CHAPTER III

JEAN PIAGET AND PHILOSOPHY

In this chapter, an attempt is made to understand the thoughts of Jean Piaget on Philosophy, which were influenced by his conception of biology. A detailed discussion of Piaget’s general framework of philosophy can be seen in his work ‘Insights and Illusions of Philosophy’, which resulted in a new philosophy, namely, ‘epistemologie genetique’.

Reflecting on the nature of philosophy, Piaget argues that recent continental philosophy has turned away from the empirical world and concentrated upon ‘introspective description’. He sees this in contrast with great past philosophers who were interested in scientific question, which in turn affected their mode of thinking. Piaget, however points out that although philosophy provides a matrix for the development of sciences such as logic, psychology and sociology, it can only give us ‘wisdom’ and not ‘knowledge’ in the real sense of the word as science does. In this connection, Piaget examines the attempts of Husserl and others to introduce a mode of knowledge specific to philosophy and of a logically higher order than science. The attempts to look for it in an elementary act of consciousness (that is the intentional act), which gives us knowledge of ‘essences’ suffers from the drawback that such acts seem to be a feature of sophisticated adult consciousness. For Piaget, however, adult intellectual activities are conditioned by earlier forms of behavior. Going back to empirical traditions of British Philosophy and Piaget’s views, as far as methodology is concerned the school
of conceptual (or linguistic) analysis, had certain affinities with that of phenomenology. For example, the view that empirical questions are irrelevant to philosophical ones and that philosophical discussion of conceptual thinking are concerned with questions of validity and not of origin. Genetic (historical) dimension is therefore excluded because, it is concerned with the process of discovery and not justification. The philosopher is interested only in the justification and not the origin. This provides a two-fold reason why it tends to be regarded as a form of knowledge. Speaking in this manner will be relative only to modern man, for whom there exists a more or less clear cut difference between science and philosophy. The most important reason, which is a historical one, says philosophy has always been considered as a form of knowledge in our western civilization. It has long been bound up with science, from the time of the earliest Greek thinkers, for whom the distinctions between science and philosophy did not exist. When the Pre-Socratic began to think about reality in a rational manner and no longer in the symbolic language of the myth, their conceptions of the world involved at one and the same time philosophy and physics as in the case of the school of Miletus, or mathematics as in the case of Pythagoreans.

It is important to note how this connection with science has remained alive for so long. This is also the characteristic of western rather than oriental thought. There is also a need to recall that there are no differences as far as nature is concerned between philosophical and scientific cognitive problems. They only differ in their delimitation or specialization and above all in their methods, which are either purely reflective or based upon systematic or experimental observation in the case of facts and rigorous algorithms.
in the case of deduction. Piaget, therefore states "It is relatively easy, to know broadly on which matters a philosopher has engaged in scientific activity or to which he has tended to have a scientific attitude (since this is primarily a matter of approach and not of boundaries in the static sense), and those about which he only philosophizes". 55

It seems undeniable that the most important systems in the history of philosophy, which have given rise to others and which have themselves had a lasting influence, have all arisen from a reflection on the scientific discoveries of their authors themselves or on a scientific revolution occurring in a period in which they lived or immediately preceding it. Consider for instance Plato, who was concerned with mathematics, Aristotle with logic and biology, Descartes with algebra and analytical geometry, Leibniz with the infinitesimal calculus, the empiricists such as Locke and Hume with their studies of psychology, Kant with Newtonian Science and its generalization, Hegel and Marx with history and sociology, and Husserl with Frege's logistic.

Besides this there were systems that stated there is no connection with science. And these systems therefore did not succeed in producing an original epistemology and have stressed the defense and interpretation of values in the form of transcendental theology like that of Plotinus, a rigorously immanent one as of Spinoza, or a radical idealism as in the German post-Kantians.

Piaget stated that "starting from the epistemological point of view, which is that in which philosophy comes closest to knowledge in the strict sense, it is of some interest to

note that the great philosophical systems owe to the kind of science which has given them their epistemological orientation, not only the emphasis put on this epistemology but also the particular kinds of epistemology that they have adopted, which is more instructive. In this respect Piaget distinguishes different kinds of epistemologies.

First there is *Platonic Realism*, which projects the structure of knowledge into a suprasensible world without their depending on either a human or transcendental subject. The subject is not active in knowledge and is limited by reminiscence or participation, to the reflection of the eternal ideas. The latter, forms the basis for the supreme values such as moral, aesthetic and religious. This realism of transcendent ideas was the only epistemology compatible with the peculiar status of Greek mathematics. Although it had rational and operational character from the time of Pythagoras, it has put all the stress in virtue of the known psychological laws, on the result of these operations and not on their functioning, for conscious realization starts from the peripheral result of actions before turning to their inner mechanism, which, moreover, it never completely attains. The Platonic ‘forms’ do not require active relationship or interaction between environment and human being. Knowing implies ‘making a copy of reality’. Piaget asserts that “knowing means ‘reacting to reality and transforming it in such a way as to include it functionally in the transformation systems with which these acts are linked’”.

Plato’s genius consisted in separating out the epistemology implicit in this general situation. We see that, if the pre-Socratic concerned themselves with activities that could

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56 Ibid... P. 47.
be described as scientific or pre-scientific as well as philosophical. Thus, the first great philosophies of western civilization originated from reflection upon an already constituted science.

Aristotle found both logic and biology. He put forth, forms that recall the platonic forms or ideas, but in one case, embodied in the subject's discourse and in the other in the structure of the organism. Aristotle accepted the same systematic and static realism, like that of Plato and whole Greek thought, while introducing the forms into physical or spatio-temporal reality according to a second kind of epistemology, which we might call as 'immanent realism'. Greek thought, has always remained alien to the concept of an active 'epistemological subject', and the two powers that Aristotle attributed to the subject are those of a conscious realization of forms and an abstraction starting from perceptions enabling a content to be given to the forms. Sophists, for instance, have stressed the need for certain norms of subjectivity, but their aim seemed to be critical as they did not arrive at the 'epistemological subject'. Similarly the theory of forms in Aristotle, instead of being directed towards a dialectical constructivism ended therefore in a static hierarchy; the higher stages explained the lower ones who's built-in finality and the concept of passage from potentiality to actuality excluded any epistemology of the subject activity. Piaget stated "it is nevertheless true that this famous doctrine draws upon two kinds of inspiration, which form the starting point of two of the most important sciences of today: logic and biology". 58

