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Notes on Early Chinese Logic (V)

VII. The principle of double negation, the law of contradiction and some related problems in early Chinese thought. — First I wish to apologise for a change in the original plan of the present series of *Notes*. As was previously announced (see RO XXVII, 1, p. 104), the present chapter VII should continue to deal with the calculus of functions in Chinese reasoning. Contrary to this announcement, it has turned out to be necessary to discuss at this point the problem of contradiction in early Chinese logic together with some corollary problems closely associated with this main topic. The present chapter (which will comprise two sections) is devoted to this discussion. I shall revert to the analysis of Chinese reasoning involving the calculus of functions (and the calculus of relations in particular) in later chapters.

The discussion of the law of contradiction and related problems in early Chinese thought was originally planned for the concluding chapter of my study, and the reasons why I have decided to shift this discussion into the middle of my *Notes* deserve to be briefly summarised. The first of these is of a technical character. So far we have been dealing with the forms of Chinese reasoning hardly involving the principle of contradiction. A particularly clear example is that of the Chinese propositional calculus (see RO XXVI, 2, pp. 91—105) which, as can easily be seen, is practically independent of the law of contradiction (in the sense that it exploits only such tautologies and rules of inference as are independent of this law). Similarly, instances of reasoning discussed in other sections so far published — although perhaps less clear in this respect than those of the propositional calculus — could be analysed without any reference to the problem of contradiction. Now, the instances of reasoning in terms of the calculus of relations, which remain to be analysed, clearly involve the use of the law of contradiction, and it seems necessary to discuss this law itself as it stands in early Chinese thought before proceeding to an analysis of the examples which involve it. Second, I should like to emphasise that it is my intention to counterbalance the characterisation of Chinese logic given by J. N e e d h a m in the second volume of his monumental *Science and Civilisation in China* (1956). To my mind, N e e d h a m's argumentation to the effect that the early Chinese logic was

'dialectical' rather than formal (cf. especially the paragraph *Logic, Formal or Dialectical?, Sc. and Civ.*, II, pp. 198—203) is not only one-sided but also partly misleading, and it seems necessary to deal with the problem at once rather than to postpone its discussion to the concluding chapter. Third, I also think that the present discussion can be useful not only from the sinological but also from the comparative point of view. More than forty years after P. M a s s o n - O u r s e l's first (and necessarily premature) attempts we are approaching the moment when 'comparative logic' becomes possible, and it goes without saying that the problem of logical contradiction, directly concerning the foundations of logic and at the same time needlessly intermingled with many misunderstandings on the part of some philosophers and scientists, deserves a comparative treatment.[1] The present chapter is also intended as a sinological contribution in this direction.

The so-called law of contradiction, $(p . p')'$, — which had better be called law of *non*-contradiction — is closely associated with some other logical laws, as the law of excluded middle (*tertium non datur*, $p \vee p'$), the law of identity ($p \equiv p$), and the law of double negation (*duplex negatio affirmat*, $p'' \equiv p$). It is not easy to talk about their relationships without falling into a *petitio principii*,[2] and it appears equally hazardous to take one of them and try to deduce others from it (possibly except for the fact that the law of identity follows rather directly from that of double negation). It would lie beyond the competence of the present writer as well as beyond the scope of a contribution claiming to be sinological to enter upon a general discussion of the 'philosophy of logic', but the following remarks seem necessary. Regardless of the precise nature of interdependence of all the aforementioned laws — which is not easy to state — the fact remains that they are interdependent in some way, that they in some sense complement each other and constitute a coherent and rather closely-knit whole concerned with the foundations of logic. The classical calculus of propositions recognises all these laws, and it is to be emphasised that the two-valued logic based on this calculus has proved to be able to achieve much in the analysis of the foundations of mathematics. The only 'rival' system of logic so far produced and having some real (not merely declarative) importance is the so-called intuitionistic logic in which the law of excluded middle and that of double negation (but not those of contradiction and identity) are explicitly rejected. It is however premature to say that the intuitionistic logic has turned out to be 'better' than the classical, and, paradoxically enough, one can even doubt whether the intuitionistic calculus is indeed so different from the classical as the intuitionists themselves purport it to be.[3] On the other hand, Hegelian dialectics and Marxist dialectical materialism are specific general theories of development, emphasising

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[1] Cf. the recent contribution by J. F. S t a a l, *Negation and the law of contradiction in Indian thought: a comparative study*, BSOAS XXV, 1, 1962, pp. 52—71.
[2] This seems to be the main reason why most writers of textbooks on logic simply pass over the problem.
[3] Cf. W. K n e a l e and M. K n e a l e, *The Development of Logic*, Oxford 1962, pp. 678 ff.

change and the 'struggle of contraries' as inherent in any process, but — contrary to what some were or are inclined to think — neither the former nor the latter is a system of l o g i c, and neither can replace formal logic conceived as a theory of valid reasoning. In particular, the view that dialectical materialism allegedly makes invalid the l o g i c a l law of non-contradiction is a gross misunderstanding (partly due to the metaphoric use of the term 'contradiction' in some contexts) which is also contrary to the daily practice of reasoning common among Marxists (and most other people as well). By the way, self-contradictory knowledge, seriously affirming and denying what is exactly the same, would be no knowledge at all, and one can hardly see of what use it might be.

Furthermore, for our present purpose it appears that it is the law of double negation which for various reasons deserves to be dealt with in the first place. Significantly enough, it is precisely this law which is nowhere mentioned by N e e d - h a m. Now, the law of double negation not only has its share in the background of logic, but also seems to play a specific intuitive rôle in the shaping of this background. I mean the psychological fact that the principle *duplex negatio affirmat*, if once firmly rooted in the mind for whatever reason, makes the mind naturally disposed for the two-valued classical logic with all its consequences. This nearly amounts to saying that the remaining three of the aforementioned laws are in some sense psychologically derivable from that of double negation, even if formally, as we know, they are hardly derivable from it (except for the law of identity). Such a reference to psychological intuitions may appear out of place in a contribution concerned with logic, since logic and psychology certainly are very different from each other. However, as a matter of fact, even modern logicians (and mathematicians) can hardly do without appealing to intuitive thinking in more than one instance, and it goes without saying that at the early (pre-symbolic) stage of logical thinking with which we are concerned psychological intuitions (and especially those arising from language) must have been of much greater importance than they are to the modern students of logic. Now, I think that at this early stage the principle of double negation — if strongly imposed on the mind — could hardly lead to anything else than "if not false, then true" ("$0' \supset 1$") and *vice versa* ("$1 \supset 0'$"), and "if not true, then false" ("$1' \supset 0$") and *vice versa* ("$0 \supset 1'$"), — which in turn suggests all the fundamental tautologies of the two-valued classical calculus. Any attempt to interpret the law of double negation within and in terms of a non-classical calculus seems possible only at a very highly sophisticated level of thinking, which is hardly attainable at the early stage. As a matter of fact, this was achieved only a few decades ago. On the other hand, the ignorance of the principle of double negation or its elimination from early Chinese thinking (not to speak of its conscious rejection) can safely be excluded because of the simple fact that, as we shall presently see, the principle was strongly imposed by Chinese grammar. It should be emphasised that among the four laws closely associated with the foundations of the classical logic it is precisely this law which is clearly inherent in the linguistic structure itself. To put it more accurately, the law is inherent in the grammatical structure of some languages

to the exclusion of others,[4] and Chinese certainly is one of the most representative examples of the first kind.

