THE LOGIC OF CAUSATION: Definition, Induction and Deduction of Deterministic Causality.

By **Avi Sion** PH.D.

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The present document contains **excerpts** from this book, namely: The Abstract; the Contents; and Sample text (Chapters 1 (sections 1-2), 2 (sections 1,3,5-6), and 3 (sections 1-2)).

Avi Sion (Ph.D. Philosophy) is a researcher and writer in logic, philosophy, and spirituality. He has, since 1990, published original writings on the theory and practice of inductive and deductive logic, phenomenology, epistemology, aetiology, psychology, meditation, ethics, and much more. Over a period of some 28 years, he has published 27 books. He resides in Geneva, Switzerland.

It is very difficult to briefly summarize Avi Sion's philosophy, because it is so wide-ranging. He has labeled it '**Logical Philosophy**', because it is firmly grounded in formal logic, inductive as well as deductive. This original philosophy is dedicated to demonstrating the efficacy of human reason by detailing its actual means; and to show that the epistemological and ethical skepticism which has been increasingly fashionable and destructive since the Enlightenment was (contrary to appearances) quite illogical – the product of ignorant, incompetent and dishonest thinking.

Abstract

The Logic of Causation is a treatise of formal logic and of aetiology. It is an original and wide-ranging investigation of the definition of causation (deterministic causality) in all its forms, and of the deduction and induction of such forms. The work was carried out in three phases over a dozen years (1998-2010), each phase introducing more sophisticated methods than the previous to solve outstanding problems. This study was intended as part of a larger work on causal logic, which additionally treats volition and allied cause-effect relations (2004).

The Logic of Causation deals with the main technicalities relating to reasoning about causation. Once all the deductive characteristics of causation in all its forms have been treated, and we have gained an understanding as to how it is induced, we are able to discuss more intelligently its epistemological and ontological status. In this context, past theories of causation are reviewed and evaluated (although some of the issues involved here can only be fully dealt with in a larger perspective, taking volition and other aspects of causality into consideration, as done in ***Volition and Allied Causal Concepts***).

Phase I: Macroanalysis.

Starting with the paradigm of causation, its most obvious and strongest form, we can by abstraction of its defining components distinguish four genera of causation, or generic determinations, namely: complete, partial, necessary and contingent causation. When these genera and their negations are combined together in every which way, and tested for consistency, it is found that only four species of causation, or specific determinations, remain conceivable. The concept of causation thus gives rise to a number of positive and negative propositional forms, which can be studied in detail with relative ease because they are compounds of conjunctive and conditional propositions whose properties are already well known to logicians.

The logical relations (oppositions) between the various determinations (and their negations) are investigated, as well as their respective implications (eductions). Thereafter, their interactions (in syllogistic reasoning) are treated in the most rigorous manner. The main question we try to answer here is: *is (or when is) the cause of a cause of something itself a cause of that thing, and if so to what degree?* The figures and moods of positive causative syllogism are listed exhaustively; and the resulting arguments validated or invalidated, as the case may be. In this context, a general and sure method of evaluation called 'matricial analysis' (macroanalysis) is introduced. Because this (initial) method is cumbersome, it is used as little as possible – the remaining cases being evaluated by means of reduction.

Phase II: Microanalysis.

Seeing various difficulties encountered in the first phase, and the fact that some issues were left unresolved in it, a more precise method is developed in the second phase, capable of systematically

answering most outstanding questions. This improved matricial analysis (microanalysis) is based on tabular prediction of all logically conceivable combinations and permutations of conjunctions between two or more items and their negations (grand matrices). Each such possible combination is called a 'modus' and is assigned a permanent number within the framework concerned (for 2, 3, or more items). This allows us to identify each distinct (causative or other, positive or negative) propositional form with a number of alternative moduses.

This technique greatly facilitates all work with causative and related forms, allowing us to systematically consider their eductions, oppositions, and syllogistic combinations. In fact, it constitutes a most radical approach not only to causative propositions and their derivatives, but perhaps more importantly to their constituent conditional propositions. Moreover, it is not limited to logical conditioning and causation, but is equally applicable to other modes of modality, including extensional, natural, temporal and spatial conditioning and causation. From the results obtained, we are able to settle with formal certainty most of the historically controversial issues relating to causation.

Phase III: Software Assisted Analysis.

The approach in the second phase was very 'manual' and time consuming; the third phase is intended to 'mechanize' much of the work involved by means of spreadsheets (to begin with). This increases reliability of calculations (though no errors were found, in fact) – and also allows for a wider scope. Indeed, we are now able to produce a larger, 4-item grand matrix, and on its basis find the moduses of causative and other forms needed to investigate 4-item syllogism. As well, now each modus can be interpreted with greater precision and causation can be more precisely defined and treated.

In this latest phase, ***the research is brought to a successful finish!*** Its main ambition, to obtain a complete and reliable listing of all 3-item and 4-item causative syllogisms, being truly fulfilled. This was made technically feasible, in spite of limitations in computer software and hardware, by cutting up problems into smaller pieces. For every mood of the syllogism, it was thus possible to scan for conclusions 'mechanically' (using spreadsheets), testing all forms of causative and preventive conclusions. Until now, this job could only be done 'manually', and therefore not exhaustively and with certainty. It took over 72'000 pages of spreadsheets to generate the sought for conclusions.

This is a historic breakthrough for causal logic and logic in general. Of course, not all conceivable issues are resolved. There is still some work that needs doing, notably with regard to 5-item causative syllogism. But what has been achieved solves the core problem. The method for the resolution of all outstanding issues has definitely now been found and proven. The only obstacle to solving most of them is the amount of labor needed to produce the remaining (less important) tables. As for 5-item syllogism, bigger computer resources are also needed.

Contents

Phase One: Macroanalysis.

Phase Two: Microanalysis.

Phase Three: Software Assisted Analysis.

Sample text (parts of chapters 1-3)

1. The Paradigm of Causation

1. Causation

Causality refers to causal relations, i.e. the relations between causes and effects. This generic term has various, more specific meanings. It may refer to **Causation**, which is *deterministic causality*; or to Volition, which is (roughly put) indeterministic causality; or to Influence, which concerns the interactions between causation and volition or between different volitions.

The term 'causality' may also be used to refer to causal issues: i.e. to negative as well as positive answers to the question "are these things causally related?" In the latter sense, negations of causality (in the positive sense) are also causality (in the broad sense). This allows us to consider Spontaneity (i.e. causelessness, the lack of any causation or volition) as among the 'causal' explanations of things.

A study of the field of causality must also include an investigation of non-causality in all its forms. For, as we shall see, even if we were to consider spontaneity impossible, the existence of causality in one form or other between things in general does not imply that any two things taken at random are necessarily causally related or causally related in a certain way. We need both positive and negative causal propositions to describe the relations between things.

In the present work, *The Logic of Causation*, we shall concentrate on causation, ignoring for now other forms of causality. Causative logic, or the logic of causative propositions, has three major goals, as does the study of any other type of human discourse.

(a) To *define* what we mean by causation (or its absence) and identify and classify the various forms it might take.
(b) To work out the *deductive* properties of causative propositions, i.e. how they are opposed to each other (whether or not they contradict each other, and so forth), what else can be immediately inferred from them individually (eduction), and what can be inferred from them collectively in pairs or larger numbers (syllogism).
(c) To explain how causative propositions are, to start with, *induced* from experience, or constructed from simpler propositions induced from experience.

Once these goals are fulfilled, in a credible manner (i.e. under strict logical supervision), we shall have a clearer perspective on wider issues, such as (d) whether there is a universal law of causation (as some philosophers affirm) or spontaneity is conceivable (as others claim), and (e) whether other forms of causality (notably volition, and its derivative influence) are conceivable.

Note well, we shall to begin with theoretically define and interrelate the various possible forms of causation, *leaving aside for now the epistemological issue as to how they are to be identified and established in practice, as well as discussions of ontological status*.

We shall thus in the present volume primarily deal with the main *technicalities* relating to reasoning about causation, and only later turn our attention to some larger epistemological and ontological issues (insofar as they can be treated prior to further analysis of the other forms of causality). The technical aspect may at times seem tedious, but it is impossible to properly understand causation and its implications without it. Most endless debates about causation (and more generally, causality) in the history of philosophy have arisen due to failure to first deal with technical issues.

2. The Paradigmic Determination

Causation, or deterministic causality, varies in strength, according to the precise combinations of conditioning found to hold between the predications concerned. We may call the different forms thus identified the **determinations** of causation.

The *paradigm*, or basic pattern, of causation is its strongest determination. This has the form:

> **If the cause is present, the effect is invariably present**;
> **if the cause is absent, the effect is invariably absent**.

Our use, here, of the definite article, as in *the* cause or *the* effect, is only intended to pinpoint the predication under consideration, without meaning to imply that there is only one such cause or effect in the context concerned. Use of an indefinite article, as in *a* cause or *an* effect, becomes more appropriate when discussing a multiplicity of causes or effects, which as we shall later see may take various forms.

We may rewrite the above *static* formula in the following more *dynamic* expression:

> If the cause shifts from absent to present, the effect invariably shifts from absent to present;
> if the cause shifts from present to absent, the effect invariably shifts from present to absent;

We shall presently see how this model is variously reproduced in lesser determinations. For now, it is important to grasp the underlying principle it reflects.

The essence of causation (or 'effectuation') is that ***when some change is invariably accompanied by another, we say that the first phenomenon that has changed has "caused" (or "effected") the second phenomenon that has changed***. In the above model, the changes involved are respectively from the absence to the presence of the first phenomenon (called the cause) and from the absence

to the presence of the second phenomenon (called the effect); or vice versa. We may, incidentally, commute this statement and say that the effect has been caused (or effected) by the cause.

