In the second place, the concrete situations we are endeavoring to understand are such that later situations do in fact contain what earlier situations do not. But the conclusion of a deduction can contain nothing that is not found in the premises. Therefore determinism cannot possibly be the explanation of the concrete situations we are endeavoring to understand.

In the third place, determinism not merely does not explain concrete situations but, in effect, denies their existence. The situations envisaged by a determinist are a series of terms related by combinations of abstract laws. From the determinist viewpoint the laws-connecting laws are all that is needed to go from one situation to the next. But if that is so, then the situations are no more than is defined by the laws. It follows that they are of the same nature as conjugate terms; they are correlatives defined by correlations, members of a series defined by the law of the series; evidently such terms are abstract, and so the determinist's situations cannot be concrete situations and must be abstract, typical, schematic situations.

Now let us end this interlude on deductivism, mechanism, and determinism. The abstractive character of observation and experiment results in abstract correlations. To reach the concrete one must add the qualification of caeteris paribus. Even when one envisages the total situation, still are-has that qualification remains, for within total situations there are coincidences and so double occurrences. The problem of understanding concrete situations is the problem of mastering coincidence and double occurrence. It is what is to be understood, and deductivism not merely does not understand it but cannot hope to understand it.

But how can coincidence be mastered by understanding? The first step is to divide data into two classes. The first class includes all data that can be systematized, that can be conceived by forming-a framing a law or functional relation. The second class includes all data that cannot be systematized, that cannot be conceived by framing a law or functional relation. The second phase of empirical method deals with the former class of data and by observation and experiment arrives at their systematization. The third phase deals with the latter class; and their common name is coincidence; and mastering them by understanding is grasping the nature of probability.

But how can coincidence be mastered by understanding? The reader will recall the section of the previous chapter on an alternative heuristic method. Just as there are data that fit into explanatory systems, so also there are data that do not. The latter are understood by proceeding from the premise that defines them, namely, from their non-systematic character. But mere coincidence is non-systematic, and therefore it is subject to the alternative heuristic procedure of determining probability expectations.

The goal of the second phase is the understanding and formulation of specific changes. Such formulation appears under a variety of names; it is correlation, concomitant variation, functional relation, law, theory, system. From the nature of the case its is general, universal, abstract, for just as the identical conjunction is connected with the understanding of data as instances, so the goal of the second phase is connected with the understanding of the data as similar, as of a kind. Hence it is not immediately concerned with understanding concrete situations. That will come in due course. But first one must grasp the nature of typical changes, of pure cases, of the specific change as specific. Hence Observation, then, is selective rather than exhaustive. As far as possible, observation is to be complemented by experiment. An escape is made from the apparent indeterminacy and obvious complexity of the concrete. The order of the day is analysis, the separation of factors and components, their isolation from chance influences, their subjection to inter-action with equally isolated factors. It is in this fashion that with gradually increasing accuracy and precision we can come to know the functional relations that, despite their abstract character and their often abstruse symbolic expression, none the less provide the determinants of the actual changes occurring in concrete situations.

Now as this work advances, it invites a revision of the initial classifications. They were based on sensible similarity. To a considerable extent they coincided with the classifications of ordinary speech. But the increasing accuracy and precision no less than the new discoveries of the second phase reveal that preliminary language to be partly inexact and partly irrelevant. Technical terminology is introduced and becomes entrenched, for though it itself is subject to revision, still the revision will not be a reversion to the initial classifications.

~~There is concealed in this phenomenon an invariant~~ form of empirical method. Let us ask what terminology will always prove both exact and relevant. The answer ~~is~~ that exactitude and relevance ~~is~~ are// guaranteed only if the terminology is based upon the laws that result from the observations and experiments. In other words the invariant form of the revised classification is the rule that the new terms are to be derived from the established laws.

What precisely doesthis mean? Any law is a relation. Any relation is between terms. Let terms be defined by their relations and they will be defined by the laws. For instance, if there is some verbal or symbolic formula relating P, Q, R, then any X will be named a P if it stands to Q and R as does P, any Y will be named a Q if it stands to P and R as does Q, and any Z will be named an R if it stands to P and Q as does R. In this fashion the classification of data by their sensible similarity is relegated to the world of ordinary speech and the scientist secures for himself a classification that cannot help being both relevant and exact ~~to the objects~~ with respect to the objects subject to his laws. Moreover, while a discovery of new laws will necessitate a new classification, still the new classification will be based on the new laws as its predecessor was based on the old laws.

