaning of $X$and one explains to him that it means the same as Y. But "meaning" is here intended in a very general sense and formally speaking, it should certainly not be assumed, especially in the context of pre-Qin logic, that a definition of X must give "the essence" of X. If we agree on that, we may say that the every sentence of the *Jingshang* is a definition.

(2) The definitions of the *Jingshang* are extremely compact and define a concept in terms of a very small number (ranging from 1 to 4) of other concepts. This shows

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that the Mohists had a keen sense of the economy of concepts in their definitions.

(3) An essential point in a good system of definitions is that there should not be vicious circles: one should not define X in terms of X, or X in terms of Y and Y in terms of X, or X in terms of Y, Y in terms of Z and Z in terms of X, etc.Taking into account a few special cases which are discussed in the references given above, we may say that the *Jingshang* has no vicious circle. This is a remarkable achievement, if you consider that there are probably very few dictionaries which are exempt of circularity.

(4) The Mohist system of definitions is rather complex : a concept X_1 may be defined using X_2, which may in turn be defined using X_3, which may be defined using X_4, etc., until you reach an undefined concept. This procedure gives us a measure of the complexity of a concept: the maximum number of steps necessary to reach an undefined concept gives us an idea of the "height" of the concept in the hierarchy of concepts. In that respect, the *Jingshang* shows a remarkable complexity, reaching even 6 levels in the case of *ci* (次): 次 is defined using *jian* (间), 间 is defined using *zhong* (中), 中 is defined using *tongchang* (同常), 同常 is defined using *jin* (尽), 尽 is defined using *ran* (然) and finally 然 is undefined and is considered as a basic concept.

(5) If you compile the list of basic undefined concepts, you will see that their number remains limited: the 75 definitions use 71 basic concepts and these appear in many different definitions. This shows that the Mohists wanted to present a system of reasonable size, sparing the basic notions. This does not yet match the economy of notions of set theory or of geometry, but it is remarkable in itself and it should be reminded that we are not dealing here with pure abstract mathematics but with a system encompassing logic, geometry, ethics, space, time, action, etc.

(6) When examining the list of the most frequent basic concepts, you obtain the following list: *de* (得), *ran* (然), *ming* (明), *suo* (所), *wei* (为). It is striking to see that the list is in perfect agreement with the conception of Mohist philosophy as a pragmatic philosophy. A detailed analysis confirms that opinion.

Let us summarize this discussion of definitions in pre-Qin logic. There is no well established reflection on the status of definitions in pre-Qin literature, but there is a number of very competent practices and uses of definitions. Such are Xunzi's extensive use of definitions, Hui Shi's accuracy and compactness of definitions, as well as the remarkable organization of the definitional system of the Mohist *Jingshang*.

5 The later Mohists' Basic Notions

We have already discussed the case of the basic laws of logic, but this is only a small part of the Mohist contributions to logic. In [20] and in [24], the reader may find a rather complete description of the basic notions of Mohist logic, which appear mainly in the *Daqu* (大取) and in the *Xiaoqu* (小取): *bian* (辩) (disputation, argu-

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mentation), *ci* (辞) (proposition), *ming* (名) /*shi* (实) /*he* (合) (name, object and their relation), *lei* (类) (class or kind or category), as well as the different types of reasoning which draw the attention of the authors. It is impossible to summarize here the detailed discussion of these concepts, but I wish to indicate two ideas which look obvious to the contemporary logician: the first one is that the Mohist remarkably anticipated quite a number of modern notions; the second is that, in the other direction, contemporary techniques of logic may help to clarify some of their questions or discoveries. This will be explained by giving three examples: their classification of names, the interdefinability of quantifiers and an explanation of their paradoxical examples given in the *mou* (侔) type of reasoning[11].

5.1 The example of the classification of names

In Canon A78, one finds the following classification of names *ming* (名)：

经上：名。达，类，私。
经说上：（名）。“物”，达也。有实，必待 * 之（多）* 名也。
命之“马”，类也。“若实”也者，必以是名也。
命之“臧”，私也。是名也止于是实也。
Canon. *Ming* (name). Unrestricted; classifying; private.
Explanation. “Thing” is “unrestricted” - any object necessarily requires this name.
Naming something “horse” is “classifying” - for “like the object” we necessarily use this name.
Naming someone “Jack” is “private” - this name stays confined in this object.

The contemporary logician will immediately recognize here three familiar notions. In “达”, we have a notion which describes the functioning of individual variables, used by logicians and mathematicians to be applied “to reach” any object (物) we want to discuss. In “类”, we have something which is very similar to the notion of predicate, which is effectively used to detect and classify things which satisfy a certain property, such as being a horse. And in “私”, we recognize the notion of individual constant, which, as long as one does not change the convention, designates in a constant manner (止) a thing or a person such as *Zang*.

[11]This is often referred to as “parallelism” or “parallel inference”, but we prefer to leave the term untranslated and reserve “parallelism” for the general phenomenon of sentence parallelism studied in the next section.