Before proceeding to the discussion of the problem as it stands in Chinese grammar it is useful to revert for a while to the law of double negation itself and its various possible formulations within logic. Usually the law is formulated for propositional variables and is given the form "$p'' \equiv p$", that is, the universal quantifier (all-operator) binding the propositional variable p is omitted.[5] However, in order to prevent any misunderstanding and for the sake of parallelism with the formulae of the functional calculus (usually quantified), it is better to give the law its full force and write it in the form:

$$\prod_{p} (p'' \equiv p)$$

that is: "for every p (= whatever be the proposition p): not-not-p (= it is not that not-p) is equivalent to p". Furthermore, it is by no means necessary to formulate this law (and other laws as well) exclusively in terms of the propositional calculus. Of course, the law holds equally good on the ground of the calculus of functions, that is, the logical calculus in which atomic propositions are analysed into functions and arguments (cf. chapters V—VI of the *Notes*). Thus, the principle of double negation, if 'translated' into the symbolic language of the calculus of one-place functions, can be given the following main forms which are all equivalent to each other:

$$\prod_{\varphi}\prod_{x} [(\varphi x)'' \equiv \varphi x]; \quad \prod_{\varphi}\prod_{x} (\varphi'' x \equiv \varphi x); \quad \prod_{\varphi}\prod_{x} [(\varphi' x)' \equiv \varphi x]$$

As is easily seen, the first of these formulae is largely similar to that given above for the propositional calculus, since in both we have to do with propositional (double) negation to the exclusion of any term-negation. The second and the third formulae are different from the first in so far as they both make use of the term-negation (namely the negation of the function-term), which in the third formula is combined with propositional negation. The distinctions spoken of are important in so far as natural languages mostly replace propositional negation by term-negation, or (in case of double negation) combine both. In particular, propositional double

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[4] Cf. J. F. Staal, l.c., p. 66, who rightly states that the background of the logical law of double negation is to be sought in the linguistic phenomenon of two negative particles cancelling each other. Linguistically (and perhaps logically as well) it is important to note that the cancelling of negatives is not a general grammatical rule and that in many languages accumulative negation is freely used just to express negation, cf. O. Jespersen, *The Philosophy of Grammar*, p. 331 ff.

[5] Such a procedure is due to the fact that propositional tautologies are always valid for all values of the variables. Thus, the universal quantifier (and only this one) is always understood with the formulae and, consequently, can be omitted without misunderstanding. Moreover, the tautologies of the calculus of propositions can be conceived not as theses about propositions, but as patterns for the construction of logically complex (molecular) propositions which are always true.

negation hardly ever occurs in idiomatic use in any of the better known languages, and even single propositional negation is expressed mostly by some periphrastic means. It follows that linguists have usually to do with natural structures corresponding to the second and the third formulae. This is also the case with Chinese in which, as a matter of fact, structures with double term-negation occur frequently. It must also be emphasised that the formal analysis of actual Chinese structures involving double negation may be (and will be in our examples) complicated by internal quantification inherent in many such structures. Non-quantified structures of the kind $\varphi_1''a \equiv \varphi_1 a$ or $(\varphi_1'a)' \equiv \varphi_1 a$ (where both φ_1 and a represent constant terms, not variables), being direct applications of the second and the third formulae, are the simplest cases.

From the descriptive point of view the problem of negation in pre-Han Chinese is rather complicated because of the prolixity of 'negative particles'. This prolixity of negatives in Chinese reflects mainly historical stratification and various stylistic requirements (both logically irrelevant) rather than logical distinctions.[6] We still lack a comprehensive linguistic survey of the problem of negation in Chinese, while the more specific problem of double negation, which forms part of the former, has to my knowledge never been dealt with by grammarians, Western or Chinese, to any extent beyond a few most elementary observations.[7] It must be stated that the following discussion is by no means intended to be a full account of the linguistic aspects of the problem. In particular, historical and stylistic considerations which are logically irrelevant as well as the exemplification shall be reduced to a minimum. My sole intention is, first, to give the reader a sufficiently clear idea of how consistently the rule of double negation works throughout the grammatical system of Chinese at least since the Early Archaic period (that is, since the 11th cent.

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[6] Except for rather few cases, Chinese negatives are largely both synonymic and 'multifunctional' from the point of view of the logical analysis of language. This means that linguistic functions logically identical are performed by various negatives and that one and the same negative can perform functions logically more or less different.

[7] Such are, e.g., L e g g e's remarks in his *Chinese Classics, passim*, to the effect that two negatives "make a strong affirmative", which perhaps remain the most important contribution to our problem up to this day. Only recently W. A. C. H. D o b s o n included a short paragraph on 'dual negatives' in his *Early Archaic Chinese*, 1962, p. 46, but the problem was entirely omitted from his *Late Archaic Chinese*, 1959. Limiting ourselves to most recent works on Chinese grammar, we must note that in the three published volumes of such an ambitious work as is C h o u   F a - k a o's *Chung-kuo ku-tai yü-fa*, Taipei 1959—1962, there seems to be no explicit reference to the rule of double negation (although many examples involving this rule are cited at various occasions), no explicit distinction of sentence negation and term-negation, etc. It seems strange indeed that scholars who undertake the task of revealing and describing the grammatical s y s t e m of Chinese so easily leave out of consideration facts which — besides having a logical importance — are first of all grammatical and (as in the case of double negation) belong to the most consistent characteristic features of the linguistic system to be described.

B. C.),[8] and second, to show that all the varieties of the linguistic usage connected with this rule not only must have imposed on the Chinese mind the l o g i c a l principle of double negation, but also must have stimulated the intuitions lying at the bottom of the classical two-valued logic. As a matter of fact, we shall find that a logically and linguistically adequate interpretation of the rule of double negation operating within the linguistic system of Chinese, itself involves logical laws hardly compatible with the rejection of any of the basic assumptions proper to classical logic.

A few years ago A. C. G r a h a m made an interesting remark concerning the common negatives *pu* 不 and *fei* 非, namely that Chinese nominal sentences ("with a noun complement") are negated by *fei*, while verbal sentences (with a main verb or an adjective in the position of main verb) are negated by *pu*. He also proposed to make use of these facts as a kind of transformational criterium for deciding the class of a sentence, whether nominal or verbal.[9] It is convenient to start with these observations of G r a h a m ' s, which need the following qualification related to the problem of double negation. First, verbal sentences negated by *pu* themselves are negated by *fei*, and there is rich documentation for this procedure. Second, it appears that nominal sentences negated by *fei* themselves are negated by *pu* — although actual examples of this are extremely rare and probably there is none outside the chapter *King-shuo hia* of the *Mo-tsï*. Even if we limit ourselves to the richly documented *fei-pu* cases (to the exclusion of the *pu-fei* ones), there arises the question whether the procedure means that verbal sentences if once negated turn into nominal ones (as it appears to follow from G r a h a m ' s criteria) and, if so, whether the operation of negation itself can have the power of shifting a sentence from one class to another. Fortunately enough, this is a linguistic problem without bearing on the logical ones with which we are concerned, and it may be left out of consideration in this place. I content myself with signalising this problem as a linguistic corollary of the logical aspects of double negation, and one particularly related to the simplest structures corresponding to the formula $\varphi_1'' a \equiv \varphi_1 a$. A classical example in this connection is *Meng-tsï*, II, ii, 1, 3 (cf. L e g g e, *Chin. Cl.* II, p. 209):

城非不高也，池非不深也，兵革非不堅利也，米粟非不多也.

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[8] It seems that structures involving double negation are not attested for the earliest historical period of Chinese which we know of, that is, the proto-Archaic language of the Shang-In inscriptions from before the 11th cent. B.C., cf. K u a n S i e - c h ' u, *In-k'ü kia-ku k'o-ts'ï-ti yü-fa yen-kiu*, 1953, pp. 39—41. But in view of the specific character of the oracle inscriptions the lack of records would not necessarily mean that the structures themselves were non-existent in the language of that period. In the earliest literary documents (the authentic chapters of the *Shu-king*) double negation is amply attested, and structures of this kind also occur in the inscriptions on bronze vessels of the Early Chou time; cf., for instance, the inscription on the *Pan kuei*, reproduced in D o b s o n ' s *Early Arch. Chin.*, p. 180—181, in which double negation occurs twice. By the way, the second of these instances, if formalised, yields a fairly sophisticated formula, see *infra*, p. 125 ff.

[9] See BSOAS XXII, 3, 1959, p. 567; and "Asia Major" VII, 1—3, 1959, p. 88.