Now, some comments about our terminology here:

The term "**change**", here, must be understood in a very broad sense, as referring to any event of difference, whatever its modality.

- Its primary meaning is, of course, *natural change*, with reference to *time* or more to the point with respect to broader changes in surrounding *circumstances*[1]. Here, the meaning is that some object or characteristic of an object which initially existed or appeared, later did not exist or disappeared (ceasing to be), or vice-versa (coming to be); or something existed or appeared at one place and time and recurred or reappeared at another place, at another time (mutation, alteration or movement). This gives rise to temporal and natural modalities of causation.
- Another, secondary sense is *diversity* in *individuals* or *groups*. This signifies that an individual object has different properties in different parts of its being[2]; or that a kind of object has some characteristic in some of its instances and lacks that characteristic (and possibly has another characteristic, instead) in some other of its instances. This gives rise to spatial and extensional modalities of causation.
- Tertiary senses are *epistemic* or *logical change*, which focus respectively on the underlying acts of consciousness or the status granted them: something is at first noticed and later ignored, or believed and later doubted, or vice-versa, by someone. This gives rise to epistemic and logical modalities of causation.

Regarding the terms "**present**" and "**absent**" (i.e. not present), they may be understood variously, with reference to the situations just mentioned. They may signify existence or appearance or instancing (i.e. occurrence in some indicated cases) or being seen or being accredited true – or the negations of these.

The term "**phenomenon**" is here, likewise, intended very broadly, to include physical, mental or spiritual phenomena (things, appearances, objects), concrete or abstract. Also, a phenomenon may be static or dynamic: that is, the changing cause and effect need not be a quality or quantity or state or position, though some such static phenomena are always ultimately involved; the cause and effect may themselves be changes or events or movements. For instance, motion is change of place,

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[1] The difference between time and circumstance as concepts of reference seems very slim. How do we *pinpoint* an undefined 'circumstance' other than with reference to time? Yet the distinction seems important, since we construct two different types of modality or modes on its basis. The only answer I can think of for now is that whereas times (e.g. "on 17 August 1999, I wrote this footnote") are unrepeatable, circumstances (e.g. "at the time Turkey experienced an earthquake, I wrote this footnote") are in principle repeatable. A circumstance is loosely specified by *describing some events* in a time (without always intending that reference item to be more than coincidental – i.e. the earthquake did not cause me to write these comments).

[2] This is the basis for a concept of *spatial modality*, which I did not treat in *Future Logic*. At the time I wrote that book, I did not take time to think about it. However, I can predict that the properties of this mode should be very similar to those of extensional modality, just as temporal modality is akin to natural (or circumstantial) modality. Spatial and temporal modality should behave in similar ways in various respects.

acceleration is change in the speed or direction of motion. What matters is the switch from presence to absence, or vice-versa, of that thing, whatever its nature (be it static or dynamic). The cause and effect need not even be of similar nature; for example, a change of quality may cause a change of quantity.

Another term to clarify in the above principle is "**accompanied**". Here again, our intent is very large. The cause and effect may be in or of the same object or different objects, adjacent or apart in space, contemporaneous or in a temporal sequence. The definition of causation contains no prejudice in these respects, though we may eventually find fit to postulate relatively non-formal rules, such as that in natural causation the effect cannot precede the cause in time or that all causation at a distance implies intermediate contiguous causations[3].

Indeed, it is in some cases difficult for us, if not impossible, to say which of the two phenomena is the cause and which is the effect. And this often is not only an epistemological issue, but more deeply an ontological one. For, though there is sometimes a **direction of causation** to specify, there is often in fact no basis for such a specification. The phenomena named 'cause' and 'effect' are in a reciprocal relation of causation; the terms cause and effect are in such cases merely verbal distinctions. All that we can say is that the phenomena are bound together, and either can be accessed through the other; the labels applied to them become a matter of convenience for purposes of discourse.

Finally, the term "**invariably**" has to be stressed. How such constancy is established is not the issue here; we shall consider that elsewhere. In the paradigm of causation given above, it would not do for the conjunction of the cause and effect, or the conjunction of their negations, to be merely occasional. We would not regard such varying conjunctions as signifying genuine causation, but quite the opposite as signs of mere coincidence, happenstance of togetherness. *Post hoc ergo propter hoc.* The problem is complicated in lesser determinations of causation; but as we shall see it can be overcome, a constancy of conjunction or of non-conjunction is always ultimately involved.

In this context, a warning is in order. When something is invariably accompanied by another, we say that the first (the presence or absence of the cause) "is followed by" the second (the presence or absence of the effect). This refers to causal sequence and should not be confused with temporal sequence; the term "followed" is ambivalent (indeed, it is also used in relation to spatial or numerical series). Even though causal and temporal sequence are often both involved (which is

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[3] Be it said in passing, these specific rules, mentioned here for purposes of illustration, though seemingly true for natural causation, are certainly not relevant in the extensional or logical modes of causation. Indeed, it is no longer sure that a 'contiguity principle' applies universally even to natural causation: recent discoveries by physicists may suggest the existence of 'instant action at a distance' between pairs of particles, which seemingly goes against Relativity Theory prediction since the limit of the speed of light is not maintained. Whatever the theoretical physics outcome of such discoveries, the current question mark demonstrates that logic theory must remain open in such issues; i.e. principles like that of contiguity must be regarded as generalizations which might be abandoned if the need to do so is found overwhelming.

why the term "to follow" is equivocal), causal sequence may occur without temporal sequence (even in natural causation) or in a direction opposite to temporal sequence (though supposedly not in natural causation, certainly in logical causation, and by abstraction of the time factor also in extensional causation). The context usually makes the intent clear, of course.

Now, for some formal analysis:

In our present treatment of causation, we shall focus principally on the logical 'mode' of causation, note well. There are (as we shall later discuss) other modes, notably the natural, the temporal, the spatial and the extensional, whose definitions differ with respect to the type of modality considered. Having investigated modality and conditioning in detail in a previous treatise (*Future Logic*, 1990), I can predict that most of the behavior patterns of logical causation are likely to be found again in the other modes of causation; but also, that some significant differences are bound to arise.

Returning now to the paradigm of causation, it may be expressed more symbolically as follows, using the language of logical conditioning (as developed in my *Future Logic*, Part III):

If C, then E; and

if notC, then notE.

A sentence of the form "If P, then Q" means "the conjunction of P and the negation of Q is impossible", i.e. there are no knowledge-contexts where this conjunction (P + notQ) credibly occurs. Such a proposition can be recast in the contraposite form "If notQ, then notP", which means "the conjunction of notQ and the negation of notP is impossible" – the same thing in other words.

Such a proposition, note, does not formally imply that P is possible or that notQ is possible. Normally, we do take it for granted that such a proposition may be realized, i.e. that P is possible, and therefore (by apodosis) Q is possible and the conjunction "P and Q" is possible; and likewise that notQ is possible, and therefore (by apodosis) notP is possible and the conjunction "notQ and notP" is possible.

However, in some cases such assumption is unjustified. It may happen that, though "If P, then Q" is true, P is impossible, in which case "If P, then notQ" must also be true; or it may happen that, though "if P, then Q" is true, notQ is impossible, in which case "If notP, then Q" must also be true. These results are paradoxical, yet quite logical. I will not go into this matter in detail here, having dealt with it elsewhere (see *Future Logic*, ch. 31). It is not directly relevant to the topic under discussion, except that it must be mentioned to stress that such paradox cannot occur in the context of causation (except to deny causation, of course).

Therefore, when discussing causation, it is tacitly understood that:

C is contingent and E is contingent[4].

That is, each of C, E is possible but unnecessary; likewise, by obversion, for their negations, each of notC, notE is possible but unnecessary. If any of these positive or negative terms is by itself necessary or impossible, it is an antecedent or consequent in valid (and possibly true) propositions, but it is not a cause or effect within the causation specified. This is, by the way, one difference in meaning between the expressions cause/effect, and the expressions antecedent/consequent. We shall see, as we deal with lesser determinations of causation, that their meanings diverge further. All the more so, when the terms cause/effect are used in other forms of causality.

Furthermore, as above shown with reference to "P" and "Q", granting the contingencies of C and E, each of the propositions "If C, then E" and "If notC, then notE" implies the following possibilities:

The conjunction (C + E) is possible; and
the conjunction (notC + notE) is possible.

All this is hopefully clear to the reader. But we must eventually consider its implications with reference to statements dealing with lesser determinations of causation or statements denying causation.

2. The Generic Determinations

1. Strong Determinations

The strongest determination of causation, which we identified as the paradigm of causation, may be called complete and necessary causation. We shall now repeat the three constituent propositions of this form and their implications, all of which must be true to qualify:

(i) If C, then E;
(ii) if notC, then notE;
(iii) where: C is contingent and E is contingent.

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[4] To avoid any confusion, we should add "in the type of modality characterizing the causal relation". But this specification would be incomprehensible to most readers, as the issue of mode of causation is dealt with in a later chapter.

As we saw, these propositions together imply the following:

The conjunction (C + E) is possible;
the conjunction (notC + notE) is possible.

Clauses (i) and (iii) signify complete causation. With reference to this positive component, we may call C a **complete cause** of E and E a **necessary effect** of C. Where there is complete causation, the cause is said to ***make necessary*** (or necessitate) the effect[5]. This signifies that the presence of C is *sufficient* (or enough) for the presence E.