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5.2 The example of the interdefinability of quantifiers

In Canon A43, we find another example of the acute logical sense of the Later Mohists:

> 经上：尽，莫不然也。
> Canon. *Jin* (exhausting/applying to all/all) is none not being so.

This is a particularly compact formulation of the reduction of the universal quantifier "all x" to the quantifier of non-existence "no x" followed by a negation; a literal translation reads: 'all' is 'none not so'. Fundamentally, this shows that the Later Mohists were not far from the so-called laws of interdefinability of quantifiers:

> $\forall x R(x)$ is equivalent to $\neg\exists x\neg R(x)$ (all x are R if and only if no x is not R);
> $\exists x R(x)$ is equivalent to $\neg\forall x\neg R(x)$ (some x are R if and only if it is not the case that all x are not R).

This contribution should be emphasized, because Aristotelian logic, probably influenced by the form of Greek propositions and the use of the verb "to be" (einai), did not decompose terms like "every man", "some man", "no man" and expressed their relation indirectly in the so-called "square of oppositions": "all man are mortal" is indeed the negation of "no man is not mortal", but this should be analyzed as

$\forall x(P(x)\rightarrow Q(x))$ is equivalent to $\neg\exists x(P(x)\wedge\neg Q(x))$

and we do not find there the reduction of the pure universal quantifier, but the reduction of the universal quantifier restricted to the predicate P. In a similar vein, we may say that Aristotelian logic missed a natural treatment of judgments such as "Socrates is mortal", treating them as "universal judgments", because it did not have the notion of constant.

5.3 Contemporary explanations of the *mou* type of reasoning

The Mohists were also quite famous by their paradoxical assertions of the *mou* type of reasoning given in the *Xiaoqu*, especially for the apparently very contradictory treatment of the two assertions:

> NO14
> 白马马也，乘白马乘马也。
> (A) A white horse is a horse, to ride a white horse is to ride a horse.
> NO15
> (B) 虽盗人人也，……杀盗人非杀人也。
> Although a robber is a man, […] to kill a robber is to kill a man.

To understand the contrast, we can refer to the historical context. There is no doubt that the first part of assertion (A) concerning the white horse is polemically opposed

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to Gongsun Long's famous "A white horse is not a horse" (白马非马), but it considers it as granted and goes on to the second part asserting "to ride a white horse is to ride a horse". The second assertion (B) is obviously designed to preserve a doctrine which wants to conciliate "universal care" (兼爱) with the punishment of offenders which is considered as an essential element not only for the stability of society but also for reaching the ideal state of universal care[12]. But essential as they may be, these explanations must not prevent us from analyzing the logical context of the assertions.

A first important observation is that they are part of a set of examples which deal with structures of reasoning. This may be shown by their classification NO13 which mainly attempts to deal will transitions from sentences of the form "X is (or is not) Y" to sentences of the form "ZX is (or is not) ZY".

> NO13
> 夫物或乃是而然，或是而不然，＜或不是而然＞，或一 * 周而一不 * 周，或一是而一 [不是] 非也。
> "Of the thing in general, there are cases where
> (1) something is so if the instanced is this thing,
> or (2) is not so though the instanced is this thing,
> or (3) is so though the instanced is not this thing,
> or (4) applies without exception in one case but not in the other,
> or (5) the instanced in one case is this and in the other is not."

Case (4) is better treated with an analysis in term of quantifiers and negations, but (1), (2), (3) and (5) are clearly dealing with variations of the form "X is/is not Y; hence ZX is/is not ZY". These have the form

(1) X is Y; hence ZX is ZY;
(2) although X is Y, ZX is not ZY;
(3) although X is not Y, ZX is ZY;
(5) X is Y, hence for some Z, ZX is ZY, but for other Z, ZX is not ZY.

That they deal with structures of reasoning is also confirmed by the text of NO15 which reads: "The latter claims are the same in kind (*tonglei* 同类) as the former." The "latter claims" presumably refer here to the controversial "although robbers are people, loving robbers is not loving people, not loving robbers is not not loving people, killing robbers is not killing people", while "the former claims" refer to their uncontroversial examples which include "robbers are people, but abounding in robbers is not abounding in people; being without robbers is not being without people; disliking the abundance of robbers is not disliking the abundance of people; desiring to be without robbers is not desiring to be without people". This looks indeed as a non trivial extension of their notion of *lei*. In most of their texts, the notion of *lei* covers

[12]See for example, Book 4, part I, "Universal Love I", in [32].

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the simple notion of class of objects; by contrast, it includes here a notion of similar *structure* of reasoning.

Granting that the Mohists deal here with structures of reasoning, we may turn to a logical explanation of the contrast between (1) and (2). I borrow here from my article [30]. Reasoning of type (A) is readily valid, when expressed under the form: $\forall x(Wx \rightarrow Hx) \vdash \forall x(Wx \wedge Rx \rightarrow Hx \wedge Rx)$. In this formalization Wx, Rx and Hx stand for "x is a white horse" "x is ridden" and "x is a horse" respectively and the whole assertion may be almost literally expressed as: from the fact that all white horses are horses, we may validly deduce (here formalized by $\vdash$) that all ridden white horses are ridden horses. But the same kind of formalization would lead us to accept the transition from from $\forall x(Rx \rightarrow Mx)$ to $\forall x(Rx \wedge Kx \rightarrow Mx \wedge Kx)$ in which formalization Rx, Mx and Kx stand for "x is a robber""x is a man" and "x is killed" respectively, thus contradicting (B). Therefore, we need other considerations to explain (B).

