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Natural Laws, Accidental Generalizations And Vyāpti*

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The problem of demarcation between natural laws and accidental generalizations is still an outstanding problem in Philosophy of Science. Though the problem no longer occupies the centre stage yet I do not think that it has been satisfactorily resolved to be kept waiting at the wings. On the contrary, one always faces this problem with a growing sense of unease. All our instincts signal that there is a distinction, our reason demands that the distinction be made, but unfortunately the distinction cannot be clinched. Scores of solutions have been offered to the problem from different concerned quarters but all of them are subsequently found to be abortive. This paper is another attempt at finding a demarcation criterion between nomic generalizations and accidental generalizations following the Nyāya analysis of *vyāpti*. To set the stage, first, I shall discuss very briefly the criteria so far offered and why they fail; then I shall try to explain why I think that the adoption of the Nyāya technique may be of some help and how actually the distinction may be drawn.

I

Search for genuine invariants in nature is the hall-mark of any scientific endeavour and belief in the existence of such genuine invariants is central to our web of beliefs. A natural law statement is a statement of genuine invariance to which there has been no exception, there is no exception and there will be no exception. In other words, law statements are universal generalizations. These are also empirical generalizations and synthetic in nature. For we have learnt from Popper that statements like "All unsupported bodies fall", "All planets of the sun move in an elliptical orbit" etc., can have the honorific "scientific" if and only if these are empirically falsifiable in principle and consequently cannot be analytic in nature.

Natural laws are hypothetical in character. Both in logic and in science universal propositions are interpreted hypothetically. For

example, "Iron rusts when exposed to exygen" is to be translated into "If x is a piece of iron, all instances of it will rust when exposed to oxygen"; symbolically, (x) $((\phi x.\psi x) \supset \gamma x))$ where ϕx, ψ, γx stand for "x is iron", "x is exposed to oxygen", "x rusts" respectively. The hypothetical character of natural laws explain how they cover the ideal cases which cannot have any direct evidence in support of them. Consider the statement: "A freely falling body is uniformly accelerated by the gravitational force of the earth". We know for certain that there is no freely falling body. So what is intended is: "If x is a freely falling body, x will be uniformly accelerated etc.". But we must note that despite its hypothetical import this is a law statement not because it is vacuously true but because it is a logical consequence of Newton's theory of gravitation.

Even though law statements do not make any existential claim, still these can be easily differentiated from ficititious general statements by virtue of their connections with some established laws. Thus the general proposition.

All unicorns are red

is non-referential and when expressed in hypothetical form simulates a natural law. But as we do not have any direct or indirect evidence in support of/against such a proposition, it does not have any claim to the nomic status.

Mere universality of hypothetical import, however, is not a sufficient characterization of a nomic generalization. A law statement is always a statement of unrestricted universality. Hence though both the following statements.

(a) All the paintings on the north wall of this art gallery are painted by Moquebul Fida Hussain;

and

(b) All the planets in our solar system move in an elliptical orbit;

are universal propositions of hypothetical import yet the proposition about paintings does not qualify as a law statement, but the proposition about planets does. For (a) is limited to a definite space-time region, viz., the north wall of the art gallery and the time of making the statement but (b) does not involve any spatio-temporal restriction and can be easily counted as a law statement.

So here emerges the first point of distinction between law statements and non-law statements. In case of non-law statements the number of instances covered are finite and this finiteness is very often

inferred from the terms of the statements themselves. But then, one may wonder, how can Kepler's law of planetary motions be regarded as a natural law? The obvious answer is: though the number of planets is certainly fixed, this fact cannot be deduced from the law itself. Besides, Kepler's law will be applicable in case of an unlisted planet too, but we cannot predict anything about unobserved instances of a now-law statement. Moreover, a generalization like (a) is only a summative report of what has been observed to be the case whereas the law statements are the results of what William Kneale calls "ampliative induction".[1] In an ampliative induction we can proceed beyond the observed instances but in a summative induction the generalization is reached by complete enumeration of actually observed instanced. Popper emphasizes the same point in "A note on natural laws and so-called counterfactual conditionals"[2] when he describes the following characteristics of a natural law. Natural laws, says Popper, are statements which may be (A) introduced by the often suppressed phrase "For all (finite) regions of space and periods of time", (B) not containing any reference to any singular or particular thing or event or space-time region, and (C) stating that things or events of a certain kind (e.g. two planets moving in different directions round a central body) do not occur. The adjective "finite" in clause (A) signifies that natural laws are realizable in all space-time regions having a history exactly similar to the actual world but differing only in initial conditions.

So the important point that we have arrived at is that natural laws are unrestricted universals whereas non-law statements involve some spatio-temporal restrictions. But we cannot distinguish non-law statements from law statements so easily. For there are non-law statements which are unrestricted generalizations and are not obtained by complete enumeration, e.g., "All crows are black", "Foxes are clever", "Royal Bengal Tigers have black and yellow stripes on their tail", etc. The question is whether these are instances of laws or not and if not, what is lacking in them? But surprisingly philosophers of science except Mackie have kept themselves preoccupied with the less intriguing problem of demarcation between non-laws which are in fact restricted universals and law statements without addressing the more difficult problem of demarcation between nomic unrestricted generalizations and non-nomic unrestricted generalizations. Following in the footsteps of the stalwarts I shall also tackle the easier problem first and then concentrate on the difficult one.

When the issue is the distinction between restricted universal statements and unrestricted nomic universal statements, it has been

shown that the former can also be relieved of all sorts of spatio-temporal specifications by broadening or restricting their antecedents strategically with a little ingenuity. Thus a generally accepted non-law statement

All the envelopes in my stamp album are first day covers

can be so qualified that any reference to specific space or time may be avoided. We can find out some general property which only these envelopes happen to possess and then qualify the given statement by ascribing those properties as follows.

All the envelopes preserved in the stamp album with "International" mark on the front page and owned by a fastidious fat lady of forty four are firstday covers.

So a non-law statement can be expressed in as unrestricted a form as a nomic generalization. Conversely, Nelson Goodman[3] points out that even an unrestricted generalization can be expressed in a way that contains a reference to particular individuals or specific places and times. For instance, the unrestricted universal proposition.

All men are mortal

has an equivalent in

All men in Calcutta or elsewhere are mortal.

It is, therefore, evident that spatio-temporal restriction is not an adequate criterion of demarcation between nomic and non-nomic generalizations.

Another widely accepted criterion of demarcation is the ability to sustain a counterfactual conditional. It is said that only those synthetic universal statements which can warrant counterfactuals are law statements. Non-law statements or accidental generalizations cannot sustain a counterfactual. Right at this point, I think, I should explain the term "accidental". The use of the term should not be taken to mean that such generalizations are true by accident in the sense that there is no causal explanation of their truth, but only that they may concern transient property relations and hence lack genuine invariance. Now both nomic and accidental generalizations are expressible in the general form

For every x, if x is S, then x is P.

But only nomic generalizations seem to warrant statements of the forms

(i) If a which is not S, were S, a would be P

and

(ii) For every x, if x were S, s would be P.

Let me elucidate this point borrowing a few examples from Chisholm in "Law statements and counterfactual inference".[4]

L.1. Everyone who drinks from this bottle is poisoned.

L.2. All gold is malleable.

These two are Chisholm's example of law statements and the following are examples of non-law statements.

N.1 Everyone who drinks from this bottle wears a necktie.