Clause (ii) and (iii) signify necessary causation. With reference to this negative component, we may call C a **necessary cause** of E and E a **dependent effect** of C. Where there is necessary causation, the cause is said to ***make possible*** (or be necessitated by) the effect. This signifies that the presence of C is *requisite* (or indispensable) for the presence E[6].

Clause (iii) is commonly left tacit, though as we saw it is essential to ensure that the first two clauses do not lead to paradox. Strictly speaking, it would suffice, given (i), to stipulate that C is possible (in which case so is E) and E is unnecessary (in which case so is C). Or equally well, given (ii), that C is unnecessary (in which case so is E) and E is possible (in which case so is C). The possibilities of the conjunctions (C + E) and (notC + notE), logically follow, and so need not be included in the definition.

Looking at the paradigm, we can identify two distinct lesser determinations of causation, which as it were split the paradigm in two components, *each of which by itself conforms to the paradigm* through an ingenuous nuance, as shown below.

Also below, I list the various clauses of each definition, renumbering them for purposes of reference. Then a table is built up, including all the causal and effectual items involved (positive and negative) and all their conceivable combinations[7]. The *modus* of each item or combination, i.e. whether it is defined or implied as possible or impossible, or left open, is then identified. In each case, the *source* of such modus is noted, i.e. whether it is given or derivable from given(s).

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[5] The expression “X makes Y *impossible*” means that X makes notY necessary, incidentally.

[6] We commonly say, in such case, that C is a ***sine qua non*** (Latin for 'without which not') or *proviso* of E.

[7] I use the word 'item' to refer to a cause or effect (or the negation of a cause or effect), indifferently. An item is, thus, for the logician, primarily a *thesis* (in the largest sense), i.e. a categorical or other form of proposition. But an item may also signify a *term*, since theses are ultimately predications. An item, then, is a thesis, or term within a thesis, involved in a causal proposition.

Complete causation:

(i) **If C, then E;**
(ii) **if notC, not-then E**;
(iii)where: **C is possible**.

Table **Error! No text of specified style in document.**.1. Complete causation.

No.	Element/compound		Modus	Source/relationship
1	**C**		**possible**	**(iii)**
2	notC		possible	implied by (ii)
3		E	possible	implied by (i) + (iii)
4		notE	possible	implied by (ii)
5	C	E	possible	implied by (i) + (iii)
6	**C**	**notE**	**impossible**	**(i)**
7	notC	E	*open*	
8	**notC**	**notE**	**possible**	**(ii)**

Complete causation conforms to the paradigm of causation by means of the same main clause (i); whereas its clause (ii), note well, concerning what happens in the absence of C, substitutes for the invariable absence of E (i.e. "then notE"), the *not*-invariable *presence* of E (i.e. "not-then E"). However, remember, contraposition of (i) implies that "If notE, then notC", meaning that in the absence of E we can be sure that C is also absent[8].

Clause (ii) means that (notC + notE) is possible, so we are sure from it that C is unnecessary and E is unnecessary; also it teaches us that C and E cannot be exhaustive. Technically, it would suffice for us to know that notE is possible, for we could then infer clause (ii) from (i); but it is best to specify clause (ii) to fit the paradigm of causation. As for clause (iii), we need only specify that C is possible; it follows from this and clause (i) that (C + E) is possible and so that E is also possible.

Note well the nuance that, to establish such causation, the effect has to be found *invariably* present in the presence of the cause, otherwise we would commit the fallacy of *post hoc ergo propter hoc*; but the effect need not be invariably absent in the absence of the cause: it suffices for the effect *not to be* invariably present.

[8] In some but not all cases, notE not only implies but causes notC, note.

The segment of the above table numbered 5-8 (shaded) may be referred to as the *matrix* of complete causation. It considers the possibility or impossibility of all conceivable conjunctions of all the items involved in the defining clauses or the negations of these items.

Necessary causation:

(i) **If notC, then notE**;
(ii) **if C, not-then notE**;
(iii)where: **C is unnecessary**.

Table **Error! No text of specified style in document.**.2. Necessary causation				
No.	Element/compound		Modus	Source/relationship
1	C		possible	implied by (ii)
2	**notC**		**possible**	**(iii)**
3		E	possible	implied by (ii)
4		notE	possible	implied by (i) + (iii)
5	**C**	**E**	**possible**	**(ii)**
6	C	notE	*open*	
7	**notC**	**E**	**impossible**	**(i)**
8	notC	notE	possible	implied by (i) + (iii)

Necessary causation conforms to the paradigm of causation by means of the same main clause (i)[9]; whereas its clause (ii), note well, concerning what happens in the presence of C, substitutes for the invariable presence of E (i.e. "then E"), the *not*-invariable *absence* of E (i.e. "not-then notE"). However, remember, contraposition of (i) implies that "If E, then C", meaning that in the presence of E we can be sure that C is also present[10].

Clause (ii) means that (C + E) is possible, so we are sure from it that C is possible and E is possible; also it teaches us that C and E cannot be incompatible. Technically, it would suffice for us to know that E is possible, for we could then infer clause (ii) from (i); but it is best to specify clause (ii) to

[9] Notice that clause (i), here, in necessary causation, was labeled as clause (ii) in complete and necessary causation. The numbering is independent.

[10] In some but not all cases, E not only implies but causes C, note.

fit the paradigm of causation. As for clause (iii), we need only specify that C is unnecessary; it follows from this and clause (i) that (notC + notE) is possible and so that E is also unnecessary.

Note well the nuance that, to establish such causation, the effect has to be found *invariably* absent in the absence of the cause, otherwise we would commit the fallacy of *post hoc ergo propter hoc*; but the effect need not be invariably present in the presence of the cause: it suffices for the effect *not to be* invariably absent.

Note the *matrix* of necessary causation, i.e. the segment of the above table numbered 5-8 (shaded).

Lastly, notice that complete and necessary causation are *'mirror images'* of each other. All their characteristics are identical, except that the polarities of their respective cause and effect opposite: C is replaced by notC, and E by notE, or vice-versa. The one represents the positive aspect of strong causation; the other, the negative aspect. Accordingly, their logical properties correspond, *mutatis mutandis* (i.e. if we make all the appropriate changes).

Following the preceding analysis of necessary and complete causation into two distinct components each of which independently conforms to the paradigm, we can conceive of complete causation *without* necessary causation and necessary causation *without* complete causation. These two additional determinations of causation are conceivable, note well, only because they do not infringe logical laws; that is, we already know that the various propositions that define them are individually and collectively logically compatible.

3. Weak Determinations

Having clarified the complete and necessary forms of causation, as well as parallelism, we are now in a position to deal with lesser determinations of causation. Let us first examine partial causation; contingent causation will be dealt with further on.

Partial causation:

(i) **If (C1 + C2), then E**;
(ii) **if (notC1 + C2), not-then E**;
(iii)**if (C1 + notC2), not-then E**;
(iv)where: **(C1 + C2) is possible**.

Table **Error! No text of specified style in document.**.3. Partial causation.					
No.	Element/compound			Modus	Source/relationship
1	C1			possible	implied by (iii) or (iv)
2	notC1			possible	implied by (ii)
3		C2		possible	implied by (ii) or (iv)
4		notC2		possible	implied by (iii)
5			E	possible	implied by (i) + (iv)
6			notE	possible	implied by (ii) or (iii)
7	C1		E	possible	implied by (i) + (iv)
8	C1		notE	possible	implied by (iii)
9	notC1		E	*open*	
10	notC1		notE	possible	implied by (ii)
11		C2	E	possible	implied by (i) + (iv)
12		C2	notE	possible	implied by (ii)
13		notC2	E	*open*	
14		notC2	notE	possible	implied by (iii)
15	**C1**	**C2**		**possible**	**(iv)**
16	C1	notC2		possible	implied by (iii)
17	notC1	C2		possible	implied by (ii)
18	notC1	notC2		*open*	
19	C1	C2	E	possible	implied by (i) + (iv)
20	**C1**	**C2**	**notE**	**impossible**	**(i)**
21	C1	notC2	E	*open*	
22	**C1**	**notC2**	**notE**	**possible**	**(iii)**
23	notC1	C2	E	*open*	
24	**notC1**	**C2**	**notE**	**possible**	**(ii)**
25	notC1	notC2	E	*open*	
26	notC1	notC2	notE	*open*	

Two phenomena C1, C2 may be called **partial causes** of some other phenomenon E, only if *all* the above conditions (i.e. the four defining clauses) are satisfied. In such case, we may call E a **contingent effect** of each of C1, C2. Of course, the *compound* (C1 + C2) is a complete cause of E,

since in its presence, E follows (as given in clause (i)); and in its absence, i.e. if not(C1 + C2), E does not invariably follow (as evidenced by clauses (ii) and (iii)). Rows 19-26 of the above table (shaded) constitute the matrix of partial causation.

We may thus speak of this phenomenon as a composition of partial causes; and stress that C1 and C2 belong in that particular causation of E by calling them *complementary* partial causes of it. Indeed, instead of saying "C1 and C2 are complementary partial causes of E", we may equally well formulate our sentence as "C1 (complemented by C2) is a partial cause of E" or as "C2 (complemented by C1) is a partial cause of E". These three forms are identical, except for that the first treats C1 and C2 with equal attention, whereas the latter two lay stress on one or the other cause. Such reformatting, as will be seen, is useful in some contexts.

We may make a distinction between *absolute* and *relative* partial causation, as follows. The 'absolute' form specifies one partial cause without mentioning the complement(s) concerned; it just says: "C1 is a partial cause of E", meaning "C1 (*with some unspecified complement*) is a partial cause of E". This is in contrast to the 'relative' form, which does specify a complement, as in the above example of "C1 (complemented by C2) is a partial cause of E". This distinction reflects common discourse. Its importance will become evident when we consider negations of such forms.