This simply means ($\varphi_1 a$): 'The city-wall *is* high, the moat *is* deep, the weapons *are* strong and sharp, the grain *is* abundant' — although each of the phrases as it stands has the *fei-pu* construction: 'The city-wall is not not high', etc., that is, $\varphi_1'' a$. Let it be remarked at once that already this first example, ultimately based on the propositional formula $p'' \equiv p$ as it is, runs counter the intuitionistic logic in which the implication $p'' \supset p$ is explicitly rejected.

One of the two *pu-fei* instances in *Mo-tsï* (*Harvard-Yenching Concordance*, 73/43/74) is:

馬不非馬 'Horse is (not not) horse'

which is clearly equivalent to 馬馬也. Although the linguistic form in the present case is largely similar to that of the first example, its logical sense is rather different. Perhaps the phrase is to be taken, first of all, as an unusual (and in some sense emphatic) statement of the identity of classes covered by the same nominal term, or rather as an application of such a statement to the class covered by the term 'horse' (A): $A \neq' A$ as equivalent to $A = A$.[10] But it goes without saying that the phrase can also be conceived in terms of class membership, — which yields the quantified formula: $\prod_x [(x \, \varepsilon'' A) \equiv (x \, \varepsilon A)]$.

The second type of logically simple constructions with double negation, that is, instances combining propositional negation with term negation according to the formulae of the kind $(\varphi_1' a)' \equiv \varphi_1 a$, may be exemplified by the phrase in *Tso-chuan*, Süan kung, 15th year (cf. L e g g e, *Chin. Cl.* V, pp. 326—327):

非我無信

which in perfect accord with our formula means: 'It is not that I do not keep to my faith' $[(\varphi_1' a)'] = $ 'I keep to my faith' ($\varphi_1 a$). The example also shows that if there is any sentence negation (in the linguistic sense of the term) in classical Chinese, it is again *fei*.[11]

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[10] This suggests that the general formula $\prod_X [(X \neq' X) \equiv (X = X)]$ and perhaps the still more general one $\prod_{XY} [(X \neq' Y) \equiv (X = Y)]$ — where X, Y are class variables — were not absent from the Mohist mind. For the logical multifunctionality of *fei* as 'negative copula' in phrases involving class terms, cf. RO XXVI, 1, p. 16.

[11] A word of warning must be inserted here that not all instances of *fei* in the initial position are those of sentence negation in the proper sense of the term. From our present point of view particular attention should be drawn upon the cases in which initial *fei* is apparently combined with a term negation, but the whole construction does not yield the equivalence of $(\varphi_1' a)'$ and $\varphi_1 a$, and, consequently, may seem to invalidate the principle of double negation as it operates in Chinese. In this connection the following complex phrase from the *Chuang-tsï* (*Harv.-Yench. Concord.* 58/22/14) is exemplary: 非不我應, 不知應我也 'Not o n l y did he not answer me ($\neq$ 'he answered me'), but he did not know how to answer me' (cf. L e g g e, *Texts of Taoism* II, p. 60). As can be seen from the context, in

From the logical point of view the most interesting instances of double negation are those in which explicit or implicit quantification is involved. Proceeding to these, we shall start with a comparatively simple case with the universal quantifier explicitly expressed. In *Meng-tsï*, V, ii, 4, 4 (cf. L e g g e, *Chin. Cl.* II, p. 380) we read:

$$凡民罔不譈$$

This means: '(Among) all the people there are none who do not detest (them)' =
= '(Among) all the people everybody detests (them)'. We are already familiar with the word *fan* 凡 as a common (although not the only) universal quantifier (all-operator) in Chinese, cf. RO XXVII, 1, p. 120, but for our present purpose the previous remarks must be expanded. Linguistically, the word *fan* stands in the determinant position to the subject it 'qualifies'; logically, this means that the restriction on the range of the quantifier is imposed by what immediately follows, that is, the nominal subject of the sentence. If *fan* by itself means "for every x: ..." $(\prod_x)$, 凡民 means "for every x which is 民: ...", that is, if we put $A = 民$, $\prod_{x \varepsilon A}$. As we shall see, the introduction of the notion of restricted quantifiers will prove to be useful also in the analysis of further examples; in the present case it is by means of the restricted quantifier just introduced that we can render best both the linguistic form and the logical intent of the phrase under discussion. If φ_1 is put for "detest (them)" and the negatives *wang* 罔 and *pu* 不 are duly rendered by the repetition of the functor of negation, we obtain the formula $\prod_{x \varepsilon A} \varphi_1'' x$ — which closely corresponds to both the logical structure and the linguistic form of the phrase as it stands and which is, both logically and linguistically, equivalent to $\prod_{x \varepsilon A} \varphi_1 x$.[12]

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this case the initial *fei* does not stand as propositional negation, but is pregnant for 'not only' and stands for some complex particle like *fei-t'u* 非徒, etc. Cf. C h o u F a - k a o, op. cit., *Syntax* I, pp. 335—337 (where however the author failed to notice that *fei* alone can be used in this specific function). As a matter of fact, the case spoken of is not one of double negation and its appearance of being so is due to the ambiguity of *fei*.

[12] A few philological remarks seem necessary in connection with the case just analysed. The sentence as it stands in the *Meng-tsï* forms part of an abridged and reformulated quotation from the *K'ang kao* chapter of the *Shu-king*, cf. L e g g e, *Chin. Cl.* III, p. 392; and B. K a r l g r e n, BMFEA no. 22, 1956, p. 41 § 15 (text) and p. 42 (translation). The chief difference between the original *K'ang kao* wording and the *Meng-tsï* quotation is that in the former between the initial restricted quantifier and the double negation there is inserted a series of phrases all of which refer to various kinds of 'villains'. Both L e g g e and K a r l g r e n understood the original *K'ang kao* wording as if the inserted phrases belonged to the range of the initial quantifier, cf. K a r l g r e n's translation of the passage: 'All people who draw guilt upon themselves, being robbers and thieves, etc...., there are none who do not detest them.' In the light of the logical analysis this is questionable,

One of the two instances of double negation recorded in the inscription on the *Pan kuei* (already mentioned supra, p. 122, footnote 8) deserves our particular attention. The logical complexity of the example will be seen from its analysis, but its full importance can be understood only in the light of the underlying historical and philological data. In this connection the following introductory remarks seem necessary, especially for non-sinological readers. The philological and historical value of the preserved inscriptional material is unique because of the simple fact that inscriptions — unlike the texts handed down by literary tradition, which, to say the least, had to be copied and recopied many times in various epochs, using various kinds of writing material, various kinds of script, etc. — are necessarily free from subsequent deformations, interpolations, and the like. As a matter of fact, regardless of all the difficulties connected with the deciphering and interpretation of the inscriptional material, early inscriptions are the most reliable and the only *sensu stricto* genuine kind of written documents of the Chinese antiquity. Now, the *Pan kuei* inscription, as is duly emphasised by D o b s o n, clearly refers to events which had taken place under the reign of the second Chou king, C h ' e n g, which reign according to the most cautious chronology must have extended over the last quarter of the 11th cent. B.C. (Some scholars would push the period in question further back). As can be seen from the context, the vessel itself must have been cast and the inscription engraved by (or on behalf of) a certain Pan, an eye-witness of the events, which means that the inscription is not later than 1000 B.C., and probably earlier than that. From the linguistic point of view it is important to note that the sentence we are concerned with forms part of what within the whole context is put forward as *oratio recta* quotation from Pan's own spoken utterance. In sum, it can safely be assumed that the sentence to be analysed represents the living colloquial usage in the Chinese language of the 11th cent. B.C. The sentence itself yields the following transcription in modern Chinese script:

文王孫亡弗懷刑

In translation: 'King Wen's grandson in nothing does not adhere to the model' = = 'King Wen's grandson in everything adheres to the model'.