(We are to suppose that L.1 and N.1 refer to the same bottle containing, say, arsenic.)

N.2. Every Canadian parent of quintuplets in the first half of the 20th century is named "Dionne".

Ordinarily speaking L.1. is not a law statement. The proper formulation of the law statement should be: Everyone who drinks arsenic is poisoned. For the person who is poisoned is not so because of this bottle but because of arsenic contained in the bottle. If anybody had taken arsenic from any other container or even straight from a source of water contaminated by arsenic, he would have been poisoned. Moreover, when we make a statement with reference to a particular bottle, our statement becomes spatio-temporarily limited and there is every possibility of confusing such a statement with an accidental generalization. Even then, I am sticking to this example because it can highlight the point which I want to bring to your notice.

Now, with the help of the different pairs of examples mentioned above we may proceed to the following assumptions. Since the law statements warrant the corresponding counterfactuals, from L.1 and L.2 we can infer:

L.1.1. If Jones had drunk from this bottle, he would have been poisoned.

and

L.2.1. If that metal were gold, it would be malleable.

But from N.1 and N.2 we cannot justifiably infer

N.1.1. If Jones had drunk from this bottle, he would have worn a

neck-tie.

and

N.2.1. If Jones, who is Canadian, had been a parent of quintuplets in the first half of the 20th century, he would be named "Dionne".

This discrepancy in logical power of nomic and non-nomic generalizations is probably due to the fact that counterfactuals are capable of having two interpretations. The antecedent of a counterfactual "If a were S" may be interpreted either as "If a had been S" or as " If a were identical with something which has the property S". This being the case, the above counterfactuals admit of interesting analysis. For instance, N.2.1. is false according to first interpretation but true according to the second. If Jones were identical with one of the Dionnes, he would be named "Dionne". On the other hand, the statement.

N.2.2. If Jones, who is Canadian, had been a parent of quintuplets during the first half of the 20th century, there would have been at least two sets of Canadian quintuplets,

is true according to the first interpretation and false according to the second.

Popper,[5] however, has observed that the difference between L-group of statements in their logical force is only apparent. Popper offers the following analysis in support of his position. From a universal statement like

(1) All A's are B's

We can always inter the indicative conditional

(2) If x is one of the A's, then x is one of the B's.

and we can also infer its corresponding counterfactual

(3) If x were one of the A's, then x would be one of the B's. but we can never deduce

(4) If x were added to one of the A's, then x would be one of the B's.

The reason behind this is quite clear. Since natural law statements are unrestricted generalizations and results of ampliative induction their antecedents can always be extended to unobserved instances. But including a new and unobserved instance of the same kind into the antecedent class is no charter for extending it to an unobserved

instance of a different class. We must not confuse this distinction with class addition. Thus if the counterfactual counterpart of our given natural law, viz., "all men are mortal" is

(5) If x were a man, x would be moral,

it means that x who is added to the class "man" does not belong to some different class, say, that of "mythical gods". So (5) can only mean.

(6) If x, who was not considered when we made (5), were identicalwith one of the members of the class "man", he would be mortal.

That is, under no circumstances the subject term of an unrestricted universal statement could be so extended as to change its original meaning. Similarly from the statement

(7) All my friends speak Bengali

we cannot deduce

(8) If an aborigine of the Toda Tribe were a friend of mine, then he would speak Bengali

For by (8) one intends to assert

(9) If an aborigine of the Toda Tribe were to be added to the group of people whom I call my friends, then he would speak Bengali.

And this is a statement of type (4). But from (7) we can deduce a statement of the form (3), i.e.,

(10) If an aborigine of the Toda Tribe were identical with one of my friends, then he would speak Bengali.

From the above analysis it is clear that both law statements and accidental generalizations are amenable to the same interpretation and both reject the possibility of class addition. So Popper maintains that there is no real difference in the logical forces of these two types of statements and natural laws can very well be reduced to universal material implications. There is no need to make obvious their supposedly superior natural force by any modal inflexion.

William Kneale,[6] however, is opposed to the reduction of natural law statements to universal implications. He upholds against Popper that natural laws are *principles of necessitation* and their unique status should be reflected in the logical notation which we want to

adopt. Characterization of natural law statements merely as unrestricted material implications is neither logically sufficient nor intuitively adequate. Kneale expounds this thesis with his famous moa example. As Kneale's story goes, moa is an extinct species of bird that were found only in Newzealand. The biological structure of moas was such that they could have survived sixty years or more under favourable conditions but due to unfavourable conditions, say, presence of a certain virus, no moa ever crossed the fifty year mark. Under the circumstances the universal statement

All moa dies before reaching the age of fifty

is true but cannot be accepted as a law statement. For, according to Kneale's assumption, it would have been possible for a moa to live longer and it is only due to accidental conditions that a moa did not live longer. If the above universal generalization were a genuine law satement, then it would have been impossible to be a moa and live more than fifty years. This is what Kneale means by saying that natural laws are "Principles of necessitation" or "principles of impossibility".

Popper counters Kneale's argument by showing that Kneale is wrongly conflating physical necessity with logical necessity. Law statements are physically necessary but not logically necessary. A logically necessary statement holds in any conceivable world but a physical necessary statement is true only in the actual world or in worlds structurally similar to it. Kneale denies this distinction. To him, conceivability of the contradictory of a proposition constitutes disproof of necessity both in mathematics and in physical science. Popper, on the contrary, is very emphatic in his assertion that"conceivable" does not have the same meaning in logical and physical contexts. A statement is logically conceivable if it is not self-contradictory but a statement is physically conceivable if it does not go against a natural law. Law statements are more kindred to contingent statements than to logical tautologies, simply because these have a contingent character which is derived from the fact that laws state relations among structural properties of the world and there may be structurally different worlds. So the only way one can distinguish between a law and a conjecture is by applying a negative criterion of physical necessity, i.e., by finding out structurally similar worlds in which a supposed law turns out to be invalid, we may prove that it is not physically necessary.

J.L. Mackie[7] proposes another criterion of demarcation between *the laws of working* and *accidental regularities involving collocations.* According to Mackie, accidental regularities are accidental insofar as

they are about actual particular circumstances that just happen to go together. A law statement, on the other hand, is characterized by strict universality and continuity in some form.

What transpires from the Kneale-Popper controversy and Mackie's intervention is that the problem of differentiating law statements from accidental generalizations virtually defies solution if we are to *prove conclusively* the non-accidental connection said to obtain in laws. Absolute necessity that Kneale talks about can be demonstrated only to a superhuman intelligence. Even weaker necessity of Popperian variety or strict universality and continuity recommended by Mackie continue to elude us. Philosophers belonging to Humean tradition, therefore, assert quite strongly that all human knowledge being purely contingent, the question of distinguishing between contingency and necessity within human knowledge does not arise at all. Quine[8] concurs with this view and holds that not only natural laws, even the laws of logic and mathematics are equally revisable. Certain laws appear to be able to provide consistent explanation of certain phenomena in a given system and within certain boundary conditions and to this extent are deemed to be "true" or "valid" and remain so until these are disproved or a more complete and accurate explanation is available. Natural laws and accidental generalizations, therefore, differ only in the degree of our belief in them.

