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LOGICAL EQUIVALENCE AND INDUCTIVE EQUIVALENCE

The notion of inductive equivalence has been developed by Professor Pranab Kumar Sen as an alternative to that of logical equivalence in the context of the problem of confirmation of scientific paper 'Approaches to the Paradox of Confirmation', published in *Ajatus* (Yearbook of the Philosophical Society of Finland, XXXIV, 1972.) It is usually claimed that if two hypotheses h_1 and h_2 are logically equivalent then :

(a) h_1 and h_2 are interchangeable in all contexts.
(b) h_1 and h_2 will be confirmed and disconfirmed by the same evidence.
(c) h_1 and h_2 are different formulations of the same hypothesis.

The equivalence between any hypothesis and its contrapositive is a paradigm of logical equivalence. Thus, one may hold 'All ravens are black' (h_1) and 'All non-black things are non-ravens' (h_2) to be logically equivalent. As such (a), (b) and (c) are true of h_1 and h_2.

The author of the paper mentioned above, raises serious objections against the above claims (a), (b) and (c) about logical equivalence and presents his concept of 'Inductive Equivalence' which he thinks satisfies the said claims better. I made some passing observations on this concept of 'Inductive Equivalence' in an earlier paper[1] and reserved a fuller discussion on it for the future. I take this opportunity to present a comparative analysis of the two concepts of *Logical Equivalence and Inductive Equivalence* and examine how far the claim that the latter should replace the former is logically justified. In Section I, I propose to explain briefly the notion of logical equivalence *vis-a-vis* contraposition and logical equivalence. In Section II, I propose to explain the concept of inductive equivalence as introduced in the said paper and try to determine its relation to logical quivalence. Section III is an attempt to critically evaluate the notion of inductive equivalence.

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I

A very simple and brief exposition of the concept of logical equivalence may be found in Jeffrey. In defining 'Logical equivalence' Jeffrey writes, "Sentences are logically equivalent if and only if they have the same truth-value regarding the joint truth and falsity of the sentence letters that appear in them."[2] It is known to every student of formal logic that logically equivalent sentences may be obtained in various ways of which application of the rule of contraposition is only one.

Further, it is claimed by formal logicians that when two sentences have exactly the same meaning, they become logically equivalent; and conversely, when two sentences are logically equivalent, they actually have the same meaning. Sentences represent states-of-affairs. When and only when two sentences, p and q, represent the same state-of-affairs, they are said to have the same meaning. Consequently, p or q may be true, if and only if the common state-of-affairs they represent be a fact; and otherwise they would both be false. This means, two sentences may have the same meaning if and only if they are logically equivalent, i.e., made true or false by the occurence or non-occurence, respectively, of the same fact. This is another way of saying that two logically equivalent sentences are propositionally, semantically or cognitively identical. This point has been vigorously challenged by Sen, the author of the concept of inductive equivalence.

It has been claimed that :-

(a) Application of the rule of contraposition cannot guarantee logical equivlence.

(b) Two logically equivalent sentences may not be propositionally or cognitively identical.

Traditional logicians directly contrapose :

(1) 'All ravens are black'

into :

(2) 'All non-black things are non-ravens'

and hold that

(1) and (2) are equivalent statements.

According to Sen, these two statements cannot be equivalent. (1)

is a statement about ravens which turns out to be either false or pointless in a world that does not contain any raven, but (2), which is a statement about non-black things, may be a true statement in that world. Again (2) turns out to be false or pointless in a world that does not contain any non-black thing, though (1) which is a statement about ravens, may very well be true in that world. According to him, every categorical statement bears some sort of existential commitment (or presupposition, in the language of Strawson) in respect of its subject term such that if the subject term be empty then the statement concerned cannot be true, - it would be false in Aristotelian view and pointless in Strawsonian view.[3]

There is, however, a different method of demonstrating the equivalent between (1) and (2). This method is usually adopted by modern formal logicians. Formal logicians first translate (1) and (2) respectively into :

(1a) ' (x) (Raven x —› Black x)'

and

(2a) ' (x) (-Black x —› -Raven x)'

and easily show that one is the contrapositive of the other.

