Dignāga's Logic of Invention*

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1 Introduction

In this paper the Indian Buddhist logic of the Middle Ages is connected to methodological aspects of logic, especially to the idea that logic can serve as an *organon*, e. g., as a tool for discovering novelties. Research on this idea can be characterized by questions like "Is there a logic of invention?", "What is the role, if any, of deductive logic in creative processes?", "What is the role of logic in philosophy of science, especially in a philosophy of science which takes the context of discovery into account?"

In Europe the sensitivity for the great efforts of Indian logic is mainly due to J. M. Bocheński's appreciation for it as expressed, e. g., in his *Formale Logik* of *1956*. Bocheński regarded Dignāga, who lived from about 480 to 540 A. D., as the Indian Aristotle. For Bocheński the Indian experience was even one of the cornerstones for his reflections on a general theory of the historical development of logic. The development of logic was in fact not a continuous one starting with Aristotle and ending with modern mathematical logic, but a series of ups and downs, full of unconscious re-inventions, and it started from a double root, the ancient Greek and the ancient or medieval Indian logic.

It might be worthwhile to sum up Bocheński's results, despite the fact that most of his positions have been disputed in the last 45 years of research. Bocheński devoted the sixth (and final) part of his *Formale Logik* to the "Indian Variety of Logic".[1] He stressed that logic arose in two distinct cultural areas, in the Occident and in India, and the Indian Buddhist logician

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[1] Available in English translation in Bocheński *1961*, recently reprinted.

Dignāga was for him a paradigm case, like his classical Greek counterpart, Aristotle (*1956*, 13). Bocheński was aware of the fact that even the Indian variety of logic was not a homogeneous one. He especially pointed out the differences between the epistemological directions of the Nyāya tradition and the Buddhist branches, the latter representing, according to his opinion, "an outspoken extensional tendency" (16).

Bocheński distinguished three branches in Indian logic which are connected to different religious directions (481). I will restrict my investigation to the Buddhist branch, for Bocheński the most important of these schools, represented by Vasubandhu, his ingenious student Dignāga, "maybe the greatest logician of India", then Dignāga's commentator Dharmakīrti and the commentator of the last, Dharmottara, all of them writing between the fourth and the ninth century A. D. Bocheński resumed that the formation of formal logic fell into these centuries. It was definitely existent already in the seventh century: "Starting from a methodology of public discussion, a real and correct, although in many respects elementary, formal logic had arisen" (483).

Bocheński reconstructed the development of Buddhist logic as a temporal succession in five steps (499):

1. Formulation of a formal rule for syllogism in the *trairūpya* theory.

2. Development of formal syllogistic in the *hetucakra*, Dignāga's wheel of reason.

3. Simplification of the syllogism.

4. Introduction of the word "*eva*" ("only").

5. Formation of the notion of a general law and other technical terms.

In the following I will be concerned only with the first two steps.

In his final evaluation Bocheński said that Dignāga's syllogistic was still completely determined by examples. Dignāga was not able to entirely free himself from the pressure of the methodological tradition (506). This criticism is a clear indicator of Bocheński's one-sided preference for *formal* logic. At several places he polemically depreciated all non-formal directions of logical theory. This is also the reason for Bocheński's isolated interest in formal aspects of the *hetucakra*. He, like later commentators, pointed at the differences between the Indian and the Greek forms of formal logic. Indian logic, he said, had no knowledge of variables, and furthermore a pronounced intensional tendency (516–517). In respect to the *hetucakra* he stressed that it was a bad, but nevertheless a formal logic (505).

Almost at the same time, in 1959, the great Viennese Indologist Ernst Frauwallner stressed the glory of Dignāga as the founder of the logical-epistemological school of Buddhism. According to Frauwallner Dignāga combined what was existent in rudiments at his time, Vasubandhu's dialectic, Sāṃkya's epistemology, and elements from the philosophy of language of the grammarians, to errect a big building the whole later school was dependent of (Frauwallner *1959*, 83). He characterized Dignāga's revisions with the help of considerations concerning the relation between reason and consequence. In the older tradition of Indian dialectic inferences by analogy were common. Working with examples stood in the core of this tradition. If there was an example showing that a reason and a consequence were connected, it was concluded that if in a given case the reason existed the consequence existed as well. With counter-examples it could be dealt in a similar way. If an example showed that the absence of a reason was connected with the absence of a consequence, it was inferred that if there was a reason in a given case there was also the consequence (Frauwallner *1959*, 93). Furthermore, the inference from an absent reason to an absent consequence was common at that time. Dignāga ended this unsatisfying state by fixing the relation between reason and consequence with the help of his wheel of reason.

