Part One

[01] Developmental psychology owes a great debt to a Swiss thinker named Jean Piaget. Without his contributions, it is fair to say that the discipline would not exist. Piaget's active career in psychological research lasted 60 years. His output of essays and empirical studies was prodigious. If all that mattered about Piaget was that he was the first psychologist to ask children whether two equal rows of eggs still have the same number after one of the rows is stretched out; or the first to ask children how many ways there are to get from one end of a room to the other--he would have done enough to merit our admiration.

[02] Piaget did a good deal more, however. One of his life-long goals was to explain development in a way that avoided both "preformation" (as he called the doctrine of innate ideas) and environmental determinism. For nearly 30 years, his ideas were completely out of favor in behaviorist-dominated American universities; between 1932 and 1950 not a single one of his books was translated into English. But Piaget outlasted behaviorism, and by 1960 his ideas were being jubilantly rediscovered by American psychologists. In his old age, he battled valiantly against the nativism of Noam Chomsky and Jerry Fodor.
He was a psychologist with a fundamentally biological orientation. He was an epistemologist who regarded empirical studies of infants, children, and adolescents as an essential source of information about the nature of knowledge. Piaget, I will argue, speaks directly to the concerns of Objectivists.

In this article, I will sketch Piaget's life and output, before turning to the essentials of his theory:

- knowledge has a biological function, and arises out of action
- knowledge is basically "operative"--it is about change and transformation
- knowledge consists of cognitive structures
- development proceeds by the assimilation of the environment to these structures, and the accommodation of these structures to the environment
- movement to higher levels of development depends on "reflecting abstraction," which means coming to know properties of one's own actions, or coming to know the ways in which they are coordinated

If you've taken a course or two in psychology, you'll be wondering why I haven't mentioned stages of development. To most American psychologists, Piaget is that fellow with the "stage theory." But Piaget attributed roughly the same significance to stages that Thomas Jefferson attributed to holding political office--they weren't important enough to mention on his tombstone. Cognitive structures mattered to Piaget. How cognitive structures change mattered to Piaget. Stages were a tool for taxonomizing thought and tracking children's progress. (Don't worry, we will get to them before we're done.)

Piaget didn't normally describe himself as a psychologist. He called his research program genetic epistemology. Nowadays, the term "genetic" has been restricted to the mechanisms of heredity in the English-speaking world; cashing Piaget's phrase out in contemporary terms would give us developmental theory of knowledge. Genetic epistemology (which, for Piaget, included the history of scientific ideas, as well as the study of development in individuals) is consistent with Objectivism in its biocentric concerns. But its focus is very different; enough so to make comparisons more difficult than they ought to be.

Other Piagetian themes have been dealt with very little or not at all in the Objectivist literature (there are no references to Piaget in canonical Objectivist writings, except for Nathaniel Branden's most recent books [note 1]). The more important of these are:

- the problem of novelty--if what develops is merely a recombination of existing elements, is it truly new?
- the need to understand infants and children in terms of their own cognitive perspectives, not "adultomorphically"
- the pitfalls of cognitive egocentrism (the failure to relate your own point of view to other people's points of view)

The early years
Jean Piaget was born in Neuchâtel, a town in the French-speaking part of Switzerland, in 1896. His father, Arthur, was a historian who encouraged his son to ask questions (one of Arthur's accomplishments was showing that a supposed Medieval document conferring privileges on the town was a latter-day forgery). His mother, Rebecca, was a bright but rather troubled woman, active in political causes. While Piaget absorbed her political worldview—as a teenager, Piaget was active in Christian Socialist groups, and anticapitalistic remarks occasionally surface in his sociological writings—he admitted later in life that he devoted so much time to his studies in part because they enabled him to get out of the house when he was a child.

Piaget's intellectual gifts became apparent early. He was often bored and restless in school; even in books written much later in life he occasionally utters scathing remarks about *l'apprentissage scolaire*, or classroom instruction. (As you might imagine, that makes extracting specific educational advice from Piaget a rather treacherous enterprise [note 2].)

At age 10, he was formally inducted into one of the biology clubs in his home town. His first published paper was a short report in a club newsletter, describing an albino sparrow he had seen in the park. Soon he was taking a leadership role in the Friends of Nature Club, which consisted almost entirely of high-school students, and had regular meetings where the members read papers. Its activities were sponsored by professors at the University of Neuchâtel. (How many American high schools could boast of this kind of intellectual life today?)

Piaget began working with a professor who was an expert on the classification of mollusks (clams and snails). He was particularly interested in *Limnaea*, a snail that lived in Swiss lakes, including Lake Neuchâtel. He began publishing on *Limnaea* in professional journals while still in high school; during this period he was offered a post as curator of a mollusk exhibit in a museum and had to turn it down.

Rather soon, classifying snails according to the shapes of their shells wasn't enough. Piaget began exploring a wide range of philosophical questions while not yet out of his teens. He worried about the basis in reality for the taxonomic distinctions he and other experts on mollusks were making—about the conflict between realism and nominalism. At age 16, he wrote a nominalistic paper titled "The Vanity of Nomenclature." Then he became enthralled, for a little while, with Henri Bergson's philosophy of "creative evolution," in part because he saw in it the basis for a "real science of genera." (Many years later, in a book called *Insights and Illusions of Philosophy*, he would reject Bergson's ideas as woolly speculation, vague wisdom that might bring about a "coordination of values," but would not lead to knowledge about reality.)

When he was 19 he published a long poem called *The Mission of the Idea* in which he traced the progress of The Idea through the world, in notably neo-Platonic terms. But he did not remain satisfied with that outlook either. During a stay at a mountain resort that was prescribed for a respiratory problem (fortunately, Piaget was not suffering from tuberculosis), he produced a much more ambitious piece of writing. His book *Recherche* has a title that is thoroughly confusing to English-speakers. *Research* isn't right at all; *Searching* or *The Search* would be closer to the mark. In its setting and its aims, *Recherche* might be compared to *The Magic Mountain* [note 3]. In its literary quality, uh, no... The spiritual crisis of a young man named
Sebastian--obviously Piaget himself--centers on the conflict between science and religion, or science and values, and the idea of equilibrium, which became central to his genetic epistemology, is first put forward in this work of fiction. At the time, equilibrium was an ideal balance between parts and whole, within the individual or within society. As yet, its psychological meaning was weakly developed.

[14] Piaget published *Recherche* and finished his doctoral dissertation during the same year, 1918. Although he made occasional use of his studies with *Limnaea* and other mollusks later on (for instance, when theorizing about the effects of altitude in the mountains, or depth in lakes, on the shapes of their shells), he had reached an impasse. His method of classifying mollusks was being superseded by methods that emphasized the animals' internal anatomy rather than the characteristics of their shells. He was 22 years old--and already out of date.

The turn to psychology

[15] It's fair to ask whether anyone would be paying all that much attention to Piaget's early writings had he not become a developmental psychologist. The answer is pretty clearly no. Without Piaget's turn toward child psychology, his ideas would be seen as little more than the halfway-considered notions of a really bright young man who never realized his promise. In fact, Piaget eventually grew embarrassed at the more speculative and religious themes in his early writings, and made little mention of them in the autobiographical articles he wrote many years later.

[16] Yet we have no terribly clear idea why Piaget made the turn to psychology. In Fall 1918, he enrolled at the University of Zürich, where German experimental psychology didn't interest him all that much--but psychoanalysis (of the Carl Jung variety) did. Then in 1919, he moved to Paris for work as a research associate under Théodore Simon, the intelligence tester who inherited Alfred Binet's laboratory. His job was trying out new intelligence test questions with children. From an intelligence-testing perspective, all that mattered was whether children gave the right answers to the questions. From Piaget's perspective, what mattered was the wrong answers children gave, and the patterns these wrong answers exhibited [note 4].

[17] Piaget had gained a new career (and a lifelong antipathy to psychometric testing! [note 5]). After writing an article on verbal comparisons made by children, he began teaching at the University of Geneva. Except for a 5-year stretch at the University of Neuchâtel and a few years during which he commuted to Paris to lecture part-time at the Sorbonne, he remained in Geneva for the rest of his life. He told interviewers that he initially planned to spend just 10 years on child psychology, but that, too, became a lifelong endeavor.

The 1920s: Egocentrism and clinical interviews

[18] Piaget's research in the 1920s focused on the use of language by children, and on their reasoning about classes, relations, and physical causality. Some of his studies were observational (for instance, when he noted that nursery school children sometimes engaged in "collective monologues": from a distance, they might appear to be playing together, but from close up it turned out that each child was interacting with a particular toy and commenting on this activity
without much regard to what the others were saying). Other studies from this period used what he called the "clinical interview" (an open-ended series of questions, modeled after clinical practice and intended to diagnose the type of thinking the child was using). For instance, he asked children, "What makes clouds move?"

