PREFACE

In this anthology we attempt to compress Jean Piaget's life work into one volume, a task formidable enough simply because of the magnitude of Piaget's *oeuvre*—over fifty books and monographs and hundreds of articles, published over a seventy-year period. This time scale compounds the problem of selection, since Piaget revisited certain problems several times. If, in the interest of brevity, we include only the latest statement as representing Piaget's final position on the subject, we commit two errors. First, we deprive the reader of the earlier works, which in some instances are less widely known and which are necessary for a picture of the growth of Piaget's ideas. Second, we may mislead the reader into thinking that there is a "final" position on any question, when there is only a man perpetually searching to deepen his grasp of an approach to the network of enterprises by which human beings obtain knowledge.

A further difficulty in selecting for this anthology stems from the multidisciplinary character of Piaget's life work, which is concerned with the nature of the growth of all knowledge—in all disciplines, and on the time scale of human intellectual history as well as the intellectual growth of one child. The scope of his intentions is exhibited in his *Introduction à l'Epistémologie Génétique*, volume 1 dealing with mathematical thought, volume 2 with physical thought, and volume 3 with biological, psychological, and sociological thought—on both of the time scales mentioned above. Piaget's more specialized studies range over the fields of biology, philosophy, psychology, and logic, with some forays into sociology, theology, and the history of science. In addition, his work on the growth of child thought leads him to consider some issues in physics and mathematics, at the very least insofar as this is necessary for understanding the thinking of children and adolescents about these matters. Since each one of the fields in which Piaget has labored has its special requirements, the most desirable course would be to present a combination of selections that give the reader both the necessary fundamentals and Piaget's own contribution.

In all scientific inquiries, a good strategy is to maximize the variable one is interested in. Piaget's strategic decision to approach epistemological problems by studying children's thinking may be viewed as such an attempt to study cognitive growth under conditions favorable for observing it. This leads to still another difficulty in composing our anthology. If we devote attention one-sidedly to children's thinking, we may lose sight of the more general epistemological aims. If we enlarge upon the latter we take up space that is necessary for concrete findings,

experimental protocols, and other details that give substance to the argument.

We have tried, then, to organize this volume so that it shows the growth of Piaget's thought, its multidisciplinary nature, and the interrelationships between empirical research and epistemological aims. Without oversimplifying, we have tried to present Piaget's work in a form that would be more readable for, and more accessible to, the general reader than has hitherto been the case.

To accomplish all these goals, we have used a variety of methods. The reader will find a number of new translations of works previously unavailable in English (and, for that matter, not easy to find in French). These fall mainly, but not exclusively, in the earlier part of Piaget's life. In selecting from previously translated material, which comprises the bulk of this volume, we have done our best to omit unduly opaque passages, while still preserving the continuity of Piaget's argument. Our own introductions, to the book as a whole and to the various sections, provide historical background, explain especially difficult passages, or fill gaps inevitable even in the most complete anthology.

As will be plain from the weight of this book, we have not assembled a collection of "nuggets" of Piaget's wisdom. With few exceptions, we try to present his work as a set of coherent wholes, primarily in his own words, but sometimes compensating for omissions by our summaries, either of whole books or of deleted passages. This approach has led to some repetition, of course, but try as we might we could not bring ourselves to use the editor's razor to eliminate all of it, and this for two quite different reasons. On the one hand, the repeated material is necessary for Piaget's argument. On the other hand, and more fundamentally, the ideas are never quite so repetitious as they may seem in a first reading. If Piaget's research has taught us one thing it is that one may profitably go over the child's thinking many times, for it is the working of an incredibly dense and complexly articulated structure. The same—no more, no less—is true of Piaget's own thinking. We believe, then, that the reader will profit from working through this book and encountering the same ideas in different theoretical contexts, as applied to different contents, or as expressed at different stages of Piaget's development.

No preface to an anthology is complete without a confessional, a list of works omitted for reasons of space. In the present instance, we draw the reader's attention to the underrepresentation of Piaget's theological writings,* and to the almost total absence of his sociological writings except as reflected in *The Moral Judgment of the Child*. Our decision not to translate any of *l'Introduction à l'Epistémologie Génétique* is perhaps less serious, since much of the ground covered there is represented in one form or another throughout this book. The absence of any selection from the 30 volumes (1957–1975) of the *Études* of the Centre International d'Epistémologie Génétique is explained in the same way; we note also that these volumes are often primarily a deepening by collaborators of an inquiry begun earlier by Piaget. Although the multidisciplinary nature of Piaget's work is certainly reflected in the

*Although we do give an almost complete translation of *La Mission de l'Idée*, other works are completely absent.

structure and contents of this anthology, we regret omitting Piaget's writings on the interrelationships among different branches of knowledge.