As (1a) and (2a) are, thus, logically equivalent. (1) and (2) must also be logically equivalent. Sen is inclined to accept the equivalence of (1a) and (2a). But he rejects the claim that they are translations respectively, of (1) and (2). So, according to Sen, the equivalence of (1a) and (2a) does not in any way prove the equivalence of (1) and (2). The standpoint adopted by Sen is clearly Strawsonian.[4] (1) and (2) have some existential commitments. (1a) and (2a) have none. The author has other objections against the notion of logical equivalence. It is normally held by logicians that two logically equivalent statements are also semantically or cognitively identical, i.e. they express the same proposition. If S_1 and S_2 are logically equivalent statements and S_1 expressess the proposition p, then S_2 must also express the proposition p. Under such a situation, S_1 and S_2 would convey the same information, they would be cognitively equivalent, i.e., they would have the same meaning, they would be semantically identical. While speaking of two logically equivalent sentences Jeffrey says, 'The columns of "t"'s and "f"'s under the two sentences are the same and, therefore the two sentences have the same meaning. Facts that would make the one sentence true would make the other true as well, and facts that would make one of them false would falsify the other, too![5] Sen accepts the idea that two logically equivalent statements are interchangeable in all entailment statements, but rejects the idea that they are interchangeable in all confirmation statements. The former follows from the definition of logical equivalence, the latter does not. Two statements to be interchangeable in all confirmation statements have to be cognitively equivalent, i.e. they have to express the same proposition. But according to Sen, two logically equivalent statements may not be cognitively equivalent. It is in this context that Sen introduces his notion of 'Inductive Equivalence'. Two inductively equivalent hypotheses, he thinks, would be cognitively equivalent, since they would express the same proposition.

II

The author introduces his concept of inductive equivalence by help of two definitions :

Definition 1 : Any pair of hypotheses h_1 and h_2 are inductively equivalent if and only if they are interchangeable in every statement of confirmation or disconfirmation.

Definition 2 : Any pair of evidence e_1 and e_2 are inductively equivalent if and only if they are interchangeable in every statement of confirmation or disconfirmation.[6]

The first definition, Sen adds, implies that the hypotheses h_1 and h_2 can be said to be inductively equivalent if they are confirmed and disconfirmed by exactly the same evidence, and cannot be said to be so if they are not. The second definition, similarly, implies that the evidences e_1 and e_2 can be said to be inductively equivalent if they confirm and disconfirm exactly the same hypotheses, and cannot be said to be so if they do not.

According to Sen it is only inductive equivalence that may ensure cognitive equivalence.

Sen declares that he would be concerned almost exclusively with the first definition expressing a relation between hypotheses. He, thus, puts off all further discussion on the second definition expressing a relation between evidences. I cannot, however, resist the temptation of raising a point that appears hostile to his second definition. The following two evidences, both, confirm the hypotheses 'All Swans are Web-footed':

e_1 - This Canadian white Swan is Web-footed

e_2 - This Australian black Swan is Web-footed

The evidence e_1 and the evidence e_2 are, therefore, inductively equivalent. Can we say that e_1 and e_2 are also, on that account, cognitively equivalent, i.e. they express the same proposition? Obviously not. e_1 and e_2 might create illusion of being cognitively equivalent only when they are expressed thus :

e_1 - This swan is Web-footed

e_2 - This swan is a Web-footed.

But the 'This swan' of e_1 and the 'This swan' of e_2 are not synonymous. The first refers to a Canadian white Swan and the second to an Australian black swan. Therefore e_1 and e_2, even in this form, do not express the same proposition and, thus, lack propositional identity. The use of what Russell would call 'an ego-centric word',-'This'- might have given the illusion of propositional identity of e_1 and e_2. I would rather emphatically state that no pair of evidences e_1 and e_2 certified by the above definition 2 to be a pair of inductively equivalent evidences can really be a pair of two propositionally identical evidence statements, unless e_1 and e_2 be mere notational variants of each other. If e_2 can increase the probability of any hypothesis h_1 already confirmed by e_1, then e_1 and e_2 must have different propositional or cognitive content, though they are inductively equivalent as per Definition 2. This appears enough to prove the sterility of the concept of inductive equivalence of evidences. Of course, Sen has not, in so many words, claimed propositional identity for two inductively equivalent evidence statements. But the context in which he presents his second definition of inductive equivalence makes it relevant, only if two inductively equivalent evidences e_1 and e_2 be claimed to be cognitively equivalent as well. If it is in the mind of the author that propositional identity can be claimed only for two inductively equivalent evidences, then I think this should have been clearly spelt out.