[19] The most important idea to come out of this work was egocentrism. When Piaget said that young children were egocentric, or thought egocentrically, he did not mean this primarily in a moral sense. Egocentrism is fundamentally a cognitive limitation; children are egocentric because they fail to understand how someone else's point of view might be different from their own—or they fail to coordinate their point of view with that other person's. A classic demonstration of egocentrism (from a later period) is the three-mountains problem, in which a child is asked to inspect a papier-mâché model of three mountains, one big one and two smaller ones. Then, while seated in one position at a table, the child is asked to pick out the photograph that shows what another child seated across the table would see. Children under age 6 pick out the photograph that shows what they see [note 6].

[20] In the 1920s Piaget was strongly tempted to equate egocentrism with primitive forms of thought. He believed that "primitive" people thought "sociocentrically" (they took their culture's beliefs and practices for granted, and subscribed to "ideologies"). He regarded such thinking as an exact parallel to the thinking of preschoolers in 20th century Europe. He also believed at the time that by age 6 or 7, when children overcome the particular forms of egocentrism that he was studying, they got rid of egocentrism for good. By the 1940s he was acknowledging that adults in "primitive" societies do think like adults, not like children; he was also realizing that failure to understand your own point of view, and how it relates to other people's points of view, is a difficulty that can arise, in new and different forms, as we develop. (We've all encountered a common form of adult egocentrism, particularly in academic circles: it consists of assuming that people who agree with us are smarter than people who don't.)

[21] Piaget was also developing doubts about his style of interviewing. Even with elaborate safeguards against leading questions, he began to feel more comfortable the data he obtained when he gave children concrete tasks to do, and observed their solution strategies--then asked them follow-up questions.

The middle period: Schemes and structures

[22] Piaget's middle period (roughly, 1930 to 1965) began with the meticulous observations that he and his wife (who was one of his first graduate students) made of their three children during infancy and toddlerhood. It took nearly a decade for these observations to be interpreted and worked up into book form (the two books on infancy appeared in French in 1936 and 1937 [note 7]). This new focus on the "sensorimotor" period of development was most salutary for Piaget--it compelled him to consider what the simplest forms of human knowledge might be like, and he responded with his conception of action schemes.

[23] At the same time, Piaget was busy codifying his conception of more advanced forms of knowledge into what he called logical structures. On the one hand, he pulled together ideas from mathematics and mathematical logic that would help him describe different forms of human
thought. On the other hand, Piaget, his research directors, and his graduate students pursued a seemingly endless suite of investigations into the way children and adolescents reason about: number, physical quantities, duration, speed, distance, geometry, mathematical probability, hierarchical classification, ordering, you name it. In 1955, he opened the Center for Genetic Epistemology, which sponsored regular visits by prominent thinkers in other fields, plus an annual "Cours" that drew attendance from all over the world. All of these activities increased the output from his institute even further.

[24] During the first half of his middle period, Piaget was off the radar screen for English-speaking psychologists. His early books were promptly translated. Then nothing... The fact that Piaget was behind enemy lines in World War II didn't help. But the major reason for this neglect was the ascendancy of behaviorism, with which Piaget never had any sympathy. As behaviorism finally came under fire in the 1950s, translations began pouring out. By the end of the decade, Piaget was being championed by educational reformers, and avidly read by many of the psychologists who were caught up in the Cognitive Revolution.

[25] Yet Piaget was growing restless with the emphasis on cognitive structure that lay behind the middle-period work. He was not satisfied with his attempts to explain how structures change, and concluded that the processes of development themselves needed to become the focus of his research.

The process-oriented period

[26] From 1965 onward (again, publications often lagged), Piaget shifted his concerns to the processes of development. Rather than concentrating on a subject matter or general principle (such as number or physical causality), he and his students attempted to isolate the operations of equilibration, or reflecting abstraction, or differentiating out new possibilities and integrating them into new necessities, or running into contradictions in your thinking, or becoming conscious of your ways of thinking. The results were books that cut across many different problem areas, and that often propounded difficult theoretical notions. Meanwhile, his research director, Bärbel Inhelder, was pushing hard for detailed inquiries into children's problem-solving procedures; she aimed at a synthesis of ideas from Piaget and from the information-processing school that is usually called "Genevan functionalism" [note 8].

[27] Piaget's thinking was continuing to change rapidly, yet he preferred tinkering with old ideas to jettisoning them; indeed, as time went on, some of his ideas about process started pulling pretty hard against some of his ideas about structure. And the tides were turning against him in the English-speaking world; some of the process-oriented books were left untranslated, and others got a cool reception.

[28] During the 1970s, more than a few American psychologists rose to academic prominence by attacking Piaget. Some of them did a service by showing that various empirical claims made by Piaget were wrong (if you put forward empirical claims for 50-odd years, chances are quite good that some of them will be wrong, especially in the face of tremendous progress in methods for testing the capabilities of babies and moderate progress in assessing the cognitive processes of children). But the anti-Piagetians generally claimed to have shown that Piaget's conception of
development was wrong. Often they criticized views that had never belonged to Piaget in the first place, then championed positions that Piaget had effectively refuted [note 9]. (While empirical methodology that conforms strictly to the local customs is prized in the academic social sciences, scholarship frequently is not.)

[29] Other American psychologists called themselves "neo-Piagetians" and maintained that their formulations had extracted all the goodness to be found in Piaget, then improved on it [note 10]. From the neo-Piagetian standpoint, the best thing Piaget could do was retire. Further activity on his part was redundant, if not positively embarrassing. To this day there are self-proclaimed Piagetians who don't think any more of his writings are worth translating.

[30] These ups and downs mattered little to Piaget. When, at age 80, he was asked to give a speech to a congress of French psychologists, his audience expected a retrospective or a wrap-up. Instead, he calmly proceeded to lay out the next year's plan of study at his institute (it eventually appeared in two volumes on necessity and possibility, which are among the strongest of his later writings). Piaget remained active until a few months before his death in 1980, leaving several complete or nearly complete works that made their way into print over the next decade.

**Piaget's chief ideas**

[31] **Genetic epistemology.** Piaget did not call what he was doing psychology. As we have seen, he preferred to identify his enterprise as *genetic epistemology*. The core insight throughout Piaget's work is that we cannot understand what knowledge is unless we understand how it is acquired. In turn, we cannot understand how knowledge is acquired unless we carry out psychological and historical investigations. We have to test our hypotheses by collecting data, not only about the thinking of human infants and children, but also about the historical development of scientific ideas. Piaget firmly rejected the idea that epistemology could be done from the armchair. He also rejected the practice, still widespread in cognitive psychology, of theorizing about memory and problem-solving and visual imagery and categorizing in adults, without regard to the manner in which these abilities developed.

[32] Piaget believed that the development of knowledge was a biological process, a matter of adaptation by an organism to an environment. He advocated what some others have called "evolutionary epistemology"--although, as we shall see in Part 2, his conception of evolution was not strictly based on variation and selection.

[33] **Operative knowledge.** Piaget believed that knowledge is primarily *operative*. Knowledge is primarily about change and transformation. (The French, to this day, rarely speak of Piagetian theory; they call his conception *la théorie opératoire*.)

[34] When Piaget studied mathematical ability, he wasn't terribly interested in how children determine that there are exactly 8 eggs in a row of eggs. (Other developmental psychologists have had to show what an intricate skill counting actually is, and have had to track what is involved in learning it.) But he was very interested in how they understand what happens when the row of eggs is spread out or squashed closer together--do these transformations affect how many eggs there are? Similarly, when Piaget studied babies' knowledge of "the permanent
object," he wanted to know whether they understood how an object moves around when they couldn't see it moving around. Just knowing that your rubber ball is currently sitting behind the couch wasn't enough, from his point of view.

[35] What is basic then, for Piaget, is knowing how to change things--or knowing how things change.

[36] **Cognitive structures.** To render the matter in greater technical detail, Piaget thought that our knowledge consists of *cognitive structures*. These come in various flavors, but for our purposes, an example of a really elementary cognitive structure and another example of a more advanced one will suffice.

[37] The simplest cognitive structures Piaget called sensorimotor action schemes (some books say "schemata," but that is a bad translation). An action scheme is a way of accomplishing some goal in some class of situations. For instance, while observing his son Laurent, who was just under 3 months old, Piaget attached a string to some rattles that were hanging from the hood of Laurent's bassinet, and tied the other end to Laurent's right wrist. After some trial and error, Laurent discovered that he could get something interesting to happen (the rattles would dance up and down and make noise) by moving his right hand or shaking his right arm. Piaget concluded that Laurent had formed what we might call a rattle-dancing scheme [*note 11*].