A first way of looking at this is to plainly say that in (B), "to kill" has a different meaning in "to kill a robber" and in "to kill a man", the first use being "to punish by death", the second being "to murder". This is undoubtedly the first basic observation, but it does not explain the insertion of this sentence in a series of examples dealing with the transition from sentences of the form "X is (or is not) Y" to sentences of the form "ZX is (or is not) ZY". The formalization translating that explanation requires two different predicates K_1 and K_2, K_1 meaning "is punished by death", K_2 meaning "is murdered" and (B) would be explained by the obviously non valid transition from "all robbers are men" to "all robbers punished by death are murdered men", a non-deducibility expressed by: $\forall x(Rx \rightarrow Mx) \nvdash \forall x(Rx \wedge K_1x \rightarrow Mx \wedge K_2x)$. This solution has the advantage of simplicity and it is firmly argued for in [9]. However, its disadvantage is that it does not reproduce the "shocking" identity of the words "to kill" in "to kill a robber" and "to kill a man", and thus obliterates the parallelism between (A) and (B).

So, what makes the difference between (A) and (B)? In [20], Liu and Zhang took the point of view of monotonicity reasoning and made a detailed study of many of the examples given for (1), (2) and (3). The authors do not deal explicitly with sentence (B), but their explanations of the example "Her younger brother is a handsome man, but loving her younger brother is not loving handsome men" make it clear that considerations of monotonicity should be completed by an appeal to intensionality. They do not elaborate on that suggestion, but a detailed semantic approach may be worked out using the idea of "possible world". In the case of the present example, one would say that Kx, "x is killed", is an intensional predicate, which means that the interpretation of K requires the consideration of different possible worlds. To explain the contrast between the two different meanings of "to kill", it suffices to consider two worlds, say $W_1 =$ the moral sphere and $W_2 =$ the social sphere. W_1 and W_2 may be constituted by the same set of objects, say men; they may be supplied with the same

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interpretations of R and M, but in W_1, the extension K_1 of K will be constituted by all things which are killed as a result of a lawful punishment and in W_2, the extension K_2 of K will be constituted by all things which are killed as a result of murder. In this way, we may construct models which show that "robbers in W_1 are men in W_1 and remain so in W_2", but "robbers which are killed in W_1 (i.e. punished by death) remain men but are not killed (by murder) in W_2". "To remain" means here that we have to define a transition from W_1 to W_2, which in this simple model may be taken as the identity. This semantic formulation may be expressed in different formalisms. In [30], I suggest two possibilities: the first one appeals to modal logic, the second one to a logic of sorts.

In modal logic, the Kripke model suggested above will show that $\forall x(Rx \rightarrow \Box Mx) \nvdash \forall x(Rx \wedge Kx \rightarrow \Box Mx \wedge \Box Kx)$, by showing that at world W_1 of the model, $\forall x(Rx \rightarrow \Box Mx)$ is satisfied, while $\forall x(Rx \wedge Kx \rightarrow \Box Mx \wedge \Box Kx)$ is not; by the standard rules of interpretation of the box-operator "$\Box$" representing necessity, the satisfaction of $\forall x(Rx \rightarrow \Box Mx)$ expresses here the idea "robbers in W_1 are men in W_1 and remain so in W_2", while the non-satisfaction of $\forall x(Rx \wedge Kx \rightarrow \Box Mx \wedge \Box Kx)$ expresses the idea that "robbers which are killed in W_1 (i.e. punished by death) remain men but are not killed (by murder) in W_2".

The same model may serve to interpret a formula written in a logic with two sorts: sort m will be interpreted in the moral sphere W_1, sort s will be interpreted in the social sphere W_2 and the transition f_{sm} from sort m to sort s, will be interpreted in the present case by the identity on W_1 ($= W_2$), but will express the idea that when x is an element of the "moral world" W_1, $f_{sm}x$ is the underlying person in the "social world W_2". The model suggested above will show that

$$\forall x_m(R_m x_m \rightarrow M_s f_{sm} x_m) \nvdash \forall x_m(R_m x_m \wedge K_m x_m \rightarrow M_s f_{sm} x_m \wedge K_s f_{sm} x_m).$$

Details, advantages and disadvantages of these approaches are discussed in [30], but I want to stress here that the approach using different sorts is in perfect consonance with the Mohist Canon B6:

> 经下：异类不比，说在量。
>
> 经说下：(异)。木与夜孰长，智与粟孰多，爵亲行贾四者孰贵，麋与霍孰高，麋与霍孰霍？……
>
> Canon. Different kinds are not comparable. Explained by: measuring. Explanation. Which is longer, a piece of wood or a night? Which do you have more of, knowledge or grain? Which is the most valuable, aristocratic rank, one's own parents, right conduct, a price? Which is higher, a deer or a crane? [...]