It is unintelligible why this second definition has been introduced at all.

The two immediate consequences of his definition of inductive equivalence between hypotheses i.e. his definition 1, are, according to Sen - the following :

(a) It is both sufficient and necessary that the hypotheses h_1 and h_2 should be inductively equivalent if we are to infer that an evidence confirms h_2 from the fact that it conforms h_1. It is sufficient for, if h_1 and h_2 are inductively equivalent, h_2 can be substituted for h_1 in the confirmation statement "e confirms h_1". It is necessary, for, if h_1 and h_2 are not inductively equivalent, such a substitution cannot be made.

(b) The question of confirmation is *Logically prior* to the question of inductive equivalence. If to say that h_1 and h_2 are inductively equivalent is to say that they are confirmed (and disconfirmed) by the same evidence, then we cannot conclude either that h_1 and h_2 are inductively or that they are not, unless we have decided whether or not they are confirmed (and disconfirmed) by the same evidence before concluding either that they are inductively equivalent or that they are not.

It occurs to me that the consequence (a) is Truism. It does not state anything more or less than the definition 1, and that the consequence (b) really does not follow from the definition 1. What really follows from the definition 1 is that the question of confirmation is only factually prior (not logically prior) to the question of inductive equivalence. Logically, they are only equivalent, as the definition commits :

$(e)(h_1)(h_2)$ $(((eCh_1.eCh_2) \rightarrow (h_1$ is inductively equivalent with $h_2))$.
$((h_1$ is inducively equivalent with $h_2) \rightarrow (eCh_1.eCh_2)))$.

(e = any particular evidence; h_1 and h_2 = two hypotheses;
C = confirms)

Sen proceeds to announce that consequences similar to (a) and (b) follow immediately from definition 2 in which inductive equivalence is construed as a relation between evidence.

If we accept Hempel's equivalence condition[7] as well as Sen's concept of inductive equivalence, then we have to admit that logical equivalence must logically imply inductive equivalence. Otherwise, Hempel's Equivalence Condition, according to which :

For any evidence e, and any pair of hypotheses h_1 and h_2, if e confirms h_1 and h_1 is logically equivalent with h_2, then e also conforms h_2.

cannot be valid. But it appears quite possible to Sen that two hypotheses are logically equivalent, in the sense of being interchangeable in all entailment statements, but not inductively equivalent in the sense of being interchangeable in all confirmation statements. So, Sen concludes that Hempel's equivalence is invalid.

The contention of Sen is obviously paradoxical. Logical truths, like mathematical truths, are necessary. Two logically equivalent hypotheses are *necessarily* equivalent. They necessarily have the same Truth-value. So, they must have the same truth-value under all conditions, and only if h_1 and h_2 necessarily have the same truth value, they may entail each other. If it is possible that h_1 is true and h_2 is false, h_1 cannot entail h_2. Again if it is possible that h_2 is true and h_1 is false, h_2 cannot entail h_1. So, if two hypotheses h_1 and h_2 are logically equivalent, they must under all circumstances have the same truth-value. Either both the hypotheses must be true or both the hypotheses must be false. If their truth-value is not exactly known, they must have the same degree of probability. If it is found that the two hypotheses h_1 and h_2, though logically equivalent, are not inductively so, then it seems probable that the two hypotheses h_1 and h_2, though surely have the same truth-value, may yet have different truth-values.

This is indeed a cotradiction in terms. I am, therefore, of the opinion that Sen's arguement fails to invalidate Hempel's equivalence condition as stated above.

Sen points out that logically equivalent hypotheses need not be alternative formulations of the same hypothesis as Hempel has taken them to be. So, logical equivalence cannot entail inductive equivalence. Only if two hypotheses express the same proposition, they may be inductively equivalent, i.e., they may be confirmed or disconfirmed by the same evidence. The only sorts of equivalence that may guarantee propositional identity are, firstly, definitional equivalence, and secondly, equivalence by mere notational variation. All logically equivalent statements may not be either definitionally equivalent or mere notational variants of one another as claimed by Hempel.