[38] At a much higher level of sophistication are the different cognitive structures that are involved in logical thinking. For instance, Piaget was interested in the kinds of inferences that children can make with hierarchical systems of classification. One that he studied on a number of occasions goes like this: if dogs and cats are kinds of animals, and there are more than zero cats present, then there must be more animals than dogs. Most children under 6 years of age just don't get what, to more advanced thinkers, is stunningly obvious. If shown 10 toy dogs and 5 toy cats, and asked, "Which is more, all of the animals or just the dogs?" they say, "More dogs." By contrast, children aged 6 on up will say that there are more animals, and, by and large, they can give a justification for their answers [*note 12*].

[39] Piaget believed that children who are able to make this inference correctly, along with some related ones, have acquired a logical structure. Piaget analyzed logical structures algebraically; he regarded the structure at work here as related to but somewhat different in its properties from a mathematical group. So if you have picked up Grouping I for Addition of Classes, you understand how a class higher in the hierarchy, like "animals," is broken down into classes lower in the hierarchy, like "dogs" and "cats," and, conversely, how classes lower down in the hierarchy are put together to yield classes higher in the hierarchy.

[40] Both action schemes and logical structures, it must be emphasized, are operative. The rattle-dancing scheme makes an interesting noise happen. The grouping for addition of classes puts higher-level classes together and takes them back apart.

[41] There is knowledge about static things. It is not nearly as important, in Piaget's view, and development would never happen if knowledge of static things were the only kind we had. Piaget called knowledge of static things *figurative* knowledge. What are examples of figurative
knowledge? Well, visual perception gives us figurative knowledge. Visual images are a form of figurative knowledge. And, for the most part, language is figurative.

Piaget did study mental images to some extent. He put in hours in the laboratory conducting research on visual illusions. But particularly in his work on visual perception, he seemed mainly concerned to show how limited a source of knowledge it was. After his early period, Piaget paid little attention to language and its use, but periodically he would sally forth with an argument as to its relative unimportance in the course of development (actually, he would say that "language is necessary but not sufficient" for normal human development to occur, but that is damning with faint praise). We will return to the problems of figurative knowledge later. For now, suffice it to say that in Piaget's theory, operative knowledge is where the action is.

What development is. Now that we know what develops (operative cognitive structures, of course), we can make sense of what development is. For Piaget, development is what cognitive structures do. Cognitive structures are active things; they are means of interacting with your environment. Human beings are not born with a fixed set of cognitive structures, preformed and ready to go, or waiting around till some episode of maturation comes along and triggers them.

Nor do human beings get their cognitive structures by passively absorbing structures that are already out in the environment. Piaget did not think that significant advances come about because of what we "note" out in the environment, or because of the data that we "read off."

Piaget, then, was not a nativist (a believer in innate ideas) or an empiricist. Rather, his view was that cognitive structures naturally change in the course of being used, and both the organism and the environment are involved in this process of change.

Whenever we make use of a scheme or logical structure, we apply it to our environment. Now applying a scheme to the same kind of object in the same old way isn't of much developmental interest, because it doesn't stretch the scheme any. Let me give an example that many of us will find familiar from childhood. If I'm five years old and a fly lands on my left arm, I raise my right hand, and I apply my fly-swatting scheme once again—all of which is routine stuff. But suppose the situation in which I apply the scheme isn't quite like those in which I've previously used it. Now it becomes distinctly possible that I will fail to accomplish the goal for which I normally employ the scheme. If, say, a June bug clumsily lands on my arm and I apply the scheme, the results may be messier than before, but I've still gotten rid of a bothersome bug with minimal negative consequences. What happens, then, when a hornet lands on my arm and I apply the fly-swatting scheme? Now I get a painful reminder that my goal has not been reached!

In Piaget's terminology, applying the scheme to a new situation is called assimilation. He would say that I assimilate the June bug or the hornet landing on my arm to the swatting scheme.

Assimilation, as we have just seen, doesn't always work. Under such circumstances of failure, the adaptive thing to do would be modify my scheme (in some cases, I might have to go further and introduce an entirely new one). In this case, I might differentiate between flying things that don't have conspicuous stingers attached to them and those that do, and continue to use my swatting scheme only when I encounter the non-stinging variety. Whereas, if the flying
thing has a conspicuous stinging module on its rear end, I will apply a different scheme--for
instance, acting calm, making no quick movements, and waiting for the thing to lose interest and
fly away.

[49] Changing the scheme to get it to work better, or fit the environment better, Piaget calls
accommodation. I can accommodate by restricting my old swatting scheme and introducing that
move-carefully-and-wait scheme to contend with flying insects that sting.

[50] The developmental ideal, according to Piaget, is a balance, or equilibrium, between
assimilation and accommodation. The bundle of processes and constraints that tend toward
equilibrium he called equilibration. These could take different forms, of course, depending on
the schemes involved, and the conditions of failure (noticing an inconsistency in your thinking is
a different kind of failure condition than being stung by a hornet).

[51] Although equilibration is the most fundamental aspect of development, there is another one
that became more important in his late works, and can be treated semi-autonomously. This is
what Piaget called reflecting abstraction. It is responsible for the bigger leaps that take place
during development.

[52] In his 1970 essay, titled simply "Piaget's theory," Piaget says that reflecting abstraction "is
the general constructive process of mathematics: it has served, for example, to construct algebra
out of arithmetic, as a set of operations on operations" [note 13]. It abstracts from, and
generalizes over, your prior ways of coordinating your actions. It is distinct from, and opposed to
empirical abstraction, which ranges over the properties of objects out in the environment.

[53] Here's what Piaget considered a rather simple example of reflecting abstraction. Why is
multiplication harder to understand than addition? They're both operations on numbers, after all.
Piaget's analysis was that to understand multiplication it is not enough to center your thinking
"on the objects that are being put together with other objects, and thus on the result of this union.
Multiplication also involves isolating the number of times that the objects are being brought
together; it means enumerating operations as such, not just the results of those operations (i.e.,
the number of objects transferred each time)" [note 14].

[54] Piaget and his students asked children to make two rows (sometimes two towers) of poker
chips, with one restriction--they had to add chips to row A two at a time, and to row B three at a
time. So, did they realize that if they did this, they could get equal rows? Did they know how
they could get equal rows?

[55] Here is how Pat responds (Piaget used three-letter codes to indicate subjects in his studies).
Pat is 5 1/2 years old and functions at Level IA. Her comments are in italics; the other quotations
are from the experimenter:

Pat... adds 2 As and 3 Bs until she discovers to her astonishment that she ends up with 6 chips of
each color: "Both have the same amount!" "How did that happen?" "I don't know." "Could you
do it again?" "No, I don't think so." "Let's try" (same procedure). "Again, they're both the same
amount!" "How did you do that?" "I counted 6 there and 6 there" (pure imagination!). "What did
you do to make your pile?" "I took 2 (at a time)." "And to make my pile?" "I took 3." "How many times did you take 3?" "I don't remember any more." "And (how many times did you take) 2?" "I don't remember either." [note 15]

[56] Pat obviously thought that adding 2 at a time to one row and adding 3 at a time to others were going to produce unequal outcomes. And she had no idea how many times she carried out the additions. At what Piaget calls Level IB (average age around 6), children eventually notice how many times they added sets of 2 or 3 chips when the rows came out equal. Piaget concludes that they have become conscious of the number of times they added, so reflecting abstraction is starting to take place. But the children can't predict in advance that adding another 3 sets of 2 and 2 sets of 3 will make the rows equal again; they just have to try and see what happens.

[57] At Level IIA (around 7 or 8) children predict that they can make the rows equal, but without being able to figure out in advance how to do it. Whereas at Level IIB they do figure it out in advance:

VAS (9;11) on the chip problem immediately sets out 3 pairs of As, then 2 triplets of Bs. "I made each one have 6." "Could you do it with smaller piles?" "No, because you have to take 2 As at a time, or 3 Bs. If you make a pile of 3 chips, that'll work for the Bs but not for the As. And if you take 4, that'll work for the As and not for the Bs." "And bigger piles?" "Yes, 12 for example." [note 16]

[58] Piaget says that "at Level IIB the multiplicative operation 'n times x' is finally understood as constituting the product of reflecting abstraction from additions of additions. Now n is no longer the number of 'packets' that had to be assembled to reach the goal, but rather the number of operations that constituted these classes" [note 17]. Piaget adds that what has happened here is a step beyond plain vanilla reflecting abstraction--it's reflecting abstraction to the 2nd power, or reflected abstraction.