Now the degree of our belief in any generalization depends on various factors, e.g., its predictive power, its acceptability, availability of sufficient evidence in its favour, etc. Let us consider these factors one at a time. Can the predictive power of a natural law serve as an adequate criterion of demarcation? The answer is: no. A definition of a law in terms of its predictive function fails to distinguish it from accidental generalizations even though it can exclude vacuous principles from the range of law statements. For predictions can be made only when there remain unobserved and untested instances of laws. So a true statement that had been used predictively would no longer be a law when none of its instances remain undetermined. To avoid this difficulty the definition may be reformulated as

> A general statement is lawlike if it is acceptable prior to the determination of all its instances.

where the phrase "prior to determination of all its instances" means that the acceptance of a law should not depend upon the determination of any particular instance.

Nelson Goodman points out that this definition is defective for two reasons. First, "acceptable" is a dispositional term and dispositional

terms are condensed counterfactuals. Since a counterfactual cannot be asserted justifiably without asserting its corresponding law, any attempt to define a law in terms of a counterfactual is considered tricky. Second, the acceptance of a sentence depends on the availability of adequate evidence and the definition is sure to lead to the riddles of induction and confirmation.

Goodman, therefore, offers projectibility as the criterion of demarcation. Unlike accidental generalizations a law statement, says Goodman, has the capability of being projected not only from past cases to future cases but also from known cases to unknown cases. But the concept of projectibility raises the problem of induction in a sophisticated form. Goodman attempts to determine projectibility of a hypothesis in terms of "entrenchment" and entrenchment is another name of establishing hypothesis on the basis of good inductive evidence. But the moot question remains: what constitutes good inductive evidence for a generalization?

People have generally considered our evidence for a general statement good on the ground of its being supported by repeated observation of positive instances along with the absence of negative instances. Goodman himself has shown that conformity to enumerative pattern fails to provide sufficient warrant for an inductive generalization. Let us dwell on this point *a la* Goodman. Suppose that all emeralds observed so far have been green. This fact leads us to conclude inductively that all emeralds, future as well as past, are green. Let us now introduce a new predicate "grue" which is defined as follows.

> An object at time t is grue if it is green at t and t is before 2000 A.D. or it is blue at t and t is after 2000 A.D.

Now if we, who are living before 2000 A.D. are asked to report our observation by using the new predicate, we shall affirm

All the emeralds we have observed so far have been grue and are, therefore, in a position to conclude

All emeralds are grue.

But this implies that emeralds existing after 2000 A.D. will be blue for to be grue after 2000 A.D. is to be blue. This conclusion is not warranted by the evidence at our disposal which should be considered good since all emeralds observed before 2000 A.D. have been found green and none have been found blue.

Because of such difficulties, Braithwaite[9] suggests that a law

statement should be supported not only by direct evidence but by indirect evidence too. When scientific hypothesis are arranged in a deductive system, the direct evidence for each lower level hypothesis may become indirect evidence for other lower level hypotheses. Naturally when these lower level hypotheses are subsumed under a higher level hypothesis, the sum total of evidence will constitute the direct evidence for the latter. Thus one lower level hypothesis is not only supported by its direct evidence, but also supported by the direct evidence of the immediate higher level hypothesis that constitutes its indirect evidence. Accidental generalizations, on the contrary, are supported by direct evidence alone.

Though Braithwaite's suggestion goes a long way in explaining law statements, it in no way helps us to distinguish them from non-laws. It can be shown that even non-law statements are deducible from higher level hypotheses which have been established on independent grounds. For example,

N.2. Every Canadian parent of quintuplets in the first half of the 20th century is named "Dionne"
may be deduced from

N.2.3. Newspapers, which are generally reliable report that all parents of quintuplets during the first half of the 20th century are named "Dionne"

and

N.2.4. If newspapers, which are generally reliable, report that all parents of quintuplets during the first half of the 20th century are named "Dionne", then such parents are named "Dionne"

These two statements may be construed as higher level aspects of a hypothetico-deductive system as also the premisses upon which most people would accept the given general statement, and reliability of these newspapers have been established otherwise.

This is in sum the story of the search for a failsafe criterion of demarcation between accidental and nomic generalizations in the western tradition where in spite of the best of efforts by the best of intellects the distinction could not be clinched. I shall now try to tackle the issue from a totally alien point of view.

II

Whenever one embarks on a comparative study especially of so disparate two traditions like western philosophy of science and an

ancient philosophical system of India, say, Nyāya, one needs to assuage a general doubt concerning the usefulness and justification of such a study. But scepticism in this case is likely to be very special and deeprooted as the two notions being compared, viz., those of law and *vyāpti* (pervasion) are from widely different contexts. The notion of law is used in the scientific context to explain natural phenomena while the notion of *vyāpti* is invoked for explaining inference in the epistemic context. A preliminary answer to the anticipated scepticism is: though the backgrounds are totally different, both law statements and *vyāpti-vākyas* are results of our quest for exceptionless regularities. Besides, the thrust of our discussion in the previous section was epistemic. Regularities that hold in nature are indeed objective relations among structural properties of the world; but we have all throughout been interested in our discovering such relations, in establishing a connection between "what laws say" and "what we believe about laws".[10] Laws that elude our grasp, even if characterized by absolute necessity, are not my concern. Hence in my discussion statements of natural law and *vyāpti-vākyas* converge very naturally.

To understand the Nyāya concept of *vyāpti* we need to recaptitulate in brief the Nyāya theory of inference. For, according to Navya-Nyāya, knowledge of *vyāpti* (the invariable concomitance between *hetu* and *sādhya*) is the special means (*kāraṇa*) of inference. Let us proceed with the stock example of Nyāya.

A man sees smoke spiralling up from a hill top. This man has seen smoke before coming out of kitehen fire and has acquired the knowledge "whatever has smoke, has fire'. Now when he sees the column of smoke on the hill top, he remembers the universal cohesion between smoke and fire. This knowledge makes him see smoke as that which is invariably copresent with fire. Unless there is any strong impediment this knowledge of the hill being characterized by smoke which is invariably concomitant with fire generates the knowledge of the form "The hill has fire' which is the conclusion of the inference made by our man. The man could not infer fire in the hill from his knowledge of smoke in the hill if he had not known that smoke is invariably concomitant with fire. Smoke is the *hetu* or the ground of this inference, fire is the *sādhya* or that which is to be inferred and the relation of invariable concomitance between the *hetu* smoke and the *sādhya* fire is *vyāpti* (pervasion). So the knowledge of *vyāpti* or the relation of invariable concomitance between *hetu* and *sādhya* is the logical ground of any inference.

Here we arrive at the first point of similarity between a law statement and a statement expressing *vyāpti*. Both of them are

universal statements. The former always states what invariably happens, i.e., whenever such and such conditions are fulfilled, such and such event always takes place, the latter also gives us exactly the same type of information, e.g., "whatever possesses smoke, possesses fire'. So pat comes the symbolization: (x) (Sx⊃Fx) where Sx means 'x possesses smoke' and Fx means 'x possesses fire'. If this symbolization is in need of any justification, I would like to offer the following reason. Though the concept of *vyāpti* varies from system to system, it has been admitted across the systems that *vyāpti* can be defined in terms of class inclusion and extension of terms and whatever can be so defined, can be translated into the language of the first order predicate logic. So wherever there is smoke, there is fire' well admits of the translation.

(x) (x is a member of the class of loci of smoke ⊃ x is a member of the class of loci of fire.)

since the class of smoky objects is included within the class of fiery objects.