Descartes' discovery of epistemological subject would be inexplicable without three mathematical and physical innovations. This forced him to revise Aristotle's epistemology and to rethink the conditions of knowledge. First, the development of algebra brought to the fore the possibility of a discipline based on the subject operation and on their arbitrary combination, and no longer on geometrical figures experienced as external or no numbers considered as existing independently of the operations that engendered them. Second, discovery of analytical geometry showed him the possibility of an exact correspondence between algebra, the domain of thought operations and geometry, the domain of extension, from which arises the permanent Cartesian theme of the relation between thought and extension, which are at one and the same time in dissociable and basically distinct. Third, Galileo's discoveries concerning inertial motion, his fundamental method consisting in taking time, henceforth uni-directional, as an independent variable; and in a general fashion, the possibility of applying computational methods to physical transformation, are innovations having considerable significance. All these explain at one and the same time the Cartesian conception of causality as the logical mathematical reasons for the transformations, the rejection of finality and the rejection of the idea of force, because Aristotle thought of it as a substantial and non-transitive property of the physical body. If under the influence of the three above innovations, Descartes discovers the epistemological subject and its powers of radically assimilating physical reality, he remains in a position intermediary between his absence of a subject in Plato and Aristotle and the structuring subject of Kantian apriorism.
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Leibniz's like that of Descartes was, well known and directly influenced by his scientific discoveries. He derived the principle of continuity and indiscernible from the infinitesimal calculus, and its application that led him to the philosophical use which he made of the principle of sufficient reason. Proceeding from the algebra of the finite to that of the infinite, which is his new calculus, he grasped better than anyone else the dynamic operational character of intelligence. Locke's empiricism could not explain the *ispe* intellectus. But convinced of the unrestricted extension of the physical application made possible by his calculus, he did not accept an idealism, which he might have done if he had only concerned himself with the new powers that he discovered in the activities of the epistemological subject. Leibnitz's pre-established harmony or "perfect parallelism" simultaneously took account of experimental knowledge, of the relation between mind and body, and of the intuitive residues discovered even in the most abstract ideas.

While the construction of new logico-mathematical structures led Descartes and Leibnitz to the discovery of the epistemological subject, psychological consideration gave rise in Great Britain to a fourth kind of epistemological interpretation, that was seen in *Locke's Empiricism*, than Hume's. The position, characteristic of innatism and the hypothesis of pre-established harmony is, in fact, an unstable one. It assumes that either the subject in general is only the reflection or the locus of structures which exist independently of itself, and there is no epistemological subject or that there is an epistemological subject and it plays an active role in knowledge, in the form of a structuring, which it imposes apriori, on all experience or under the forms of progressive construction conserving the internal necessity characteristic of the apriori, but under a
dynamic and no longer static form. To adhere to innate ideas is to limit this construction,
either a priori or dialectically, in favor of a kind of pre-formation or pre-determination
which remains halfway between the initial realism and later achievements. Due to this,
empiricism has questioned the hypothesis of innateness, using quite new arguments
whose late historical development showed that they formed the starting point of an
independent science: psychology founded on methodological observation and
experiment. Locke wanted to start from the facts and was not interested in resolving
questions by metaphysical deduction, and Hume attempted to introduce the experimental
method of reasoning into moral subjects. Empiricists had the great merit of looking for
verification in the facts, stating the problem in a way glimpsed by Aristotle, but which
was new in its generality and its absence from all pre-suppositions. How are ideas
formed in reality that is as they appear to observation and experiment? Empiricists
proceed themselves by an empirical method, they have only observed in the factors
constitutive of the origin of ideas the part played by experience with, in addition, an
organizing factor that Locke referred to by the global phrase "operations of our minds"
known by reflection, and Hume reduced it to the association of ideas.

Kant originated another type of epistemological interpretation: that of a-priori
construction. According to Kant, it replaced the epistemological subject by knowledge
conceived of as being a copy of reality. The most important scientific event of which
Kantianism tried to give a general interpretation was anything but a simple copy: the
impressive success of the Newtonian doctrine of gravitation and its extension to a varied
range of phenomena was striking evidence of an agreement between logico mathematical
deduction and experience. It was therefore, the two fold proof, on the one hand, that the epistemological subject exists and its construction form the very stuff of the understanding. On the other, experience is structured and even capable of being structured indefinitely, and does not consist in the simple additive collection of recorded facts that satisfied empiricism in its interpretation. It is therefore, a question of elaborating a concept of the epistemological subject, satisfying the two fold function of indefinite constructability and of structuring experience whatever it may be.

The question whether philosophy has the status of 'wisdom' or a form of 'knowledge' is not an unnecessary or simple theoretical problem. Piaget considers this as a vital question, as it affects the success or failure of many.

As soon as he was introduced to this subject, like many children, got fascinated by natural history, and at the age of 11 years, had the good fortune to become the 'famulus'. This was the phrase the old zoologist, Paul Godot, used for Piaget, who then directed the museum, at Neufchatel solely on his own resources. He introduced Piaget to malacology and gave a number of shells of land and freshwater mollusks with the help of that Piaget made a collection at home.

It is in this context that Piaget discovered philosophy. But having, a father who was a historian did not help Piaget much, that's because his own father did not believe in historical knowledge. It was Piaget's godfather, who took a lot of interest in him. He was alarmed by exclusive specialization of Piaget and one summer, he invited Piaget to stay at his own house. There he explained to Piaget, 'Bergson's Evolution Creatrice'. This was a tremendous experience for Piaget and for two equally strong reasons, both of
which merged with those basic interests that impel adolescents toward philosophy. The first reason was cognitive. It was to find the answer to the great problems met during Piaget’s intellectual development. Deeply interested in biology, understanding nothing of mathematics, physics, nor of the logical reasoning Piaget, was fascinated by the dualism of the *élan vital* and of matter falling back on itself, or by that of the intuition of duration and of intelligence unable to understand life because its logical and mathematical structures and oriented in the direction of inert matter. Piaget thus discovered philosophy answering exactly to his intellectual interests.

This made him devote his life to philosophy, whose central aim was to reconcile between sciences on the one hand and religious values on the other. Arnold Reymond his own teacher influenced Piaget, in two opposing directions. On the one hand, he got Piaget to appreciate rational values and on the other hand, he influenced Piaget indirectly and gradually making him doubt the value of the profession of philosophy. This was the same person who criticized the work of Bergson, which at first made Piaget to object to his essentially mathematical approach. Arnold Reymond was also a philosopher by inclination and he remained for Piaget the fullest and most admirable example of a thinker. With the help of Arnold Reymond, Piaget made progress in epistemology. After study on the epistemology of biology as science, he began to contemplate, in keeping with his former interests, a more long winded work on the theory of knowledge. All this Piaget looked at from a biological standpoint in other words, a study similar to that of Spencer, but without its empiricist perspective and in line with present knowledge in epistemology and biology.
Piaget arrived at two central ideas: (1) "was that every organism has a permanent structure, which can be modified under the influence of the environment but is never destroyed as a structured whole; all knowledge is always assimilation of a datum external to the subject's structure. (2) that the normative factors of thought correspond biologically to a necessity of equilibrium by self regulation: thus logic would in the subject correspond to a process of equilibrium".\(^{59}\)

Piaget felt that in order to analyze the relation between knowledge and organic life, it would be useful to study experimental psychology. This was possible because Piaget had the extraordinary luck to work in a laboratory of a school, where he was given a free hand and entrusted with study aiming in principle to restandardize intelligence tests. This in fact allowed Piaget to analyze the different levels of the logic of classes and relations in child's thought. Piaget's studies on the logic of children were given a friendly reception by L. Brunschvicg and A. Lalande. Arnold Reymond regarded them as a kind of extension or parallel of the historico-critical method applied, as L. Brunschvicg said, to the "ages of intelligence" instead of to history. All this Piaget said, in order to show that he did not begin his career with unfavorable prejudice towards philosophy. Piaget states that "true in 1929, I rejoined a faculty of science and taught, in Geneva, at first the history of scientific thought then experimental psychology. But I did this without dogmatic prejudice and simply in order to find a more extensive field of experience".\(^{60}\) He analyses three important reasons, for his dissatisfaction with