A different kind of epistemology

[59] Now we have moved--at a rapid clip--through Piaget's basic ideas (there is one slightly less basic idea, developmental stages, which will require some attention at the beginning of Part Two). If you are at all like me (I studied the Introduction to Objectivist Epistemology in depth before I was terribly familiar with Piaget), I suspect you are good and perplexed! When I began to delve into Piaget's writings, everything seemed topsy-turvy. I was used to thinking about knowledge in terms of perception first, then concepts. But Piaget considered perception static and extremely limited; he had little to say about language after the 1920s (except to admonish readers not to overrate its importance to development); and whole books in his vast canon go by without any references to concepts as a form of knowledge. Worse yet, he made favorable references to that dreadful fellow, Immanuel Kant; and he exhibited a strong commitment to knowledge arising from action that had more than a little in common with pragmatism and its rejection of "spectator" conceptions of knowledge. Yet, amongst all of this weirdness I could see a detailed and dogged analysis of many different forms of knowledge, a dedicated charting of change, an insistence that we really do learn new things and acquire novel knowledge, and a
commitment to explaining development in a way that was neither nativist nor empiricist. Those were what kept me reading. I hope they will encourage you to do the same.

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**Part Two**

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**Developmental stages**

[60] We have some unfinished business with developmental stages. Let's take care of it.

[61] Piaget began his scientific career classifying snails. For him, stages were a means of classifying children's thinking (specific instances of thinking, not whole children!). Stages helped him chart children's progress, and (especially during his middle period) each stage was associated with special kinds of cognitive structures.

[62] Piaget divided the course of human development into four *major stages* (sometimes called periods). Major stages beyond the fourth were also considered possible, and each stage could be divided into substages.

[63] We begin at birth with the *sensorimotor period*. Our primary means of knowing during the six substages of the sensorimotor period is our sensorimotor action schemes. We are limited, during this stage, to "thinking in action." That is, we can't contemplate the consequences of applying one of our schemes; we just have have to apply it. Many important accomplishments take place by the end of the sensorimotor period, most notably a full understanding of permanent objects, and the ability to imitate someone else's action on the basis of memory alone.

[64] Around 2 years of age, we enter the *preoperational period*. The preoperational period is marked by the ability to anticipate--that is, to think about some possibilities before acting on them. It is also characterized by the appearance of the semiotic function, which embraces speaking and understanding language as well as pretend play. However, many elementary forms of logical reasoning are not yet available: children can't compare the class of dogs with the class of animals; they think that making a row of eggs longer makes it have more eggs; and so on. You've already encountered preoperational thinking in the multiplication example: Level IA is early preoperational and IB is more advanced [note 18].

[65] Around 6 or 7 years of age, we see the onset of *concrete operations*. During this stage, logical structures like Grouping I for hierarchical classification become available, as do structures for seriation (putting things in order in terms of length or some other dimension), conservation of physical quantities, and mathematical operations on numbers. But children are still quite limited in their ability to generate possibilities systematically or to test hypotheses which require keeping track of multiple possibilities. Early and late concrete operations were tagged as IIA and IIB in the multiplication example.
[66] From age 12 or so, we move into formal operations. Formal thinking is marked by the ability to systematically generate and work with larger spaces of possibilities, including possibilities that are quite abstract. Inhelder and Piaget tested for formal thinking by asking children and adolescents to design and conduct scientific experiments--for instance, experiments to determine what determines the period of a pendulum, or what factors affect the bending of rods that vary in shape, length, size, material, and so on. But thinking explicitly about your values and your course in life, and comparing them with other possible values, and other possible courses in life, also qualifies as formal thinking. We did not see an example of formal thinking on the multiplication problem, because the problem was too easy, but Piaget usually formal thinking Stage III.

[67] (One sign of the tension in late Piaget between structures and processes is that we saw a good example of reflecting abstraction at Level IB [it didn't have to wait till Level II]. We encountered a good example of reflected abstraction at Level IIB [it didn't have to wait for Level III]. So, if reflecting abstraction is truly what moves you up from one major stage to the next, then it would seem that the boundaries between the stages need to be drawn in different places. Piaget never did resolve this tension.)

[68] Textbooks nearly always say that formal operations are universal--that is, every normal person acquires them--and that they are the final stage of development. Piaget used to believe the first claim, but abandoned it in the early 1970s, when he was faced with evidence that a substantial percentage of college freshmen cannot design and carry out a good pendulum experiment or rod-bending experiment. As for the second claim, I can't imagine Piaget ever taking it seriously. For him there was no fixed limit to human development, and, wisely, he did not attempt to forecast future creative activity. Piaget did suggest that beyond formal operations, there are postformal operations, or "operations to the nth power." Inevitably these would be of a highly specialized nature, and might be found in the thinking of professional mathematicians or experts in some other fields [note 19].

[69] It is time now to draw up an assessment of what is valuable in Piaget--and what is not so valuable.

**What is of lasting value**

[70] In assessing Piaget's work, we will concentrate on the philosophical ideas. There are multitudinous empirical claims about child development in Piaget's writings. Many of these have been borne out in subsequent empirical studies. Others have not. With one exception, to be mentioned later, I'll stay out of those controversies; a serious examination of them would require a volume or two.

[71] Piaget's most obvious accomplishment is overcoming the dichotomy between Nature and Nurture. In 1997 there is a cliche among developmental psychologists, dutifully recited in every textbook: development is not simply the unfolding of a pattern dictated by the genes, nor is it simply the importation of structures from the physical and social environment. But this has become a cliche through the tireless efforts of Piaget and a few of his contemporaries, such as Lev Vygotsky (1896-1934). It is easy to forget that during much of Piaget's career, purely
maturationist accounts of development (such as that of Arnold Gesell) and, of course, purely environmental accounts of "learning" (such as those of Clark Hull and B. F. Skinner) were taken more seriously than Piaget's views were. Even today, it isn't hard to find unrepentant environmental determinism in academic psychology (read a few of those studies that purport to show how watching violence on television makes children violent). Nor is it hard to find unrepentant preformationism (pick up a book by Noam Chomsky, and you will encounter his assertion that we are all born knowing a Universal Grammar--handily encoded in whatever notation Chomsky currently favors!).

[72] An accomplishment of comparable fundamentality is impressing on psychologists that knowledge arises from action and fulfills a biological function. For a long time there was Piaget's theory, and there was the ecological psychology of James J. Gibson and his followers. Elsewhere little attention was being paid to the biological functions of knowledge. Nowadays, there are many schools of thought that place a comparable emphasis on action--Interactivism, Dynamic Systems, and Reactive Robotics are three that come to mind [note 20]. Still, there is no shortage of researchers who think that human beings are like digital computers, carrying out computations on symbolic data structures without interacting with their environments in any meaningful way. Others find it credible that some of our knowledge (such as our knowledge of grammar) is so completely unlike any other knowledge we might attain that it must be both innate and evolution-proof.

[73] There are other issues on which Piaget was well ahead of the "cutting edge" during his lifetime. He remains so 17 years after his death.

[74] **We acquire novel knowledge.** The toughest and deepest problem raised by Piaget is the problem of novelty. During the course of development, new knowledge emerges. We acquire it through equilibration and we acquire it through reflecting abstraction. We are all creative, not in the sense that the ideas we arrive at are new and specially useful to others in our culture, but in the sense that they are new to us, different in kind from what we knew before. It is not merely the idiosyncratic acquisitions that are creative (such as my three year daughter brandishing an eyedropper like a syringe, and saying, "I want to shot you"). Such a humdrum acquisition as realizing that the amount of water is not affected by the shape of the vessel into which you just poured it is creative. A serious commitment to novelty requires us to abandon the persistent assumption that knowledge is made out of knowledge-atoms--primitive concepts, features, or mental entities of some other sort, that we can reshuffle and repackage but not add to. Most conceptions of human cognition continue to imply that novel knowledge is impossible; some proudly state this conclusion. Meanwhile, Objectivist writings have prepared the ground by dispensing with knowledge-atoms, but have not tackled the question of novelty as such.

[75] **Infants and children don't always think the way we do.** If there are qualitative differences in knowledge, then thinking at the earlier developmental stages is different in kind from thinking at later stages. It is not merely that we as adults think faster, or know more; we really do think differently from babies and children, and the differences can be radical. For instance, if Piaget is correct about the way babies think during the first two sensorimotor substages, young babies don't experience physical objects. They experience what Piaget called *tableaux*. When a 1-month-old sees a rattle, the 1-month-old doesn't understand some things
about the rattle that we have long taken for granted (such as what will happen to it when it falls over the side of the crib--and not just where it will go, but whether it will continue to exist once out of sight) [note 21].