One way to see the appropriateness of our definition of partial causation, *its conformity to the paradigm of causation*, is by resorting to nesting (see *Future Logic*, p. 148). We may rewrite it as follows:

From (i) if C2, then (if C1, then E);
from (ii) if C2, then (if notC1, not-then E);
from (iii) if notC2, not-then (if C1, then E).[11]

Clause (i) tells us that given C2, C1 implies E. Clause (ii) tells us that given C2, notC1 does not imply E. Thus, under condition C2, C1 behaves like a complete cause of E. Moreover, clause (iii) shows that under condition notC2, C1 ceases to so behave. Similarly, *mutatis mutandis*, C2 behaves conditionally like a complete cause of E.[12]

Let us now examine the definition of partial causation more closely. The terminology adopted for it is obviously intended to contrast with that for complete causation.

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[11] These three forms are implied, respectively, by our first givens; but they do not imply them unconditionally.

[12] We can also, incidentally, view the matter as follows, by focusing on the nested clauses. Clauses (i) and (iii) mean that the partial cause C2 of E may be regarded as a complete cause of the new effect "if C1, then E". Similarly, *mutatis mutandis*, clauses (i) and (ii) can be taken to mean that C1 is a complete cause of "if C2, then E".

Clause (i) informs us that in the presence of the two elements C1 and C2 together, the effect is invariably also present. However, that clause alone would not ensure that both C1 and C2 are *relevant* to E, *participants* in its causation. We need clause (ii) to establish that without C1, C2 would not by itself have the same result. And, likewise, we need clause (ii) to establish that without C2, C1 would not by itself have the same result.

Suppose, for instance, clause (ii) were false; then, combining it with (i), we would obtain the following simple dilemma:

> If (C1 + C2), then E – and – if (notC1 + C2), then E;
>
> therefore, if C2, then E.

That is, C2 would be a complete cause of E, without need of C1, which would in such case be *an accident* in the relation "If (C1 + C2), then E", note well. Similarly, if clause (iii) were false, it would follow that C1 is sufficient by itself for E, irrespective of C2. In the special case where both (ii) and (iii) are denied, C1 and C2 would be parallel complete causes of E (compatible ones, since they are conjoined in the antecedent of clause (i)). Therefore, as well as clause (i), clauses (ii) and (iii) have to specified for partial causation.

Furthermore, our definition of partial causation thus mentions three combinations of C1, C2 and their respective negations, namely:

- C1 + C2
- notC1 + C2
- C1 + not C2

And it tells us what happens in relation to E in each of these situations: in the first, E follows; in the next two, it does not. One might reasonably ask, what about the fourth combination, namely:

- notC1 + notC2?[13]

Well, for that, there are only two possibilities: either E follows or it does not. Note first that both these possibilities are logically compatible with clauses (i), (ii) and (iii).

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[13] Note that the combination "notC1 + notC2" may occasionally be impossible. In such case, notC1 implies C2 and notC2 implies C1. But according to syllogistic theory (see *Future Logic*, pp. 158-160), this would *not* allow us to abbreviate clauses (ii) and (iii) of the definition to "If notC1, not-then E" and "If notC2, not-then E". Thus, even in such case, the definition remains unaffected.

Suppose that "If (notC1 + notC2), then E" is true. In that case, notC1 and notC2 would each have the same relation to E that C1 and C2 have by virtue of clauses (i), (ii), (iii). For if we combine this supposed additional clause with clauses (ii) and (iii), we see that, whereas E follows the conjunction of notC1 and notC2, E does not follow the conjunction of not(notC1) with notC2 or that of notC1 with not(notC2). In that case, we would simply have two, instead of just one, compound causes of E, namely (C1 + C2) and (notC1 + notC2), sharing the same clauses (ii) and (iii) which establish the relevance of each of the elements. Though at first sight surprising, such a state of affairs is quite conceivable, being but a special case of parallel causation! Thus, the proposition "If (notC1 + notC2), then E" may well be true. But may it be false? Suppose that its contradictory "If (notC1 + notC2), not-then E" is true, instead. Here again, the causal significance of the first three clauses remains unaffected. We can thus conclude that what happens in the situation "notC1 + notC2", i.e. whether E follows or not, is irrelevant to the roles played by C1 and C2. Our definition of partial causation through the said three clauses is thus satisfactory.

Lastly the following should be noted. If we replaced clauses (ii) and (iii) by "If not(C1 + C2), not-then E", to conform with clause (i) to the definition of complete causation, we would only be sure that the compound (C1 + C2) causes E. It does not suffice to establish that both its elements are involved in that causation, since it could be adequately realized by the eventuality that "If (notC1 + notC2), not-then E". For this reason, too, clauses (ii) and (iii) are unavoidable.

Regarding clause (iv), which serves to ensure that the first three clauses do not lead to paradox, it is easy to show that the possibility of the conjunction (C1 + C2) is the minimal requirement. For this through clause (i) implies that E is possible and (C1 + C2 + E) is possible. Additionally, clause (ii) means that (notC1 + C2 + notE) is possible, and therefore implies that (notC1 + C2) is possible and each of notC1, C2, notE is possible. Similarly, clause (iii) means that (C1 + notC2 + notE) is possible, and therefore implies that (C1 + notC2) is possible and each of C1, notC2, notE is possible. It is thus redundant to specify these various contingencies.

The **methodological principle** underlying the definition of partial causation is well known to scientists and oft-used. It is that *to establish the causal role of any element such as C1, of a compound (C1 + C2...) in whose presence a phenomenon E is invariably present, we must find out what happens to E when the element C1 is absent while all other elements like C2 remain present*. That is, we observe how the putative effect is affected by removal of the putative cause ***while keeping all other things equal***[14]. Only if a change in status occurs (minimally from "then E" to "not-then E"), may the element be considered as participating in the causation, i.e. as a relevant *factor*.

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[14] This phrase "keeping all other things equal" is not mine – but a consecrated phrase often found in textbooks. I do not know who coined it first.

Once this is understood, it is easy to generalize our definition of partial causation from two factors (C1, C2) to any number of them (C1, C2, C3...), as follows:

(i) If (C1 + C2 + C3...), then E;
(ii) if (notC1 + C2 + C3...), not-then E;
(iii) if (C1 + notC2 + C3...), not-then E;
(iv) if (C1 + C2 + notC3...), not-then E;
...etc. (if more than three factors);
and (C1 + C2 + C3...) is possible.

Clause (i) establishes the complete causation of the effect E by the compound (C1 + C2 + C3...). But additionally there has to be for each element proof that its absence would be felt: this is the role of clauses (ii), (iii), (iv)..., each of which negates *one and only one* of the elements concerned. Thus, the number of additional clauses is equal to the number of factors involved.

Whatever the relation to E of other possible combinations of the elements and their negations, the partial causation of E by elements C1, C2, C3... is settled by the minimum number of clauses specified in our definition. As we saw, with two factors the combination "notC1 + notC2" is not significant. Similarly, we can show that with three factors the following combinations are not significant:

- notC1 + notC2 +C3
- notC1 + C2 + notC3
- C1 + notC2 + notC3
- notC1 + notC2 + notC3

And so forth. Generally put, if the number of elements is n, the number of insignificant combinations will be is $2^n – (1 + n)$. Whether any of these further combinations implies or does not imply E does not affect the role of partial causation signified by the defining clauses for the factors C1, C2, C3... per se. Other causations may be involved in certain cases, but they do not disqualify or diminish those so established.

The very last clause, that (C1 + C2 + C3...) is possible, is required and sufficient, for reasons already seen.

Clearly, we can say that *the more factors are involved, the weaker the causal bond*. If C is a complete cause of E, it plays a big role in the causation of E. If C1 is a partial cause of E, with one complement C2, it obviously plays a lesser role than C. Similarly, the more complements C1 has, like C2, C3..., the less part it plays in the whole causation of E. We may thus view the degree of

determination involved as inversely proportional to the number of causes involved, though we may (note well) be able to assign different *weights* to the various partial causes[15].

Note finally that we can facilitate mental assimilation of multiple (i.e. more than two) partial causes through successive reductions to pairs of partial causes, one of which is compound. Thus, (C1 + C2 + C3 + ...) may be viewed as (C1 + (C2 + C3 +...)), *provided* all the above mentioned conditions are entirely satisfied.

Let us now turn our attention to contingent causation.

Contingent causation:

(i) **If (notC1 + notC2), then notE**;
(ii) **if (C1 + notC2), not-then notE**;
(iii)**if (notC1 + C2), not-then notE**;
(iv)where: **(notC1 + notC2) is possible**.

Table **Error! No text of specified style in document.**.4. Contingent causation.

No	Element/compound			Modus	Source/relationship
1	C1			possible	implied by (ii)
2	notC1			possible	implied by (iii) or (iv)
3		C2		possible	implied by (iii)
4		notC2		possible	implied by (ii) or (iv)
5			E	possible	implied by (ii) or (iii)
6			notE	possible	implied by (i) + (iv)
7	C1		E	possible	implied by (ii)
8	C1		notE	*open*	
9	notC1		E	possible	implied by (iii)
10	notC1		notE	possible	implied by (i) + (iv)

[15] For instance, with reference to concomitant variations (see Appendix on J. S. Mill's Methods); if the C1 and C2 enter in a mathematical formula like, say, $E = C1^2 + C2$, C1 has less weight than C2.