In both reading and translation I largely follow D o b s o n, *Early Arch. Chin.*, pp. 179—184, but not without some qualification which deserves to be stated for clarity's sake. The last character of the sentence, which on the inscription itself has the form 井, is transcribed by D o b s o n as 型 'model', since, as he says

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and I think that the inserted phrases do not belong to the range of the initial quantifier but merely explain what 'all people detest'. Consequently, the correct translation would be: 'Among all the people — with regard to those who draw guilt upon themselves, are robbers or thieves, etc.... — there are none who do not detest them'. The present interpretation is also substantiated by the *Meng-tsï* quotation which is, in fact, a kind of 'transformation' operated on the original wording and in which two of the inserted *K'ang kao* phrases are involved but are positionally excluded from the scope of the quantifier.

(p. 179), 井 is a "common Western Chou orthographic convention" for 型. One can hardly agree with this statement (and the Chinese authorities on which it possibly is based), since the form 型, nowhere attested in Chou texts, is a late innovation (probably Han, or slightly earlier) which does not even figure in K a r l g r e n ' s *Grammata Serica*. All we can say is that 井 in the Chou inscriptions usually stands for 刑 (cf. D o b s o n ' s own transcription of the *Mao-kung ting* inscription, op. cit., p. 214), and so it is transcribed in the reading adopted here. The problem is not one of mere orthography, since the character *hing* 刑 is ambiguous and its principal meaning is 'punishments, laws, legal sanctions' rather than 'pattern of behaviour; model',—although it is attested in this latter meaning already in the authentic part of the *Shu-king* (ch. *Lo kao*). It follows that the expression *huai hing* 懷刑 at the close of the sentence may mean 'to adhere to the model' as well as 'to adhere to legal sanctions', and one can hardly decide that the first rendering is certainly the right one.[13] With all this, D o b s o n ' s rendering, although necessarily conjectural, makes good sense and can be retained, the more so as from the point of view of the logical analysis of the sentence the only important fact is that the expression *huai hing* is the explicit function term (which is beyond doubt), while the actual meaning of this function term is of no logical significance. Another point of difference between D o b s o n and myself is that he considers the initial noun group as a 'vocative' lying outside the sentence: "The grandson of King Wen! In nothing did he not adhere to the model [of King Wen]" (op. cit., p. 184). To my mind, there is no justification for this, and the phrase "King Wen's grandson" simply is the grammatical subject or topic of the sentence (logically: the object-argument). Grammatically, the sentence as it stands is rather simple since it consists of two explicit terms (nominal argument term and verbal function term) with two negatives, *wang fu* 亡弗, between them. At the first glance the sentence may appear structurally similar to the *Meng-tsï* instances of double negation analysed supra, p. 122—123.

Now, in contrast to this grammatical simplicity, the logical structure of the sentence is fairly complex and it largely differs from all the cases so far spoken of, since it evidently involves a quantified function-variable. If we put a to represent the argument *King Wen's grandson*, and ψ_1 to represent the function *adheres to the model*,

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[13] The more so as the only instance of the expression *huai hing* in the body of (later) Chou literature, *Lun-yü*, IV, 11 (L e g g e, *Chin. Cl.* I, p. 168), is precisely one of 'to adhere to legal sanctions'. By the way, D o b s o n ' s own inconsistency in dealing with 井 = 刑 as it stands in the *Mao-kung ting* inscription is a good example of confusion arising from the ambiguity of the character. The phrase 用先王作朙刑 is rendered in his 'literal translation' as "use/former Kings/make/ bright/model" (op. cit., p. 217), while his 'free translation' of the same reads: "avail yourself of the *penal statutes* made illustrious by the former Kings" (p. 219). To my mind, the *Mao-kung ting* phrase can plausibly be conceived as 'Take the former kings as illustrious model (for you)'; this is one of the reasons why I am inclined to think that the same word on the *Pan kuei* (which is of about the same period as the *Mao-kung* vessel) also means 'model' rather than 'laws'.

we have still to introduce the variable φ (without subscript) and the existential quantifier in order to render adequately the logical intent of the sentence as it stands:

$$[\underset{\varphi}{\Sigma} \ (\varphi a \cdot \psi_1' a)]'$$

It can easily be seen that this formula adequately renders the sense of the sentence if the formula itself be read in the following way: "It is not that: there is a function φ such that King Wen's grandson φ-ies and King Wen's grandson does not adhere to the model" — which is a sophisticated and linguistically highly artificial way of saying what is just said by the Chinese sentence and its first English rendering supra, p. 125.[14] Our formula also has the advantage of making clear the specific rôle of double negation, *wang fu* 亡 弗, in the present case, which rôle is largely different from that of two negatives simply cancelling each other. In the present case it is only the negative *fu* which — like *pu* in the *Meng-tsï* examples previously analysed — negates the explicit function term, *huai hing* (= ψ_1). On the other hand, the negative *wang* — although positionally as close to *fu* as *fei* was to *pu* in the *Meng-tsï* examples — does not simply negate the already negated function term ψ_1', but plays a logically complex rôle, different from that of *fei* in any instance so far spoken of. It is precisely this negative *wang* which (logically and in some sense linguistically) involves non-explicit quantified function-variable φ, and o n l y then negates the conjunction of both the quantified function-variable it itself has involved and the explicit function-term negated by *fu*.[15]

So much concerning the analysis of the sentence as actually formulated in Chinese and corresponding to the first English rendering on p. 125. But there can be no doubt that the sentence had been meant as 'strongly affirmative' in the sense of its second English rendering, — which yields the following formula:

$$\underset{\varphi}{\Pi} \ (\varphi a \supset \psi_1 a)$$

that is, "for every function φ: if King Wen's grandson φ-ies, King Wen's grandson adheres to the model".[16] Since both interpretations are linguistically equivalent,

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[14] By the way, we can make the formula correspond more closely to the linguistic form of both the Chinese sentence and the English rendering if we write it as $a \ [\underset{\varphi}{\Sigma} \ (\varphi \cdot \psi_1')]'$, that is, with a = "King Wen's grandson" as subject and the complex expression $[\underset{\varphi}{\Sigma} \ (\varphi \cdot \psi_1')]'$ = "in nothing does not adhere to the model" as predicate to this subject. This, of course, would be against the conventions accepted by logicians, but not against logic. Practically, nothing forbids us to devise a system of logistic notation which would better correspond to the linguistic structure of Chinese than do the systems now in use. Cf. the 'quasi-formalisation' of the *Mo-tsï* reasoning in my *Notes...* (*IV*), RO XXVIII, 2, p. 110.

[15] This latter point is perhaps made clearer by the unorthodox formula of the predicate, $[\underset{\varphi}{\Sigma} \ (\varphi \cdot \psi_1')]'$, given in the preceding footnote.

[16] The present formula can also be given the unorthodox form: $a \ [\underset{\varphi}{\Pi} \ (\varphi \supset \psi_1)]$, the bracketed part corresponding to what linguistically is the predicate.

we can safely assume the following formula of equivalence:

$$[\underset{\varphi}{\Sigma}\,(\varphi a \cdot \psi_1' a)]' \equiv \underset{\varphi}{\Pi}\,(\varphi a \supset \psi_1 a)$$

which, I think, will be clear to anybody who has followed the preceding analysis. It must be emphasised at once that this formula — although arrived at by means of linguistic considerations on our Chinese example — is at the same time a good (even if perhaps unusual) tautology of the classical logical calculus. The Chinese example just discussed and leading to our final formula must have been unknown to L e g g e, but if we look at it in the light of L e g g e ' s rule that "two negatives make a strong affirmative" (cf. supra, p. 121, footnote 7), we have to state that the 'strengthening' of the linguistic effect in the present case simply consists in making use of the logical laws governing quantifiers, in particular those concerning the transition from existential to universal quantifiers by means of negation.