The last comment is sure to encounter very strong objectious. Haven't we heard at least thousand and one times that Nyāya language is intensional and resists extensional rendering? So the suggestion of translating a statement of *vyāpti* into quantificational notation is simply atrocious. This charge, however, can be met by pointing out that the Nyāya language is a curious mixture of the intensional with the extensional. It is true that to a Naiyāyika expounding the notion of *vyāpti*, the class membership relation is not the fundamental one but the relation of occurrence (*vṛttitā*) is. It is also true that in the Nyāya system a limitor or *avacchedaka* performs the job of a quantifier. For example, the sentence,

The mountain possesses an occurrence of fire

may be taken as universal or existential depending on the nature of the limitor (avacehedaka).[12] Limitor is a property and hence can be rendered better by an intensional property abstractor than by a quantifier. These facts surely suggests an intensional reading of Nyāya. But at the same time, it is to be admitted that in Nyāya the spirit of quantification still persists. Hence the overall intensional nature of Nyāya language does not substantially affect the extensional rendering of *vyāpti*. That is why Matilal writes, "... the language of the Naiyāyikas can be translated into extensional language involving quantification. The point to be noted is this: the Navya-Nyāya language may be translated into extensional language although it is not by itself extensional'.[13] The most important reason why Nyāya

logic cannot be out and out extensional is: it is embedded in the domain of cogition.[14]

Now to justify the use of '⊃' in symbolizing *vyāpti-vākya* I would like to bring to your notice the Nyāya-Bauddha debate centering the nature of *vyāpti*. According to Dharmakīrti,[15] the Buddhist logician, *vyāpti* is an inseparable relation (*abinābhāva Sambandha*) which is based either on the relation of identity (*tādātmya*) or on the causal connection (*tadut-patti*). *Tādātmya* is actually a relation of class inclusion manifested in the sentence 'All *śiṁśapās* are plants' on which is grounded the inference: 'It is a plant since it is a *śiṁśapā*. *Vyāpti* relation of the second type depends on the inseparable connection between cause and effect, viz., 'wherever there is smoke, there is fire'. A *vyāpti-vākya* of the first type is definitely an analytic sentence whereas that of the second type is non-analytic. (I am not suggesting that Dharmakīrti anticipated the analytic-synthetic distinction),[16] but to Dharmakīrti both the sentences are necessary. In an inferential situation, we can say that *hetu* and *sādhya* are invariably concomitant only if there exists a necessary relation among them and this alone guarantees that the relation of entailment holds among the premiss(es) and the conclusion. The Naiyāyika severely criticized the Buddhist view of *vyāpti* as well as their scheme of classification. According to Nyāya, to determine whether a *hetu* is an unfailing mark of a *sādhya* or not, we only require the knowledge of universal concomitance between them. The Buddhists, on the other hand, argue that if *hetu* and *sādhya* are not necessarily related, then it becomes unintelligible why they should be universally related. So it is clear that a *vyāpti-vākya* as admitted by the Naiyāyikas is a synthetic universal proposition of the form "All S is P" where S is connected with P neither *a priori* nor out of necessity but simply as a matter of fact. This, I think, is sufficient justification for the use of '⊃'. As *vyāpti-vākya* is not characterized by necessity, no modal operator is called for. This may be considered another extensional trait of Nyāya logic.

I must mention at this point though *vyāpti-vākya* is symbolized as a universally quantified sentence, not all cases of *vyāpti* according to the Naiyāyika involve generalizations from observed facts. For instance, when one infers the presence of an individual quality or property in a particular thing on the basis of the presence of another quality as in the inference *etadrūpavān etadrasāt* (*this* fruit has *this* colour because it has *this* taste),[17] observation of only one thing, that which possesses this particular colour, is sufficient for establishing this type of *vyāpti* relation holding between two qualities of the same thing. Since, the locus here is *etadrūpavān*, i.e., that which is being referred to by the

use of the demonstrative 'etad'. The Naiyāyikas take it to be a case of singular reference for the locus of the *sādhya*, in which colocation of the *hetu* warrants the inference of the above form, is a unique particular.

Again when one infers the universal substanceness (*dravyatva*) from the universal potness (*ghatatva*), the underlying pervasion (*vyāpti*) is established just from single observation of two objects. There is no generalization from observed cases to unobserved cases. But when one infers the presence of fire in some locus from the presence of smoke there, the *vyāpti* involved is a geunine case of generalization on the basis of observed particulars.

The difference in these types of *vyāpti* which has been mentioned above is due to the difference in their mode of establishment. In the first instance one ordinary sensuous perception is said to be sufficient; in the second, the single perception involved in the sensuous perception of extra-ordinary variety whereas in the third case repeated observation of concomitance between *sādhya* and *hetu* together with the absence of knowledge of contrary instance are required. But difference in the mode of establishment of *vyāpti* does not affect its universal import. Even in the first case, one needs to go beyond the unique particular to use the socalled singular vyāpatī in a genuine inference. Therefore, the use 'this (*etad*) in the *vyāpti-vākya*, 'whatever has this taste, has this colour', should be treated as vacuous. In the second case, invariable concomitance is established between subtanceness and potness. But the pervasion will continue to hold in all individual instances of substanceness and potness though there exists in the world only one universal substanceness and one universal potness.

If *vyāpti* is not a necessary relation then what type of a relation is it? A Naiyāyika takes *vyāpti* to be a natural relation (*svābhāvika sambandha*). A natural relation is an unconditional (*anaupādhika*) relation which is not affected by any associate condition (*upādhi*).[18] An associate condition is the property which accompanies all cases of *sādhya* but only some cases of *hetu*. Consider the generalization 'All cases of fire are cases of smoke' the knowledge of which grounds the inference, 'The hill has smoke, since it has fire'. It is only a pseudo statement of pervasion; for not all fire causes smoke but only fire with wet fuel does. So wet fuel in this case is the associate condition.

Since *vyāpti* is an unconditional invariable concomitance between two features, presence of an associate condition enables us to distinguish statements of pervasion from statements of non-pervasion. Consider the following inference[19]

Citrā is dark-complexioned since she is a daughter of Mitrā.

The ground of this inference is the knowledge of the generalization,

All daughters of Mitrā are dark complexioned.

The last statement though universal in form cannot be regarded as an example of the statement of *vyāpti* because it depends on an associate condition. Mitrā has a dark baby whenever she takes leafy vegetables during pregnancy. So another dauther of Mitrā, say, Rohinī is fair complexioned because Mitrā took no leafy vegetables during that pregnancy, instead she drank lots of milk. Here "taking leafy vegetables' is the associate condition or *upādhi* on which the first generalization depends. But natural law or *vyāpti* does not depend on any such associate condition. So one may think that not possessing any *upādhi* may serve at least as a negative criterion of demarcation between law and non-law statements. But there are at least a couple of problems in this solution.

(i) Our not finding an *upādhi* will not prove that there is no *upādhi*, i.e., we can never be sure whether a generalization in question depends on any *upādhi* or not and ii) by sufficient restriction a generalization with an associate condition can be turned into a law-like generalization. Thus though

All daughters of Mitrā are dark

fails to pass the test of lawlikeness,

All daughters of Mitrā during whose gestation Mitrā took leafy vegetables are dark

is a legitimate candidate for being law-like.