My point against such a standpoint of Sen is firstly, that two hypotheses, if logically equivalent, have to be inductively equivalent as well without regard to the question whether they express the same proposition or not. This I have already explained. Secondly, I like to emphasize that two logically equivalent hypotheses must also express the same proposition, since they have the same truth-value under all conditions, and if they express the same proposition, they must have the same meaning. A proposition is the meaning of an indicative sentence. If two hypotheses, h_1 and h_2 bear different sets of meaning elements, they cannot be said to have the same truth-value under all possible conditions. Let us imagine that h_1 bears the meaning elements m_1, m_2 and m_3 while h_2 bears the meaning elements m_2, m_3 and m_4. It is easy to see, then, that any condition which would falsify m_1 and uphold m_2, m_3 and m_4 would falsify h_1 but uphold h_2. Again any condition that would uphold m_1, m_2 and m_3 and falsify m_4, would uphold h_1 but falsify h_2. Any possible difference in meaning is bound to bring in some differences in truth-conditions. Jeffrey, thus, categorically maintains that when two sentences are logically equivalent, they make the same statement. 'Thus "It will not both rain and snow" is another way of saying that either it will not rain or it will not snow........ The columns of "t"'s and "f"'s under the two sentences are the same and, therefore, the two sentences have the same meaning.'[8]

Sen, however, presents a counter-example to such claims. The raven hypothesis (x)(Rx—›Bx) and its contrapositive, after Max Black, (x) ((Rx v-Rx)—› (-Rx v Bx)) are logically equivalent. But they do not express the same proposition. Thus, Sen holds that the two expressions, though logically equivalent, are not merely notational variants of each other; they bear different meaning. They are cognitively different.

I find it difficult to accept the view of Sen in regard to the two expressions mentioned above. Even if one accepts Sen's criterion, i.e., inductive equivalence of the hypotheses concerned, one may see that the two expressions

(x) (Rx—›Bx) .... S_1

(x) ((Rx v -Rx) —› (-Rx v Bx).... S_2

really express the same proposition. Let us enquire what sort of evidence confirms these two hypotheses. No body objects to the view that the existence of a black raven, i.e., RB, confirms S_1 and that of non-black raven, $R\bar{B}$, disconfirms it. This is just an application of Nicod's instance theory of confirmation. But what confirms S_2? S_2 being a contigent expression needs confirmation by empirical evidence. Everything satisfies the antecedent of S_2 which is a tautology. But everything is not relevant to its contingent consequent. The truth-value of any expression with a tautologous antecedent is the truth-value of the consequent under all circumstances. S_2 simply exemplifies a universally quantified expression with a tautologous antecedent and a contigent consequent. The claim that (x) / (Rx v -Rx) —› (-Rx v Bx)/ is true is nothing more and nothing less than the claim that (x) (-Rx v Bx) is true. Thus, the truth of the comprehensive S_2 is totally dependent on the truth of (x) (-Rx v Bx). The evidence that confirms (x) (-Rx v Bx) is the only evidence that can confirm S_2 and the evidence that disconfirms (x) (-Rx v Bx) is the only evidence that disconfirms S_2. So (x) (-Rx v Bx) is inductively equivalent with (x) [(Rx v -Bx) —› (-Rx v Bx)] , i.e. S_2. But the propositional functions -Rx v Bx and Rx —› Bx are only notational variants of each other by definition. So,

(x) (Rx —› Bx) .... S_1
(x) [(Rx v -Rx) —› (-Rx v Bx)] .... S_2

are indeed inductively equivalent. But, then, they must be cognitively equivalent too, expressing the same proposition. S_2 is an extremely circumlocutory way of saying what S_1 says.

Sen's points against logical equivalence are many and varied. He, firstly, argues, "Logical equivalence is relative to a system. For, it is determined by the entailment relations in which the sentences that are said to be logically equivalent stand with one another, and with other sentences in the system".[9] These entailment relations, in their turn, are determined by the rules of inference which the system recognises. But the rule of one system may not be recognised by another. So, the sentences that are logically equivalent in one system may not be logically equivalent in another. If so, then confirmation becomes relative to a system. We may only say : If $h_1 \equiv h_2$ in a system L, and if e confirms h_1, then e confirms h_2 in that system. This contention of Sen does not give possibly the full story about logical equivalence. It is not logical equivalence, but notations used and meaning attached to different notations that are really relative to particular systems. Logical equivalence between propositions is an ontological relation. Different systems are different ways of understanding logical relations between propositions. The ontological relations between propositions may not be identical with the way a system understands them. Had it been so, science and civilisation would all end in chaos, meetings and conferences would turn into battlefields.