[76] Some investigators have objected to this account on empirical grounds (how babies respond to objects under different circumstances than those under which Piaget tested them), and that may be a reasonable thing to do. However, the underlying objection is very often, "We know these things about objects, so how could babies not know them?" Piaget showed repeatedly that such adultomorphic thinking is inappropriate. Indeed, it is liable to prevent us from understanding development.

[77] **Knowledge of necessity and possibility.** For Piaget, operative knowledge is knowledge of what could happen, and (sometimes) knowledge of what must happen. Piaget wasn't just interested in whether children thought that adding 2 to one row and 3 to the other resulted in the rows being equal on this particular occasion, or that particular occasion. He wanted to know whether they thought adding 2 to one row and 3 to other could result in their being equal. Or must result in their being equal. And if it must result in their being equal, why is this so? Most other schools of psychology still pay no attention whatsoever to possibility and necessity. Meanwhile Objectivism has focused extensively on necessity as a metaphysical issue, but not particularly as an epistemological one. (If anything, Objectivists have tended to assume that because there is natural necessity, all human beings have to do to grasp it is know the relevant facts; nothing more, except an occasional stern reminder from an Objectivist philosopher, is required for them to understand that these facts are necessary!)

[78] **Reflecting abstraction and prise de conscience.** From the 1920s onward, Piaget was concerned about the difference between success and understanding, between being able to do something and being reflectively conscious of how you do it. *La prise de conscience*, becoming conscious of your ways of knowing, or of the coordinations of your actions, was always basic to his theory. In later years, he placed increasing emphasis on reflecting abstraction as the way in which we become reflectively conscious.

[79] It hasn't been customary for psychologists to make any such distinction. Some still believe that knowing something automatically means knowing that you know it. Others effectively flatten all of our knowledge down into a single layer of knowledge about things in the environment. In information-processing theory, for instance, knowledge takes the form of data structures; there are no data structures that are about other data structures. However, the popularity since the late 1970s of research on "the child's theory of mind"--for instance, on children's ability to recognize that they and others can have false beliefs--has given reflecting abstraction a higher profile in developmental psychology [note 22].

[80] Though Ayn Rand's *Introduction to Objectivist Epistemology* states no distinction between empirical and reflecting abstraction, much in the book hints at such a distinction. Rand makes it clear that "concepts of consciousness" cannot be formed unless a good many "existential concepts" precede them ("one cannot form concepts of consciousness without reference to their existential content" [note 23]). Rand's treatment of definitions has an expressly developmental aspect; many concepts have been formed and used before explicit definitions can be provided for
any of them [note 24]. You have to form the concept chair (and others that tend to come after it, like furniture) before you can define a chair as a type of furniture. A Piagetian way of saying this would be that explicit definitions (particularly those by genus and differentia, which require explicit knowledge of the classification hierarchy and its properties) are the product of reflecting abstraction on the concepts being defined.

[81] On the other hand, Piaget would hasten to note that reflecting abstraction enables us to draw distinctions and make generalizations that are abstract in a different way than those which result from empirical abstraction. Whereas Rand treats abstractness as a matter of where a concept is located in an inclusion hierarchy (animal is more abstract than dog, because it is superordinate to dog and includes it). Piaget would have questioned Rand's statement that "the relationship of concepts to their constituent particulars is the same as the relationship of algebraic symbols to numbers. In the equation 2a = a + a, any number may be substituted for the symbol 'a' without affecting the truth of the equation" [note 25]. He would have wanted to know how we come to have explicit knowledge about the operations of addition and subtraction (and, to take matters a step further, how we come to know that "any number whatever" will satisfy various algebraic equations). For Piaget, these are matters of reflecting or even reflected abstraction--not empirical abstraction.

[82] Egocentrism. Finally, there is egocentrism, at least in its later, generalized version. Piaget came to realize that egocentrism isn't an affliction restricted to babies and young children, cured once and for all when we acquire concrete operations. Rather, there are forms of egocentrism that are characteristic of each stage. Babies, according to Piaget, are so egocentric that they have to work really hard just to be able to distinguish physical objects from their ways of searching for them. Preschoolers are egocentric in linguistic and spatial ways, as we have seen.

[83] But there is egocentrism at higher stages, too. Adolescents can think about their values, and wonder what sort of values they ought to have, but by the same token they may draw the conclusion that only they are evaluating their values, so everyone else (including their parents, of course) must have phony values. Old forms of egocentrism are overcome, but new and more sophisticated forms of egocentrism take their place. Piaget eventually realized that every stage of development includes beliefs or assumptions that are not reflectively known at that stage (consequently they are taken for granted, and, if wrong, are difficult or impossible to correct). Reflecting abstraction can make these assumptions explicit and available for examination, but when you engage in reflecting abstraction, you move to the next higher stage, which has its assumptions that are not reflectively known...

[84] This insight of Piaget's is not generally understood; other psychologists still think of egocentrism as a problem that is cured once and for all. Moreover, they are in the habit of thinking of developmental advances as leading to more and more right answers, instead of new kinds of right answers--and new kinds of mistakes [note 26].

What is problematic
Le patron at work. I've supplied what I think is a rather impressive list of Piagetian insights. But there are many flaws in Piaget's thinking, and we need to be aware of these as we sift through his legacy.

On a personal level, Piaget fit many stereotypes of academic absorption and eccentricity. His desk was forever piled with tottering stacks of books and papers, whose locations made sense only to him. And he came out of a French-Swiss tradition that discounted literary style or elegance of expression as an impediment to saying what is in your heart. His writing at its best is graceless—French with a German sentence structure. And when the thinking gets more difficult for Piaget (as it often did in the theoretical portions of his later books) the writing gets more convoluted. It is incumbent on translators to break up his tortuous sentences and to clarify his cryptic allusions (both to his own work and to the work of others); failure to do these things guarantees a result that few will want to suffer through in English [note 27].

Piaget became prominent early—by the time he was 35 he was the most famous psychologist in the French-speaking world—so no one dared to look over his shoulder, wield the blue pencil, and tell him to rewrite. His custom was to write his books chapter by chapter, without looking back. Often Piaget had different ideas when it came time to write the conclusion than he'd had when he wrote the introduction (and other ideas might come and go in the middle). As you can see, the common habit of speed-reading Piaget by heading straight to the conclusions chapter is intellectually hazardous!

Piaget became the director of a research institute before he was thirty; for the rest of his life he presided over the activities of squads of graduate students and several full-time professional researchers. Everyone addressed him as le patron (literally, the boss). Grad students did research for Piaget a couple of days a week, for one of the research directors a couple more. Finally when Friday rolled around they could head back to the local schools and run their own empirical studies. Compared to some other heads of European research institutions, Piaget seems to have wielded his authority rather benignly. Still, the patron system inevitably promoted some degree of conformity in thinking.

And because of the patron system, I can't always give adequate credit to Piaget's students and collaborators. (It doesn't help that nearly all of them learned to write like Piaget! But writing in slavish imitation of your mentor is characteristic of more than one intellectual movement.) I can say that Bärbel Inhelder (1913-1996) and Alina Szeminska (1907-1986) were leaders in their own right. Inhelder directed empirical studies for 40 years, and interpreted Piaget to a wider audience. She also pushed hard for consideration of the detailed processes by which children solve problems; for instance, she was responsible for all of the empirical portions of the book on adolescent reasoning (while Piaget concerned himself with laying out the logical structures he regarded as responsible for formal thinking). Szeminska, meanwhile, was responsible many of the studies of mathematical knowledge during the 1930s. Imprisonment by the Nazis and restrictions on her postwar activities by the Communist regime in Poland (because he was ideologically suspect, she was forbidden to translate Piaget into Polish) kept her from collaborating with Piaget again until 1967 [note 28].
Philosophical limitations. More to the point for us, Piaget had a number of philosophical limitations. The fact that Piaget was still intensively active in the 1970s, happily discussing molecular biology, cybernetics, and quantum mechanics, as well as the latest developments in symbolic logic, can blind us to the fact that his convictions and prejudices were largely formed between 1910 and 1920.

Language and perception. What we react against may end defining us. And negative self-definitions can be hard to change. Piaget's puzzling and unsatisfactory treatment of "figurative" knowledge (perception, imagery, and language) was driven by his rejection of the uses others wanted to make of it. Traditional empiricists claimed that visual perception gives us a string of static snapshots that have to be interpreted by higher mental processes; Piaget heartily agreed with them, and concluded that perception couldn't contribute much to development. In consequence, Piaget produced a treatment of perception that tends to embarrass even his staunchest supporters, and he missed the opportunity to take advantage of the discoveries of James Gibson and others.