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traditional philosophy. The first reason for growing dissatisfaction with traditional methods of philosophy was caused by the conflict that he felt within himself. It was between the habits of verification of the biologist and psychologist, and speculative reflection, which constantly tempted him, but which could not possibly be submitted to verification. Speculative reflection is fertile and has been a necessary heuristic introduction to all inquiry. It can only lead to the elaboration of hypothesis, as sweeping one like, to be sure, but as long as one does not seek for verification by a group of facts established experimentally or by a deduction conforming to an exact algorithm, the criterion of truth can only remain subjective, in the manner of an intuitive satisfaction, of 'self-evidence,' etc. When it is a question of metaphysical problem that involves the coordination of values, only speculative reflection remains the only method possible; but remaining bound up with the whole personality of the thinker. It can only lead to a wisdom or rational faith and is not knowledge from the point of view of objective or interindividual criteria of truth. When it is a question, on the other hand, of the more delimited or de-limitable problems of epistemology, then an appeal to facts or to logico-mathematical deduction becomes possible: the historico-critical method, psychogenetic analysis of the formation of concepts and operations, the logical analysis of the foundations of mathematics, provide methods of testing that individual reflection is unable to provide. The second reason Piaget gives for the dissatisfaction is with regard to the pure philosophers. It refers to something which from the psycho-sociological point of view is very significant: this is the surprising dependence of philosophical ideas in relation to social or even political change. The third reason for dissatisfaction is the same
reason that made Piaget to become a professional psychologist, albeit one with interests centered on problems of epistemology, rather than a philosopher temporally occupied with psychological verifications before going on to outline a genetic epistemology. This reason has been the reaction to a number of philosophers whose interpretations gave Piaget the impression that we no longer speak the same language. This is not because they (philosophers) were critical, but because it seemed to Piaget to indicate an attempt having little validity on the part of philosophical judgment to meddle in the field of scientific research. Piaget rejected being called a positivist. Positivism for him "is specifically a doctrine intended to limit science, to assign definite boundaries to it, while for non-positivist scientists, science, is indefinitely open and can inquire into any problem, provided a method can be found about which scientists agree".

By 1929, Piaget returned to Geneva as part of the faculty of science. He felt freed from philosophy and was even more determined to study epistemological structures using the historico critical approach, and above all the psycho-genetic one. Piaget began to study the operational structures in mental development (with his colleague B. Inhelder) and produced a kind of logical formalization applicable to the collected facts. He conducted a series of research experiments on perceptual development that completed his work on the psychology of the child.

Piaget relates and greatly values his experiences as former philosopher. These experiences enabled him to undertake the task of formulating a scientific epistemology that he always dreamed of. According to Piaget, one needs to remember that the

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boundary between philosophy and science is always changing because it does not depend on the problems themselves. Neither of the two can ever be said to be definitely scientific or metaphysical. It is only on the possible delimitation and the selection of methods that enable us to deal with these circumscribed questions in relying on experimentation, on logic-mathematical formalization or both. He therefore, dreamed of "genetic epistemology" which would delimit the problem of knowledge in dealing with the question 'how does knowledge grow?' which concerns both its formation and historical development. Though Piaget is considered as one of the most significant child developmental psychologists he always called his position "genetic epistemology".

The reasons why Piaget is called a child psychologist is mainly because he has studied scores of children engaged in games such as marbles and pouring water into glasses of different sizes. Piaget's observations made him think as to why children act as they do and what they are capable of learning. Thus Piaget was only trying to understand some of the philosophical views about knowledge. Therefore, we would be mistaken if we picture Piaget as a child psychologist. To understand his genetic epistemology we need to understand why he was concerned with the construction of such an epistemology. By means of his epistemology he wanted to show the conditions in which knowledge occurs. He was certain that one could arrive at 'knowledge' if one were to approach it scientifically as most biologists would. Thus, in order to find a bridge between biology and theory of knowledge, it was necessary to study mental development, the development of intelligence and the genesis of ideas. To study epistemology objectively and scientifically we must not take knowledge with capital K, as a state in its higher forms,
but seek the processes of information: how one passes from a lesser degree of knowledge to a greater one; relative to the level and point of view of the subject. Piaget calls "the study of such transformation of knowledge, the progressive adjustment of knowledge......genetic epistemology".\(^{62}\)

Before we proceed further, it is important to note the distinction that Piaget noted between Genetic Epistemology, Genetic Psychology and Child Psychology. Beginning with "child psychology it is the study of the child himself or herself. Whereas genetic psychology seeks within the study of the child the solutions to general problems, such as those of the mechanisms of intelligence, perception, etc., for it is only in analyzing the formation of such mechanisms that one can provide their causal explanation. Genetic epistemology is the formation of knowledge itself. It deals with the cognitive relation between the subject and the object. Not only that it bridges the gap between genetic psychology and epistemology in general, which in turn helps to enrich development".\(^{63}\)

Though epistemology contains genetic psychological pre-supposition, it is more than genetic psychology. Apart from factual pre-suppositions and questions, it also involves normative and logical consideration. There cannot be a cognitive psychology without priori epistemological analysis. If one restricts oneself to a static psychology like that of an adult, one may find it easy to draw a line of demarcation between psychology and epistemology. But if we are to explain behavior and mental mechanisms by their development, we find we are forced to decide what in this formation depends on the


\(^{63}\) Cf., Jean Piaget, From Genetic Psychology to Epistemology, In psychology and Epistemology(trans. A. Rosin),, New York, PP. 23-44.
objects, on the activities of the subject, or and the nature of the form between the two.
Here, therefore we are forced with epistemological problems, whether we like it or not.
In other words it is compulsion for anyone to understand the problem as Piaget saw it.
What was the available solution according to him? What made him construct such a
theory?

Although one cannot give a detailed answer of these questions, one can briefly
describe, some of the prominent features. These prominent features will help us to
understand the various intellectual currents of thoughts that flowed. These constitute the
basis of Piaget's thought. The discussion is of 19th century origin and such thoughts are
not shared by the 20th century thinkers. These include evolutionary biology, rationalism,
pragmatism and functionalism, the historico-critical philosophy of science, and holism
versus atomism.