It has further been said, "The minimum (and, most probably also the maximum) requirement for propositional identity, i.e., identity in respect of the proposition expressed, between S_1 and S_2, it appears to me, is that S_1 and S_2, are derivable from one another by definitional equivalence alone."[10] This drives a wedge between logical equivalence and defitional equivalence - the former cannot guarantee propositional identity while the latter can. Such a distinction between logical equivalence and definitional equivalence seems to be unwarranted. A logical equivalence must be either itself a defitional equivalence or, derivable from it according to rules that are meaning preserving.

Notwithstanding what has been said above, we may provisionally accept the view that rules of logic are relative to the system, that a pair of sentences that are treated as logically equivalent in one system may not be so in another system. But the statement : "If h_1 is logically equivalent with h_2, then h_1 inductively equivalent with h_2" must be admitted. This is true for every system. Two systems of logic, L_1 and L_2, may differ in their attitude towards the rules of double Negation, Simplification, Disjunctive Syllogism or Contraposition. So they may differ as to whether h_1 is really logically equivalent with h_2. This is altogether a different question. But if a system accepts that h_1 is logically equivalent with h_2, it has to admit that they are inductively equivalent as well. A system, say L_1, would just contradict itself by accepting the logical equivalence of h_1 and h_2 in L_1, and rejecting their inductive equivalence. Two tailors may have different yard-sticks of measurement, such that according to one a particular piece of cloth is 2 ft. in width while according to the other it is only 13/4 ft. Yet, they both agree that 2 ft x 2 ft is equal to 4 ft. None of the tailors can say, 'I do not agree that 2' x 2' = 4', because what is 2' in your yardstick is not so in my yardstick'. None of Sen's arguement is an effective challenge to Hempel's equivalence condition laid down in the second premise of the paradox generating arguement of Hempel. For any evidence e, and any pair of hypotheses h_1 and h_2, if e confirms h_1 and h_1 is logically equivalent with h_2, then e also confirms h_2.

However, Sen does challenge that logical equivalence between 'All non-black things are non-ravens' and ' All ravens are black' asserted by the third premise of the paradox generating arguement, since he refuses to accept contraposition as a valid rule that may guarantee logical equivalence. I shall not discuss this point in this paper in detail partly because this has already been argued against in an earlier paper[11] and partly because this is strictly outside the scope of the present paper. I may be permitted here only to mention that Sen refuses to accept the derivation of (x) (-Bx ⟶ -Rx) from (x) Rx ⟶ Bx) because this would involve the acceptance of the law of Double negation : 'p = --p'. Neither equivalence between p and --p is definitional, nor is the difference between them merely notational. If we recall that '-' is a contradiction forming operator, that '-p' means 'p is false' in the sense that p is not true, then the equivalence between p and --p becomes definitional and the indifference just notational. In fact, the equivalence between p and --p must be a theorem in all systems that accept '-' as a contradiction forming operator.

III

I am strongly inclined to believe that there is something wrong with the notion of inductive equivalence. Confirmation is a matter of degree, but equivalence is not. So, equivalence of any sort cannot be based on confirmation. The question of confirmation establishing propositional identity does not, therefore, arise.

Counter example - 1

Propositions with the same subject and the same predicate differing only in modality are all confirmed or disconfirmed by the same evidence. But they are neither cognitively equivalent nor propositionally identical.

Thus :

h_1 - Possibly, all Swans are white.
h_2 - All Swans are white.
h_3 - All Swans must be white.

All will agree that h_1, h_2 and h_3 of this example are all confirmed by the evidence of a Canadian White Swan. They may all be disconfirmed as well by the evidence of an Australian black Swan. h_1, h_2 and h_3 of this example are, therefore, inductively equivalent. But nobody would treat them either as cognitively equivalent or propositionally identical.

Inadequacy of the concept of inductive equivalence may be proved in a diferent way.

Counter example - 2

Let us assume that there are ravens in all countries of the world including Australia. Three Ornithologists O_1, O_2 and O_3, make the three hypotheses, one each, respectively :

h_1 - All ravens are black.
h_2 - All Australian ravens are black.
h_3 - All African ravens are black.