The very fact that in the Chinese language of the 11th cent. B.C. we actually detect such sophisticated instances of double negation as the one just analysed is, to say the least, highly interesting. Still more important from our present point of view and for more than one reason are the logical implications of this fact. First, our formula of equivalence arrived at by the logical analysis of a purely linguistic phenomenon indirectly involves one of the so-called D e M o r g a n ' s laws for quantifiers, which, on the whole, are hardly valid within a calculus lacking any of the basic assumptions of the classical logic. Second, since D e M o r g a n ' s laws usually are formulated for quantified object-variables and the one here concerned has the form $(\underset{x}{\Sigma}\,\varphi' x)' \equiv \underset{x}{\Pi}\,\varphi x$, it follows that what our formula of equivalence directly involves is a specific and rather unusual application of the law to quantified function-variables, namely $(\underset{\varphi}{\Sigma}\,\varphi' a)' \equiv \underset{\varphi}{\Pi}\,\varphi a$, rather than the law itself. This, in turn, emphasises the highly sophisticated quality of both our formula and the linguistic use of double negation it represents, the more so as quantification of function-variables is not very common in Western logic. Third, as is known, D e M o r g a n ' s laws for quantifiers involve the principle of excluded middle, and the one inherent in our linguistic equivalence, $(\underset{x}{\Sigma}\,\varphi' x)' \equiv \underset{x}{\Pi}\,\varphi x$, is explicitly rejected by the intui-tionists; it follows that our equivalence itself involves the logical law of excluded middle. Fourth, not only does our formula involve a specific application of D e M o r g a n ' s law to the quantification of functions, but also — owing to the complex quality of the scope of the quantifier — it involves the transition from negated conjunction in the first expression to non-negated implication in the second. Now, transformations of the type $(\varphi a \cdot \psi' a)' \equiv (\varphi a \supset \psi a)$ are directly based on the propositional tautology $(p \cdot q')' \equiv (p \supset q)$ which together with the logical law of double negation leads to the law of (non-)contradiction.[17] In sum, the conclusion

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[17] As a matter of fact, if we posit the logical law of double negation $p'' \equiv p$ and the propositional tautology $(p.q')' \equiv (p \supset q)$ which is clearly involved in our formula based on the linguistic equivalence, we easily obtain the law of (non-)contradiction $(p.p')'$ by means of elementary transformations.

to be drawn from the present analysis is evidently this: provided that the Chinese sentence just discussed really corresponds to both its first and second English rendering on p. 125, — which, I think, can hardly be questioned by any sinologist — the specific linguistic use of double negation involved in the sentence can be interpreted in the most natural (if not the only) way within the framework of the classical two-valued logic. For my part, I do not see the possibility of any adequate or nearly adequate interpretation of our linguistic example in the framework of any 'dialectical' logic in N e e d h a m's sense of the term (that is, a logic rejecting the basic assumptions of the classical calculus, cf. *Sc. & Civ.* II, p. 201).

A specific and common type of double negation in Chinese deserving our attention is the combination of the negative 莫 *mo* with some other negative particle (mostly *pu* 不). This *mo* itself is sometimes considered by the Chinese grammarians as functionally equivalent to the common negative *pu*, but only late and unconvincing examples are given for this,[18] so that the linguistic equivalence *mo = pu*, if any, is a later development. The principal linguistic quality of *mo* has been defined as that of a negative pronoun corresponding to the English word 'none'[19] or that of an 'agential distributive' (D o b s o n), but nobody to my knowledge has ever noticed the specific logical rôle of *mo* within the linguistic system of Chinese. Now, in pre-Han Chinese *mo* is first of all the linguistic word for what logically is *zero-quantifier*. This means that *mo* is not a simple functor of negation (as are for instance *pu* and *fei*), but a negative operator equivalent to the negation of the existential quantifier. Thus, we have to revert for a while to the problem of quantification in logic and that of linguistic quantifiers in Chinese.

Mathematical logic does not make use of zero-quantifier since the operation it performs can easily be defined by means of either the existential or the universal quantifier and negation.[20] Consequently, there is no symbol for this quantifier in

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[18] Cf. Y a n g S h u - t a, *Ts'ï-ts'üan*, ed. of 1957, p. 26.

[19] Cf. for instance C h o u F a - k a o, op. cit., *Substitution*, pp. 233 ff. (also for *mo* in various contexts, including those of double negation).

[20] As a matter of fact, either of the two quantifiers commonly used in the logical calculus can be defined by means of the other plus the functor of negation in accordance with D e M o r g a n's rules already referred to. This means that theoretically only one quantifier (no matter whether existential or universal) would do in logic. Such a limitation however would lead to considerable complications of the formulae and would needlessly make the calculus itself strongly different from the ordinary language (in which words like 'some' and 'all' or 'every' are frequently used). On the other hand, the introduction of the zero-quantifier ('none') in addition to the existential and universal ones — although logically unnecessary — not only is necessary for our present purpose, but seems useful from the point of view of the logical analysis of natural languages in general. In classical Chinese, for instance, it is precisely the zero-quantifier *mo* ('none') which is of much higher frequency than other linguistic quantifiers ('some', 'all'). In other words, the ordinary logical calculus entirely eliminates the zero-quantifier on behalf of the two others, while in classical Chinese, inversely, the use of the universal quantifier is often eliminated by that of the zero-quantifier. Curiously enough, the zero-quantifier *mo*, so common

the ordinary logistic notation, and we have to introduce such a symbol for our own purpose. We shall write the zero-quantifier: Z_x, to be read: "for no x: ...", and shall define it by means of equivalences:

$$ \underset{x}{Z}\varphi x \equiv (\underset{x}{\Sigma}\varphi x)' \qquad \text{and} \qquad \underset{x}{Z}\varphi x \equiv \underset{x}{\Pi}\varphi' x $$

Both definitions themselves are, of course, equivalent $((\underset{x}{\Sigma}\varphi x)' \equiv \underset{x}{\Pi}\varphi' x$ simply is one of D e M o r g a n ' s laws) and, theoretically, one of them would do to define the newly introduced symbol, but it is useful to remember both for further considerations. Now, the first equivalence shows that the zero-quantifier actually is nothing else but the negative counterpart of the existential quantifier, which does not affect the original scope of the (existential) operator; this can be made clearer if we write the first equivalence somewhat unorthodoxically as $\underset{x}{Z}\varphi x \equiv (\underset{x}{\Sigma})'\varphi x$. As we shall see in a while, this intimate (although negative) connection between the zero-quantifier and the existential quantifier is not without philological importance in Chinese, since it leads to a plausible hypothesis concerning the etymology of the word *mo*. The second equivalence, in turn, is important in so far as it allows us to interpret the instances with *mo* in terms of universal (negative) statements and, in particular, to interpret the instances of double negation with *mo* as 'strongly affirmative' according to the slightly different but obvious variant of the equivalence $\underset{x}{Z}\varphi' x \equiv (\underset{x}{\Pi}\varphi'' x \equiv)\ \underset{x}{\Pi}\varphi x$.

The problem of the etymology of *mo* requires a few remarks on the system of linguistic quantifiers in pre-Han Chinese and the position of *mo* within this system. Besides the universal quantifier *fan* 凡 (already referred to supra, p. 124), which is rather isolated since it has no specific counterpart for existential quantification, there is a complete series of quantification words consisting of *kie* 皆 (universality), *huo* 或 (existentiality) and *mo* 莫 (non-existentiality)[21]. Unlike *fan*, words of this series cannot stand in the determinant position to the grammatical subject; they are put after the subject, if any. Logically, this means that restriction upon the range of such quantifiers is imposed by the nominal expressions which precede them, but it must be noted that all these words (and especially *huo*) frequently occur as unrestricted quantifiers (without nominal subject before them). Not all of these quantification words originally belong to the same chronological level of Chinese, and the whole series appears to be in common use only since the Middle Archaic period. In particular, it may safely be assumed that *huo* is the oldest member of the series (since it is rather richly attested in the authentic parts of the *Shu-king* and also has some paleographic documentation), while *mo* certainly is of a later appearance, not earlier than the *Shï-king* (since it does not figure in the genuine

in the classical language, has entirely disappeared from modern spoken Chinese (not only from standard Pekinese, but also, as it seems, from all dialects).