One of the characteristics of Piaget's method has led to the coining of the phrase, "the epistemic subject." Typically, Piaget uses one group of children for the investigation of one topic, such as children's ideas about chance, and another group for another topic, such as movement. Since his primary interest is not in the individual variations but in the typical, he must merge the results of different studies in order to get a comprehensive picture of the growth of knowledge. Now this composite does not apply to any real child, but only to a somewhat idealized growth process, hence "epistemic."

There is also an "epistemic Piaget," the one we refer to throughout this volume when we use his name to describe the work of the Geneva school. Piaget could not be, and indeed would not want to be, one person doing all these things. Many of his published works contain at the beginning a list of collaborators, the research assistants who worked with him on that study. In addition, many of his works have more than one author listed on the title page. By far the most frequent of his coauthors, often listed as the first author of important works, is his collaborator of some 40 years, Professor Bärbel Inhelder. It is hard to imagine the epistemic Piaget without the real Inhelder.

We ourselves owe much to Professor Inhelder for her encouragement, for valuable suggestions, and for practical help at every stage in the preparation of this anthology.

We are also indebted to Marie-Paule Michiels, Pierre Nicole, Laszlo Peczi, Sylvie Reichenbach, and Anne-Sylvie Vauclair—all at one time or another members of the staff of the Archives Piaget. Carol Doyle helped with some of the translations. When we were thoroughly lost in a thicket of our own making, Robert Cornman prepared an invaluable conceptual atlas to help us find our way again. Simon Gruber did a mammoth job of photocopying. Janet Demierre was a superb secretary, handling not only the typing of our manuscript but a complex correspondence regarding permissions to reprint material. In the background, there was Laura Vonèche-Cardia, tiding us over many difficult moments. We thank also Jakob Tschopp for bibliographic assistance and Gilbert Voyat for various suggestions.

We owe special thanks to Dr. Christiane Gillièron for many of the illustrations in this book, as well as for a critical reading of parts of the manuscript.

Herb Reich, our editor at Basic Books, did much to make this work possible, often going well beyond the customary duties of an editor. We thank him and his staff. One of us, H. Gruber, acknowledges help received from the John Simon Guggenheim Memorial Foundation and from the Research Council of Rutgers University, without which many trips to Geneva would have been impossible.

Both of us are grateful to our colleagues in the Institute for Cognitive Studies of Rutgers University and in the Faculté de Psychologie et des Sciences de l'Education of the University of Geneva for helping to create the atmosphere necessary to fruitful work; also the librarians of our respective institutions for innumerable services.

Finally, we thank Jean Piaget for encouraging us in our work, for giving us necessary permissions to publish materials, and for making available some unpublished material that would have otherwise been inaccessible. As we write these lines, his eighty-first birthday is approaching. We salute him for a wonderfully productive and illuminating career.

Bibliographic Note

When a book or article was coauthored by Piaget and someone else, we have indicated this in the table of contents by a parenthesis, e.g., "(with Inhelder)." The source note at the beginning of each selection and in the consolidated bibliography gives the sequence of authors' names as it appeared in the original publication. The names of other collaborators, such as students and research assistants, also appear in the source note and bibliography, but not in the table of contents.

The consolidated bibliography includes all works by Piaget or by Piaget and coauthors, cited in the volume, in the editors' comments, in the text of Piaget's works, and in the citations for the selections themselves. This is, however, not a complete bibliography of all of Piaget's writings; that would be a whole book in itself.*

*In the text, we have left Piaget's references to other authors in their original form, i.e., as footnotes, often incomplete. Our own references to other authors also appear only as footnotes, not in the consolidated bibliography.

With regard to personal pronouns, we have left previously translated works intact. In our own commentaries we have alternated between *she* and *he*, using one or the other (but not both) within a given context.

INTRODUCTION

"A man, therefore, who gets so far as making the supposed unity of the self twofold is already almost a genius, in any case a most exceptional and interesting person. In reality, however, every ego, so far from being a unity is in the highest degree a manifold world, a constellated heaven, a chaos of forms, of stages and stages, of inheritances and potentialities . . . not yet a finished creation but rather a challenge of the spirit"*

A tribute to the human need to know: the baby's delight in her first amazed discovery of her own hand, or that a parent comes when called, or that an object fallen from her grasp remains much the same when it is regained. Another tribute to the same need to know: scientific theories on all subjects repeatedly capture widespread public attention.

Psychological theories touch a special chord, our natural interest in ourselves and in each other. Different theories, although they may be seen as competing for the best way of integrating psychological knowledge, can also be viewed as reflecting different aspects of this complexity of self and social interest.