Logical positivists claimed that logic and mathematics were reducible to language; logical truths were supposedly based on arbitrary linguistic conventions. Behaviorists claimed that language was mere verbal behavior. Piaget responded by denying that language had much to do with the development of logical or mathematical understanding—or with cognitive development in general. So he was ill-prepared in later years to contend with the rise of Noam Chomsky. From his standpoint, Chomsky was structuralist (good) but, for some unclear reason, also nativist (bad). And Piaget had no formal treatment of language to put up against Chomsky's. In a public debate that took place when he was 79, Piaget, whose general view that language development is part of cognitive development I think most of us would sympathize with, was pretty badly trounced by Noam Chomsky and Jerry Fodor [note 29].

Piaget absorbed a number of beliefs during his school days that influenced his later thinking. On the face of it, a psychologist who blasted logical positivism and was constantly taken to task by American psychologists for not being empirical enough, would seem immune to positivistic influences. But the impact of Auguste Comte on turn-of-the-century French thinking about science was immense, and Piaget did not fully escape it. To the end of his days, Piaget never spoke of testing a scientific hypothesis, but of verifying it, just as Comte did. And for a thinker who occupied a Chair of Philosophy for 5 years, and is likely to go down in history as a major philosopher, Piaget had little good to say about the subject. For him, "philosophy" meant speculation like Bergson’s. "Metaphysics," needless to say, was a dirty word. Piaget regarded epistemology as "positive" science, not as philosophy.

Alongside these positivistic prejudices, Piaget shared with many other 20th century figures a thoroughgoing disdain for Aristotle. Aristotle is never mentioned in Piaget's writings about moral development (nor is any other Greek moral philosopher, including Plato!). In the works on biology or physical causality, Aristotle does occasionally surface, as a quaint fellow who thought there were final causes everywhere and had an essentially preoperational understanding of the physical world. Piaget never tired of taking pokes at Aristotle's conceptions of potentiality and actuality (he probably encountered these in Thomistic writings, as he always referred to them by the Scholastic names "potency" and "act"). Yet Piaget's psychology is in many respects an
Aristotelian enterprise; he once summarized his work for an interviewer as the study of "the powers of the knowing subject," and for him human development has a telos—it's called equilibrium. A ruefully extensive history could be written on recent philosophers who propounded some strikingly Aristotelian ideas while never having a good word for Aristotle—Karl Popper is another example.

[95] Non-standard treatment of evolution. Another sign of the times in Piaget is his rather eccentric treatment of evolution. It took Piaget about 20 years to shake loose from recapitulationism—the doctrine that the development of the individual recapitulates the evolution of the species. (Recapitulationism was so popular as to be an occupational disease for late 19th and early 20th-century thinkers. Freud was shot through with it, and the writings of once-celebrated developmental psychologists, like James Mark Baldwin and Heinz Werner, are badly marred by the same error.)

[96] But while Piaget did kick recapitulationism, and was an evolutionary epistemologist through and through, he never accepted the neo-Darwinian synthesis. There are early works in which he goes so far as to question the existence of genes. Throughout his career, he never became comfortable with the idea that blind trial and error was the most primitive form of variation and selection; he wanted the trials, or variations, to be heuristically guided, even when that required attributing a strange and unexplained kind of foreknowledge to the organism [note 30]. He never completely rejected the Lamarckian conception that acquired characteristics could be inherited.

[97] These peculiarities come into focus when we realize that Piaget formed his views on evolution before there was a neo-Darwinian synthesis. Prior to 1920, it was widely supposed that genetic mutations were contrary to Darwin's theories (Darwin had lacked an adequate explanation of the mechanism of heredity). And in turn-of-the-century France, resistance to Darwin was particularly ingrained and Lamarckian ideas never died out.

[98] Reverse psychologism. So far we have cited tendencies in Piaget that would be generally recognized as errors today. Indeed, they make his ideas harder for contemporary readers to assimilate. But there are two more errors in Piaget that, to my mind, are just as serious as any of the foregoing—yet most readers would accept them with a nod.

[99] The first of these is the assumption that an adequate description of the accomplishments of which we are capable is also an adequate description of the processes by which we produce those accomplishments. (As Robert Nozick once said, I realize this formulation lacks pizzazz—but bear with me.) For instance, Piaget observed that children from age 6 onward become able to make a set of related inferences about classes: if all tigers are animals, then not all animals are tigers; if Tony is a tiger, then Tony is an animal; if Tony is an animal, Tony could be any sort of animal, tiger or otherwise; and so on. He found that a mathematical structure, Grouping I for addition of classes, gave a concise formal description of the set of inferences they could make. So far, so good.

[100] But the next step was a doozy. Piaget concluded that Grouping I is actually part of these children's knowledge, that it exists in their minds, that it is "psychologically real" [note 31]. Perhaps it's easier to recognize the fallacy if we consider an individual who exhibits a different
set of accomplishments. Greg Maddux of the Atlanta Braves certainly knows how to throw a sinkerball. A physicist, with some effort, can describe Maddux's sinkerball accurately, using a set of mathematical equations. We would not conclude, however, that because these equations correctly describe his sinkerball, Maddux therefore knows these equations--or that he uses them when he throws a sinkerball.

[101] The error Piaget committed with his mathematical structures is endemic in some areas of psychology, especially the psychology of reasoning and the psychology of language. A colleague of mine, Terry Dartnall, calls this error "reverse psychologism," because systems of formal logic or linguistics get read into the minds of those who reason or use language [note 32]. Objectivists can fall into the same trap when they consider an example of human reasoning that conforms to the rules of formal logic and conclude that the reasoner actually used those same rules in arriving at the conclusion. Not necessarily!

[102] Knowledge by correspondence. The other non-obvious mistake I would like to comment on is Piaget's incomplete criticism of what he called "copy theories." Piaget rejected what Objectivists would call "naïve realist" theories of perception, and, unusually for him, he got right to the point:

To know is to transform reality [through action] in order to understand how a certain state is brought about. By virtue of this point of view, I find myself opposed to the view of knowledge as a copy, a passive copy, of reality. In point of fact, this notion is based on a vicious circle: in order to make a copy we have to know the model we are copying, but according to this theory of knowledge the only way we know the model is by copying it, until we are caught in a circle, unable to know whether our copy of the model is like the model or not.

[103] Obviously Piaget rejected any notion of passive knowing. But was he going farther, refuting the notion that knowledge is constituted by correspondence between things in the mind and things in the world? Maybe not. For he continued,

To my way of thinking, knowing an object does not mean copying it--it means acting upon it. It means constructing systems of transformations that can be carried out on or with this object. Knowing reality means constructing systems of transformations that correspond, more or less adequately, with reality. They are more or less isomorphic to transformations of reality. The transformational structures of which knowledge consists are not copies of the transformations in reality; they are simply possible isomorphic models among which experience can enable us to choose [note 33].

[104] Piaget still has correspondences, then. It's just that they are many-to-one instead of one-to-one. The problem that Piaget glimpsed but did not solve is that it does little good to characterize knowledge as structures in the mind that correspond to structures in the world. Such a characterization would work for an observer that already knows the world and has theories about the organism's mind. But it does nothing for the organism itself. The organism could not know about such correspondences unless it knew its environment (and its mind!) in the first place.
Objectivist writers have recognized this problem when they reject the representative theory of perception [note 34]. But how about concepts? Are concepts entities in the mind that constitute knowledge by virtue of correspondence with things in the world? If we believe they are, do we have an adequate account of knowledge?

DeKanting Piaget

We won't be solving the problems of knowledge-by-correspondence here: they are fodder for an essay of their own. But we can shed some light on the relationship between Jean Piaget and a philosopher whose ideas he often presented in a favorable light. According to Piaget, his genetic epistemology was directly indebted to Immanuel Kant's epistemology. Where Kant identified the mental categories (and "forms of intuition") that shape our experience, such as objects, space, time, and causality, it was Piaget's task to discover how each of these Kantian categories develops.

Not only did Piaget take this problem definition from Kant, but other Kantian ways of thinking left their traces in his writings. A minor one was blaming the "resistance of the object" when he found that problems about one content area were harder than problems about another, even though both seemed to require the same sort of cognitive structure. Piaget was much more persuasive when he offered a systematic explanation for these differences in difficulty.