[21] Cf. A. C. G r a h a m, *The Logic of the Mohist Hsiao-ch'ü*, "T'oung Pao" LI, 1, 1964, especially pp. 11—14.

chapters of the *Shu* and lacks any paleograhic documentation). These chronological considerations show that *mo* 'none' may well be a secondary formation.

From the logical point of view, the etymology of *mo* as the actual negative counterpart of the existential quantifier (*huo*) is to be sought, first of all, in complex expressions of the type *negative* + *huo* to which *mo* directly corresponds. Such dissyllabic expressions, *wu huo* 無或 and (to a lesser extent) *wang huo* 罔或, '(there is) not any' = 'none' are, in fact, sufficiently attested in early texts (the genuine chapters of the *Shu* and *Tso-chuan*).[22] It is also significant that these expressions entirely disappear from Late Archaic texts in which *mo* becomes a high-frequency word (we do not find instances of *wu huo* in such extensive later texts as *Mo-tsï, Chuang-tsï* and *Sün-tsï*). Both logical and philological evidence inevitably leads to the assumption that *mo* should be a blend of *wu huo* or *wang huo* (or both), which replaced the original dissyllabic formations, and this, in fact, finds strong corroboration at the phonetic level. For *mo* is Archaic $**m\hat{a}k$, and independently of all the controversies over K a r l-g r e n's system of Archaic reconstructions there is no doubt that both *wu* 無 and *wang* 罔 had an initial *m-*, while *huo* 或 was a *ju-sheng* word with final *-k* — which itself gives a sufficient phonetic framework for our 'logical' hypothesis. More specifically, according to K a r l g r e n's reconstructions we obtain: $**m\underset{.}{i}wo\text{-}g'w\vartheta k >$ > $**m\hat{a}k$ or $**m\underset{.}{i}wang\text{-}g'w\vartheta k > **m\hat{a}k$, which both appear to be good phonetic formulae for $**m\hat{a}k$ (*mo*) as resulting from an allegro contraction of the original dissyllabic formations into a single monosyllable. In sum, the present etymological hypothesis — which to my knowledge has so far never been put forward in the discussions on 'fusion words' in Chinese — is highly probable, if not certain, and it is perhaps worthy of note that the problem itself has been suggested by the logical analysis of Chinese.

Instances of double negation *mo* (= *wu huo*) + *negative*, corresponding to the equivalence $\underset{x}{Z}\varphi'x \equiv \underset{x}{\Pi}\varphi x$, occur by scores in nearly every Chinese text since the Middle Archaic period. The exemplification here must be limited to one single instance; I choose a slightly more complicated one, with a nominal subject, that is, one involving *mo* as restricted zero-quantifier. In *Chuang-tsï*, 73/26/1 (cf. L e g g e, *Texts of Taoism* II, p. 131) we have:

人主莫不欲其臣之忠

In translation: 'None of the rulers does not wish his ministers to be loyal' = 'Alll

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[22] By the way, K a r l g r e n's emendation of the two *wu huo* cases in the *K'ang kao* chapter of the *Shu* into 無惑 'do not erroneously...' (BMFEA no. 20, p. 289; and no. 22, pp. 40—41) is highly questionable and, to my mind, has rightly been rejected by D o b s o n, op. cit., p. 71. Two further instances of *wu huo* in the *Shu* (*P'an Keng* and *Lü hing*) are accepted *tels quels* by K a r l g r e n, and there are others in the *Tso-chuan*. Not less questionable is K a r l g r e n's emendation of the *wang huo* instance in the *Wen hou chï ming* chapter of the *Shu*, BMFEA no. 21, p. 196; and no. 22, pp. 78—79. — The fact that *wu huo* sometimes occurs in injunctive contexts ('let there be not any...') has no bearing on our problem.

rulers wish their ministers to be loyal'. As is easily seen, restriction upon the range of *mo* is imposed by the grammatical subject 人 主 'rulers' = A; thus, the first three characters are to be rendered symbolically as $Z_{x \varepsilon A}$. Furthermore, representing the function "wishes his ministers to be loyal" by φ_1 we obtain the formula of the whole sentence: $Z_{x \varepsilon A} \varphi_1' x$. The 'strongly affirmative' sense of the sentence (according to the second English rendering) yields: $\Pi_{x \varepsilon A} \varphi_1 x$, that is:

$$Z_{x \varepsilon A} \varphi_1' x \equiv \Pi_{x \varepsilon A} \varphi_1 x$$

which, of course, is a particular case of the general formula of equivalence given supra, p. 130.

It is convenient to close this short review of the linguistic and logical aspects of double negation in pre-Han Chinese by a few remarks on the rhetorical-interrogative particle *k'i* 豈 'is it that...?'.[23] The specific quality of this initial particle (sometimes put after the exposed subject) is that it implies an answer in the negative: 豈 *p* 'is it that *p*?' is largely equivalent to 'surely, it is not that *p*'.[24] Now, if this *k'i* is combined with a functor of negation (mostly *pu* or *fei*), it is equivalent to an answer in the positive, that is, the negation implicit in *k'i* is cancelled by the other negative inherent in the sentence to which *k'i* is prefixed: 豈 *p'* means 'is it that not-*p*?' = 'surely, it is that *p*'. Let this again be exemplified by a single instance drawn this time from the *Sün-tsï*, 71/19/28 (cf. H. D u b s, *The Works of Hsüntze*, p. 224):

禮豈不至矣哉

In translation: 'Is it that *li* (rules of conduct) is not the greatest (of all principles)?' = 'Surely, *li* is the greatest'. Thus, the problem of *k'i* takes us back to the simplest cases of double negation, that is, the cancelling of negatives.

The foregoing discussion together with its exemplification (necessarily limited as it was) inevitably leads to at least two conclusions. The first is that the rule of double negation works throughout the linguistic system of Chinese with a remarkable consistency, the functioning of the rule admitting of no exceptions and involving rather sophisticated cases which cannot be reduced to a simple 'cancelling of negatives'. The second conclusion is that all these linguistic instances of double negation from the simplest to the most complex ones (involving zero-operator and the like) can be adequately interpreted in the most natural and uniform way within the classical logic. I do not venture to say that this constitutes a sufficient formal basis for

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[23] The particle does not figure in D o b s o n ' s *Early Arch. Chin.*, since it is not attested in the inscriptions and does not appear in the samplings of literary texts selected by the author for his description of the Early Archaic language. It must however be noted that *k'i* actually occurs in the (authentic) *P'an Keng* chapter of the *Shu*, cf. K a r l g r e n, BMFEA no. 22, p. 22 and 24, paragraph 26.

[24] Cf. D o b s o n, *Late Archaic Chinese*, p. 153, where however the rôle of *k'i* in connection with the problem of double negation has not been clearly stated.

all the fundamental principles of the classical logic, but I have to emphasise once more that these principles must have been at least intuitively implicit in the Chinese rule of double negation which, consequently, must have had its part in the shaping of early Chinese logical thinking in the sense of the classical two-valued logic. In particular, the principle of non-contradiction, so vigorously challenged by N e e d- h a m on behalf of "the dialectical and many-valued logics of the post-Hegelian world" (*Sc. & Civ.* II, p. 201) and claimed to be non-existent in early Chinese logic because of the 'dialectical' character of this latter, not only appears to be implicit in some linguistic cases of double negation (see supra, p. 128 and footnote 17), but also is explicitly referred to more than once in early Chinese philosophical writings, as we shall see, in a fairly sophisticated way. Before proceeding to this, it is necessary to say a few words on the position of the principle itself in modern logic and its various formulations within the various kinds of logical calculi.