11		C2	E	possible	implied by (iii)
12		C2	notE	*open*	
13		notC2	E	possible	implied by (ii)
14		notC2	notE	possible	implied by (i) + (iv)
15	C1	C2		*open*	
16	C1	notC2		possible	implied by (ii)
17	notC1	C2		possible	implied by (iii)
18	**notC1**	**notC2**		**possible**	**(iv)**
19	C1	C2	E	*open*	
20	C1	C2	notE	*open*	
21	**C1**	**notC2**	**E**	**possible**	**(ii)**
22	C1	notC2	notE	*open*	
23	**notC1**	**C2**	**E**	**possible**	**(iii)**
24	notC1	C2	notE	*open*	
25	**notC1**	**notC2**	**E**	**impossible**	**(i)**
26	notC1	notC2	notE	possible	implied by (i) + (iv)

Two phenomena C1, C2 may be called **contingent causes** of some other phenomenon E, only if *all* the above conditions (i.e. the four defining clauses) are satisfied. In such case, we may call E a **tenuous effect**[16] of each of C1, C2. Of course, the *compound* (notC1 + notC2) is a necessary cause of E, since in its presence, notE follows (as given in clause (i)); and in its absence, i.e. if not(notC1 + notC2), notE does not invariably follow (as evidenced by clauses (ii) and (iii)). Rows 19-26 of the above table (shaded) constitute the matrix of contingent causation.

We may thus speak of this phenomenon as a composition of contingent causes; and stress that that C1 and C2 belong in that particular causation of E by calling them *complementary* contingent causes of it. Indeed, instead of saying "C1 and C2 are complementary contingent causes of E", we may equally well formulate our sentence as "C1 (complemented by C2) is a contingent cause of E" or as "C2 (complemented by C1) is a contingent cause of E". These three forms are identical, except for that the first treats C1 and C2 with equal attention, whereas the latter two lay stress on one or the other cause. Such reformatting, as will be seen, is useful in some contexts.

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[16] I use the name "tenuous effect" for lack of a better one, to signify a lesser degree of non-independence than a "dependent effect". Alternatively, broadening the connotation of dependence, we might say that the effect of a necessary cause is strongly dependent (it depends on that one cause) and the effect of a contingent cause is weakly dependent (it depends on that cause, if no other is available).

We may make a distinction between *absolute* and *relative* contingent causation, as follows. The 'absolute' form specifies one contingent cause without mentioning the complement(s) concerned; it just says: "C1 is a contingent cause of E", meaning "C1 (*with some unspecified complement*) is a contingent cause of E". This is in contrast to the 'relative' form, which does specify a complement, as in the above example of "C1 (complemented by C2) is a contingent cause of E". This distinction reflects common discourse. Its importance will become evident when we consider negations of such forms.

Here again, we can demonstrate that our definition of contingent causation *conforms to the paradigm of causation* through nesting. We may rewrite it as follows:

From (i) if notC2, then (if notC1, then notE);
from (ii) if notC2, then (if C1, not-then notE);
from (iii) if C2, not-then (if notC1, then notE).

Clause (i) tells us that given notC2, notC1 implies notE. Clause (ii) tells us that given notC2, C1 does not imply notE. Thus, under condition notC2, C1 behaves like a necessary cause of E. Moreover, clause (iii) shows that under condition C2, C1 ceases to so behave. Similarly, *mutatis mutandis*, C2 behaves conditionally like a necessary cause of E.

Note well that the main clause of contingent causation is not "If not(C1 + C2), then notE"[17], but more specifically "If (notC1 + notC2), then notE". Considering that in partial causation the antecedent is (C1 + C2) and that this compound behaves as a complete cause, one might think that in contingent causation the antecedent would be a negation of the same compound, i.e. not(C1 + C2), which would symmetrically behave as a necessary cause. But the above demonstration of conformity to paradigm shows us that this is not the case. The explanation is simply that two of the alternative expressions of "If not(C1 + C2), then notE", namely "If (C1 + notC2), then notE" and "If (notC1 + C2), then notE" are contradictory to clauses (ii) and (iii), respectively. Therefore, only "If (notC1 + notC2), then notE" is a formally appropriate expression in this context. Our definition of contingent causation is thus correct.

We need not repeat our further analysis of partial causation for contingent causation; all that has been said for the former can be restated, *mutatis mutandis*, for the latter. For partial and contingent causation are *'mirror images'* of each other. The one represents the positive aspect of weak causation; the other, the negative aspect. All their characteristics are identical, except that the polarities of their respective causes and effect are opposite: C1 is replaced by notC1, C2 by notC2, and E by notE, or vice-versa.

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[17] This form, note well, does not specify which of the three alternative combinations (C1 + notC2), (notC1 + C2) or (notC1 + notC2) implies notE; it means only that *at least one of them* does.

Note that partial and contingent causation each involves a *plurality* of causes, though *in a different sense* from that found in parallelism.

We should also mention that partial causation often underlies *alternation* or plurality of effects.

Consider the form "If C, then (E or E_1)", which may be interpreted as "the conjunction (C + notE + notE1) is impossible", and therefore implies "If (C + notE), then E_1" and "If (C + notE_1), then E". Take the latter, for instance, and you have a type (i) clause. If additionally it is true that (notC + notE_1 + notE), (C + E_1 + notE), (C + notE_1) are possible conjunctions, you have clauses of types (ii), (iii) and (iv), respectively. In such case[18], C is a partial cause of E (the other partial cause being notE_1 or, more precisely, some complete and necessary cause of notE_1).

Just as we may have plurality of effects in partial causation, so we may have it in contingent causation.

Note, concerning the term '*occasional*'. When parallel complete causes may occur separately (i.e. neither implies the other), they are often called occasional causes; however, note well, the same term is often used to refer to partial causes, in the sense that each of them is effective only when the other(s) is/are present. The term occasional effect is used with reference to alternation of effects; i.e. when a cause has alternative effects, each of the latter is occasional; but the term is also applicable more generally, to any effect of a partial cause as such, i.e. to contingent effects.

Partial and contingent causation may conceivably occur in tandem or separately; i.e. no formal inconsistency arises in such cases.

5. The Four Genera of Causation

We have found the minimal formal definitions of, respectively, complete, necessary, partial and contingent causation. We are now in a position to begin synthesizing our accumulated findings concerning these determinations of causation. Remember how we developed these four concepts....

We started with the paradigm of causation (later named complete and necessary causation). From this we *abstracted two constituent forms*, or (strong) determinations, which we called complete causation and necessary causation. Then we *derived by means of an analogy two additional forms*, or (weak) determinations, which we called by way of contrast partial causation and contingent causation.

These four constructs apparently *exhaust* what we mean by causation, in view of their respective conceptual derivations from the paradigm of causation, and of their symmetry in relation to each

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[18] As can be seen by renaming C as "C1" and notE1 as "C2".

other and the whole. No further expressions of the concept of causation, direct or indirect, seem conceivable.

The four forms thus identified can thus be referred to as the genera of causation, or as its **generic determinations**. And we can safely postulate that:

> ***Nothing can be said to be a cause or effect of something else (in the causative sense), if it is not related to it in the way of at least one of these four genera of causation.***

We shall need **symbols** for these four genera, to facilitate their discussion. I propose (remember them well) the following letters, simply:

n for Necessary causation,

m for coMplete causation (to rhyme with **n**),

p for Partial causation, and

q for 'Qontingent' causation (to rhyme with **p**)[19].

This notation will be found particularly useful when we deal with causative syllogism. We will also occasionally distinguish between absolute and relative partial or contingent causation, by means of the symbols: $\mathbf{p}_{abs}$ and $\mathbf{q}_{abs}$ for absolutes (i.e. those not mentioning any complement) and $\mathbf{p}_{rel}$ and $\mathbf{q}_{rel}$ for relatives (i.e. those specifying some complement). Unless specified as relative, **p** and **q** may always be considered absolute.

It follows from what we have just said that we may interpret the causative proposition "**P is a cause of Q**" as "P is a complete or necessary or partial or contingent cause of Q (or a consistent combination of these alternatives)".

It is easy to demonstrate that any compounds of the four genera involving both **m** and **p**, and/or both **n** and **q**, are inconsistent, i.e. formally excluded. That is, one and the same thing cannot be both a complete and partial cause of the same effect; for if clause (i) of **m**, namely "if C1, then E", is true, then clause (iii) of **p**, namely "if (C1 + notC2), not-then E", cannot be true, and vice-versa. Similarly, necessary and contingent causation, i.e. **n** and **q**, are incompatible. We shall see at a later stage that certain other combinations are also formally impossible.

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[19] I have previously used, in my work *Future Logic*, the letters **n** and **p** for the *modalities* of necessity and possibility (or more specifically, particularity or potentiality). These should not be confused, note well. In any case, their relations are very different. In modality, **n** implies **p** (i.e. if something is necessary, it is possible). But here, in causation, as we shall soon see, **n** and **p** are merely compatible (i.e. a necessary cause need not be a partial cause, though something may be both a necessary and partial cause).

We shall consider the remaining, *consistent compounds* involving the four generic determinations, which we shall call the **specific determinations**, in the next chapter.

We may, as already suggested, refer to something as a *strong cause*, if it is a complete and/or necessary cause; and to something as a *weak cause*, if it is a partial and/or contingent cause. Conversely, a necessary and/or dependent effect may be said to be a *strong effect*; and a contingent and/or tenuous effect, it may be said to be a *weak effect*. Mixtures of these characters are conceivable, as we shall see.

Another classification based on common characters: if something is known to be a complete or partial cause, it may be called a '*contributing cause*'[20]; and if something is known to be a necessary or contingent cause, it may be called a '*possible cause*'. Likewise, if something is known to be a necessary or contingent effect, it may be called a '*possible effect*'; and if something is known to be a dependent or tenuous effect, it may be called (say) a '*subject effect*'.