Now that I have reviewed the highlights of the Nyāya concept of *vyāpti*, I would like to discuss a few important definitions of *vyāpti* as explained in the Navya-Nyāya literature with the expectation that our much sought for criterion of demarcation may get determined in the process. Whoever is familiar with the notion of definition (*lakṣaṇa*) in Indian Philosophy will recognize immediately what supports this expectation. A proper definition of any form, according to the Indian philosophers, serve two purposes: (a) it provides us with the most salient characteristic of the term leading to the correct use of it (*vyavahāra*) and (b) it serves as a distinguishing criterion (*itaravyavartaka*). So a correct definition of pervasion should enable us to distinguish pervasion from cases of non-pervasion. We have

already seen how closely law statements and *vyāpti-vākyas* resemble one another. Therefore, we may hope to have some clue to the method of differentiating laws from non-laws by applying the technique of defining *vyāpti*. But before that, I need to explain a few technical terms of the Navya-Nyāya literature.

Gangesa, the author of *Tatvaciñtāmaṇi*[20] has defined *vyāpti* in terms of the relation of *Sāmānādhikaraṇya*, i.e., the relation of sharing a common locus. Two "features" may be related to each other by occurring in the same locus. Here I must mention that according to a Navya-Naiyāyika, all physical objects, e.g., glass, water, smoke, fire may be treated as features inasmuch as they are locatable in such loci, viz., table, cup, hill, kitchen, etc. When a glass is on the table, the table may be said to be characterized by the glass and in this sense the glass is a feature of the table. On the same ground, smoke and fire may be considered features of a kitchen where these are located. Now, the relation of colocation may be understood in three different senses.

(a) Two features may have exactly the same loci. For example, the features of knowability (*jñeyatva*) and nameability (*abhidheyatva*) have exactly the same loci, viz., all ultimate categories (*padārthas*), hence these two are co-extensive.

(b) All loci of one feature fall within the lociof the other but not vice versa. This is generally taken to be a standard case of pervasion. For instance, the class of loci of smoke is a *proper subclass* of the class of loci of fire because red-hot-iron which is a locus of fire is not a locus of smoke.

(c) Two features must have at least one locus in common. For example, smoke and fire have at least one common locus, viz., the kitchen. This is the accepted meaning of *Sāmānādhikaraṇya*. In the second sense the relation of sharing a common locus may be either a case of pervasion or a case of deviation. When every locus of one feature is the locus of the other, it is pervasion. When on the other hand, some loci of one feature are loci of the other but some other loci of the former are not the loci of the latter, then it is a case of deviation. Pervasion is thus opposed to deviation.

The same fact may be expressed in a different language if we say that pervasion implies a relation between two features of which one is pervaded (*vyāpya*) and the other pervades (*vyāpaka*). A feature is said to be pervaded by another if it is always accompained by the other. On the other hand, a feature is said to pervade another, if it always accompanies the other. So in the smoke-fire example, smoke is the pervaded (*vyāpya*) and fire is the pervader (*vyāpaka*).This difference

between the pervader and the pervaded is not that important in the context of *samavyāpti* or symmetrical concomitance as instantiated in the case (a). The relation of pervasion holds among two features say A and B if and only if anything is a locus of A, then it is a locus of B. This conditional does not admit of vacuous interpretation. So when we say that the *hetu* (h) is pervaded by the *sādhya* (s), then from the presence of h in a particular locus, we can validly infer the presence of s in it.

Gangesa in the *Vyāptivāda* of *Tattvaciñtāmaṇi* has rejected five definitions of pervasion given by his opponents because none of these applies to the cases of *Kevālanvayī* inference, where the universal concomitance is between two all-pervasive attributes. But Raghunatha Siromani has pointed out in his commentary[21] on Gangesa that if we set aside the cases of *Kevalānayi* inference, the first of the five definitions of *vyāpti* is quite all right. Since natural laws have nothing to do with all-pervasive attributes, I shall analyze the first definition along with Gangesa's final definition (*siddhānta-lakṣaṇa*) of *vyāpti*. The first definition and the final definition of *vyāpti* are complimentary to each other as these two definitions tackle the same item from two directions, the first one proceeds from the *Sādhya* to the *hetu* whereas the second proceeds from the *hetu* to the *Sādhya*.

The first definition of *vyāpti* is: *Sādhyābhāvavadavṛttitvam*, i.e. h is prevaded by s if there is non-occurrence of h in the locus of the absence of s.

Now this definition should apply to cases of genuine relations of pervasion and fail to apply to cases of pseudo- *vyāpti* relations. Let us, therefore, examine whether this definition is technically correct.

Let us take once again the example, the hill has fire because it has smoke as the example to be examined. Here h is smoke and s is fire *sādhyabhāva* means the absence of fire and the locus of *sādhyabhāva*, i.e., *sādhyā*bhavavat in this case is lake, jar etc. So *sādhyābhāvāvadavṛttitva*, i.e., the non-occurrence in the locus of the absence of *sādhya* will signify in this case the absence of something in a lake which does not posses fire. The feature of residing in the lake which is the locus of the absence of s, *sādhyābhāvavat-vṛttiva*, is possessed by sea-weeds, fish etc., but not by smoke for smoke does not reside in a lake. So the feature of being non-occurrent in the locus of the absence of *sādhya* resides in *hetu* which in this case is smoke. Since this definition applies to a case of pervasion it is initially free from the fallacy of being too narrow.

This definition does not apply to the cases of non-pervasion like "All cases of possessing fire are cases of possessing smoke". Here h is

fire and s is smoke; *sādhyābhāva*, is the absence of smoke and the locus of the absence of smoke may be jar, lake, red-hot-iron ball etc. So the non-occurrence in the locus of the absence of *Sādhya* may mean in this case the non- occurrence of anything in red-hot iron ball which is one of the loci of the absence of *sādhya*. Now, as the feature of being non-occurrent in the locus of the absence of *sādhya* resides in fire which is the *hetu* of the given inference, the definition of *vyāpti* does not apply here.

This definition of *vyāpti* has, however, been amended in order to exclude cases of non-pervasion. The ramified form, though this is not the final ramification, that will serve our purpose is as follows.

Sādhyatāvacchedakasambandhāvacchinna- Sādhyatāvacchedakāvacchinnapratiyogitāka - Sādhyābhāvādhikaraṇanirūpita -hetutāvacchedakasambandhāvacchinnavṛttitāsāmānayābhavo vyāptiḥ

This formidable definition needs to be explained step by step.

Sādhyatāvācchedakasambandha means the type of relation in which the *sādhya* resides in the *pakṣa* and *sādhyatāvācchedakadharma* is that feature qua which the *sādhya* has been taken in the inference. For instance, in the valid inference: 'The hill has fire because it has smoke', the *sādhya* is fire, the *hetu* is smoke and the *pakṣa* is the hill. Here fire resides in the hill in the relation of conjunction (*saṁyoga*). So conjunction is the *sādhyatāvacchedakasambandha* here. The *avacchedaka dharma* or the limitor of the *sādhya* in this case is fireness (*bahnitva*), not the feature of producing smoke (*dhūmajanakatva*) or the feature of producing burns (*dāhajanakatva*). Similarly, by *hetutāvacchedaka-sambandha* is meant that type of relation in which the *hetu* resides in the *pakṣa*. In the given instance that too is conjunction. It has also been stated in the definition that the non-occurrence of the *hetu* in the locus of the absence of *sādhya* should be taken to mean each and every non-occurrence and not this or that particular non-occurrence. This qualification empowers the definition with the force of a negative existential sentence which is essential for capturing the permanent property relation expressed in a law statement or in a statement of *vyāpti*. So the whole definition may be rendered as: the *hetu* is pervaded by the *sādhya* if the *hetu* is in no way occurrent by the relation of *hetutāvacchedaka* in the locus of the absence of the *sādhya* which is characterized by the *sādhyatāvacchedakadharma* and also by the *sādhyatāvacchedakasaṁbandha*. In case of our stock example there is relation of *vyāpti* between the *hetu* smoke and the *sādhya* fire because no smoke ever resides by way of conjunction in a lake which is the locus of the absence of fire qua

fire by the relation of conjunction.