As is known, A r i s t o t l e, who devoted to the principle of contradiction a whole book in his *Metaphysics*, exaggerated the rôle of this principle as an alleged ἀρχή of all other principles of logic and one on which allegedly all forms of logical reasoning are ultimately based (cf. I. M. B o c h e ń s k i, *Formale Logik*, p. 71). It is also known that a considerable 'positive' fragment of logic can be constructed which is independent of this principle, but in which there are no theorems involving the functor of negation.[25] On the other hand, an expansion of this 'positive' logic to a more comprehensive one, making use of negation as a logical functor, inevitably involves the principle of contradiction already at the intuitionistic stage (not to speak of the complete logical calculus). Thus, improving on A r i s t o t l e's standpoint in the *Metaphysics*, we have to state that the actual rôle of the law of non-contradiction is not that no logical reasoning is possible without it, but that the law is unavoidably involved in any form of deductive reasoning transgressing the 'positive stratum' of logical thinking. From the point of view of the logical practice, it is particularly important to note that this law is directly resorted to in any form of *reductio ad absurdum* (occurring also in Chinese philosophical texts), and that any such form of reasoning becomes impossible, if not meaningless, if the principle of contradiction be rejected.[26] In other words, only a fragmentary logical calculus — but not a complete one — is possible without this very principle which N e e d h a m rather astonishingly would like to dismiss from Chinese thought and which for some obscure reason is stigmatised by him as a hindrance to scientific thinking. Irrespective of all the exaggerated statements expressed by A r i s t o t l e with regard to the principle of

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[25] Cf. A. G r z e g o r c z y k, *Zarys logiki matematycznej* [= *Outlines of Mathematical Logic*, in Polish], Warszawa 1961, pp. 85—86. In some sense, Chinese propositional calculus previously described (cf. also supra, p. 117) is such a kind of 'positive' logic, and its fragmentary character is largely due to this 'positivism'. On the whole, however, early Chinese logic could hardly stop at such a 'positive' stage precisely because of the principle of double negation, so strongly imposed by language and directly involving negation as a logical functor.

[26] I shall revert to this particular problem later on, in ch. VIII of my *Notes*.

contradiction, it is certainly not because of this principle that the Aristotelian logic (in its traditional guise) proved to be an inadequate tool for scientific research. This fact is largely due to the limited character of syllogistics which — although actually nothing more than a specific and rather narrow calculus of classes — was unjustifiably considered up to the middle of the 19th cent. a complete and nearly perfect system of deductive logic. Such an assumption must have hindered the development of other branches of formal logic, much more important for science than syllogistics, that is, the calculus of functions and, in particular, the calculus of relations — in which however the principle of non-contradiction is as unavoidable as it is in the Aristotelian logic, provided that we want to go beyond the 'positive stratum' and arrive at a more or less complete kind of calculus. I willingly agree with N e e d h a m' s statement to the effect that "relation... was probably more fundamental in all Chinese thought than substance" (*Sc. & Civ.* II, p. 199), but a few points must at once be emphasised in this connection. First, the rôle of relations in Chinese thought — which indeed appears to be greater than in early Western thought — is largely due to the influence of the linguistic structure making Chinese a natural quasi-calculus well adapted for spontaneous reasoning in terms of functions (cf. my *Notes... (IV)*, RO XXVIII, 2, pp. 87—111); second, this emphasis on relations hardly has anything to do with the fact that early Chinese thought was "unfettered by Aristotelian logic" and by the principle of non-contradiction in particular. As a matter of fact, the most sophisticated explicit references to non-contradiction in Chinese texts as well as the actual instances of reasoning most directly resorting to this law are precisely those formulated in terms of relations.

The principle itself usually is given the propositional form $(p.p')'$ which, of course, is equivalent to $\underset{p}{\varPi}\,(p.p')'$. It must however be noted that even within the propositional calculus this latter formula is to be expanded, since contradiction occurs not only with the conjunction of two propositions of which one differs from the other merely by the functor of negation, but also with any pair of propositions of which one i m p l i e s the negation of the other. Thus, we obtain the following expanded formula of the law for contradictory propositions which do not differ by mere negation:

$$\underset{pq}{\varPi}\,[p \cdot q \cdot (q \supset p')]'$$

Furthermore, similarly to the principle of double negation (cf. supra, p. 120), the law of non-contradiction can be given various formulations in the symbolism of various logical calculi. Thus, for the calculus of one-place functions and that of relations (two-place functions) we have the following main formulae:

$$\underset{x\ \varphi}{\varPi\varPi}\,(\varphi x \cdot \varphi' x)' \qquad \text{and} \qquad \underset{xy\ R}{\varPi\varPi}\,[(xRy) \cdot (xRy)']'$$

which are mere translations of the main propositional formula and which admit of further modifications. The rejection, if any, of the principle of non-contradiction actually means that the final symbol of negation in such formulae is to be removed, for instance, $*\underset{x\ \varphi}{\varPi\varPi}\,(\varphi x \cdot \varphi' x)$, to be read: *"for every object-argument x and every function φ:

φ of x and non-φ of x." Consequently, such a formula represents the standpoint that every positive and every negative statement concerning the same thing are equally true — which amounts to the assumption that e v e r y proposition is equally true — and this is precisely what N e e d h a m appears to postulate for both the logic of science and the 'dialectical' logic of the Chinese. There certainly must be some misunderstanding in all this, and one must also be warned against a 'weaker' interpretation of the rejection of the law, namely in the sense that the dropping of the final negation in our formulae should be combined with the change of the universal quantifier (or quantifiers) into existential one(s), for instance $*\Pi\Sigma_{x\,\varphi}(\varphi x \cdot \varphi' x)$. This latter formula, to be read as: *"for every x there is a function φ such that φ of x and non-φ of x", does not make the impression of a total rejection of the law. It goes without saying that a thesis to the effect that some — but not all — pairs of contradictory propositions about an object are equally true may look attractive for some philosophically-minded people and probably would be accepted by them as a *medium aureum* between the total acceptance and the total rejection of the law. Unfortunately, this cannot be the issue of our problem, since the logicians and mathematicians teach us that if contradiction be admitted in one single case, whatever proposition would imply whatever other proposition, that is, every proposition would become 'true'. Thus, our 'weaker' formula turns out to be practically equivalent to its stronger counterpart (with universal quantifiers), and we inevitably have to choose either the total acceptance of the law of non-contradiction (as represented by the first four formulae given above and their derivations) or its total rejection. I venture to pronounce myself for the first alternative, and this also appears to be the case with at least some of the early Chinese thinkers.

The technical Modern Chinese term for 'contradiction' is *mao-tun* 矛盾 (= *mao-shun* 矛楯), literally 'spear (and) shield', and it is convenient to start the discussion of the explicit references to (non-)contradiction in pre-Han philosophical texts with a story — better known to linguists and etymologists than historians of Chinese philosophy — which besides being closely connected with our main problem at the same time explains the origin of the unusual Chinese term. In the body of pre-Han literature the passage appears more than once. In the *Han-fei-tsï* it is quoted twice, in ch. 36 (*Nan-i*) and (in a slightly different wording) ch. 40 (*Nan-shï*); moreover, another version of the story has been preserved in Y a n g S h ï - h ü n ' s commentary (of the T'ang period) to the *Ku-liang chuan*, Ai kung, 2nd year, where the story itself is put forward as a quotation from the *Chuang-tsï*.[27] Curiously enough, the passage which is of undeniable logical import and is, in fact, a kind of rather

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[27] Y a n g S h ï - h ü n ' s record deserves emphasis insofar as the *Chuang-tsï* is the principal among the early texts of Taoism and constitutes one of the main sources for N e e d h a m ' s 'dialectical' conception of early Chinese (and mostly Taoist) logic. It must however be noted that there is no corresponding passage in the *textus receptus* of the *Chuang-tsï*, and the story must have belonged to the lost chapters of this extensive text, cf. F u T i n g - i, *Lien-mien tsï-tien*, vol. VII, s.v. *mao-tun*.

sophisticated definition of contradiction together with the explicit rejection of self-contradictory statements, has so far remained unnoticed by nearly all historians of Chinese philosophy, both Chinese and Western.[28] I give the Chinese text as it stands in the *Nan-i* chapter of the *Han-fei-tsï*, *Sï-pu ts'ung-k'an* ed., III, f. 2v:

楚人有鬻楯與矛者, 譽之曰: 楯之堅, 莫能陷也. 又譽其矛曰:吾矛之利, 於物無不陷也. 或曰: 以子之矛陷子之楯, 何如? 其人弗能應也. 夫不可陷之楯與無不陷之矛, 不可同世而立.