Moreover: we have characterized complete and partial causation as positive aspects of causation; and necessary and contingent causation as its negative aspects, comparatively. We may in this sense, relative to a given set of items, speak of 'positive' or 'negative' causation. The latter, of course, should not be confused with negations of causation. Accordingly, we may refer to *positive or negative causes or effects*.

The reader is referred to the **Appendix** on J. S. Mill's Methods, for comparison of our treatment of causation in this chapter (and the next).

6. Negations of Causation

So far, we have only considered in detail *positive* causative propositions, i.e. statements affirming causation of some determination. We must now look at *negative* causative propositions, i.e. statements denying causation of some determination or any causation whatever. For this purpose, to avoid the causal connotations implied by use of symbols like C and E for the items involved, we shall rather use neutral symbols like P and Q.

Statements denying causation may be better understood by studying the negations of conditional propositions.

A *'positive hypothetical'* proposition has the form "If X, then Y" (which may be read as X implies Y, or X is logically followed by Y); it means by definition "the conjunction (X + notY) is impossible". Its contradictory is a *'negative hypothetical'* proposition of the form "If X, not-then

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[20] In the sense that it is a cause *to some extent*, sufficient or not.

Y"[21] (which may be read as X does not imply Y, or X is not logically followed by Y); it means by definition "the conjunction (X + notY) is possible".

In the positive form, though X and notY are together impossible, they are not implied (or denied) to be individually impossible. In the negative form, since X and notY are possible together, *each of* X, notY is also formally implied as possible. In either form, there is no formal implication that notX be possible or impossible, or that Y be possible or impossible. As for the remaining conjunctions (X + Y), (notX + Y), (notX + notY) – nothing can be inferred concerning them, either.

However, as we have seen, when such statements appear as implicit clauses of causation, the interactions between clauses will inevitably further specify the situation for many of the items concerned.

The negation of complete causation or necessary causation, through statements like "P is not a complete cause of Q" or "P is not a necessary cause of Q", is feasible if *any one or more* of the three constituent clauses of such causation is deniable. That is, such negation consists of a disjunctive proposition saying "not(i) and/or not(ii) and/or not(iii)", which may signify non-causation or another determination of causation (necessary instead of complete, or vice-versa, or a weaker form of causation).

To give an example: the denial of "P is a complete cause of Q" means "if P, not-then Q" *and/or* "if notP, then Q" *and/or* "P is impossible". These alternatives may give rise to different outcomes; in particular note that if "P is impossible" is true, then P cannot be a cause at all, and if "if P, then Q" and "if notP, then Q" are both true, then Q is necessary, in which case Q cannot be an effect at all.

The negation of strong causation as such means the negation of both complete and necessary causation.

With regard to negation of partial or contingent causation, we must distinguish two degrees, according as *a given* complement is intended or *any* complement whatever.

The more restricted form of negation of partial causation or contingent causation mentions a complement, as in statements like "P1 (complemented by P2) is not a partial cause of Q" or "P1 (complemented by P2) is not a contingent cause of Q". Such negation is feasible if *any one or more* of the four constituent clauses of such causation is deniable. That is, such negation consists of a disjunctive proposition saying "not(i) and/or not(ii) and/or not(iii) and/or not(iv)".

In contrast, note well, the negation of partial causation or contingent causation through statements like "P1 is not a partial cause of Q" or "P1 is not a contingent cause of Q", is more radical. "P1 is not a partial cause of Q" means "P1 (*with whatever complement*) is not a partial cause of Q" – it

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[21] The proposition "If X, not-then Y" is not to be confused with "If X, then notY", note well. The latter implies but is not implied by the former.

may thus be viewed as a conjunction of an infinite number of more restricted statements, viz. "P1 (complemented by P2) is not a partial cause of Q, and P1 (complemented by P3) is not a partial cause of Q, and... etc.", where P2, P3, etc. are *all* conceivable complements. Similarly with regard to "P1 is not a contingent cause of Q".

A restricted negative statement is very broad in its possible outcomes: it may signify that P1 is not a cause of Q at all, or that P1 is instead a complete or necessary cause of Q, or that P1 is a weak cause of Q but a contingent rather than partial one or a partial rather than contingent one, or that P1 is a partial or contingent cause (as the case may be) of Q but with some complement *other than* P2.

A radical negative statement comprises many restricted ones, and is therefore less broad in its possible outcomes, specifically excluding that P1 be involved in a partial or contingent causation (as the case may be) with *any* complement(s) whatsoever. A restricted negation is *relative* to a complement (say, P2); a radical negation is a generality comprising all similar restricted negations for the items concerned (P1, Q), and is therefore relative to *no* complement (neither P2, nor P3, etc.).

The negation of weak causation as such means the negation of both partial and contingent causation, either in a restricted sense (i.e. relative to some complement) or in a radical sense (i.e. irrespective of complement).

This brings us to the relation of **non-causation**, which is also very complex.

As we saw, the positive causative proposition "P is a cause of Q" may be interpreted as "P is a complete or necessary or partial or contingent cause of Q". Accordingly, we may interpret the negative causative proposition "P is not a cause of Q" as "P is not a complete *and* not a necessary *and* not a partial *and* not a contingent cause of Q", i.e. as a denial of all four genera of causation in relation to P and Q (with whatever complement).

It is noteworthy that we cannot theoretically *define* non-causation except through negation of all the concepts of causation, which have to be defined first[22]. In contrast, on a practical level, we proceed in the opposite direction: in accord with general rules of induction, we presume any two items P and Q to be without causative relation, until if ever we can establish inductively or deductively that a causative relation obtains between them.[23]

Nevertheless, 'non-causation' refers to denial of causation, and is not to be confused with ignorance of causation; it is an ontological, not an epistemological concept.

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[22] We shall later see that this truism is ignored by some philosophers.

[23] The philosophical problems of defining causation (its forms) and identifying specific cases of causation (its contents), are distinct, as we shall see.

Note well that non-causation is *not* defined by the propositions "if P, not-then Q, and if notP, not-then notQ". Such a statement, though suggestive of non-causation, is equally compatible with partial and/or contingent causation; so it cannot suffice to distinguish non-causation. *To specify a relation of non-causation, we have to deny every determination of causation*.

Furthermore, "P is not a cause of Q" refers to *relative* non-causation – it is relative to the items P and Q specifically, and does not exclude that Q may have *some other* cause P_1, or that P may have *some other* effect Q_1. Two items, say P and Q, taken at random, need not be causatively related at all (even in cases where they happen to be respectively causatively related to some third item, as will be seen when we study syllogism in later chapters). In such case, P and Q are called *accidents* of each other; their eventual conjunction is called a *coincidence*.

Relative non-causation is an integral part of the formal system of deterministic causality. We have to acknowledge the possibility, indeed inevitability, of such a relation. If I say "the position of stars does not affect[24] people's destinies", I mean that there is no causal relation *specifically between* stars and people; yet I may go on to say that stars affect other things or that people are affected by other things, without contradicting myself.

Relative non-causation should not be confused with *absolute* non-causation. The *causelessness* of some item A would be expressed as "nothing causes A", a proposition summarizing innumerable statements of the form "B does not cause A; C does not cause A;...etc.", where B, C,... are *all existents other than* A. Similarly, the *effectlessness* of some item A would be expressed as "nothing is caused by A", a proposition summarizing innumerable statements of the form "B is not caused by A; C is not caused by A;... etc.", where B, C,... are *all existents other than* A.

We thus see that whereas positive causative propositions are defined by conjunctions of clauses, negative ones are far more complex in view of their involving disjunctions.

The negations of determinations, or the negation altogether of causation, should not themselves be regarded as further determinations, since they by their breadth allow for non-causation (between the items concerned), note.

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[24] To 'affect' some thing is to cause a change in it.

3. The Specific Determinations

1. The Species of Causation

We shall now look into the consistent combinations of the four genera of causation, symbolized as **m**, **n**, **p**, **q**, with each other or their negations. Implicit in our gradual development of these concepts of causation from a common paradigm, was the idea that they are abstractions, indefinite concepts that are eventually concretized in the more specific and definite compounds.

We have already found some of their combinations, namely **mp** and **nq** to be **inconsistent**. This was due to incompatibilities between clauses of their definitions, or in other words, certain rows of their matrices. Thus, row 6 of **m** (C + notE is impossible) is in conflict with row 22 (C1 + notE is possible) of **p**; similarly, row 7 of **n** (notC + E is impossible) is in conflict with row 23 (notC1 + E is possible) of **q**.

It is also possible to prove certain other combinations to be logically impossible. This can be done formally, but not at the present stage of development, because we do not yet have the technical means at this stage to treat *negations* of generic determinations. To define *not***m**, *not***n**, *not***p**, *not***q** in verbal terms would be extremely arduous and confusing. I will therefore for now merely affirm to you that **combinations of *any one positive* generic determination with *the negations of the three other* generic determinations, for the very same terms, are inconsistent**.

By elimination, we are left with only *four* consistent compounds, i.e. remaining combinations give rise to no inconsistency, i.e. whose respective clauses do not contradict each other. This means that, from the logical point of view, they are conceivable, and therefore worthy of further formal treatment. We may refer to them as the specific determinations, or species of causation.

The following table (where + and – signify, respectively, affirmation and denial of a determination) lists all combinations of the generics and identifies the logically possible specifics among them:

Table **Error! No text of specified style in document.**.5. Possible specifications of the 4 generic determinations.