Evolutionary biology: The late 19th century is characterized by a historical or the
evolutionary outlook. This outlook was adopted by the intellectual figures of the century
such as G.W.F. Hegel, Karl Marx, August Comte and Henry Bergson. This outlook
reached its scientific culmination in the evolutionary biology of Jean Baptiste Lamarck,
Charles Darwin, Alfred Russell Wallace and T.H. Huxley. This evolutionary biology,
genetics and developmental biology has always influenced Piaget's thinking especially
conceptual and theoretical problems in theoretical biology. Piaget is also concerned with
issues such as vitalism, mechanism, teleology and chance. The common belief that
evolutionary theorist have is that life is a process that evolves. This influenced Piaget's
mind. Secondly, all the evolutionary thinkers believed in the stages of development that
proceeds according to relatively fixed laws. Evolution seems to proceed in a specific
direction towards a greater equilibrium, adaptation, freedom to the classless society and
so on. This directional evolutionary process was considered to be an instance of progress.
A theory or philosophy developed to answer questions in one particular context, for
example, in biology could be applied to the other area like that of embryology or the
history of ideas. As Kitchener points out "all reality biological, physical, psychological,
sociological, intellectual is evolving in the direction of progress. This evolutionary
direction tends towards increasing equilibrium and this process of equilibration is not due
to accident or chance but rather is subject to the same underlying law or explanatory
principle wherever it is found". Piaget's theory of evolution is an alternative to neo-
Darwinism and vitalism. Piaget is a naturalist in the same sense like that of Aristotle or
John Dewey. He is not a materialist or reductionist. Piaget's naturalism is a kind of
rationalism—a biological and naturalistic rationalism and not a Cartesian or platonic one.
Piaget has always been committed to a biological (especially evolutionary) epistemology.
For Piaget, to give a biological explanation of knowledge is central to explaining
knowledge. One should not understand this as reduction of epistemology to biology. On
the contrary, Piaget believes that biological processes have a rationality of their own.

Rationalism: For Piaget reason is not fixed; rather it evolves. Reason he says cannot
explain what happens by chance nor by means of causality. Reason is something that
evolves rationally. How can this be explained in terms of evolutionary perspective?

64 Richard, F Kitchener, Piaget Theory of Knowledge Genetic Epistemology and Scientific Reason, Yale
Piaget claims that "our knowledge of the physical world presupposes apriori logico-mathematical structure into which sensory information is assimilated". Piaget explains the development of logic-mathematical knowledge in terms of changing relationship between organism and environment. According to this model, development is characterized as a process of increasing equilibrium between organism and environment. In such a process, partial equilibrium gives way to more complete equilibrium that can be characterized as a shift from organic causality to rational necessity. If reason is understood in terms of increasing equilibrium between organism and environment then we are forced to interpret the nature of reason and logic quite differently from traditional thinkers. In which case, the reason in the latter tradition becomes theoretical and contemplative. It becomes a kind of requirement for organism for the adaptation. Rationality thus consists in coping with one's environment and satisfying one's need just as much as it consists in constructing a logical proof.

Functionalism and Pragmatism: These are basic epistemological issues and the basic unit of epistemic analysis. It explains how organism adapts to a changing environment. Epistemic items such as ideas, beliefs and theories are to be evaluated in terms of how they function in the actual environment to facilitate successful goal attainment and adaptation. Piaget's model of equilibrium is similar to John Dewey's pragmatism. If an organism is adapted to its environment and all its needs are satisfied, intelligence and inquiry would never be needed. Only when there is some initial need, mental life, intelligence, and conscious awareness begins. Intelligent activities consist in constructing

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and testing hypothesis about solutions to problems. If a hypothesis is successful, then the organism is once more adapted and equilibrium is restored. Progress is located in the increasing adequacy of the hypothesis for solving actual problems and anticipating possible ones. Although Piaget's concept of equilibrium is inspired by functionalism, he shares it with Charles Pierce's and Dewey's pragmatism.

Historic-critical philosophy of science: This conception of knowledge is taken by Piaget from a group of French thinkers. Richard Kitchener mentions few such as Jerome Lalonde, Gary S. Mayerson and others. They belonged to heterogeneous movement known as 'historico-critical philosophy of science'. Although, it is difficult to characterize, the essential features of the movement, one can say that they were all concerned with a critical analysis of science and the basic concepts underlying scientific knowledge. All these thinkers in some way or the other were influenced by Kant's attempt to construct a critique of reason. In the late 19th century, Kant's original twelve categories were jettisoned by the influential neo-Kantians. These were replaced by concepts which were more basic to science. Kant always gave an a priori, transcendental deduction (justification) of his particular categories of thought; but these philosophers believed that one had to look to the historical development of reason to determine its nature and function and to discover what if anything was necessary. There can be no apriori transcendental deduction of the categories of thought, for, these concepts change over the course of time and may be expected to change in the future. The influence of this school on Piaget cannot be over estimated as Piaget always stressed its importance. Piaget sees himself as belonging to this tradition and even claims that genetic
epistemology constitutes a simple extension of the historico-critical method that is its extension to the individual level. This school was also convinced that reason evolves rationally. A crucial part of Piaget's program is to carry out the historico critical program at the level of the individual.

Holism and individualism: These concepts apply not only to the social realm but also extend beyond it. This is purely a debate about the ontological nature of social wholes but in view of Piaget it has implications in other areas. Although both the alternatives that is, holism and individualism are inadequate Piaget puts forth another alternative namely relationism. Where Piaget states that "a whole is not reducible to the sum of the individual parts but neither does the whole have properties not possessed by the members. The whole is equivalent to the parts plus all of their relations"66.

The social whole according to Piaget is the addition of all the relations between the individual members, a point neither position adequately recognized. Thus Piaget says, if we know all the interactions between the individuals, we would have so-called composition laws, which would allow us to explain the social whole. This relationism, and is central feature of Piaget's social psychology, his structuralism and his genetic epistemology in general. Society is to be explained to Piaget in terms of the relations between individual's relations of constraints, cooperation, social ideas and so on. It is not restricted to non-relational properties of individuals. In short, Piaget is claiming that individual psychology is inadequate to account for the sociological dimension but that social psychology can accomplish such a task.

If one understands the above mentioned intellectual views about Piaget, then the task of genetic epistemology becomes apparent. It would study the development of knowledge. Given that knowledge has increased from a lesser state to a more adequate one. But how could one describe and explain this epistemic transition? One, can show that Piaget's theory of equilibration becomes central to epistemic dynamics, and it provide basis for explaining epistemic transformations. Further Piaget's structuralism, led him to conceptualize epistemic states as holistic structures. An epistemic structure therefore consists of an epistemic stage interpreted in Kantian type of structure in which epistemic categories are crucial. Thus in short, genetic epistemology attempts to study the developmental transition from one epistemic stage to the next.

Such an epistemology would stress the essential need for empirical questions to be answered by empirical means, because it stresses the empirical (scientific) dimension. Piaget's genetic epistemology crucially depends on scientific information which was not readily available. Piaget took upon himself the task of doing the necessary empirical research that would answer the above questions. Genetic epistemology and Piaget's own theory of cognitive development are so intertwined that one cannot be understood without the other. Although the main focus is on genetic epistemology, it becomes necessary to have a preliminary over view on his theory of cognitive development.

Piaget is widely known for his cognitive development theory. This is the theory that emphasizes epistemological psychological cognition in the individual. This theory is often taken to be a pure psychological theory about child development, a scientific theory of psychological development that makes factual claims about what happens in the
course of development, claims backed to some degree of scientific evidence. According to Piaget "this process of development proceeds in terms of series of stages, each of which has an underlying cognitive logical structure"\(^{67}\). What does Piaget mean by stages in his theory?

Piaget speaks of qualitative changes in the underlying processes themselves as a fundamental fact of mental growth. These qualitative changes are grouped into a succession of four global stages, which could be also called as "periods". There are certain key properties of the stage concept itself.