In my opinion, this canon is best interpreted as asserting that notions such as "long" "more" "valuable" "high", ..., depend on *lei*s, which behave here like independent sorts as they are conceived in the logic of sorts ([23]). The present author has

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applied the same kind of analysis to the famous "Discourse on the white horse" of Gongsun Long ([22]) and shown that it may be used to give a unified view of many of the Mohist examples of reasoning[13].

In any case, the technical analysis given above shows that the Mohist were not incoherent in maintaining (A) and (B) together.

6 Parallelism

Parallelism is a striking phenomenon of ancient texts and especially of pre-Qin texts. By parallelism, we understand here the parallelism of sentences[14], which may be described as a repetition of sentences having the same or at least a very similar syntactical structure. The syntactical structure is expressed by functional terms such as conjunctions, prepositions, interjections, or simply by a pause, denoted in modern texts by a typographical device such as a comma, a dot, an exclamation mark, a question mark, etc. These functional terms are repeated in each one of the parallel sentences, or repeated with minor variations, or adapted to grammatical requirements. The parallelism may be direct or opposite.

Let us first describe direct parallelism. We will take our examples from the *Lunyu* (论语)[15], but almost all other pre-Qin texts abound in such examples.

Lunyu 13.4
子曰："小人哉，樊须也！
"上好礼，则民莫敢不敬；
"上好义，则民莫敢不服；
"上好信，则民莫敢不用情。
"夫如是，则四方之民襁负其子而至矣，焉用稼？"
The Master said, "A small man, indeed, is Fan Xu!
If a superior man love propriety, the people will not dare not to be reverent.
If he love righteousness, the people will not dare not to submit to his example.
If he love good faith, the people will not dare not to be sincere.
Now, when these things obtain, the people from all quarters will come to him, bearing their children on their backs - what need has he of a knowledge of husbandry?"

[13] See [26]. As a side remark, let me add that wanting to limit the size of this article, I refrained from discussing here Gongsun Long's Discourse on the white horse, but it should be said that there is on the subject an extremely abundant literature making an extensive use of contemporary logical notions.

[14] As already noted above, we reserve the word "parallelism" to sentence parallelism and not to the *mou* type of reasoning.

[15] In this article, text and references of the *Lunyu* are quoted from [41] and the translation from [17].

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Three sentences emerge here, having almost the same length and with many common words at the same place. The common structure is of the form 上好 X，则民莫敢不 Y. It seems clear that the structure conveys a general meaning which the structure expresses as: "if the superior man loves X_1, then the people will not dare not abiding by quality X_2". Knowing that *li* (礼), *yi* (义), *xin* (信) are among the most fundamental virtues for a ruler and that *jing* (敬), *fu* (服) and *qing* (情) are the expected answers of the people, the Master's message clearly emerges: if the ruler shows virtues of respect for the people, then the people will respond to him by similar virtues. This interpretation is confirmed in 12.16, 12.17, 12.18, 12.19 (which contains the celebrated analogy of the virtue of the ruler with the wind moving over the grass). What does this mean from a logical point of view? A first rough analysis shows that we have three sentences, the structure of which may be described by

$\Phi(A', B')$,
$\Phi(A'', B'')$,
$\Phi(A''', B''')$,

where the homologous terms A', A'', A''' have similar meanings and the homologous terms B', B'', B''' also have similar meaning. The definition of direct parallelism is just a simple extension of what has been described with this example. Now, what is the deductive role associated with direct parallelism? In some cases, the intention of the writer is simply to repeat the same sentences with minor variations to convince the reader. But in many cases, the repetition of the same structure calls for a generalization or an abstraction; in the present example, the writer expects the reader to look for an abstraction A^* of the meaning of the homologous terms A', A'', A''' and an abstraction B^* for the homologous terms B', B'', B'''. This may be interpreted as an implicit reasoning of a form which translates the idea of an extended generalization[16]:

$\Phi(A', B'), \Phi(A'', B''), \Phi(A''', B''')$; *hence* $\Phi(A^*, B^*)$.

This is in fact a very broad extension of the argument by generalization. The traditional example of the ravens may be presented in exactly that way:

"raven a' is black",
"raven a'' is black",
"raven a''' is black",
etc.

hence, "the general raven a^* is black" (meaning "all ravens are black"). This type of example is restricted in the sense that generalization bears here only on individuals,

[16]In his commentary of this passage, Slingerland ([38]) notes: "Here Confucius is speaking to someone who wields real power in the state of Lu: Ji Kangzi, head of the most powerful of the infamous Three Families who were the de facto but illegitimate rulers of Lu. He receives similar advice about ruling from Confucius in 12.17–12.19 below : essentially, make yourself virtuous and the people will follow."

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while general direct parallelism suggests generalization on other syntactic categories, such as predicates, relations, modifiers of predicates, of relations, etc. One may also consider that the so-called "argument by the exemplars" falls under our scheme of extended generalization.