It is of great importance to grasp the principle underlying the transition to technical language. As is known, there are derivative technical terms that can be defined by employing more basic terms. But what is the nature of the basic terms? Unless they rest on solid grounds, not only the derived terms but all formulations are a rickety structure.

To meet this issue let us say that basic terms are conjugate when 1) they are fixed by their mutual relations and 2) these relations are established through the techniques of the second phase, that is, through observation, experiment ~~if possible, and verification. From the logical viewpoint this procedure amounts to taking experimental results and employing their correlations as a model for postulates. It is in this manner that in mechanics one begins from ordinary notions, such as "light" and "heavy," advances to the notion of "weight," to arrive at a coefficient of inertia termed "mass" that is independent of the acceleration of gravity~~ when possible, and verification. Thus it is that in mechanics one begins from ordinary notions, such as "light" and "heavy," advances to the notion of "weight," to arrive at a coefficient of inertia named "mass"; once it is reached "weight" becomes a derived term defined by the product of "mass" and the "acceleration of gravity" while "light" and "heavy" denote relative weights. But the point to be grasped is that a similar transposition takes place all along the line. There may or may not emerge new names, but there do emerge new concepts. The "distance" and "time" of ordinary speech are one thing; the "distance" and "time" of Newtonian mechanics are another; and the "distance" and "time" of relativity mechanics are a third. Basic ~~xxx~~ terms are conjugate; they form a system in which the determining factor is the pattern of relations between the terms; and this pattern is modelled on the correlations and laws that are reached by observation, experiment and verification.

Three observations are in order. First, a terminology based upon conjugate terms cannot but be exact and relevant; for it rests on the exactitude of the established laws and its range of application is identical with the range of the laws. Secondly, just as the laws themselves are subject to revision in the light of further evidence, so also the basic terminology is subject to revision. Thirdly, and this is our point, no matter how numerous and radical are the revisions, still there will be no reversion to the initial type of classification based upon mere sensible similarity. On the contrary, the reformulation of the laws results in a revision of the terminology only inasmuch as the new terminology is constructed according to the rule of conjugate terms. We conclude that, as the first phase reveals the ~~invariant-form~~ identical conjunction as a constrant and invariant form in empirical method, so the second phase reveals the conjugate as similarly constant and invariant.

There is a further observation. The introduction of conjugate terms in the second phase not merely results in the reformation of initial classifications of data as similar but also can require a reclassification of the identical conjunctions set up in the first phase. The outstanding example of this is provided by chemistry; its periodic table of elements is a table of identical conjunctions. Still, they are not identical conjunctions that are concrete unities of instances of data as similar; they are concrete unities of instances of conjugates. The elements in the periodic table are defined by the pattern of relations into which the elements fit.

The third phase of empirical method is engaged in understanding data as elements in concrete situations. It is concerned with the actual changes that occur. It supposes as known the correlations or laws that govern the pure case, the typical situation, the ideal event. It aims at using this knowledge under concrete circumstances, at understanding the series of changes that actually take place, at grasping the sequence of concrete situations. For example, the theory of evolution appeals to general laws but its goal is understanding as a whole the process of life that has occurred and is occurring on this planet.

The first remark to be made is that the transition from specific law to the concrete takes place under a blanket reservation of caeteris paribus. The abstract law is stated without reservations, precisely because it is abstract. Let us suppose that some formula relating P, Q, and R is true definitively and absolutely. Still that does not mean that any circumstances whatever, P, Q, and R will conform to the formula. It means no more than that P, Q, and R are so related from the nature of the case; and it has no intention of denying that under concrete circumstances other factors may intervene to modify the result that otherwise would be expected. When a demonstrator performs an experiment before a class to illustrate a necessary law of nature, he takes every precaution to ensure its success; he has to do so because the abstract necessity of the law offers no guarantee of the concrete success of the experiment; and even when every precaution has been taken either oversight or factors beyond human control may intervene to make the experiment a flop.

The necessity of the reservation, caeteris paribus, is simply the inverse of the abstractive character of the method of observation and experiment. Observation, it is true, takes place in concrete situations; but the observation itself is not exhaustive of the concrete; it is guided by a viewpoint and an objective; and its results are expressed in the general terms inevitable in language of every kind. Experiment, it is true, is performed under concrete circumstances; still the experiment itself is an ideal plan of operations; it is performed under laboratory conditions precisely inasmuch as a concrete situation was successfully contorted into an approximation to a typical situation. Exact measurements are made; but they are made more than once; and the accepted result is the probable mean of actual results. Concrete

materials and instruments are employed; but the interpretation and significance of the experiment are based upon the theoretical definitions of the materials and the ideally, often schematically, constructed instrument. Finally, the experiment itself is repeated; it may be repeated anywhere by anyone; and the conclusions will degree agree, approximately, with so many significant decimal places and so great a possible margin of error. Now this evidently abstractive character of the method of observation and experiment would be utterly paradoxical were it expected to yield knowledge of the concrete. But that is not the expectation. The aim of the second phase was the understanding and formulation of the specific laws of change; what is specific, is not concrete but general, universal, and abstract. The necessity of introducing the reservation, caeteris paribus, on returning to the concrete is no less than the necessity of abstractive procedures to reach general laws.