The first important feature is that Piaget believes his stages are real and not arbitrary. They are real in the sense that they are comprises of natural groupings of cognitive contents that occur at specified points during development. Piaget's assumptions that his stages are real and natural entities, itself makes his theory apart from other approaches to cognitive development.

In its most general sense, Piaget's stage concept is a means of grouping together qualitative changes in schemes. Scheme changes come in two varieties namely: 1) broadening a given scheme to include a wider range of situations. 2) Differentiation of new scheme from the old ones. When the second type of scheme change occurs, the child passes from one stage of cognitive functioning into the next higher stage. Piaget's stages of cognitive development are totally dependent on his ideas of scheme and scheme changes. Thus to say that a child is at a particular stage of cognitive development is to say that a certain set of sensory-motor or cognitive structures are present, and to say that

a child has entered a new stage of cognitive development is to say that qualitative
c changes in sensory-motor or cognitive structures have occurred. According to Piaget,
stage must satisfy a certain set of criteria. The exact number of criteria given is three and
five. But the most important ones seem to be four.

1. Qualitative changes in cognitive contents.

2. A culturally universal invariant sequence in the overall progression of stages.

3. Inclusion of the cognitive structures so each preceding stage is in the next
   subsequent stage.

4. An overall integration of the structures of each stage.

Requirement (a) is Piaget's way of assuming that each stage will have
qualitatively different cognitive structures. Unless there are qualitative changes in overt
behavior, there is no reason to infer qualitative changes in underlying organizations. This
requirement may be illustrated by an apparently qualitative behavioral change which
takes place during infancy. There are improvements in grasping and looking behavior
during infancy. Another change that occurs is that the two behaviors become tightly
coordinated. In addition to the separate incremental improvements in looking and
grasping, the behavior eventually become sub-ordinate to a single system that
psychologist sometimes call the 'eye-hand' schemes. Another example may be the
concept of transitivity that provides another case of qualitative looking changes in
cognitive content.

Requirement (b) -- according to stage requirement (b) every child passes through Piaget's
stages in exactly the same order. The first stage succeeds the second stage invariably, not
just on the average. The same things holds true for the relationship between the second stage and the third stage and the third stage and the fourth stage. The invariant sequence of Piaget's stages is referred to as their natural acquisition order. According to Piaget, there must be an invariant order in the emergence of his stages for the good and sufficient reason that the underlying structures of preceding stages are always incorporated by the structures of the subsequent stages. This sort of invariant progression that Piaget is talking about is called a logically guaranteed progression.

Stage requirement (c) is the hierarchization of requirement, and is closely related to the invariant sequence requirement. The hierarchization requirement is one way of insuring an invariant progression of stages. The central idea expressed by requirement (c) is that earlier and more primitive cognitive structures form the foundation on which more advanced levels of structures are built.

Stage requirement (d) maintains that the various structures that characterize a given stage must be consolidated into a uniform while before a new stage is declared. Requirement (d) follows the first three both logically and developmentally. (a), (b) and (c) requirements are necessary condition for the stage whereas (d) is only a sufficient condition.

According to Piaget, there are definite stages of cognitive development which are also called as "epistemic stages". Epistemic stages consist of a set of epistemic concepts related to each other in a logical way. These concepts include sensory-motor schemes operations, real categories (space, time, causation and object permanence), formal categories (classification, number and quantity), perceptions, concepts, semiotic
categories (ideas, images, symbols, and signs), moral, emotional and social categories and so on. With the help of these epistemic elements, we can know the world and the means by which the world is assimilated and we can take on a variety of structural forms and organizations. Each structure represents a kind of logic, a set of formal and quasi-formal relationship. According to Piaget, a structure has three properties, that is, it is a whole, it consists of law and transformations and it is self-regulating.

According to Piaget, cognitive development proceeds by means of four basic stages:

1. The sensory-motor stage that is from 0-2 years.
2. The pre-concrete operational or intuitive stage that is from 2-7 years
3. The concrete operational stage from 7-12 years
4. The formal operational stage from 12-15 years.

The sensory motor scheme that is from 0-2 years. Piaget begins his analysis of the development of intelligence with a detailed study of the changes that occur in the baby's understanding of the world around him during the first two years of life. According to Piaget, the child at birth has no awareness of self and of not self, of an individual set in an environment. The world for the baby is spaceless, timeless and objectless, an undifferentiated experience at present. The sensory motor system of the baby is very restricted as the baby at this stage can receive sensation arising from within his body and from the immediate surroundings to which he can make certain limited responses. At this stage, the baby shows limited innate behavior patterns grasping, sucking and gross body activity. When these reflex-like patterns interact with the environment, a modification and development of behavior occurs. For example the
tendency to suck any object can be exercised only when the object comes in contact with the lips. As soon as the baby learns to suck objects, through experience he/she comes to know which objects have suck-able properties and which ones do not have. By this, the child will know the difference sensations associated with sucking the nipple, the bottle, the thumb, or the corner of the pillow. Changes also occur in sensory motor functions. Vision is at first, a reflex response to light intensity, but the eyes begin to focus on specific objects and to follow them as they move. Grasping is at first a reflex response to an object placed against the hand, but the hand begins to search, grasp and release objects without the initial tactile stimulus. Gradually, these separate areas of reflex activity become coordinated. In summary, it can be seen that the internal needs of the baby are satisfied by the exercise of his reflex behavior patterns upon the environment in which he is placed. This is the first stage. Thus the first period of mental development that is the sensory motor period extends broadly from birth to the appearance of language. The sensory motor stage is called by Piaget as stage of 'egocentricism'. The child cannot distinguish the self from the world, because he or she does not yet have a sense of the world or the self. There exists at this stage a kind of pure neutral experience, and it is much later stage that the individual comes to differentiate and construct the self and object world as two co-relative poles of experience. The process of overcoming the egocentricism begins by means of the 'Copernican revolution', where the individual begins to become aware of him/her as one 'constructed 'object among others. This process of 'decentration' itself pre-supposes the development and construction of certain categories like object, permanence, space, time, causality and their elaboration into a
framework of reality. The child at this stage knows the world only externally that is by means of his or her actions on it. This is an epistemology of 'pure praxis'. Rationality at this stage is purely instrumental rationality. One possessing "logic of action"—a kind of primitive means 'end' rationality based on success instead of understanding. There are no internal ideas, no abstract thought, no conceptual thought and no full blown propositional logic.

The second stage is called pre-operational or intuitive thought that extends from 2-4 years to 4-7 years. Piaget calls this stage as a stage of 'semiotic' function. The crucial item of this stage is the development of the ability to represent or symbolize by means of imitation, play, signs and symbols. The child begins to symbolize and represent actions and thus to reason about them. Here Piaget gives the example that the child can use a mental picture of a bicycle or the word bicycle or a small schematic toy to stand for the real bicycle when it is not in immediate view. The ability to represent in this way makes it possible for the child to operate on new levels.