The *Hetucakraḍamaru*, the drum of the wheel of reason, as the Sanskrit title would have to be translated into English, is the first of Dignāga's works on logic (cf. Frauwallner *1959*, 88–89), a short manuscript, but extremely influential for the development of Indian logic. It was originally written in Sanskrit, but only a Tibetan translation survived. In the given documents the proper *hetucakra*, i. e., the wheel of reason, is represented by a 3×3 matrix. The structure is thus not that of a wheel, but of a rectangular. Nevertheless it should be interpreted as an octogon or a circle with a central element (see Fig. 1). Otherwise the cryptic verses 8 and 9 were not intelligible, as Lambert Schmithausen has shown in a recent note (Schmithausen 1999).

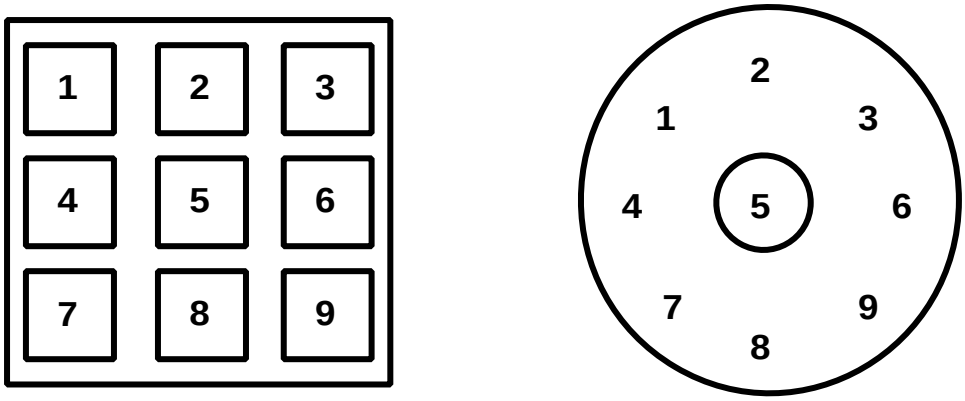

Fig. 1 (following Glashoff 1999*, 81)*

Let me now present the text which might give you an impression of the difficulties one is confronted with in attempting to interpret it. I will take the translation from Vijay Bharadwaja's book *Form and Validity in Indian Logic* from 1990 (16–18):

Text of Dignāga's *Hetucakranirṇaya*,
known in Tibetan as
gtan tshigs kyi hkhor lo gtan la dbab pa
Obeisance to *Mañjuśrikumārabhūta*

1. After obeisance to the Omniscient (Buddha) who is the destroyer of the snares of ignorance, the determination of *hetu* with threefold characteristic is pointed out.

2-4a-b. There will be the presence, the absence as well as both the presence and the absence (i. e. presence in some part, while absence in another) of the *hetu* in the *anumeya* (that which is to be proved *probandum*). If there be the presence of *hetu*, the conclusion will be correct, while the absence thereof will make it invalid. If there be both the presence and the absence (of the *hetu* in the *anumeya*) the conclusion will be doubtful just like an invalid one.

3c-d-4a-b. There will be the presence, the absence as well as both (of the *hetu*) in the *sapakṣa* (that which is analogous to the *pakṣa* – *anumeya* or the object of inference). And similarly in the *vipakṣa* (that which is opposed to the *pakṣa*) there will be the presence, the absence, as well as both the presence and the absence of the *hetu*. So there will be three classes of the threefold *hetu* (i. e. nine varieties in all).

4c-d-5a-b. The *hetus* at the top and the bottom (in the middle of the *hetucakra* or the table of *hetus* i. e. nos. 2 and 8) are valid, while those on the two sides (in the middle of the *hetucakra*, i. e, nos. 4 and 6) are contradictory. The *hetu* is uncommon (*asādhāraṇa*) in the centre (i. e. no. 5) and (the *hetus*) in the four corners (i. e. nos. l, 3, 7 and 9) are common (*sādhāraṇa*).