No. of genera	Compound	**m**	**n**	**p**	**q**	Modus
Four	**mnpq**	+	+	+	+	**mp**, **nq** impossible
Three	**mnp**	+	+	+	-	**mp** impossible
	mnq	+	+	-	+	**nq** impossible
	mpq	+	-	+	+	**mp** impossible
	npq	-	+	+	+	**nq** impossible
Two	**mp**	+	-	+	-	**mp** impossible
	nq	-	+	-	+	**nq** impossible

	mn	+	+	-	-	**possible**
	mq	+	-	-	+	**possible**
	np	-	+	+	-	**possible**
	pq	-	-	+	+	**possible**
Only one	**m-alone**	+	-	-	-	*will be proved impossible*
	n-alone	-	+	-	-	*will be proved impossible*
	p-alone	-	-	+	-	*will be proved impossible*
	q-alone	-	-	-	+	*will be proved impossible*
None	**non causation**	-	-	-	-	**possible**

The formulae given in the above table for each specific determination is as brief as possible. For instance, since **m** implies the negation of **p** and **n** implies the negation of **q**, '**mn**' (meaning both complete and necessary causation) tacitly implies 'not**p** and not**q**' (neither partial nor contingent causation, *with whatever complement*); the latter negations need not therefore be mentioned. Similarly, an expression like **m-alone** signifies the affirmation of one generic determination (here, **m**) *and* the denial of all three others (i.e. not**n** and not**q**, as well as not**p**). This notation is far from ideal, but suffices for our current needs, since many combinations are eliminated at the outset.

We see that four specific determinations, namely **mn**, **mq**, **np**, **pq**, are formed by conjunction of positive causative propositions; these we shall call (following J. S. Mill's nomenclature) **joint determinations**. It follows from the above table that each generic determination has only *two* species. Each generic determination may therefore be interpreted as a disjunction of its two possible embodiments; thus, **m** means **mn** or **mq**; **n** means **mn** or **np**; **p** means **np** or **pq**; and **q** means **mq** or **pq**. Also note, we could refer to **mn** as 'only-strong causation' and to **pq** 'only-weak causation', while **mq** and **np** are 'mixtures of strong and weak'.

The four specific determinations formed by composing positive causative propositions with negative ones, namely **m-alone**, **n-alone**, **p-alone**, **q-alone**, will be called **lone determinations**. This expression is introduced at this stage to contrast it with generic and joint determinations. Clearly, one should not confuse an isolated generic symbol such as **m** with the corresponding specific symbol **m-alone**; I use this heavy notation to ensure no confusion arises. Moreover, *nota bene*: In the above table, these forms are eliminated at the outset, because they concern *absolute* partial or contingent causation, i.e. they are irrespective of complement and mean **m-alone**$_{abs}$ etc. But as we shall later see, when they involve *relative* partial or contingent causation, i.e. when some complement is specified (in **p**$_{rel}$ or **q**$_{rel}$ or their negations), so that they mean **m-alone**$_{rel}$ etc., they remain possible forms. This need not concern us at the moment, but is said to explain why these forms need to be named.

We would label as, simply, **causation** (or 'any causation'), the disjunctive proposition "**m** or **n** or **p** or **q**", or the more specific "**mn** or **mq** or **np** or **pq**". Such positive propositions merely *imply* causation, if they involve less disjuncts or an isolated generic or joint determination. The

contradictory of causation, **non-causation**, is the only remaining allowable combination, our table being exhaustive. This last possible combination involves negation of *all four* generic or joint determinations, note well. That is, it means "neither **m** nor **n** nor **p** nor **q**" or equally "neither **mn** nor **mq** nor **np** nor **pq**".

The above table also allows us to somewhat interpret complex negations. The negation of any compound is equivalent to the disjunction of all remaining four compounds (three of causation *and* one of non-causation). For instance "**not(mn)**" means **mq**, **np**, **pq**, or **non-causation**. Similarly with any other formula.

Note that where one of the weak determinations is denied by reason of the affirmation of the contrary strong determination (**m** in the case of **p**, or **n** in the case of **q**), any and all proposed complements are denied. Where one of the weaks is affirmed (even if the other is radically denied), at least one complement is implied; and of course, the contrary strong determination is denied. In all other cases, we must remember to be careful and distinguish between restricted and radical negations of **p** or **q**, as already explained in the previous chapter.

2. The Joint Determinations

We shall now examine in detail the four joint determinations, symbolized by **mn**, **mq**, **np**, and **pq**, each of which is obtained by consistent conjunction of two generic determinations. Each is thus a species shared by the two genera constituting it. Thus, **mn** is a specific case of **m** and a specific case of **n**; and so forth.

We have already encountered one of these joint determinations, viz. complete and necessary causation, the paradigm of causation. We shall now examine it in further detail, and also treat the other three joint determinations.

Complete and Necessary causation by C of E:

(i) **If C, then E**;
(ii) if notC, not-then E (may be left tacit);
(iii) where: **C is possible**.
And:
(iv) **if notC, then notE**;
(v) if C, not-then notE (may be left tacit);
(vi) where: **C is unnecessary**.

Table **Error! No text of specified style in document.**.6. Complete necessary causation.				
No.	Element/compound		Modus	Source/relationship
1	**C**		**Possible**	**(iii)**
2	**notC**		**Possible**	**(vi)**
3		E	Possible	implied by (v)
4		notE	possible	implied by (ii)
5	C	E	possible	(v) or implied by (i) + (iii)
6	**C**	**notE**	**impossible**	**(i)**
7	**notC**	**E**	**impossible**	**(iv)**
8	notC	notE	possible	(ii) or implied by (iv) + (vi)

Notice how the merger of clauses (i), (ii) and (iii) with (iv), (v) and (vi) renders clauses (ii) and (v) redundant (though still implicit). Rows 5-8 of the above table (shaded) constitute the matrix of complete-necessary causation.

Complete but Contingent causation by C1 of E:

(i) **If C1, then E**;
(ii) if notC1, not-then E (may be left tacit);
(iii)where: C1 is possible (may be left tacit).
And:
(iv)**if (notC1 + notC2), then notE**;
(v) **if (C1 + notC2), not-then notE**;
(vi)**if (notC1 + C2), not-then notE**;
(vii) where: **(notC1 + notC2) is possible**.

Table **Error! No text of specified style in document.**.7. Complete contingent causation.

No.	Element/compound			Modus	Source/relationship
1	C1			possible	(iii) or implied by (v)
2	notC1			possible	implied by (vi) or (vii)
3		C2		possible	implied by (vi)
4		notC2		possible	implied by (v) or (vii)
5			E	possible	implied by (v) or (vi)
6			notE	possible	implied by (iv) + (vii)
7	C1		E	possible	implied by (v)
8	**C1**		**notE**	**impossible**	**(i)**
9	notC1		E	possible	implied by (vi)
10	notC1		notE	possible	(ii) or implied by (iv) + (vii)
11		C2	E	possible	implied by (vi)
12		C2	notE	*open*	if #12 is impossible, so is #24; and in view of (i): if #12 is possible, so is #24
13		notC2	E	possible	implied by (v)
14		notC2	notE	possible	implied by (iv) + (vii)
15	**C1**	**C2**		*open*	if #15 is impossible, so is #19; and in view of (i): if #15 is possible, so is #19
16	C1	notC2		possible	implied by (v)
17	notC1	C2		possible	implied by (vi)
18	**notC1**	**notC2**		**possible**	**(vii)**
19	C1	C2	E	*open*	if #19 is possible, so is #15; and in view of (i): if #19 is impossible, so is #15
20	C1	C2	notE	impossible	implied by (i)
21	**C1**	**notC2**	**E**	**possible**	**(v)**
22	C1	notC2	notE	impossible	implied by (i)
23	**notC1**	**C2**	**E**	**possible**	**(vi)**
24	**notC1**	**C2**	**notE**	*open*	if #24 is possible, so is #12; and in view of (i): if #24 is impossible, so is #12
25	**notC1**	**notC2**	**E**	**impossible**	**(iv)**
26	notC1	notC2	notE	possible	implied by (iv) + (vii)

Notice how the merger of clauses (i), (ii) and (iii) with (iv), (v), (vi) and (vii) renders clauses (ii) and (iii) redundant (though still implicit). Rows 19-26 of the above table constitute the matrix of complete-contingent causation.

Concerning the four positions labeled *open* in the above table, note that the moduses of Nos. 12 and 24 are tied and likewise those of Nos. 15 and 19. Proof for the first two: if #12 (C2 + notE) is impossible, #24 (notC1 + C2 + notE) must also be impossible; if #24 (notC1 + C2 + notE) is impossible, then knowing #20 (C1 + C2 + notE) to be impossible, #12 (C2 + notE) must also be impossible; the rest follows by contraposition. Proof for the other two: if #15 (C1 + C2) is impossible, #19 (C1 + C2 + E) must also be impossible; if #19 (C1 + C2 + E) is impossible, then knowing from (i) that #20 (C1 + C2 + notE) is impossible, #15 (C1 + C2) must also be impossible; the rest follows by contraposition. The interpretation of these open cases is as follows.

(a) Suppose #12 is impossible; this means that "If C2, then E". We know from #14 that "If notC2, not-then E"; and from #3 that "C2 is possible". Whence, C2 satisfies the definition for being a *complete* cause of E, just like C1. Thus, in such case, C1 and C2 are simply *parallel* complete (and contingent) causes of E. This is quite conceivable, and as we have seen in an earlier section such causes may be compatible or incompatible. If #15 is possible, they are compatible; and if #15 is impossible, they are incompatible.