This stage enables the child to move towards the internal sphere of thought; still the child is egocentric in his or her representations. Intelligence of the child is practical and this alone helps the child to move to a more "thoughtful" intelligence. The child's thought at this stage is limited. The external sphere of motor behavior thus remains pre-logical. At this stage, the child interacts quite effectively with the immediate world of things and of people around him. He possesses schemes enabling him to manipulate objects and use them as means for the attainment of his goals. The infants also experiments with things to achieve a practical understanding of their properties. All these
abilities are less concrete and are always limited to immediately present objects. For example, the infant may be able to use a stick to bring an object within reach. He cannot conceive of relationship between objects that are not within his immediate scope of vision. At this stage, the infant is able to act only on things which are perceived directly. The child begins to develop novel cognitive or mental processes.

Semiotic function also allows the evocation of the past. It manifests itself in several ways, wherein the child begins to employ mental symbols to engage in symbolic play and to use words. With regard to the nature of the mental symbol, it is difficult to answer this question. There is no method which permits a direct look at the child’s thought. Partially, one can understand it in terms of child’s visual images. Although sometimes, a person may use visual imagery, he may at other times represent objects, by their sounds or even by an abbreviated form of their movements. There could be two possible answers. One is the ability to symbolize. This is an entirely new function which suddenly makes it appearance when the child is about two years of age. Secondly, another possibility is that symbolism has pre-cursors in the sensory motor period. Emphasizing continuity in intellectual development, Piaget adopts the second alternative. He holds the view that the semiotic is derived from imitation. Piaget argues that such imitation of things is the sensory-motor forerunner of mental symbolism. Another crucial point is meaning, it means the process by which the child acquires meaning. Take for example, what does bicycle designate? Our response to this question is to say that both the mental symbol and the word obviously refer to the real bicycle. But for Piaget, this is complicated. This is because, the signified is what the symbol or the word stands for or
its meaning is not the real object. But rather the child’s understanding or intellectual
collection of the real object. To put it in different words, meaning does not refer to
things, but instead stands for one’s knowledge of things. For example, one child may
think that bicycle is something that goes delightfully fast as well as it is one kind of
vehicle. For another child, the signified may be somewhat different, that is having fallen
often from bicycles, and he may feel that they are frightening and dangerous. Further, he
has no conception of the bicycle as a vehicle. But one should note here that for both
these children the word bicycle evokes some common meaning that is it is having two
wheels, handle bars and so on. Both the child can easily identify what bicycle is and
what it is not. In denotative sense, the word does refer to the real object, but at the same
time disagreement arises between the two children regarding the meaning of words that
is for one, a bicycle is delightful and for the other, it’s frightening.

In Piaget's terms, each child has assimilated the word “bicycle” into a different
set of schemes (the signified or the meaning). Therefore, the word bicycle, or the
children’s personal mental symbols for it, does not refer to the real things, but to their
understanding of it. To summarize, internal imitation (accommodation) provides the
child with symbols. The child then endows these symbols and words too with meanings.

Another aspect about the semiotic function is how the child uses language and
gives its meaning. The meaning of the words is not constant for a young child. In fact,
for him, words have little socially agreed upon meaning, instead they are quite personal
and they resemble idiosyncratic mental symbols. The development of language also
involves the use of words in a representational way. At about 2 years of age, the child
generally begins to use words to stand for absent things or events. This use of words of a child is similar to the adult use of words.

One can also see some types of reasoning at this stage. The child shows three different kinds of reasoning. The first type of reasoning is where the child is faced with a simple situation which has been experienced before. The child "reasons" about the situations very concretely in terms of what had occurred in the past. For Piaget "this type of reasoning is simply an application of previous experience to a current situation and this not to be confused with the genuinely deductive reasoning of mature persons"\(^{68}\). The second type of reasoning is where the child's desires distort thinking. At this stage, the child attempts to reason to achieve some goal, but thought distorts reality in accordance with desires. This is similar to Freud's notion of wish fulfillment. The third type of reasoning is what Piaget calls trans-deductive. Piaget states that "the young child's reasoning lies in between induction and deduction. The child does not go from the general to the particular or from the particular to the general, but rather from the particular to the particular without touching the general"\(^{69}\). Transcendental reasoning sees a relationship between two or more concrete (particular) terms when there is none.

When the child reaches the age of five to six years, there is continuity of development of sensory motor schemes that are applicable to a wide range of objects, here is improvement in the skills of language. The child tries to acquire mental representation for increasing large portions of the surrounding world. The child's development extends into a number of new areas. This second sub stage is marked by the

\(^{69}\) Cf., ibid
beginning of decentering and the discovery of certain objective relationships by means of what we call constituent functions. One can also note a striking similarity in relations holding between the second phase of pre-operational representative intelligence and the first and the second and the first phase of sensory-motor intelligence. In both cases we have a transition from radical ego-centricism to relative de-centring by objectification and spatialization.

Apart from the similarity there is a point of difference that is at the sensory-motor level, the initial centering is connected with the body itself, with the subject being aware of this, whereas with conceptualization from the level of two to four years there is simple assimilation. There is simple assimilation of objects and their powers to the subjective characteristics of actions itself. What the individual has already acquired on the sensory-motor level is now constructed on a new plane.

A child of five to six years can be relied upon to know that if he pushes an upright rectangular plane at its centre, say with a pencil, it will move in a straight line, but if one of its sides are pushed 'it turns'; or that if he is shown a piece of thread placed to form a right angle ($\perp$) he will be able to predict that pulling one of its ends will make the length of one of its segments increase and shorten that of the other. Thus in such cases, pre-relation becomes true relations by reason of their co-ordinations.

This stage could be concluded by noting chief important features that is with that of logic and of causality. Beginning with logic, one can note that coordination between conceptualized actions have resulted in an important advance that is that the child now invariably differentiates between individual and class. Collection is no longer figural but
consists of small groups of elements without spatial configurations. Quantification of "all" and "some" is still far from being achieved, for the understanding of A<B for example involves the reversibility A=B- A and the conservation of the whole B. Once the part A is subtracted from its complimentary A. Lacking reversibility and lacking even these very elementary methods of quantification, there is yet no conservation of collection or material quantities. This is proved on the basis of the many studies carried out in several countries and the experiments in this connection have also confirmed the existence of these non-conservation characteristic of the pre-operational levels.

Turning to the notion of causality, and specifically to the process of transmission through intermediaries we also encounter the same lack of notion of transitivity. For example a number of marbles are placed in a row, the first is struck by another marble and the one moves off alone. Children at this level, do not understand, as they do at the following stage, that part of the impulse has passed through the intermediary marbles. Instead they imagine a succession of immediate transmissions as if each marbles pushed the following one in the way in which spatially separated marbles do.

The third stage is called "concrete operations" that begins from the age of 7 to eleven. This stage is highlighted by the beginning of true logical operations of symbolic thought. The thoughts that arose during the preceding period lacked certain logical properties; these finally attain equilibrium at this stage. Before, they did not constitute what Piaget calls an "operation". By operation Piaget means "an action which has been
internalized, made reversible and integrated into a larger holistic structure typically a

Psychologically operations are actions which are internalizable, reversible and
coordination into systems characterized by laws which apply to the system as a whole.
They are actions that are carried out on objects before being performed on symbols.
They are internalizable since they can also be carried out in thought without losing their
original character of actions. They are reversible as against simple actions which are
irreversible. In this way, the operation of combining can be inverted immediately into
the operations of dissociating whereas the act of writing from left to right cannot be
inverted to one of writing from right to left without a new habit being acquired differing
from the first. Since operations do not exist in isolation, they are connected in the form
of structured wholes. The concept of reversibility is especially crucial. The logical
operation at this stage result from the coordination of the actions of combining,
dissociating, ordering and the setting up of correspondences which then acquire the form
of reversible systems. Concrete operations belong to the logic of classes and relations but
do not take into account the totality of possible transformation of classes and relations.