· In translation:

"In Ch'u there was a man selling shields and spears; he praised (his shields) saying: "(My) shields are so strong that nothing can pierce them". And again he praised his spears saying: "My spears are so sharp that there is nothing they do not pierce". Somebody asked him: "How about your spear piercing your shield?" The man was not able to reply. *Now, a shield which cannot be pierced and a spear for which there is nothing it does not pierce cannot stand at the same time".*

It is clear that the story involves contradictory statements about 'spears and shields', — which latter expression actually came to be used for 'contradiction' in Chinese.[29] But in spite of its intuitive clarity, the passage involves a very specific case of contradiction, yields a fairly complicated formalisation, and certainly gives

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[28] The only exception I know of is H o u W a i - l u, T u S h o u - s u and K i H ü a n - p i n g, *Chung-kuo sï-siang t'ung-shï*, ed. of 1951, vol. I, pp. 532—533 (where however no formal analysis of the passage is attempted). I follow the punctuation of the passage as given in this work, but not the emendations, none of which has any significance for our purpose.

[29] This only means that the passage just quoted is the ultimate source of the Modern Chinese *mao-tun*, and I think that the term in its technical sense must have come into Modern Chinese via Sino-Japanese (*mujun; mujunritsu*, Chin. *mao-tun-lü*, 'law of contradiction'). This term is not listed in the recent repertory of loan-words in Chinese, K a o M i n g - k ' a i and L i u C h e n g - t ' a n, *Hien-tai Han-yü wai-lai-ts'ï yen-kiu*, Peking 1958, and the authors obviously consider it a purely Chinese formation. But as is known, a considerable part of Modern Chinese technical and learned vocabulary had actually been coined by the Japanese (although often on the basis of classical and post-classical Chinese texts) and only subsequently reborrowed by the Chinese themselves since the end of the 19th cent. Probably this is also the case with *mao-tun*, the more so as the formation is not easy to trace in post-classical Chinese literature. There are only very few and rather ambiguous instances of the use of the term in post-classical epoch; the clearest one is perhaps that in the biographies of L i Y e - h i n g (*Wei-shu*, ch. 84; and *Pei-shï*, ch. 81): 卿言豈非自相矛楯 'Are not your words, Sir, self-contradictory?' I also wonder whether the expression 持矛楯 occurring in a poem by H a n Y ü and rendered by E. v. Z a c h (*Han Yü's Poetische Werke*, 1952, p. 93) literally as "(wir) verteidigten uns mit Speer und Schild" does not actually mean 'holding contradictory (opinions)'. That is nearly all I could trace, but it would be useful to see whether the term does not occur in Chinese Buddhist texts and also in early textbooks on Western logic translated or compiled by the Jesuits.

evidence of the logical keenness of the early Chinese mind. The last sentence of the passage, stating the impossibility of the conjunction of the contradictories involved in the story, deserves special attention, since it inevitably reminds us of what A r i s t o t l e says about contradiction (cf. B o c h e ń s k i, *Ancient Formal Logic*, p. 39), and even the expression 同 世 'at the same time' used by the Chinese author recalls the Greek ἅμα in the Aristotelian definitions. On the other hand, the main differences between the Aristotelian definitions and the Chinese passage just quoted appear to be as follows. First, A r i s t o t l e's formulations are more abstract than the Chinese example in which rather concrete terms are used; second, A r i s t o t l e formulates general laws to the effect that contradiction as such is impossible, while the Chinese example only illustrates contradiction (and its rejection) by means of a particular case; third, A r i s t o t l e has in view contradictory qualities in reference to one and the same object (or contradictory propositions about the same object), while the Chinese author formulates contradiction in terms of relations between objects.[30] It follows from the last point that A r i s t o t l e's definition can be adequately formalised within the calculus of one-place functions (cf. B o c h e ń s k i, ibidem), while the Chinese example requires (rather complicated) formalisation in terms of the calculus of relations.

Proceeding to the formalisation itself, we must remember that the Chinese weapon-dealer puts forward two statements as equally true, first, that there are shields (namely his shields) which nothing can pierce; second, that there are spears for which there is nothing they do not pierce (= which pierce everything; please note the occurrence of double negation also in this context). In the last sentence the Chinese author himself takes the position which, I think, will be shared by any modern logician or mathematician, and rejects the conjunction of the two statements as impossible. Keeping closely to the language of our text, we shall have to start with rather complex formulae involving restricted quantification.[31]

Let A represent the *class of spears* and B the *class of shields*; let R_1 stand for the relation *pierces*. If so, the first statement put forward by the weapon-dealer can be adequately rendered as $\sum\limits_{y \varepsilon B} [\sum\limits_{x} (xR_1y)]'$, while the second statement leads to the formula $\sum\limits_{x \varepsilon A} [\sum\limits_{y} (xR_1y)']'$. The conjunction of both is:

$$*\{\sum\limits_{y \varepsilon B} [\sum\limits_{x} (xR_1y)]'\} \cdot \{\sum\limits_{x \varepsilon A} [\sum\limits_{y} (xR_1y)']'\}$$

Transforming both members of the conjunction according to D e M o r g a n's rules for quantifiers and putting the second member in place of the first and *vice versa* (according to $q \cdot p \equiv p \cdot q$), we get a slightly clearer formula

$$*[\sum\limits_{x \varepsilon A} \varPi_{y} (xR_1y)] \cdot [\sum\limits_{y \varepsilon B} \varPi_{x} (xR_1y)']$$

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[30] This is perhaps in line with N e e d h a m's statement concerning the importance of relations in Chinese thought, cf. supra, p. 134.

[31] I wish to acknowledge my indebtedness to Dr. A. E h r e n f e u c h t, Institute of Mathematics of the Polish Academy of Sciences, for valuable help and advice in the formalisation of the Chinese example now under discussion.

which however is not yet clear enough to allow us immediately to see the contradiction involved, since the second member obviously is not a direct negation of the first. None of the factors can be directly transformed in a way to yield the negation of the other factor, and to show that for some x and some y there actually is contradiction in the conjunction as it stands, we shall proceed by substitution.

Let a be such an x which stands in the first member of the conjunction; thus we obtain:[32]

$$*[\underset{y}{\Pi}(aR_1y)] \cdot [\underset{y \varepsilon B}{\Sigma}(aR_1y)']$$

Again, let b be such a y which stands in the second member of the conjunction; thus we get:

$$*(a\ R_1\ b) \cdot (a\ R_1\ b)'$$

Furthermore, since a is, after all, an x, and b a y, we finally derive the following formula as implied by the conjunction we have started with:

$$*\underset{xy}{\Sigma}[(xR_1y) \cdot (xR_1y)']$$

This, as is easily seen, is in flagrant incompatibility with the law of non-contradiction as formulated in terms of relations supra, p. 134. As a matter of fact, this latter formula, if negated as it should be according to both the requirements of the classical logic and what is said by the Chinese author in the last sentence of our passage, immediately yields a specific application of the law of non-contradiction to the given relation R_1:

$$\{\underset{xy}{\Sigma}[(xR_1y) \cdot (xR_1y)']\}' \equiv \underset{xy}{\Pi}[(xR_1y) \cdot (xR_1y)']'$$

I think that this rather lengthy and complicated analytical procedure — without which however one could hardly realise the specific logical background of our Chinese example — itself shows that only a sophisticated mind could have invented the whole story as an illustration of what contradiction is, and condemn this very specific case of contradiction on behalf of its contrary.

(*To be continued.*)

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[32] The substitution x/a can also be effectuated in the second member of the conjunction. The fact that in the first member x is bound by the restricted quantifier, $\underset{x \varepsilon A}{\Sigma}$, while in the second it is bound by the unrestricted one, $\underset{x}{\Pi}$, does not matter here, since the unrestricted universal quantifier embraces also all such x which happen to be A. Similarly for the substitution y/b.