I shall now explain the final definition of *vyāpti* (*siddhāntalakṣaṇa*) as formulated by Gangesa from a diametrically opposite direction in terms of sāmānādhikaraṇya and not in terms of absence so that even pervasion amongst two all-pervasive features can be accommodated. The final definition of *vyāpti* has also undergone various modifications into the details of which I am not going to enter. The definition, as Gangesa states it, is:

Pratiyogyasamānādhikaraṇayatsamānādhikaraṇatyantābhāvāpratiyogiā vacchedakāvacchinnaṁ yanna bhavati tena saha tasya sāmānādhikaraṇyam vyāptiḥ

Shorn of all embellishments this definition simply means: the *hetu* is pervaded by the *sādhya* if the *hetu* is colocated with the *sādhya* which is not the counterpositive (*pratiyogin*) of the absolute negation (*atyantā-bhāva*) which occurs in the locus of the *hetu* but does not occur in the locus of the counterpositive. In our example, the *hetu* smoke is pervaded by the *sādhya* fire for it is colocated with fire, say, in the hill, and fire is different from the counterpositive (jar, cloth, etc.) of the absolute negation (absence of jar etc.) which occurs in the hill, the locus of the *hetu* smoke, but does not occur in the locus of the counterpositive.

This definition does not apply to the invalid inference: 'The hill has smoke since it has fire'. For here, the *hetu* fire is colocated with *sādhya* smoke in the hill which, however, can very well be the counterpositive of the absolute negation (*dhūmābhāva*) occuring in the red-hot iron-ball, a locus of the *hetu* fire.

Let us now see what bearing these definitions have on our demarcation problem. We shall consider a pair of statements the first of which is generally said to have a nomic character while the second is an accidental generalization.

(1) All men are mortal

(2) All crows are black.

If the definitions of *vyāpti* applies to these, these will be declared lawlike otherwise accidental.

The generalization (1) can be the basis of the valid inference: 'This being is mortal since this being is human', Here 'mortality' is the *sādhya* and 'the attribute of being human' is the *hetu*. Does the first definition of *vyāpti*, *sādhyābhāvavadavṛttitvam*, apply to it? Let us see *sādhyābhāva* in the present case is 'the absence of mortality' and the

locus of the absence of the *sādhya* may be 'god', 'angel', etc. The non-occurrence in the locus of the absence of the *sādhya* means the non-occurrence of anything in 'gods', etc. which is the locus of the absence of mortality. One such feature that resides in the locus of the absence of mortality is 'godhood' (devatva). So the feature of residing in gods is possessed by 'godhood' and not by the feature of being human.

Here, *sādhyatāvacchedakasambandha* is svarūpa. Since mortality is to be interpreted as the feature of being the counterpositive of destruction (*dhvaṁsapratiyogitā*)[22] *sādhyatāvacchedakadharma* is 'mortal' (*maranasilatvatva*) and *hetutāvacchedakasambandha* is inherence since the feature of being human (*manuṣyatva*) is a *jāti* (universal) and according to Nyāya, the relation between a *jati* and its instanting individual (*vyakti*) is inherence. The absence of *vṛttitā* is the absence of *vṛttitā* in general since in gods, etc., (i.e., in every locus of the absence of the *sādhya*) the feature of being human is absent.

What about the second generalization, 'All crows are black'? This generalization may warrant an inference like 'This bird is black since it is a crow' where the *sādhya* is 'blackness', the *hetu* is the feature of being a crow and the *pakṣa* is 'bird'. So *sādhyābhāva* is the absence of blackness and the locus of the absence of blackness may be an albino crow where the *hetu*, the attribute of being a crow resides. Therefore, the definition of *vyāpti* fails to apply in this case.

Let us now check these generalizations against the final definition of *vyāpti*. In the first case, 'mortality' is the *sādhya* and the feature of being human is the *hetu*. The locus of the *hetu* is 'human being' where there is absence of 'jerness',"clothness' etc. The counter-positive of these absences are 'jarness', 'clothness' respectively which are definitely different from the *sādhya* 'the feature of being mortal' and this *sādhya* is colocated with the *hetu* 'the feature of being human' in human beings. Hence the definition applies.

In case of the second inference, the *sādhya* is 'blackness' and the *hetu* is 'the attribute of being a crow'. The locus of the *hetu* is 'This bird'. The final definition would fail to apply in this case if the absence of blackness could be taken as the relevant negation (*atyantābhāva*) occurring in the locus of the *hetu*, i.e., crow. But unless there is a non-black crow the counterpositive of the absence occurring in the locus of the *hetu* will not coalesce with the *sādhya*. Hence we cannot prove the accidental character of the generalization. The first definition failed to apply to this generalization simply because we took into consideration the albino crows. But then the generalization have already been proved false and does not fall within

the scope of the demarcation problem. An accidental generalization which can be confused with a nomic generalization is the one to which no exception or disconfirming instance has yet been observed. So, we have to admit that we cannot demarcate such accidental generalizations from the nomic ones by applying the definition of *vyāpti*. Our pious hope has thus reached a dead end.

Perhaps, we had hoped too much. It now appears to me what the Naiyāyikas have been trying to establish all along is unrestricted exceptionless universality of the *vyāpti-vākyas*, mere universal concomitance between two things. Since there is no difference between nomic and accidental generalization in this respect, it is very natural that, the definition of *vyāpti* would not throw any light on our demarcation problem.

But haven't the Naiyāyikas *ever* felt that we should distinguish between universal concomitance? To answer this question we need to make a quick survey of the Nyāya account of the modes of knowing *vyāpti* (*vyāpti-grahopāya*).

The Naiyāyikas have pointed out as against the Mīmāṁsakas that repeated observations (*bhūyodarśana*) of co-existence between two phenomena are neither necessary nor sufficient for ascertaining *vyāpti*. It goes to the credit of the Naiyāyikas that they could rightly envisage the problem of induction and were addressing the ame question made famous much later a by J.S. Mill: why is a single instance, in some cases is sufficient for complete induction, while in others myriads of concurring instances fail to establish a universal proposition? Hence, according to Gangesa and his followers, neither repeated observations, nor single observation (*sakṛddarśana*) can be said to be the cause of ascertainment of *vyāpti*. *Vyāpti* is established by observation of positive instances and non-observation of any negative instance.[23] It follows, therefore, that knowledge of a contrary instance blocks our knowledge of *vyāpti*.