It is here the occasion to remind the reader that a reasoning of that kind is not valid in general, but it is beyond doubt that it contributes to our everyday knowledge and plays an important role in natural sciences. In fact, the *Lunyu* is full of examples of direct parallelism which may be analyzed along similar lines: 2.10, 2.18, 2.20, 6.26, 7.8, 7.26, 7.38, 8.2, 12.11, 12.22, 13.4, 17.9. For more details, I refer the reader to [31].

Along direct parallelism, one also speaks of opposite parallelism. In the case of two sentences, it consists in sentences having the form

$$\Phi(A', B', C', \ldots)$$
$$\Phi(A'', B'', C'', \ldots)$$

where some homologous terms have an opposite meaning, while the remaining homologous terms (if any) have a similar meaning. In that case, it would be unreasonable to look for a generalization of all the homologous terms. This may be shown by examining a simple case of sentences of the form "p implies q", in symbols $(p \to q)$. When "opposite" is negation, we have three cases of opposition:

Case1 : $(p \to q), (p \to \neg q)$;
Case 2 : $(p \to q), (\neg p \to q)$;
Case 3 : $(p \to q), (\neg p \to \neg q)$.

In each one of these cases, we have an almost automatic logical conclusion. Case 1 corresponds to a *reductio ad absurdum*, whose conclusion will be $\neg p$. Case 2 corresponds to a dilemma, whose conclusion will be q. Case 3 allows one to draw the conclusion $(p \leftrightarrow q)$.

What is extremely interesting is to see that cases similar to case 2, dilemmas, arise in the *Lunyu*: 14.36, 15.7, 13.16 and 15.28. Here is the example of 15.28 :

> 子曰："众恶之，必察焉；众好之，必察焉。"
> The Master said, "When the multitude hate a man, it is necessary to examine into the case. When the multitude like a man, it is necessary to examine into the case."

Implicit conclusion: in any excessive behavior of the multitude, it is necessary to examine the case.

Cases similar to case 3 are extremely frequent in the *Lunyu*, often opposing the behavior of the *Junzi* and of the *Xiaoren*. Here is the typical example of 4.11:

> 子曰："君子怀德，小人怀土；君子怀刑，小人怀惠。"

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> The Master said, "The gentleman cherishes virtue, whereas the petty person cherishes physical possessions. The gentleman thinks about punishments, whereas the petty person thinks about exemptions."

The correct analysis of that kind of example will go beyond conclusions of equivalence, completing this by an implicit deontic recommandation of the type "Behave like the *Junzi*, not like the *Xiaoren*".

I did not find clear-cut examples of Case 1, *reductio ad absurdum*, in the *Lunyu*. They are certainly present in the Later Mohist discussions of self-refuting assertions (B71, B79) or in the elaborate proof that it is useful to learn (B77), but in a more complex apparatus than opposite parallelism.

For a more profound discussion of parallelism, I refer the reader to the already quoted [31] and to [27].

7 Analogies and Analogical Reasoning

The sketch of analogical arguments given in section 2 gives an oversimplified view of analogical reasoning, especially of analogical reasoning of the pre-Qin period.

The first correction to that oversimplified view is that analogies compare not only objects, but organized systems of objects, which logicians approach through the notion of structure: a structure is given by a set S of objects (called domain of S), distinguished elements a, b, c, $\cdots$ of S, unary (or binary predicates or predicates of a higher degree) on S. This defines a first-order structure, which suffices in many cases to explain the analogy. However, in certain cases, it will be necessary to consider more elaborate structures, having for example predicates of predicates or modifiers of predicates. The second correction is that we have to define what we understand by a similarity of structures S and S'. There is room for variations on this notion, ranging from homomorphism from one structure into another, to more general relations between the two structures. Concerning most analogies found in pre-Qin texts, the important thing is that structures S and S' have the same logical type, relating ingredients of S to ingredients of S' of the same syntactical category: elements of S are related to elements of S', n-ary predicates of S to n-ary predicates of S', etc.

In the pre-Qin texts, most, if not all analogies, can be explained by a similarity of structures. This is true of the simplest analogies such as Confucius' well-known comparison of the ruler with the North polar star:

> *Lunyu* 2.1
> 子曰："为政以德，譬如北辰，居其所而众星共之。"
> The Master said, "He who exercises government by means of his virtue may be compared to the north polar star, which keeps its place and all the stars turn towards it."

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We have a structure S to be explained and a more familiar structure S' which is supposed to explain S. In order to keep things simple and avoid details on quantification here, we will represent by b the "general people" and by b' the "general star" so that both structures have two distinguished elements.

Structure S is defined by:

the underlying set of elements is $\{a, b\}$

$a =$ the virtuous ruler

$b =$ the general people

$bRa = b$ is related to a [b obeys a].

Structure S' is defined by:

the underlying set of elements is $\{a', b'\}$

$a' =$ the North Polar star

$b' =$ the general star

$b'R'a' = b'$ turns around a'.