5c-d-6a. (The *hetus* in the several divisions of the *cakra* are respectively as follows):

(1) *prameya* (knowable), (2) *kṛtaka* (effected), (3) *anitya* (non-eternal), (4) kṛta (effected), (5) *śravaṇa* (audible), (6) *yatnaja* (made by efforts), (7) *anitya* (non-eternal), (8) *yatnaja* (made by efforts), (9) *amūrta* (incorporeal).

6b-7a (1) *nitya* (eternal), (2) *anitya* (non-eternal), (3) *prayatnaja* (made by efforts), (4) *nitya* (eternal), (5) *nitya* (eternal), (6) *nitya* (eternal), (7) *ayatanaja* (not made by efforts), (8) *anitya* (non-eternal), (9) *nitya* (eternal).

These (nine) beginning with the *nitya* are put (in the *cakra* as *sādhyas*) those that are to be proved.

7b-8a. There are two valid *hetus* in the middle at the top and the bottom (i. e. in nos. 2 and 8 of the *cakra*), and two contradictory *hetus* in the middle at the top and the bottom (i. e. in nos. 4 and 6 of the *cakra*).

8b-9a. There are four uncertain (*anaikāntika*) *hetus* in the four corners (i. e. in nos. 1, 3, 7 and 9 of the *cakra*). And the *hetu* is uncertain and uncommon (*anaikānta asādhāraṇa*) in the centre (i. e. in no. 5 of the *cakra*) obtained by the cross connection of the four corners.

9b-c. The table of nine *hetus* is what has been now described.

9d-11a. (The *dṛṣṭāntas* or examples in the table are as follows):
(1) *nabhaghaṭavat* (like the space and the pitcher), (2) *ghaṭākāśavat* (like the pitcher and the space), (3) *ghaṭavidyudviyadvat* (like the pitcher, the lightning and the space), (4) *viyadghaṭavat* (like the space and the pitcher), (5) *ākāśaghaṭavat* (like the space and the pitcher), (6) *viyadghaṭataḍidvat* (like the space, the pitcher and the lightning), (7) *vidyudākāśaghaṭavat* (like the lightning, the space and the pitcher), (8) *ghaṭavidyudviyadvat* (like the pitcher, the lightning and space), (9) *ākāśāṇukarmavat* (like the space, atom and action).

11b-f. What was taken up (for discussion) has thus been determined. With regard to the problem (of the *hetu*) which is very difficult owing to doubts, there is the *cakra* consisting of nine cases based upon the presence, the absence and both the presence and the absence (of the *hetu*).

The text deals with the relations between reasons, theses and examples. The constellation can be represented by the schema in Fig. 2. All the examples are dealing with sound. Let me give you only two of them (cf. Bharadwaja *1990*, 19):

1. (a) Sound is eternal
   (b) because it is knowable like the space and the pitcher.

Given the *hetucakra*, this example represents a case of the constellation in corner 1. It is not acceptable because the reason is common, i. e., so general that it would equally support the contrary of the thesis, namely "sound is non-eternal".

The second argument runs:

2. (a) Sound is non-eternal

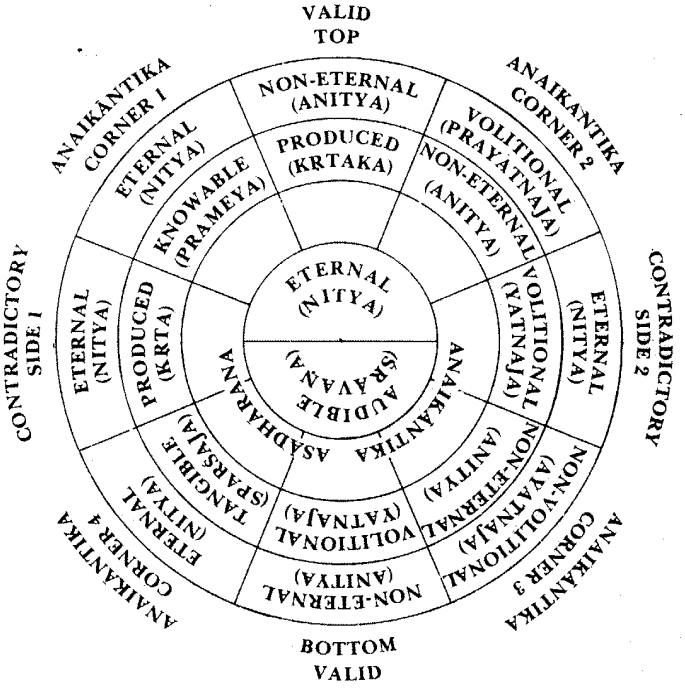

Fig. 2 (Bharadwaja 1990*, 24)*

(b) because it is produced like a pitcher and the space.