A major one was his policy of restricting the scope of moral development to reasoning with moral rules, which progress from a "heteronomous" dependence on external authority to an "autonomous" source in one's own conscience.

The biggest one was rejecting natural necessity. Logical and mathematical necessity pose no deep problems for Piaget, because on his view they derive from the coordinations of the knowing subject's activities. But physical necessity? There's nothing necessary out there in the objects and their properties. Instead, we develop an understanding of necessary physical causality because we impute our operatory cognitive structures to external objects.

How Piaget absorbed these Kantian ideas is itself an interesting question. The moral views did not come from reading Kant, though Piaget did study him later. They are traceable to Piaget's religious training. Influential Protestant thinkers in the French-speaking area of Switzerland during the second half of the 19th century were completely immersed in Kantian moral philosophy. Several of them taught that God actually dwells in each of us, in the form of a conscience that constantly reminds us of our duties. (Piaget continued to write about religion until around 1930, by which time it was clear that his view that God was "immanent" in the operations of human minds was too liberal and unorthodox for Swiss Protestants, who were returning to Calvinism.) Piaget's moral writings are out of character for him in their nearly total obliviousness to other philosophical points of view [note 35].

In the case of physical causality, Piaget did read Kant fairly early, but was more immediately drawn in by the "historico-critical" theories of Léon Brunschvicg (1869-1944), an immensely learned neo-Kantian philosopher who wrote detailed accounts of the evolution of
Western thought about mathematics, physical causality, and consciousness. The Piaget-Brunschvicg connection remains to be explored in depth [note 36].

[112] The important point for us is that the most frankly Kantian areas of Piaget's thought are ones in which he clearly failed.

[113] What is wrong with Piaget's treatment of moral development is basically the same as what is wrong with Lawrence Kohlberg's. I discussed Kohlberg's neo-Kantian theory at the Summer Seminar in 1996, so I won't try to cover that ground again [note 37].

[114] What went wrong with Piaget's treatment of physical causality would also take some time to explain in detail, but I will try to net it out.

[115] It becomes easier to appreciate the strengths and weaknesses of Piaget's theories about cognitive development if we keep in mind the priority of logic and mathematics in his thinking. Cognitive structures were always characterized in mathematical terms; reflecting abstraction was also basically understood in logico-mathematical terms. While Piaget's treatment of mathematical development is by no means problem-free, clearly the difficulties tended to mount as Piaget moved farther from this home area. His treatment of children's knowledge of space and time emphasized development toward an understanding of units of measurement and of metric properties of these dimensions; he was also much taken with analogies between stages in the child's understanding of space and various systems of geometry (interestingly, the supposed order of development was the reverse of the order in which these systems emerged historically). Tellingly, he referred to the concrete operations that applied to space and time as "infralogical" [note 38]. Reflecting abstraction applied in a straightforward fashion to the logical and mathematical domains; with some stretching, it could be said to apply to spatial reasoning as well. But applying reflecting abstraction directly to our understanding of physical causality was too much for Piaget. Physical causality was easiest to encompass within the Piagetian framework to the extent that causal relations in the world could be modeled mathematically.

[116] Physical causality proved to be a sticking point for Piaget throughout his career. He published two books on children's causal thinking in the 1920s, but grew progressively dissatisfied with them over the years. In 1950, he devoted one of the massive volumes of his philosophical magnum opus to the development of physical thinking. Finally, in the early 1970s, he completely reworked his treatment of the development of physical causality, publishing no fewer than 6 new books on the topic. In this later theory, Piaget claimed that our understanding of physical causality comes about because we impute our logico-mathematical cognitive structures to physical objects [note 39]. The obvious subjectivism of this formulation aside, it is only going to work if we have the right kinds of structures to impute. Piaget thought we must impute the kinds of logical and mathematical structures that are typical of concrete operations (structures that have the property of reversibility) in order to have an understanding of causal mechanism (roughly, the specific means by which cause and effect are related). Yet empirical research by Merry Bullock and her colleagues has shown that children as young as 3 can understand the operations of a simple causal mechanism and use their knowledge to make predictions [note 40]. And it is easy to show that three-year-olds just don't reason about
classification, ordering, and number in a concrete operational way; their mathematical understanding is far too limited to meet Piaget's requirements.

[117] Despite his Kantian denial of necessity in nature, Piaget never subscribed to Kant's dichotomy between phenomena and noumena. Nor did he subscribe to the "prior certainty of consciousness" that was part of Kant's Cartesian heritage. Piaget never doubted that what we know is the environment first, and our own minds second. Generally, he would say that we attain more complete knowledge of "the object" as we reach higher levels of development and coordinate more and more perspectives on it. He frequently used the metaphor of approaching a mathematical limit, which can be also found in Charles Saunders Peirce and others. This view may not be entirely adequate, but it is consistent with metaphysical realism [note 41].

[118] When Piaget got himself into trouble (outside the realm of causal necessity) and made antirealist-sounding statements, I think the source was his assumption that structures in the mind are isomorphic to structures in the world. If you're not being careful about what the rules of logic describe, it's easy to slip them into the mind of the reasoner. If you're accustomed to thinking of our cognitive structures for apprehending physical objects as isomorphic to the physical objects themselves, or our cognitive structures for dealing with physical space as isomorphic to physical space, it is easy to fall into talk about "constructing the permanent object," or "constructing space," as Piaget often did. (The British philosopher D. W. Hamlyn reacted to Piaget's book *The Construction of Reality in the Child* with raised eyebrows: "Really? All by himself?"). Piagetians will do themselves and others a service by adhering to consistent distinctions between what is known and our means of knowing it, between physical objects and our ways of knowing them, between mathematical relations that are necessary and our knowledge that they are necessary.

[119] Kant was actually in deep trouble as soon as Piaget decided to go the developmental route. It is much easier to claim that the human mind makes the known world when you are under no obligation to explain how the human mind got to be the way it is. Kant was a default nativist who treated the categories as though they came implanted in us from birth. And in his time Kant did not have to face evolutionary questions about the origins of innate mental structures. Kant was convinced that epistemologically necessity is always *a priori*. Piaget's reply: "Necessity is no more *a priori* than possibilities are predetermined" [note 42]. What Piaget meant was that in order to understand what is necessary, we need to know what the relevant possibilities are. And we are not born knowing all of those possibilities; we have to discover what they are, by exercising our schemes.

[120] We have been dwelling on Piaget's faults, and on his sometimes questionable sources of inspiration. But most of his mistakes were smart mistakes, rather than foolish ones. His failure to distinguish between logical or mathematical descriptions of a person's possible accomplishments and the means by which the person actually does those accomplishments is still pervasive in psychology (and I have not seen it criticized heretofore in the Objectivist literature). His critique of "copy theories" of perception has implications that he himself did not fully appreciate (and that Objectivists need to pay attention to as well). Finally, though Piaget drew explicitly on Kantian ideas, his most Kantian hypotheses about development were signal failures, he was too strongly committed to realism to be a good Kantian, and he was far too strongly committed to
explaining how our knowledge originates. What remains valuable in his intellectual legacy--and there is a lot of it--can be successfully deKanted.

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Nathaniel Branden, Diana Hsieh, and David Kelley made helpful comments at various stages in the life of this project.

Notes


2. Piaget's writings on education make up a tiny portion of his overall output; practical guidelines for "Piagetian" education are the work of others. Two essays written for the United Nations, "Où va l'éducation?" (1971) and "Le droit à l'éducation dans le monde actuel" (1948) appeared in English as To understand is to invent: The future of education (translated by George-Anne Roberts, New York: Grossman, 1973). Two essays of greater theoretical interest, "The new methods: Their psychological foundations" (1935) and "Education and teaching since 1935" (1965) were bundled into Science of education and psychology of the child (translated by Derek Coltman, New York: Orion, 1970).