One of the most important operation system is that of classification or the
inclusion of classes under each other for example sparrow (a) <birds (b) <animals(c)
<living beings (d).

Another important operational system is that of seriation or the linking of a
symmetrical transitive relations into a system. For example the child is given a certain

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number of unequal rods say A, B, C, D ..... to arrange in order of the increasing length. If the rods are marked unequal, there is no logical problem as he can conduct a series by relying on observation alone. But if the variations in length are small, so that the rods have to be compared two at a time before they can be arranged in such a series, the following is observed. Before the age of seven, on the average, the child proceeds unsystematically by comparing the pairs BD, AE, CG, etc and then corrects the results. From seven years onwards, the child uses a systematic method. He looks for the smallest of the element, then the smallest of those which are left over etc. And in this way easily constructs the series. This method pre-supposes the ability to coordinate two inverse relations that is E>D, B, A AND E<F, G, H, etc.

Other systems that appear during the same period having a multiplicative character are for example, the child can classify the same object taking account of two characteristics at time sequence (A1) and non-square(A1) and red(A2). In a similar fashion, the child acquires the capacity for multiplying relations using tables of different kinds, correspondences, etc. These different systems of logical operations are of special importance in the constitution of the concept of number, time and motion and in the construction of different geometrical relations. From seven to eight years, children become aware of the transitive character of equalities in the case of lengths, but only towards nine to ten years in the case of ‘weight’ and towards the age of 11-12 years of ‘volume’.

Operational system at this level is restricted and fragmentary. With the aid of concrete operations, the individual can classify, order serially from equalities or set up
correspondences between objects, without operations being combined into a single structure whole. From the psychological point of view, this means that operations have not yet completely achieved equilibrium, and this will only occur in the following stages.

The fourth stage is the formal operation that proceeds from eleven to twelve years and reaches the equilibrium at about fourteen to fifteen years. According to Piaget, an individual reaches the peak of cognitive development at this stage. The feature of this stage is the ability to reason by hypothesis. Therefore, the child is able to reason about abstract, formal, and propositional objects. At this stage individual has a slightly different logical structure in which four types of operations can be performed. These are, inversion, negation, reciprocity and correlative (INRC). These are called formal operations. They represent the kind of transformation that may be performed on hypothesis in order to delineate the possible relations between all of them.

The hypothetico-deductive reasoning is characterized interalia by the possibility of accepting any sort of data as purely hypothetical and reasoning correctly from them. For example, when the child has read out to him the following sentence from Ballard’s nonsense sentence test: 'am glad I do not eat onions, for if I liked them, I would always be eating them and I hate eating unpleasant things". The subject at the concrete level criticizes the data that for instance, onions are not unpleasant, it is wrong not to like them, etc. Subjects at the present level accept the data without discussion, but also merely bring out the contradiction between 'I liked them and onions are unpleasant '. But it is not only on the verbal plane that the subject reason by hypothesis, this new capacity has also a profound effect on his behavior in the laboratory experiments. Subjects at this pre-
operational level enhance shown apparatus from the laboratory behave quite differently from those at the concrete level. For example, when they are given a pendulum and allowed to vary the length and amplitude of its oscillations its weights and initial impulse, subjects of eight to twelve years simply vary the factors in a haphazard way and classify order serially and set correspondence between the results obtained. Subjects of twelve to fifteen years endeavor after a few trials to formulate the entire possible hypothesis concerning the operative factors and hen arrange their experiments as a function of these factors.

Logic of the individual is with propositions as well as objects. A group of propositional operations such as implication P implies Q, disjunction PvQ, incompatibility P/Q are being constructed. This is connected with the appearance of a new group of operations or “schemata”. The first of these operational schemata is combinational operation (combinations, permutations, aggregation). At this stage, the subject who is of may be twelve years or so is able to construct all the possible combinations in an experiment.

The second operational schema is that of proportions. On this, experimental findings have shown that subjects from eight to ten years are unable to discover the proportionalities involved. From eleven to twelve years onwards, the subject constructs a qualitative scheme of proportions which quickly leads him onto metrical proportions often without learning about these in school.

Another operational schema whose constructions can be profitable analyzed is that of mechanical equilibrium involving equality between action and reaction. This
period includes two important acquisitions. Firstly, the logic of proposition which is both a formal structure holding independently of content and a general structure. There is coordinating the various logical operations into a single system. Secondly, a series of operational schemata which have no apparent connection with each other or with the logic of proposition.

Piaget entire developmental process comprises of several important themes, these in turn could be considered not just psychological features, but also epistemological features too. This could be also understood as empirical properties of epistemological development.

a) *The law of decenteration*: In the process of cognitive development, the individual becomes less egocentric in his or her epistemological outlooks. The individual further attains greater degrees of objectivity and rationality. According to Piaget, egocentricism is the failure to distinguish the self from other objects and persons. Piaget defines the term “egocentricism” as “on the one hand primacy of self satisfaction over objective recognition.....and on the other distortion of reality to satisfy the activity and point of view of the individual. In both cases, it is unconscious, being essentially the result of failure to distinguish between the subjective and the objective”\(^7\).

According to Piaget, at the beginning of the mental evolution, there is no definite differentiation between the self and the external world that is impressions that are experienced and perceived are not attached to a personal consciousness sensed as a ‘self’ not to objects conceived as external to the self. Self and the objects exist in a dissociated

block. They are spread out on the same plane which are neither internal nor external but widely between the two poles. These opposing poles gradually become differentiated. Thus, it follows that due to the lack of dissociations; everything that is perceived is centered on the subject's own activity. This failure is mainly due to the infant's experience which is neutral. His or her activity can be characterized as a set of relations or interactions. There is yet no subject or object with which to be interacted. The egocentricism of the child is unconscious since the child is aware only of his or her actions and their results, not of the self or the underlying cognitive mechanism which produce the action. It is only by means of friction with other minds, by means of exchange and opposition thought that it becomes conscious of its own aims and tendencies.

Egocentricism, is thus, replaced by objectivity and rationality; this is mainly due to the law of decentration. According to this principle, the individual then decanters him/her from a privileged frame of reference. This occurs by a process of construction. A more objective, external frame of reference is created in which the individual is situated merely as one object among many others in which all points of view are equally represented and none are special, in which relations between points of view become especially important. Such a process could be characterized as a transition from a naïve Phenomenalism to objectivity, reciprocity of point of view and relativity of framework. In other words, for Piaget, decentration refers to a "condition whereby the individual
ultimately achieves the capacity to see the other viewpoint or place himself in the other person’s position.  