This argument is a good argument. It represents the case on top of the *hetucakra*.

Already from these few examples it is clear that the *hetucakra* serves as a method to determine the conditions a reason has to follow to be a good reason for a given thesis. It is furthermore a quasi-mechanical device to check given arguments whether they are valid or not.

One can now ask, what are the justifications for the reason–thesis combinations represented by the *hetucakra*? They are justified by the *trairūpya* theory giving the three conditions for a reason, i. e., requirements for valid inferences, in determining what is and what is not a reason (cf. Bharadwaja *1990*, 2; Potter *1977*, 191–195). These conditions are the following:

1. The reason advanced in justification of the thesis must be relevant to the thesis.

2. It must support the thesis.

3. It must not support the opposite of the thesis.

I have followed Bharadwaja's interpretation based not on the cryptic texts, but on the examples given there.

For my purpose it is not important to determine whether the *trairūpya* theory antedates the *Hetucakraḍamaru* or not. Some documents, however, seem to indicate this assumption (cf. Bharadwaja *1990*, 1). More important is Klaus Glashoff's thesis that the *trairūpya* theory is formulated and proved in the *hetucakra* which therefore gives the theoretical base of the former. Consequently he claims that it makes no sense to use the *trairūpya* theory for explaining the entries of the *hetucakra*. This interpretation might follow from Glashoff's approach to explain the *hetucakra* by interpreting it in terms of Aristotelian syllogistic logic, an approach he shares with most other modern commentators. They employed even in their translations the conceptional framework of deductive, extensional logic, using, e. g. "middle term" for *hetu*, i. e., reason, or "minor term" for "*pakṣa*", i. e., the thesis. They used furthermore graphical means like Venn diagrams (like Chi *1969*) or Carroll diagrams (like Glashoff *1999*). This way of interpretation begins already with Satis Chandra Vidyabhusana, the early historian of Indian logic. He interpreted inferences in Indian logic as Aristotle style syllogisms (cf. e. g. *1920*, 289–299). The syllogistic approach was elaborated by scholars like H. N. Randle (cf. *1924*; *1930*, 182) and was still employed by R. S. V. Chi (cf. *1969*, e. g., xv–xvix, xxiv–xxx). The latter also used the predicate calculus as an interpreting device like the Polish Stanisław Schayer before him in the 1930s (cf. Schayer *1932–33*, *1933*).

As mentioned above, most interpreters discuss the *Hetucakraḍamaru* as an instantiation of a deductive, extensional logic, a view which is disturbed, however, by Dignāga's extensive use of examples. Stcherbatsky remarked (*1959*, 282): "The Indian Syllogism indeed is not only the formulation of a deductive reasoning, it also contains an indication of that Induction which always precedes Deduction." According to Stcherbatsky the examples give the individual facts of which the general rule, or major premise, is a generalization. Later he speaks of the central inductive-deductive process of thinking. For him, it seems "impossible or quite artificial" to cut this process into two different halfs, induction and deduction. "Both are complementary of one another and cannot be separated otherwise than in abstraction" (299). These words show that Stcherbatsky as well argues from the perspective of European 19th century (philosophical) logic, although he does not exclusively follow the paradigm of deductive extensional logic.

The approach of reducing Indian logic to Aristotelian syllogistic and other forms of Occidental logic has been severely criticized. Recently it has even been called "the colonization of reason" (cf. Ganeri *2001*), a judgment I consider as much to harsh. I partially follow Glashoff who insisted on using modern logic as a tool-box for discussing old Indian texts in order to uncover the structure of argument and to determine the points where the Occidental

and the Indian approaches deviate from each other.[2] This conceded, one has to state, however, that modern logic has nevertheless some blind spots, not only in its relation to its Indian predecessors, but also in general. These blind spots concern especially the *organon* aspect of logic, i. e., the usage of logic as a tool for finding the truth or even new knowledge. I refer to the *ars inveniendi*, or the art of finding the truth, and the *ars iudicandi* or the art of evaluating given assumptions presumed to be true which traditionally belong to the methodological part of logic.