It has now become pretty obvious why we could not prove that generalizations like "All crows are black", to which no exception has been found till date, are not laws. Even then, at any time, we may doubt that all crows will continue to be black in future. That is, it is always possible for us to doubt whether any particular h is a deviant h or not. And, according to Nyāya, not only certain knowledge of a contrary instance but a mere doubt that a contrary instance is present can successfully block our knowledge of *vyāpti*. We should, therefore, make utmost effort to remove such doubts. The Naiyāyika suggests that in case of such doubts we should fortify *vyāpti* by indirect proof or *tarka*. Suppose, for arguments' sake, that somebody doubts that the

generalization: 'All that possesses smoke, possesses fire' is true and holds its contradictory 'sometimes smoke is not accompanied by fire' true. That means there may be smoke without fire. To remove this sort of scepticism, one needs to resort to *tarka*. *Tarka* is a kind of *reductio ad absundum* argument with a counterfactual premiss which in this particular case involves the following steps:

1) Deviation of fire is pervaded by the absence of being caused by fire.

2) If smoke had deviated fire, then it would not have been caused by fire.

3) But smoke is caused by fire.

4) Therefore, smoke cannot deviate fire.

Even a coursory glance at the above steps is sufficient to see that a *tarka* is founded upon the tacit assumption of invariable concomitance at two levels. First, the relation of universal concomitance is assumed between the absence of universal connection between smoke and fire and the absence of the fact that smoke is produced by fire in (1). Second, the argument from the counterfactual hypothesis is backed by a causal law (vide (2) and a causal law is once again an instance of *vyāpti*. Thus we are getting bogged down in an infinite regress. (*tarkasya vyāpati grahamūlakatvena anavasthā iti cet*). Both Udayana[24] and Gangesa respond quite emphatically that there is no such infinite regress. For the concomitance which a reasoning presupposes does not require another reasoning for the doubt about the invariable concomitance between the consequent (*āpādya*) and the ground (*āpādaka*) does not arise at all. Such a doubt can be entertained only at the cost of a self contradiction.[25] That is, if one holds that one thing deviates from another, then one is bound to hold that the former is not caused by the latter. So in absence of doubt the concomitance in (1) need not be established by another *tarka*. But the counterfactual premiss is still open to doubt. What happens if someone doubts whether smoke is really caused by fire? The doubt may take any of the three following forms. (i) Probably smoke is produced only in absence of fire or (ii) Probably in some cases smoke is not produced by fire or (iii) Probably smoke is produced without any cause at all?[26] It is obvious that doubt in the third form is impossible. For smoke is known to be a product and denying or doubting it will amount to contradiction of an undeniable truth. The Naiyāyika will not allow the second doubt because it is based on belief in the possibility of a plurality of cause. The first alternative is blocked by a person's knowledge of agreement in presence and absence of smoke and fire. If in spite of having such

knowledge somebody doubts that smoke is caused by fire then Gangesa will point out that this doubt is totally insincere. If one believes that there may be smoke without fire, then why does one look for fire when, one needs smoke? So, here, there is a contradiction between ones doubt and ones behaviour. So the Naiyāyikas have established by *tarka*: (i) one cannot doubt that if smoke deviates from fire then smoke is not caused by fire as long as one believes that smoke is caused by fire, (ii) one cannot doubt that smoke is not caused by fire as long as one invariably lights a fire to have smoke and therefore (iii) smoke is universally concomitant with fire.

So to resolve doubt in the above case, the Nyāya appeals to the law of causation. Here, the Nyāya position comes very close to that of Mackie who, we may recall, attempted to distinguish between laws and accidental generalization in terms of strict universality and some from of continuity.[27] So the moa hypothesis of Kneale can be converted to a law by showing its relation to some biological law expressing a form of continuity. Similarly, a Naiyāyika will maintain that unless and until we can establish an intimate connection between 'being a crow' and 'being black', we shall not have any supporting (*anukūla/prayojaka*) *tarka* in favour of the generalization "All crows are black". But all possible doubts in connection with generalizations like 'wherever there is smoke, there is fire", 'Whatever is a man, is mortal" can be eliminated with the help of a *prayojaka tarka*. The Naiyāyika is very much aware of thefact that resorting to causal connections will not be helpful in all cases, especially not in the case of *sāmānyatoidṛṣṭa* inferences.[28] But this type of inference cannot be set aside. To establish statements about theoretical constructs of science which are unobservable, we have to take help of *sāmānyatoidṛṣṭa* type of inference. There, perhaps we shall have to rely on some other form of continuity. So causality is not the only ultimate fact that disarms doubt. All doubts can be resolved by tracing to an ultimate fact whose validity is self-evident and the denial of which involves self-contradiction.

But now the question is: what gives causality and its functional analogues the required sanctity? If causal connection is also to be established by *sahacāradarśana* and *vyābhicārādarśana*, can't we have doubt or śaṅka, in case of causal generalizations too? Will not the Naiyāyika face the same difficulty as the logicians of the west when they uphold that the ground of induction is itself an induction? In response to this quiry, Potter and Sibajiban Bhattacharya write: 'The Nyāya theory does not involve this paradox, for although Nyāya uses, in two types of inference, the causal connection to remove doubts

about deviation and therefore to establish pervasion, yet Nyāya never tries to justify pervasion by the causal principle, and any causal connection can be an object of doubt unless contradicted by action. So there is no difficulty for the Nyāya philosophers holding that the causal connection is itself a special case of pervasion"[29] Alternatively, it may be maintained that the justification that a *prayojaka tarka* provides to pervasion is at best a quasideductive one and not an inductive justification.

This point brings us to the most controversial theory of Nyāya, that is of *sāmānyalakṣaṇa pratyakṣa.*[30] Can we not be sure of the *vyāpti* relation by *sāmānyalakṣaṇpratyakṣa,* as has been uphold by many later Naiyāyikas?[31] The answer suprisingly is 'no'. *sāmānyalakṣaṇapratyakṣa,* according to Nyāya, is a sensuous perception of an extra-ordinary kind. It is that type of perception which gives us a knowledge of all the instances of a class (in case of eternal (*jāti*) and non-eternal classes alike)[32] when a single instance of the class is actually presented. The class-character of *sāmānya* which is present in the single perceived instance functions as an operative relation between the sense organ and all the instances of the class. Thus when we *perceive* one instance of smoke we come to know all instances of smoke via its class-character smokeness (*dhūmatva*). Similarly single perception of fire gives us an immediate knowledge of all fire through the mediation of fireness. Again, when we perceive one instance of colocation of fire and smoke through the class-character of co-colocation (*sāmānādhikaraṇyatvena*) we come to know all instances of co-location between smoke and fire. When these three immediate cognitions combine into a determinate knowledge we actually have the knowledge of invariable concomitance between smoke and fire. But *sāmānādhikaraṇyatva* being a non-enternal universal, the doubt remains whether *dhūma* is always *bahnisamānādhikaraṇa* or not. That is, it is open to doubt whether future cases of smoke will be co-located with fire. So the only course open to a Naiyāyika to remove doubt regarding *vyāpti* once for all is through *tarka.*

It is heartening to notice that Nyāya thus retains its fallibilist stance and the laudable scientific spirit right till the end. But I would like to reopen the issue whether *vyāpti,* according to Nyāya, is just universal concomitance between two events totally denuded of necessity or not.