Both essays in this second volume contain largely favorable but rushed and cryptic references to the work of Maria Montessori (see, for instance, pp. 147-148). The Piaget-Montessori connection was actually much stronger than anyone would gather from these writings. The experimental nursery school in Geneva, La Maison des Petits, where Piaget carried out his first studies of children in the 1920s, was a modified Montessori institution, and Piaget was for a number of years the head of the Swiss Montessori Society (see Rita Kramer, Maria Montessori: A biography, New York: G. P. Putnam's Sons, 1976, pp. 311, 321, 326). Piaget seems to have grown dissatisfied with Montessori's lack of theoretical rigor in psychology, but disgust with her long and ultimately futile collaboration with the Mussolini regime in Italy (1922-1934) may have played a more decisive role. Thanks to Marsha Enright for alerting me to this "hidden history." Because of the rift between academic psychology and academic education departments, and the even deeper rift between academics and practitioners, the Piaget-Montessori connection remains unknown to most contemporary Piagetians. In fact, an article by David Elkind, written in 1967 when both thinkers were getting renewed interest in the United States (Piaget and Montessori, Harvard Educational Review, 37,535-546) correctly identifies several points of agreement without showing any awareness of Piaget's role in the Montessori movement.[Return]

3. As most Objectivists know, Ayn Rand used The Magic Mountain, by Thomas Mann, as a negative exemplar--a lesson in how not to write a philosophical novel. [Return]

5. For instance, in a discussion of the difficulties of measuring children's mastery of various kinds of mathematical reasoning in a way that would permit exact comparisons of their progress in different areas, Piaget remarked that simply correlating children's scores on tasks in the different areas "can only give misleading results if it is not accompanied by a very extensive qualitative analysis--unless one transforms the tasks into 'tests' in which a statistical precision can no doubt be obtained without much difficulty, but at the expense of no longer knowing exactly what one is measuring" (Jean Piaget and Alina Szeminska, *La genèse du nombre chez l'enfant*, Neuchâtel: Delachaux et Niestlé, 1941, p. 193; the published translation is mediocre at best, so I have used the late Michael Chapman's rendition of this passage). [Return]


10. A classic statement of this position can be found in Robbie Case, *Intellectual development from birth to adulthood*, New York: Academic Press, 1985. [Return]


12. The basic issues are discussed in Bärbel Inhelder and Jean Piaget, *The early growth of logic in the child: Classification and seriation* (New York: W. W. Norton, 1965). I am simplifying some matters of empirical method here; the wording of the question turns out to make a difference, and I would argue that the use of "all" and "only" is more appropriate, even though it was not the usual practice of Piaget and his students. [Return]


15. Ibid. [Return]

16. Ibid, p. 62. [Return]

17. Ibid, p. 66. [Return]

18. Piaget employed the roman numeral system mentioned here in most of his middle and late-period writing. In some works, however, the stages and substages are numbered differently. [Return]

19. The classic volume on formal operations and adolescent thinking is Bärbel Inhelder and Jean Piaget, *De la logique de l'enfant à la logique de l'adolescent: Essai sur la construction des structures opératoires formelles* (Paris: Presses Universitaires de France, 1955; translated by Anne Parsons and Stanley Milgram as *The growth of logical thinking from childhood to adolescence: An essay on the construction of formal operational structures*, New York: Basic Books, 1958). Unfortunately this difficult book was not very well translated, especially in its theoretical sections. Piaget retracted his claims of universality in his 1972 article, *Intellectual evolution from adolescence to adulthood*, *Human Development*, 15, 1-12. An early example of "operations to the nth power" is Piaget's statement that constructing axiomatic systems in geometry requires a level of thinking that is a stage beyond formal operations: "one could say that axiomatic schemas are to formal schemes what the latter are to concrete operations" (*Introduction à l'épistémologie génétique, Vol. 1: La pensée mathématique* (Paris: Presses Universitaires de France, 1950, p. 226; there is no published English translation, so I have used Michael Chapman's). [Return]


24. Ibid., pp. 42-43. This is Rand's example of how the definition of the concept *man* changes during development. Notice that although Rand refers to any way of distinguishing the concept *man* from other concepts as a definition, the first two "definitions" that she describes are "wordless." In the current terminology, they are not explicit definitions.

A most interesting study could be written about the covert role of developmental psychology in Objectivist writings. Nathaniel Branden's treatment of human personality has always been developmental. There are several discussions of the course of conceptual development in the *Introduction to Objectivist epistemology*, only the most prominent of which is singled out above. Then there are two treatments of the developmental origins of our understanding of physical causality: an abbreviated one in Leonard Peikoff, *Objectivism: The philosophy of Ayn Rand* (New York: Meridian, 1993), and a much more elaborate and sophisticated theory offered by Rick Minto in *Parmenides' last stand: The metaphysics of persistence and change*, two lectures presented at the 1997 IOS Summer Seminar. Minto's account draws on the psychological theories of James J. Gibson as well as the philosophy of Thomas Reid.

Strangely, this developmental streak in Objectivist thinking (which in other respects has also been strongly naturalistic in its orientation) has up to now coexisted with a completely traditional demarcation between psychology and philosophy. On the traditional view, philosophy can be done entirely from the armchair; there is no need for philosophers to conduct specialized empirical research, or to rely on any such research as conducted by others. Piaget's life-work is a powerful, direct challenge to the traditional demarcation. [Return]

25. *Introduction to Objectivist epistemology*, p. 21. [Return]

26. See Campbell and Bickhard, *Knowing levels and developmental stages* (Basel: S. Karger, 1986), Chapter 7, for a discussion of egocentrism as a recurring problem in development. [Return]


28. Alina Szeminska's story is told by Jacqueline Bideaud, Introduction, in Jacqueline Bideaud, Claire Meljac, and Jean-Paul Fischer (Editors), *Pathways to number: Children's developing numerical abilities* (Hillsdale, NJ: Lawrence Erlbaum, 1992), pp. 1-17. Szeminska's name was also arbitrarily removed from the English translation of a book that she had co-authored. [Return]


31. Piaget really did mean this. On one occasion, he declared that doubting the psychological reality of a structure like Grouping I makes as much sense as doubting the physiological reality of hearts and lungs. See Bärbel Inhelder and Jean Piaget, Procédures et structures, *Archives de Psychologie, 47*, 165-176 (1979). [Return]


36. Brunschvicg is frequently cited in Piaget's writings from the 1920s. Vidal notes the importance of this connection but does not discuss it further. Meanwhile, Brunschvicg has been ignored since his death, even in the French-speaking countries; the only book about him is René Boirel, *Brunschvicg; Sa vie, son oeuvre, avec un exposé de sa philosophie* (Paris: Presses Universitaires de France, 1964). [Return]


39. One of the 1920s books was *La représentation du monde chez l'enfant* (Paris: Alcan, 1926; translated by Joan and Andrew Tomlinson as *The child's conception of the world*, Littlefield, Adams & Co., 1960), which contains the famous dialogues about clouds moving. In 1950, Piaget devoted the second volume, *La pensée physique*, of his single most important work, *Introduction à l'épistémologie génétique* (Paris: Presses Universitaires de France) to issues of physical causality viewed historically and developmentally. (The availability of these volumes in English would have dispelled many misunderstandings of Piaget's ideas over the years.) Then in the early 1970s, Piaget and his Center produced a roundtable discussion of physical causality by philosophers: Mario Bunge, François Halbwachs, Thomas S. Kuhn, Jean Piaget, and Leo Rosenfeld, *Les théories de la causalité* (Paris: Presses Universitaires de France, 1971). This was followed by four volumes of empirical studies, focusing on problems in Newtonian mechanics: *La transmission des mouvements* (PUF, 1972); *La direction des mobiles lors de chocs et de poussées* (also 1972); *La formation de la notion de force* (1973); and *La composition des forces et le problème des vecteurs* (1973). Only what was intended as the summary volume has appeared in English: Jean Piaget and Rolando Garcia, *Les explications causales*, (Paris: Presses Universitaires de France, 197; translated by Donald and Marguerite Miles as *Understanding causality*, New York: W. W. Norton, 1974). But this volume is extraordinarily hard to follow without the original data, or the philosophical underpinnings provided by the 1950 treatise. [Return]

40. Merry Bullock, Rochel Gelman, and Renée Baillargeon, *The development of causal reasoning*, in William J. Friedman (Editor), *The developmental psychology of time* (New York: Academic Press, 1982), pp. 209-254. In the 1980s there was a major incursion of neo-Aristotelian ideas about physical causality into developmental psychology, which can be seen in the work of Tom Shultz, Barbara Koslowski, Susan Gelman, and Frank Keil, as well as Merry
Bullock. (A primary source for all of this work was Rom Harré and Edward H. Madden, *Causal powers* [Oxford: Basil Blackwell, 1975.]) Despite this trend in describing children's thinking, most psychologists, when they go about "doing science," still restrict their explanatory resources to efficient causality... [Return]


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What is learning? Jean Piaget's "Genetic Epistemology" addresses how humans come to know things. Jean Piaget's Cognitive Development Theory addresses the critical questions theory. Jean Piaget was born on August 9, 1896 in Switzerland and is the eldest of Professor Arthur Piaget and Rebecca Jackson Piaget. He was awarded numerous prizes and honorary degrees from all over the world. He married Valentine Chatenay and conceived two daughters and a son. His ideas were central to the creation of development psychology and influential in other fields including education, sociology and computer science. He studied the thought process of children.