The essence of the analogy consists in explaining structure S by its similarity with structure S'; a rough mathematical approach of this could be given by a homorphism h from the structure S' to the structure S, i.e. a mapping h from $\{a, b\}$ to $\{a', b'\}$ respecting $h(a) = a'$ (the virtuous ruler is assimilated to the north polar star), $h(b) = b'$ (the general people is assimilated to the general star) and for all x, y, $xR'y$ implies $h(x)Rh(y)$ (the relation tying b to a is assimilated to turning around). All readers will understand that the relation R is a relation of obedience and respect; we put between square brackets a rough description of what follows implicitly from the analogy. *Lunyu* 12.19, comparing superior and inferior to wind and grass, and the celebrated analogy of the atom with a solar system have exactly the same structure.

Simple analogies may be explained by similarity of structures, but that is also true of very elaborate analogies, such as the analogy given in *Lunyu* 19.23:

> 叔孙武叔语大夫于朝，曰："子贡贤于仲尼。"子服景伯以告子贡。子贡曰："譬之宫墙，赐之墙也及肩，窥见室家之好。夫子之墙数仞，不得其门而入，不见宗庙之美，百官之富。得其门者或寡矣。夫子之云，不亦宜乎！"
>
> Shu Sun Wu Shu observed to the great officers in the court, saying, "Zi Gong is superior to Zhong Ni." Zi Fu Jing Bo reported the observation to Zi Gong, who said, "Let me use the comparison of a house and its encompassing wall. My wall only reaches to the shoulders. One may peep over it, and see whatever is valuable in the apartments. The wall of my Master is several fathoms high. If one do not find the door and enter by it, he cannot see the ancestral temple with its beauties, nor all the officers in their rich array. But I may assume that they are few who find the door. Was not the observation of the chief only what might have been expected?"

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The comparison between Zi Gong and Zhong Ni is here explained by two quite complex structures which may be suggested as follows. As before, the square brackets indicate the elements which have to be supplied by the "reader".

Structure S	Structure S'
[Zigong's virtue]	the valuable things of a small house
[is small]	are not numerous
[it is easy to see it]	it is easy to see them by peeping over the wall
[everybody can see it]	everybody can see them
[Zhong Ni's virtue]	the valuable things of a big house
[is big]	are numerous
[but difficult to see it]	[it is difficult to see them because the wall is high]
[most people will overlook it]	[most people will not see them]
because they do not know how to look	because there are few who find the door
[only those who know how to look at it will see it]	only those who find the door will see them

But this does not yet give us examples of analogical reasoning, which consist in the transfer of a property Φ of structure S' to structure S, a kind of reasoning which we may represent as a type of reasoning having two premises and a conclusion:

S *is similar to* S', $\Phi(S')$; *hence* $\Phi(S)$.

To find such examples, we will have to turn to dialogical contexts, where an analogical argument given by locutor L_1 will meet the opposition of locutor L_2. No wonder that one will find excellent examples of elaborate reasoning by analogy in the *Mencius*. As is apparent from the general form given above, there are three ways of objecting to the analogical way of reasoning:

(Ref 1) one can refute the first premise, negating the similarity of S with S';
(Ref 2) one can refute the second premise, asserting that $\Phi(S')$ is false;
(Ref 3) and finally, even accepting the first and the second premise, one can claim that property Φ is "irrelevant", *i.e.* is not of the kind which is involved in the analogy, thus objecting to the deduction from the two premises to the conclusion.

Here are examples of the three kinds of refutation, which I borrow from [28], leaving out many details, to concentrate on the results and, more importantly, to suggest possible explanations of the strength of the arguments by analogy.

Example of (Ref 1). Refutation of S *is similar to* S'.

In the well known dialogue with Gaozi given in *Mencius* 6.A.2[17], we find a good

[17] In this article, text and references of the *Mencius* are quoted from [41] and the translation from [18].
告子曰："性犹湍水也，决诸东方则东流，决诸西方则西流。人性之无分于善不善也，犹水之无分于东西也。"
告子曰："性，犹杞柳也；义，犹桮棬也。以人性为仁义，犹以杞柳为桮棬。"孟子曰："子能顺杞柳之性而以为桮棬乎？将戕贼杞柳而后以为桮棬也？如将戕贼杞柳而以为桮棬，则亦将戕贼人以为仁义与？率天下之人而祸仁义者，必子之言夫！"

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example of a refutation of similarity of structures. Gaozi compares here human tendency towards good or bad to water going east or west indifferently; to this, Mencius opposes the analogy of water naturally going down and going up only when forced. These analogies may be represented by the following structures:

Structure S to be clarified:	Structure S' proposed by Gaozi:	Structure S'' proposed by Mencius:
$a =$ human nature	$a' =$ water	$a'' =$ water
$b =$ good	$b' =$ east	$b'' =$ down
$c =$ bad	$c' =$ west	$c'' =$ up
$Tab = a$ tends to b	$T'a'b' = a'$ tends to b'	$T''a''b'' = a''$ tends to b''
$Tac = a$ tends to c	$T'a'c' = a'$ tends to c'	$T''a''c'' = a''$ tends to c''

The analogical reasoning of Gaozi is given by the rule of analogy applied to structures S and S' and to the following Φ :

$\Phi(S') = T'a'b'$ or $T'a'c'$ indifferently (water goes east or west indifferently),

which by transfer from S' to S gives :

$\Phi(S) = Tab$ or Tac indifferently.