2) From perception to thought: This is another way of expressing virtually the same point about egocentricity. Initially the child trusts his or her naïve perception. These perceptions of the child are as immediate, non-critical perceptual appearance of things. In the course of development, these naïve appearances are corrected by reason; it is only by reasoning about appearances and correcting them, that rational knowledge is possible. Piaget gives the following example “if the child were to trust naïve appearances, he or she would respond that a ball of clay transformed into a patty (or hot dog) has less (more) clay than the original ball”. This judgment is based on the naïve appearances of things. The correct answer requires the child to reason about the underlying process and to allow ‘reason to triumph over sense appearance’. Similarly, when a ball is hidden in a box and the box is removed, the child uses reason to determine that the ball has remained in the box during this process. Once again, naïve appearance that is where the ball last disappeared from view—must be suitably reinterpreted and corrected by reasoning. There is a transition from a kind of naïve empiricism to critical rationalism, a transition from perception to thought.

3) Internalization of action: A third general characteristic of cognitive development can be called the principle of internalization. In the initial stages of development cognition is purely manifested in the form of external actions, such as, that of sensory

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motor schemes such as sucking, grasping and pulling. Even the thoughts are exclusively external. The individual's mentality, therefore, is exclusively external and resides in observable actions. Gradually, these schemes are transformed into habits and intelligent behaviour, and the external actions become represented externally by imitation and play and internally by images. Sensori motor schemes thus give way to egocentric thinking involving 'pre-concepts' and these give rise to concepts. The key issue is that which allows external behaviour to be represented internally.

4) From irreversibility to reversibility: this stands in close relation to the above notion. It states that in the process of cognitive development there is a movement from irreversibility to reversibility. Perception is irreversible in nature but thought is reversible. Although we cannot reverse perceptual sequence, we can reverse sequences in thoughts which are multi-directional as well as temporal. Because thought, is reversible, necessity is possible, since necessity itself is a temporal. Necessity therefore, can only be lodged in thought and not in perception. This transformation from irreversibility to reversibility is related to the internalization of action and to the transition from perception to thought. This also pre-supposes the view that there lies a fundamental difference between gestalt structures and the logical structures of thought. This could be explained by giving the example, that in the course of development there is initially a predominance of rhythms, which gives way to regulations and then to grouping. Rhythms are non-reversible, regulations are semi-reversible and grouping is completely reversible. Such theme underlies and accounts for the progressive
developmental transformation of merely causal facts into rational norms and the transcendence of biological processes by psychological and sociological ones.

5. The **grasp of consciousness** (Claparede’s law): According to this law, as long as one successfully meets one’s needs and adapts to its environment, consciousness of the self or internal mental mechanism does not arise. Only when there is some frustration of needs for example an environmental obstacle or hindrance then we begin to become aware of ourselves and our internal mental life. We are aware only of environment objects and the results of our actions. The direction of consciousness is centripetal in the sense it proceeds from the external results of our mental activities to the internal mental mechanism themselves. This realm of internal mental mechanisms and structures resulting in action is the cognitive unconscious. For Piaget, introspection does not occur if actions are successful, it will not even be possible if one remains solely on plane actions. Becoming aware of internal structures requires a movement from the plane of actions to the plane of thought, a shift from a lower level to higher level, which Piaget calls “abstract reflective abstraction”.

6. The **law of temporal displacement**: During the process of development, the individual passes through a series of cognitive structural stages. According to Piaget each stage is constructed by the individual himself, this construction involves reflective abstraction. The construction is not linear but proceeds in terms of the law of temporal displacement or vertical decalage. The construction of an earlier stage must be constructed at a later stage. Piaget calls this as re-learning and it requires on the part of individual to pass from one stage of consciousness, for example, sensory motor stage to
the next higher one, for example, representation. This relearning is sometimes characterized as 'redoing' the work of coordination between assimilation and accommodation. It is a repetition of the construction that occurred on the earlier plane but is now carried out on the higher plane. It represents a re-equilibration involving the creation of a new structure. Such a displacement, lag, or decalage occurs when the child is able to do something at the earlier stage (for e.g., understand spatial relations in terms of correctly acting in its environment) but cannot do so at a higher stage (e.g. represent spatial relations propositionally). Thus one should expect that such a displacement would normally be present and would last a certain length of time as the relearning or reconstruction occurs. This would be followed by a closing of the gap as a new structure is formed and becomes re-equilibrated. Such a reconstruction involves reflective abstraction.

7. **Reflective abstraction:** In the course of development each stage is constructed by means of a principle of reflective abstraction. Elements of the previous stages are abstracted and reflected onto a later and higher stage and then it is constructed into a new whole. Thus the whole concept of reflective abstraction is basic for understanding the related concept of the grasp of consciousness, egocentricism, introspection, and vertical decalage and so on.

Reflective abstraction is an important mechanism which may explain the way that individuals construct conceptual knowledge. Piaget used the notion of abstraction to describe a subject's interactions with external objects and the subject's internal mental operations. Von Glasserfeld's distinguished between three types of reflective abstraction:
His summary is particularly useful since he relied on Piaget's original writings in French and attempted to maintain the distinctions between the different types of reflective abstraction. The first level of reflective abstraction is defined as recognition. The recognition level is the ability to recognize characteristics of a previously solved problem in a new situation and to believe that one can do again what one did before. Individuals operating at this level would not be able to anticipate sources of difficulty and would be surprised by complications that might occur as they attempted their solution. The second level of reflective abstraction is representation. Representation is described as the level where a student becomes able to run through a problem mentally and is able to anticipate potential sources of difficulty and promise. Individuals who operate at this level are more flexible in their thinking and are not only able to recognize similarities between problems, but are also able to notice the differences that might cause them difficulty if they tried to repeat a previously used method of solution. Such individuals could be imagined using the methods they might encounter but they cannot take the results as given. At this level, the subject would be unable to think about potential methods of solution and the anticipated results of such activity. The next level of reflective abstraction is called structural abstraction. Structural abstraction is said to occur when the student evaluates solution prospects based on mental run-throughs of potential methods as well as methods that have been used previously. The student is able to discern the characteristics that are necessary to solve the problem and is able to evaluate the merits of a solution method based on these characteristics. This level evidences
considerable flexibility of thought. The final level of reflective abstraction described is structural awareness. An individual operating at this level is able to anticipate the results of potential activity without having a complete mental run-through the solution activity. The problem structure created by the individual has become an object of reflection. The student is able to consider such structures as objects and is able to make judgments about them without resorting to physically or mentally representing methods of solution. This levels of reflective abstraction described above indicate that as individuals attain the higher levels, they become increasingly flexible in their thinking.

Piaget's four stages of development of knowledge, is the process of the development of knowledge that is based on three principles namely assimilation, accommodation, and equilibration. Assimilation is when a child incorporates new objects or events into existing schemes. Accommodation occurs when a child must modify existing schemes to incorporate new objects or events. Equilibration is described as the "master developmental process". It encompasses both assimilation and accommodation. It is most evident at the end of a developmental stage. At this point, the child begins to find shortcomings in their way of thinking. This results in disequilibrium, which is overcome by moving to the next stage. In other words, the child moves from disequilibrium at one stage to equilibrium at a higher stage.