Let us return to the *Hetucakraḍamaru* in order to illustrate this assessment. The wheel of reason provides an aid for determining the validity of a given argument. It gives the criteria for the choice of possible premises for a valid inference. It lists the possible relations between three different types of theses and three different types of reasons in a combinatorial form. Each of the resulting combinations is evaluated asking whether it is valid, invalid or doubtful. The wheel of reason works therefore as a quasi-mechanical device for

1. checking a given argument whether it is valid or not. The wheel of reason can therefore be used as a tool for the *ars iudicandi*,

2. helping to find for a given thesis the reasons necessary for providing its validity, because it lists the conditions a valid argument has to follow. The wheel of reason plays, thus, also a role within an *ars inveniendi*.

Given this reconstruction, it makes no sense to investigate in the "logic of the *hetucakra*", but only in the "logic underlying the doctrine of the *hetucakra*." The *hetucakra* is therefore the expression or the codification, better the application of a logic elaborated elsewhere. It is a natural approach to take the *trairūpya* theory as a suitable candidate for such logic. I have no problems to accept that this theory can be analyzed using the means of syllogistic or modern logic, but I have problems to accept that the *hetucakra* itself represents anything like an Indian syllogism or that it is itself formal logic. I therefore contradict Randle's claim that the *Hetucakraḍamaru* gives "a formal scheme of nine valid and invalid types of inference which appear to be the earliest specimen of formal 'syllogistic' in Indian logic" (Randle *1930*, 225). The analysis of the *trairūpa* theory and the *hetucakra* might even lead to the conclusion that both are no formal logic at all, as Bharadwaja (*1990*, 15) and Matilal (*2001*, 199) have claimed.

This reconstruction does not determine a unique Indian way of dealing with arguments. My analysis in terms of the *ars inveniendi* and the *ars iudicandi* shows already in the choice of terminology that I see similarities

[2] Glashoff *1999*, 79. A similar position is supported by Matilal *2001*, 199–201.

with developments in Occidential logic. These analogies should, however, not be looked for in the history of formal logic, but in the history of general methodology, i. e., in applied logic. Similarities can be found in what has been called "the method of analysis and synthesis" which gives some sort of general approach to research in mathematics and in the sciences. The *locus classicus* for the method of analysis and synthesis is book VII of the *Collection* of Pappus of Alexandria, the great commentator of Euclid's *Elements*. Let me quote the respective passage (Pappus *1986*, 82):

> Now, analysis is the path from what one is seeking, as if it were established, by way of its consequences, to something that is established by synthesis. That is to say, in analysis we assume what is sought as if it has been achieved, and look for the thing from which it follows, and again what comes before that, until by regressing in this way we come upon some one of the things that are already known, or that occupy the rank of a first principle. We call this kind of method "analysis", as if to say *anapalin lysis* (reduction backward). In synthesis, by reversal, we assume what was obtained last in the analysis to have been achieved already, and, setting now in natural order, as precedents, what before were following, and fitting them to each other, we attain the end of the construction of what was sought. This is what we call "synthesis".

What could be the role of the *hetucakra* in such a process of analysis and synthesis? The *hetucakra* marks the results of a general analytic enterprise. It codifies these results in the wheel which can now be used as a pattern in order to shorten further analyses. The fact that it is a quasi-mechanical device does not reduce its value within creative processes. Take as an example the great master of logical methodology, Gottfried Wilhelm Leibniz, who used deductive methods like combinatorics, syllogistic and algebraic or arithmetical logical calculi for inventing new truths. He always tried to employ these means for routine tasks, he even invented mechanical calculators designed to free man from this routine work.

The combinatorial character of the *hetucakra* lets come to one's mind the *ars magna* of Raymundus Lullus. Lullus used the method of combining concepts with the help of tables and wheels for the mission of non-Christian heathens. The *ars magna* was a tool for answering all possible questions concerning the Christian God. First of all a question had to be analyzed in its whole complexity. The basic concepts employed in this question were listed, then combined with each other. The possible combinations had then to be checked step by step with the aim of formulating an answer which takes all relevant aspects into account.

The process of such regressive analysis is, of course, no deductive process. It is not logically determined, but contains elements of intuition and arbi-

trariness. In most cases, it is furthermore not a formal process, but a process which usually takes the contents of given statements into account. It leads to basic elements which then can serve as starting points of deductions. This could be one of the tasks of the *hetucakra*. Statements following the provisions of the *hetucakra* for valid arguments could be used as such starting points of deductions. So it has even a function in the synthetic part of the method of analysis and synthesis.

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