The analogical reasoning of Mencius is based on the similarity of structures S and S'' and to the following Ψ :

$\Psi(S'') = T''a''b''$ naturally and $T''a''c''$ against nature (water goes naturally down and not naturally up),

which by transfer from S'' to S gives :

$\Psi(S) = Tab$ naturally and Tac against nature.

Example of (Ref 2). Refutation of $\Phi(S')$.

In the opening dialogue 6.A.1[18], Gaozi compares the fashioning of human nature by benevolence and righteousness with the manufacturing of a cup from a willow tree and Mencius replies by criticizing the truth of the property to transfer : manufacturing a cup from the willow violates the nature of the willow.

Structure S to be clarified:	Structure S' proposed by Gaozi and accepted by Mencius:
$a =$ human nature $b =$ benevolence and righteousness (仁义)	$a' =$ the willow tree $b' =$ a cup

[18]告子曰："性，犹杞柳也；义，犹栝棬也。以人性为仁义，犹以杞柳为栝棬。"孟子曰："子能顺杞柳之性而以为栝棬乎？将戕贼杞柳而后以为栝棬也？如将戕贼杞柳而以为栝棬，则亦将戕贼人以为仁义与？率天下之人而祸仁义者，必子之言夫！"

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The analogical reasoning of Gaozi is given by the rule of analogy applied to structures S and S' and to the following Φ :

$\Phi(S') =$ fashioning b' out of a' agrees with the nature of a',

which by transfer from S' to S gives :

$\Phi(S) =$ fashioning b out of a agrees with the nature of a.

The structure proposed by Mencius is the same as S', but property $\Phi(S')$ is criticized and in fact negated : fashioning a cup out of willow does violence to the nature of the willow and Mencius proposes the transition of property Ψ, which is in fact the negation of Φ:

$\Psi(S') =$ fashioning b' out of a' violates the nature of a' ;

hence

$\Psi(S) =$ fashioning b out of a violates the nature of a.

Example of (Ref 3). Refutation of the relevance of Φ.

Mencius 2.B.3 contains an analogical argument designed to embarrass Mencius by comparing three different situations. For our purpose, it suffices here to look at the analogical argument based on the first analogy proposed by Chen Zhen:

> 陈臻问曰：“前日于齐，王馈兼金一百而不受；于宋，馈七十镒而受；于薛，馈五十镒而受。前日之不受是，则今日之受非也；今日之受是，则前日之不受非也。夫子必居一于此矣。”孟子曰：“皆是也。当在宋也，予将有远行。行者必以赆，辞曰：‘馈赆。’予何为不受？当在薛也，予有戒心。辞曰：‘闻戒。’故为兵馈之，予何为不受？若于齐，则未有处也。无处而馈之，是货之也。焉有君子而可以货取乎？”
>
> Chen Zhen asked Mencius, saying, “Formerly, when you were in Qi, the king sent you a present of 2,400 taels of fine silver, and you refused to accept it. When you were in Song, 1,680 taels were sent to you, which you accepted; [...] If your declining to accept the gift in the first case was right, your accepting it in the latter case(s) was wrong. If your accepting it in the latter case(s) was right, your declining to do so in the first case was wrong. You must accept, Master, one of these alternatives.”

A simplified analysis of the argument shows that it is based on the similarity of structures S and S':

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Structure S	Structure S'
$a =$ Mencius	$a' =$ Mencius
$Qa = a$ is in Qi	$Q'a' = a'$ is in Song
$b =$ amount of 2400 taels	$b' =$ amount of 1680 taels
$Gab = a$ is given b	$G'a'b' = a'$ is given b'

On the other hand, the transfer from one structure to the other structure bears on the property $\Phi(S')$ meaning that in situation S', Mencius accepted the gift b'. By transfer to S, this gives the result that in situation S, Mencius should have accepted the gift b, thus contradicting what really happened. To this Mencius replies that the situations were different: in situation S', the acceptation of b' is justified by the fact that b' was a present to cover his travel expenses, while in S, there is no such justification and b should there be considered as a bribe.

This analysis shows thus not only that we have varied kinds of argumentation dialogues, but the comparison of the three examples may help us to appreciate the strength of the refutations, at least in the present examples. The strongest refutation seems to be given by (Ref 3), in which there is no change of the basic structures, but an expansion of these structures. Mencius' answer shows that he fully accepts the similarity of structures S and S', but claims that these structures are not enough to represent the full complexity of the situations : when dealing with behaviors, we should take into account the reason or the motivation of these behaviors. Logically speaking, he expands structures S and S' into S_1 and S'_1, taking into account the circumstance of travel expenses, thus breaking the analogy:

Structure S_1	Structure S'_1
$a =$ Mencius	$a' =$ Mencius
$Qa = a$ is in Qi	$Q'a' = a'$ is in Song
$b =$ amount of 2400 taels	$b' =$ amount of 1680 taels
$Gab = a$ is given b	$G'a'b' = a'$ is given b'
$\neg Ta = a$ is not going to travel	$T'a' = a$ is going to travel

In (Ref 2), Mencius keeps also the analogy proposed by his opponent, but has to blankly negate the property to be transferred: the first element is a good point, but the second element is in bad need of justification.