(b) Suppose #12 is possible; this means that "If C2, not-then E", in which case C2 is not a complete cause of E. This is quite conceivable, covering situations where one of the contingent causes (namely, C1) is also complete, while the other (C2) is not complete. Additionally, we can say: if #15 is possible, they are compatible; and if #15 is impossible, they are incompatible; there is no problem of consistency either way.

However, a very interesting question arises in such case: is a contingent but not complete cause (like C2, here) bound to be a partial cause? C2 is certainly not a partial cause of E in conjunction with C1, since C1 is a complete cause of E. Therefore, *if* C2 is a partial cause of E, it will be so in conjunction with *some other* partial cause of E, say C3. But since C3 is unmentioned in our original givens, its existence is not formally demonstrable. We thus have no certainty that an *incomplete* contingent cause is implicitly a *partial* contingent cause! We will return to this issue later.

Partial yet Necessary causation by C1 of E:

(i) **If notC1, then notE**;
(ii) if C1, not-then notE (may be left tacit);
(iii)where: C1 is unnecessary (may be left tacit).
And:
(iv)**if (C1 + C2), then E**;
(v) **if (notC1 + C2), not-then E**;
(vi)**if (C1 + notC2), not-then E**;
(vii) where: **(C1 + C2) is possible**.

Table **Error! No text of specified style in document.**.8. Partial necessary causation.

No.	Element/compound			Modus	Source/relationship
1	C1			possible	implied by (vi) or (vii)
2	notC1			possible	(iii) or implied by (v)
3		C2		possible	implied by (v) or (vii)
4		notC2		possible	implied by (vi)
5			E	possible	implied by (iv) + (vii)
6			notE	possible	implied by (v) or (vi)
7	C1		E	possible	(ii) or implied by (iv) + (vii)
8	C1		notE	possible	implied by (vi)
9	**notC1**		**E**	**impossible**	**(i)**
10	notC1		notE	possible	implied by (v)
11		C2	E	possible	implied by (iv) + (vii)
12		C2	notE	possible	implied by (v)
13		notC2	E	*open*	if #13 is impossible, so is #21; and in view of (i): if #13 is possible, so is #21
14		notC2	notE	possible	implied by (vi)
15	**C1**	**C2**		**possible**	**(vii)**
16	C1	notC2		possible	implied by (vi)
17	notC1	C2		possible	implied by (v)
18	notC1	notC2		*open*	if #18 is impossible, so is #26; and in view of (i): if #18 is possible, so is #26
19	C1	C2	E	possible	implied by (iv) + (vii)
20	**C1**	**C2**	**notE**	**impossible**	**(iv)**
21	C1	notC2	E	*open*	if #21 is possible, so is #13; and in view of (i): if #21 is impossible, so is #13
22	**C1**	**notC2**	**notE**	**possible**	**(vi)**
23	notC1	C2	E	impossible	implied by (i)
24	**notC1**	**C2**	**notE**	**possible**	**(v)**
25	notC1	notC2	E	impossible	implied by (i)
26	notC1	notC2	notE	*open*	if #26 is possible, so is #18; and in view of (i): if #26 is impossible, so is #18

Notice here again how the merger of clauses (i), (ii) and (iii) with (iv), (v), (vi) and (vii) renders clauses (ii) and (iii) redundant (though still implicit). Rows 19-26 of the above table (shaded) constitute the matrix of partial-necessary causation.

Concerning the four positions labeled *open* in the above table, note that the moduses of Nos. 13 and 21 are tied and likewise those of Nos. 18 and 21. These statements may be proved in the same manner as done for the preceding table; this is left to the reader as an exercise. We can also interpret these situations in similar ways. If #13 is impossible, C2 is a partial and necessary cause of E, parallel to C1; and notC2 is either compatible or incompatible with notC1 according to whether #18 is possible or impossible. If #13 is possible, C2 is a partial but not necessary cause of E, and notC2 is either compatible or not with notC1, according to whether #18 is possible or not.

However, it is not formally demonstrable that an *unnecessary* partial cause is implicitly a *contingent* partial cause; and the implications of this finding (or absence of finding) will have to be considered later.

Partial and Contingent causation by C1 of E:

(i) **If (C1 + C2), then E**;
(ii) **if (notC1 + C2), not-then E**;
(iii)**if (C1 + notC2), not-then E**;
(iv)where: **(C1 + C2) is possible**.
And:
(v) **if (notC1 + notC2), then notE**;
(vi)**if (C1 + notC2), not-then notE**;
(vii) **if (notC1 + C2), not-then notE**;
(viii) where: **(notC1 + notC2) is possible**.

Table **Error! No text of specified style in document.**.9. Partial contingent causation.

No.	Element/compound			Modus	Source/relationship
1	C1			possible	implied by (iii) or (iv) or (vi)
2	notC1			possible	implied by (ii) or (vii) or (viii)
3		C2		possible	implied by (ii) or (iv) or (vii)
4		notC2		possible	implied by (iii) or (vi) or (viii)
5			E	possible	implied by (vi) or (vii)
6			notE	possible	implied by (ii) or (iii)

7	C1		E	possible	implied by (vi)
8	C1		notE	possible	implied by (iii)
9	notC1		E	possible	implied by (vii)
10	notC1		notE	possible	implied by (ii)
11		C2	E	possible	implied by (vii)
12		C2	notE	possible	implied by (ii)
13		notC2	E	possible	implied by (vi)
14		notC2	notE	possible	implied by (iii)
15	**C1**	**C2**		**possible**	**(iv)**
16	C1	notC2		possible	implied by (iii) or (vi)
17	notC1	C2		possible	implied by (ii) or (vii)
18	**notC1**	**notC2**		**possible**	**(viii)**
19	C1	C2	E	possible	implied by (i) + (iv)
20	**C1**	**C2**	**notE**	**impossible**	**(i)**
21	**C1**	**notC2**	**E**	**possible**	**(vi)**
22	**C1**	**notC2**	**notE**	**possible**	**(iii)**
23	**notC1**	**C2**	**E**	**possible**	**(vii)**
24	**notC1**	**C2**	**notE**	**possible**	**(ii)**
25	**notC1**	**notC2**	**E**	**impossible**	**(v)**
26	notC1	notC2	notE	possible	implied by (v) + (viii)

Rows 19-26 of the above table (shaded) constitute the matrix of partial-contingent causation. We note that here none of the original clauses are made redundant by the combination of partial and contingent causation. Furthermore, no position in the above table is left open, with regard to the possibility or impossibility of the item or combination concerned.

Additionally we can say that if C1 and C2 are, as here, *complementary* partial contingent causes of E, then they have the same set of relations to each other and to E. But this does not mean that if C1 and C2 are complementary partial causes of E, they are bound to be complementary contingent causes of E, since as we have seen both or just one of them may be necessary cause(s) of E. Similarly, we cannot say that if C1 and C2 are complementary contingent causes of E, they are bound to be complementary partial causes of E, since as we have seen both or just one of them may be complete cause(s) of E.

There may, of course, be more than one complement to C1 (i.e. complements C3, C4..., in addition to C2) in the last three joint determinations, **mq**, **np** or **pq**. Such cases may be similarly treated, as we have explained when considering the weaker generic determinations separately.

It is with reference to the joint determinations **mq** and **np** that the utility of reformatting sentences about partial or contingent causation becomes apparent. An **mq** proposition is best stated as "C1 is a complete and (complemented by C2) a contingent cause of E", and an **np** proposition is best stated as "C1 is a necessary and (complemented by C2) a partial cause of E".

We must now consider the **hierarchy** between the above four forms, since there are clearly differences in degree in the 'bond' between cause(s) and effect. Causation is obviously at its *strongest* when both complete and necessary (**mn**). It is difficult to say which of the next two forms (**mq** or **np**) is the stronger and which the weaker, they are not really comparable to each other; all we can say is that they are both less determining than the first and more determining than the last; let us call them *middling* determinations. Causation is *weakest* for each factor involved in partial and contingent causation (**pq**).

With regard to **parallelism**, we can infer that it is conditionally possible with reference to our previous findings in the matter.

Two complete-necessary causes, C, C_1, of the same effect E, may be parallel, provided they are neither exhaustive nor incompatible with each other, i.e. provided "if C, not-then notC_1 and if notC, not-then C_1" is true.

For complete-contingent causation, it is conceivable that C1, C2 have this relation to E and C3, C4 have this same relation to E, provided the complete causes C1 and C3 are not exhaustive and the compounds (notC1 + notC2) and (notC3 + notC4) are not exhaustive. An interesting special case is when C2 = C4, i.e. when the two complete causes have the same complement in the contingent causation of E.

For partial-necessary causation, it is conceivable that C1, C2 have this relation to E and C3, C4 have this same relation to E, provided the necessary causes C1 and C3 are not incompatible and the compounds (C1 + C2) and (C3 + C4) are not exhaustive. An interesting special case is when C2 = C4, i.e. when the two necessary causes have the same complement in the partial causation of E.

For partial-contingent causation, the same condition of non-exhaustiveness between the parallel compounds involved applies. And here, too, note the special case when C2 = C4 as interesting.

Tables involving all the items concerned and their negations in all combinations may be constructed to analyze the implications of such parallelisms in detail.

The **negations** of the four joint determinations may be reduced to the denial of one or both of their constituent generic determinations. That is, **not(mn)** means 'not-**m** and/or not-**n**'; **not(mq)** means 'not-**m** and/or not-**q**'; **not(np)** means 'not-**p** and/or not-**n**'; and **not(pq)** means 'not-**p** and/or not-**q**'. Each of these alternative denials in turn implies denial of one or more of the constituent clauses, obviously.

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