Granting that Nyāya tries to resolve any doubt about *vyāpti* by appealing to a contradiction at the factual level, we may raise the question following Sriharsa:[33] why is it that the cogency of practical behaviour serve as an impediment to emergence of doubt regarding pervasion? Is it because our doubt comes into conflict with the age-old

widsom which is grounded on the habit of our expectation? Gangesa does not think that universal acceptance constitutes an evidence for the ultimate truth of any generalization. Nor does he accept the suggestion of some of his predecessors who uphold that belief in causality is so ingrained in human mind that any proposition having causal relation as its content is acceptable to one and all. What Gangesa is after is not any psychological certainty regarding *vyāpti* but objective validity of it which, however, cannot be grasped a priori. Under the circumstance all doubts get eliminated only if one admits impossibility of a deviant instance.

Moreover, notice what the Nyāya response is to the question, 'Probably in some cases smoke is not produced by fire?' recorded by Sriharsa. According to Nyāya, if there is smoke which is not produced by fire, that is a different kind of smoke and the Nyāya position will not be affected by the admission of smoke of such a heterogenous nature.[34] Does not this response imply that smoke insofar as it is characterized by smokeness must be produced by fire? That means, if the structure of the world remains the same, smoke will be produced by fire and fire alone; or smoke and fire will be universally concomitant in all structurally similar worlds. Is this interpretation of *vyāpti* in terms of natural necessity an unjust imposition on Nyāya? Probably not. For the Naiyāyikas believe that almost all the common causes (*sādhāraṇa kāraṇa*) responsible for production of this world will remain the same for all times to come. The only change that may come is in the *adṛṣṭa* of the *jīvas* but that will not be sufficient to change the basic structure of the elementary particules.

Hence my conclusion is: *vyāpti* insofar as it is a *niyama* is not merely universal concomitance but is naturally necessary. But this element of necessity has not been reflected in the Nyāya definitions of *vyāpti* for there is no difference between law statements and accidental generalizations in respect of their logical forms. In the context of ascertaining *vyāpti* the causal laws have been accorded an exalted status. For *prayojakatva* of a *tarka* depends on the availability of a causal law. So now we are in a position to provide a solution to our original problem of demarcation within a fallibilist framework. A nomic generalization is that which has a *prayojaka tarka* in favour of it and the so-called accidental generalization lacks the support of such a *tarka*. But we shall have to go on searching for a support for accidental generalizations. May be with advancement of knowledge we shall be able to establish some connection between two terms of an 'accidenal' generalization. But till such time we cannot afford to ignore the difference between the nomic and the non-nomic.

NOTES AND REFERENCES

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11. The problems of symbolization have been discussed in detail by Goekoop C. in *The Logic of Invariable Concomitance in the Tattvacinṭāmaṇi,* D. Reidel Publishing Company, Dordrecht - Holland, 1967 and by Bhattacharya S. in 'Some Aspects of the Navya-Nyāya Theory of Pervasion', *Doubt, Belief and Knowledge,* Indian Council of Philosophical Research in association with Allied Publishers, New Delhi, 1987.

12. See Jagadisa's distinction between *Parvatatvāvacchedena bahnisādhyakānumitiḥ* and *parvatatvasāmānādhikaraṇyena bahnisādhyakanumitiḥ in Pakṣatā Prakaraṇam,* ed. Sri Sivadatta Misra, Chaukhamba Sanskrit Sansthan, Varanasi, India, 2nd edition, 1980.

13. Matilal B.K., *Logic, Language and Reality: An Introduction to Indian Philosophical Studies,* Motilal Banarasidass, New Delhi, 1985, p. 169.

14. Mohanty, J.N., *Reason and Tradition in Indian Thought,* Clarendon Press, Oxford, 1982, pp. 125-131.

15. Dharmakīrti, *Nyāyabindu,* ed. Chandrasekhar Sastri, Chaukhamba, Benares, 1954.

16. See *Logic, Language and Reality,* by Matilal, p. 142.

17. *'Yatra ekameva sādhyādhikaraṇaṁ tatra etadrūpavān etadrasādityadau ādyāpi abhinnaiva'*, Jagadisa Tarkalankara's commentary on Gangesa's *Siddhāntalakṣaṇam,* ed. Sri Sivadatta Misra, Chaukhamba Sanskrit Series, Benares.

18. The translation is from Matilal, 1985.

19. See *Upādhi-parīkṣā* in *Bhaṣā-pariccheda* with *Siddhānta- muktāvalī* by Visvanatha Tarkapancanana, ed. Pancanana Bhattacharya, published by Sanskrit Pustaka Bhandar, Calcutta, 1970.

20. Gangesa, *Tattvacintāmaṇi* ed. Kamakhyanath Tarkavagish, Motilal Banarasidass, Delhi, 1974.

21. *Tattvacintāmaṇi* ed. with Dīdhiti of Raghunatha Siromani and *Jagadisi,* by S. Nyayopadhyay, Chaukhamba, Varanasi, 1906-8.

22. The Naiyāyikas do not generally admit dispositional properties and therefore *maranaśilatva* have been given an episodic rendering.

23. *Vyābhcārajñānavirahasahakṛtaṁ sahacāradarśanaṁ vyāptigrāhakaṁ... tadvirahaśca kvacid vipakṣabādhak*atarkat *kvacit svatahiddha eva - Tattvacintāmaṇi.*

24. The Naiyāyikas do not recognize *tarka* as a *pramāṇa.* but the Jainas do.

25. Udayana, *Nyāyakusumāñjalī,* eds. P. Upadhyaya and D. Sastri, Chaukhamba, Varanasi, 1957. *Vyāghātāvadhirāśaṅka tarkaḥ śaṅkāvadhirmataḥ* -NKu, Udayana, Na, *yāvadāśaṅkaṁ tarkānusaranāt, yatra ca vyāghātena śankaiva nāvatarati tatra tarkaṁ vinaiva vyāptigrahaḥ* - TCM, Gangesa.

26. .... *kim dhumo'vahnereva bhabiṣyati? kvacid vahniṁ vināpi bhabiṣyati ahetuka eva va utpadyate? iti śaṅkā syāt, sarvatra svakriyav-yāghātaḥ syāt* -TCM.

27. Mackie talks about three kinds of continuity: (1) spatio-temporal, (2) continuance of functional dependence revealed by functional laws or (3) qualitative homogeneity (e.g., temperature and pressure though heterogenous as perceptual items may be shown to be relatable to the mean kinctic energy of molecules).

28. For an account of *samanyatodṛṣṭa* inference see vatsyayana's *bhāṣya* on Goutama's *Nyāya-sūtra,* ed. G. Jha, Oriental series, Poona, 1939.

29. Encyclopedia of India Philosophy, eds. Karl H. Potter and Sibajiban Bhattacharya, Vol. VI, Motilal Banarasidass, Delhi, First Indian edition, 1993, p. 80.

30. See *Tattvacintāmaṇi Pratyakṣakhanda,* also *Bhāṣāpariccheda* with *Siddhānta-muktāvalī.*

31. Annaṁbhatta, e.g., in his Tarkasṁgraha with *Dīpikā* has mentioned it as an accepted means of ascertaining *vyāpti,* translated and eluciated by Gopinath Bhattacharya, Progressive Publishers, Calcutta, 1983.

32. *Parantu samānānaṁ bhavah sāmānyam. Tacca kvacinnityam dhūmatvādi, kvaciccanityaṁ ghatādi - Siddhāntamuktāvalī* on Kārikā 63.

33. Sriharṣa, *Khandanākhandakhādya,* ed. with Sankara Misra's commentary, N. Jha, Kashi Sanskrit Series, Benaras, 1970.

34. ....*na ca vācyameva hi sati dhumsya aikajatitvam.....*