In (Ref 1), Mencius has to change the analogical structures, but he keeps the changes to a minimum: it deals with water and with its "tendencies" and the change is limited to b', b'' and c', c''. This is a strong point. On the other hand, he also has to change the transferring property, replacing Φ by Ψ. This is a weaker point.

These three examples seem to suggest that in dialogues involving analogical arguments, the strongest position is given by the locutor who keeps the changes of structure to a minimum. Although this goes beyond formal appreciation, keeping the initial analogy and extending the structure may be psychologically more acceptable

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than changing the structure or its properties : in (Ref 3), Mencius says in fact "I agree with you, but do not forget to take the motivation into account". By contrast, in (Ref 1) and (Ref 2), Mencius's attitude will presumably provoke more opposition because of the change of structure S' or the blank denial of the property $\Phi(S')$ proposed by Gaozi : in these cases, Mencius says in fact "you are making a mistake". Another relevant element of appreciation is that of the symmetry of the situations. In (Ref 3), there is no privilege of S over S' and we could have represented Mencius in Song in the structure on the left side and Mencius in Qi in the structure on the right side of our schema; both situations are equally concrete and the analogy is not designed to explain an abstract situation by a concrete situation, but to bring to the forefront a contradiction in Mencius' behavior. This is not the case of (Ref 1) and (Ref 2), where the analogies attempt to bring light on abstract structures by way of more concrete structures; the exchanges of argument in (Ref 1) and in (Ref 2) are more challenging from the point of view of content, but they seem weaker from the formal point of view. The two suggested criteria —minimal change of structures and symmetry of structures —are not yet formally very precise and they should be further investigated, but they can already help us to understand the overall structure of those dialogues and the relative strength of the arguments.

8 Conclusion

In this article, I have proposed a rather broad conception of logic, which includes not only logic in the strict sense of the study of valid reasoning, but also some elements of the theory of argumentation. This proposal is at least partly justified by recent developments of logical techniques and has the advantage of opening a common space where two opposing views on the study of logic in ancient China may meet: some logicians, often but not always Western philosophers, promote the use of contemporary logical techniques to study the ancient texts, while other logicians, often but not always Chinese philosophers, are reluctant to do so and defend the idea of a specifically Chinese logic.

With this broad conception at hand and with all the necessary precautions explained at the end of Section 2, I take a number a examples to illustrate how the use of contemporary techniques of formalization and notions of formal logic may help us to analyze the pre-Qin logic, thus bringing to the fore not only the universal value of some pre-Qin contributions to logic, but also emphasizing some of their specificities. In Section 3, I propose a very detailed analysis of the exact contribution of the Mohists to the discovery of the basic laws of logic, the principle of non-contradiction and the principle of the excluded middle. Section 4 is devoted to the logical theory of definition : there are some timid theoretical elements present in the *Xunzi*, but the practice of definitions by pre-Qin philosophers is much more remarkable than their theory; Xunzi himself has made an abundant use of definitions, but Hui Shi's theses 1,

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5 and 10 show a keen sense of the nature of definition, while the first Mohist Canons constitute a very well organized system of definitions. In Section 5, I emphasized two important contributions of the Mohists to logic: the discovery of constants, of variables and predicates and the interdefinability of quantifiers. I suggest also how contemporary notions of logic may help us to better grasp and solve the difficulties of their *mou* reasoning. Section 6 is devoted to parallelism, which hides arguments of the kind found in the theory of argumentation but includes also implicit logically valid arguments such as dilemmas or deduction of equivalences. I add here that in my opinion, the use of parallelism is probably a more characteristic feature of the logical character of the pre-Qin texts than the use of analogies. Nevertheless, it remains important to discuss analogical reasoning, a task which I present in section 7, sketching the notion of analogical structures and analyzing three paradigmatic examples of the *Mencius*, suggesting ways of evaluating the relative strength of the arguments involved in the dialogues.

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现代逻辑视域下的先秦逻辑分析

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摘　要

文章论述了如何以现代逻辑的概念或方法，以及论证理论的要素来更好地理解中国古代伟大思想家的逻辑贡献。第一、二节提出拓展逻辑的通常理解，使之包括一些论证理论的要素，以期构建一个“西方逻辑”与“中国逻辑”均能满足的开放空间，并用先秦逻辑一些重要思想的详细分析作出说明例证。三到五节从传统意义上的逻辑作分析：后期墨家及其逻辑基本规律、关于定义的理论和应用、名的分类、量词互相定义和侔式推理的现代解释。第六节分析了句子的排比句现象，揭示表明其隐藏的论证理论的一些形式化要素，如泛化关联论证，它包含一些未言明但完全有效的论证。第七节详细分析了《孟子》的类比推理，并提出评价论证强度的形式化方法。

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