'Australian ravens' and 'African ravens' represent two non-empty subclasses of the non-empty class represented by 'ravens', such that if h_1 i.e. 'All ravens are black' be true, h_2 i.e. 'All Australian ravens are black' and h_3 i.e. 'All African ravens are black' also become true, because h_1 intuitively entails h_2 and h_3. There is no system of logic that may challenge this. A research worker R finds the evidence of an Indian black raven which we name e_1. Then, he finds e_2 i.e. the evidence of an Australian black raven, and e_3, the evidence of an African black raven. That e_2 confirms h_2 and e_3 confirms h_3 will be readily acceptable to all. But whatever confirms h_2 or h_3 must also confirm h_1 because instances of h_2 and h_3 are also instances of h_1. Again e_1 is also an instance of h_1. So, each of e_1, e_2 and e_3 confirms h_1 according to the instance of theory of confirmation. But h_1 entails h_2 and h_3. Does not each of e_1, e_2 and e_3 thereby confirm h_2 and h_3 as well? Obviously it does. Whatever evidence confirms h_1 also confirms h_2 and h_3. But then h_1, h_2 and h_3 become inductiovely equivalent. According to Sen h_1, h_2 and h_3, then, should be cognitively equivalent as well, having propositional identity. I do not believe anybody will accept such a position and commit that 'All Australian ravens are black' means the same thing as 'All African ravens are black', or these two have the same meaning as 'All ravens are black'.

The concept of inductive equivalence is, thus, logically sterile. The concept of confirmation, though useful to science, cannot be a criterian of any equivalence of logical importance. An evidence confirms different statements not only in different degrees, but also in different ways. The above Counter-example - 1 demonstrates a condition of confirmation, the modality condition, which may be expressed as :

For an evidence e_1, and any pair of hypotheses h_1 and h_2 if e confirms h_1, and h_1 differs from h_2 only in modality, then e also confirms h_2.

The Counter example - II similarly demonstrates the entailment condition of confirmation that may be stated thus :

For an evidence e, and a pair of hypotheses h_1 and h_2, if e confirms h_1, and h_1 entails h_2, then e also confirms h_2.

As a condition of confirmation, Hempel's equivalence condition must be a stronger condition than the modality condition or entailment condition, because two hypotheses that are logically equivalent to each other have more factors or points common between them than two hypotheses differing in modality or two hypotheses of which only the one entails the other.

I therefore, conclude that inductive equivalence cannot guarantee propositional identity. Rather, it is propositional identity between two statements that may enable them to be confirmed equally by the same evidence. However, the propositional identity turns out to be wild goose if pursued beyond formal limits.

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NOTES

1. Deb : 'Paradox of Confirmation' - *The Journal of the Indian Academy of Philosophy,* Vol. XX, No. 2, 1981.
2. R.C.Jeffrey : *Formal Logic : Its Scope and Limits*; (McGraw-Hill Book Company, 1967), p.20.
3. A critical evaluation of the views of Aristotle and Strawson appears in the following two papers :
   (a) Deb : 'Strawson's Interpretation of Traditional Form' - *Journal of the Indian Academy of Philosophy*, Vol. XVIII, No. 1, 1979.
   (b) Deb : 'Strawson on Existential Import of General Propositions' - *Journal of the Indian Academy of Philosophy*, Vol. XIX, No. 2, 1980.
4. A fuller account of this notion of general propositions may be found in:
   (a) P.F.Strawson : *Introduction to Logical Theory*, (Methuen & Co. Ltd. 1952)
   (b) P.K.Sen : 'Analysis of General propositions' - *Indian Philosophical Quarterly*, Vol V, No. II, 1978.
5. Jeffrey : *Op. Cit.* p.20.

6. P.K.Sen : 'Approaches to the paradox of Confirmation' - *Ajatus* (Year Book of the Philosophical Society of Finland), p.57.
7. C.G.Hempel : 'Studies in the logic of Confirmation' - *Mind*, Vol.LIX, 1945. Also in *Aspects of Scientific Explanation*, (New York, 1965)
8. Jeffrey : *Op. Cit.* pp.19-20.
9. Sen : *Op. Cit.* p 62.
10. Sen : *Op. Cit.* p. 60.
11. Deb : 'Paradox of Confirmation' - *Journal of the Indian Academy of Philosophy*, Vol. xx, No.2, 1981.