This point is so essential to the very existence of the third phase that I may be permitted to illustrate it in another fashion. Behind all deductivist and mechanist viewpoints there lies the assumption that if only we knew all the specific laws and had exact information on all the relevant data then we could deduce the future history of the universe. Thus, Laplace is credited with the remark: Give me the distribution of masses and forces at any time, and I will establish what will happens has happened and will happen throughout the course of time. But how many accurate decimal places are needed in the required information? Clearly if there is a limit upon the accuracy of the/ /information that can be supplied, there is bound to a limit upon the accuracy of the conclusions that can be deduced; and the more remote the conclusions, the less trustworthy they become. Still, this is the minor objection. The more important point is that concrete situations are not typical situations. The sum of specific laws relevant to a concrete situation is less no more than an abstraction from the situation; and the abstract is less than the concrete. There are in the course of history items of greater general interest than the distribution of masses and forces; but no deductive process can yield conclusions that contain anything not found in the premises. Or to invert the matter, were it possible to settle history by specific laws, then concrete historical situations would be the/terms defined by the relations conjugate/ expressed in the laws; but conjugate terms are abstract; and so concrete historical situations would have to become abstractions. The fallacy of deductivism and its more popular fellow, mechanism, is the notion that the concrete is just a pure realization of the abstract. The caeteris paribus is overlooked. of the abstract. It is fancied that because one says "all the laws" and adds "all the relevant data" this generous use of the word "all" will somehow exorcize the reservation, caeteris paribus.

It also means that everything within the enclosed volume of space occurs in accord with law. Moreover, it is this second element that is the more important for it is the ground and the significance of the first. Were real isolation the meaning of caeteris paribus, then it would be surprising that experiments ever succeed, for real isolation is not practicable. In fact, what is required is sufficient isolation to exclude what may be called the double occurrence and that, as we shall see, is not subject to law in a manner that could satisfy deductivism.

What, then, is the double occurrence? Suppose that the plaster on a ceiling cracks and falls; suppose that in a beautiful array of delicate test-tubes a magnificent experiment is in process; suppose that the falling plaster smashes the test-tubes. Now there are a set of laws to which the cracking and falling of the plaster can be reduced. There are another set of laws to which the expected result of the experiment can be reduced. But there is no third set of laws to which the smashing of the test-tubes can be reduced. From the viewpoint of mechanical analysis the smashing reduces to exactly the same set of laws as the falling; ~~falling-and-smashing-are-a-double occurrence~~ the smashing is the falling when the test-tubes happen to be in the way. In other words, the falling is a single occurrence; the falling and smashing is a double occurrence; and what makes the difference is that the test-tubes happen to be there. The point of caeteris paribus is the exclusion of the double occurrence; and once double occurrences are excluded, there is a sufficient isolation of a given process from other processes to make its results predictable.

Now when the deductivist envisages the total situation, he does succeed in excluding outside influences but he does not succeed in excluding double occurrences. He obtains a perfect isolation, for outside the sum of things there is nothing. But he does not obtain what really is wanted, for within ~~the~~ his total situations there are the totality of double occurrences. Still he will think that he can account for double occurrences no less than for single occurrences. In a sense he is correct; in another sense he is not. He is correct inasmuch as ~~the~~ one coincidence can be reduced to another. Double occurrences are coincidences; falling happens to be smashing because test-tubes happened to be where they were. But the initial situation, on which the deductivist has complete information, is an aggregate of coincidences. In that situation not only are there the causes of plaster and its falling and the causes of the test-tubes and their position but also there is the coincidence of their being so placed that the double occurrence is deducible.

Still this complicates the deductivist position. It is no longer simply a matter of knowing all the laws and having complete information of some single total situation. ~~To-determine-subsequent-situations~~ It is also a matter of envisaging all the coincidences in the initial total situation and from each coincidence deducing its double occurrences. Moreover, these deductions cannot be made independently. One must ~~simply~~ simultaneously deduce from