Only a few psychologists in our century have approached the status of household word: Freud and his lineal descendant Erikson, Pavlov and his lineal descendant Skinner, and Piaget. To understand Piaget's particular impact, it is useful to reflect a moment on the differences among these points of view. Psychoanalysis focuses its attention on the animal, irrational, unconscious aspects of human experience and conduct. It promises amelioration of human ills through new techniques for establishing healthier relations between the rational, which it does not deny, and the irrational, which it acclaims. Behaviorism challenges the simplistic rationalism of previous centuries from another quarter, denying scientific status to the very idea of consciousness, and promising control of behavior through the management of external stimuli and rewards. Whatever their raisons d'être, or their merits, neither psychoanalysis nor behaviorism dwells on certain essential human characteristics from which we derive our species name *homo sapiens*: we think, we know, we act knowingly, we strive for greater knowledge and understanding.

Piaget's whole scientific effort addresses itself to this human need to know. When he received the Distinguished Scientist Award from the American Psychological Association in 1969, the citation included this sentence: "He has approached questions up to now exclusively philo-

*H. Hesse, *Steppenwolf*.

sophical in a resolutely empirical manner, and has made epistemology into a science separate from philosophy, but related to all the human sciences." Piaget promises nothing direct in the way of practical application of his ideas, although others have drawn on his work for various purposes. He offers only a point of departure for that unquenchable curiosity that resides somewhere in each of us, to know more, to understand the sources of our own knowledge, to understand others by grasping how they have come to think as they do.

But he does not provide satisfaction in the form of a brief or easily summarized formula. One of his greatest merits, his scope, is also one of the sources of his readers' greatest despair. His ideas and discoveries are spread out in some fifty books and hundreds of articles. In his work as a psychologist, for which he is best known, he has tried to show the childhood origins of human knowledge in almost every sphere: logic, space, time, chance, morality, play, language, mathematics. He has dealt with a wide spectrum of psychological processes: reasoning, perception, imagery, memory, imitation, action. Beyond this, or rather interwoven with this vast effort, is his concern with elaborating a philosophical point of view, genetic epistemology, and with exploring in considerable depth its biological as well as its psychological implications.

In the present work we attempt to reduce Piaget's entire oeuvre to one volume. But a question remains: Can there be an *essential* Piaget? Is there a body of thought so fixed and stable that it can be captured and pinned down in any single volume without destroying its vitality? Piaget's incessant literary output can be understood to mean that his system or essence remains permanently under construction. He has said that he cannot think without pen in hand; for him thinking is writing. The products of his pen are not so much fixed ideas or "findings" or essences as they are the very flow of his thought.

In keeping with this view, our Introduction is not an attempt to provide a simplified summary of what is to follow. Rather, we try to give some sense of the restless interplay between a few major ideas, with special attention to the tensions produced, the unanswered questions. Our aim is to encourage the reader to join in thinking with Piaget about the next steps to be taken in the construction of knowledge. For us, that is the essence of Piaget's several essences.

Piaget's work, whether it be thought of as philosophy, biology, or psychology, is all directed at elaborating a theory of knowledge, of how the organism comes to know its world. Among possible theories, at one extreme is the Kantian view that the infant is born with a set of innate or a priori ideas which constitute the fundamental outlines of all knowledge. (Of Piaget's relation to apriorism we shall say more later.) At another extreme (and there are more than two extremes, since theories of knowledge do not comprise a simple linear array) is the empiricist view that the infant is born with no innate ideas, and that all knowledge results from the accumulation of experience, so that knowledge is a direct copy of the reality with which each person is incessantly confronted. Experience in this sense, then, is sensory or perceptual. But experience can be thought of in several ways: Do we mean the direct perception of external reality, which tells us what the world out there is like? Or do we mean our actions upon the world, or better, our interactions with it? And in either case—experience of world as

perceived, or as acted in and upon—how is such experience affected by and incorporated into whatever knowledge has been previously acquired? These are the sorts of questions that Piaget's or indeed any theory of knowledge must confront.

We begin our discussion with a few observations made by Piaget at different points in time, all bearing on the relations among perception, action, and knowledge.

Reality and Perception: Action and Knowledge

Piaget questions children about the behavior of heavenly bodies:

> Adult: Does the moon move or not?
> Child (age 7): When we go, it goes.
> Adult: What makes it move?
> Child: We do.
> Adult: How?
> Child: When we walk. It goes by itself.*

Neither Piaget nor his young subjects, of course, were the first to notice that the moon seems to move when we do. Every child has seen it move, and adults can too, if they remember to look. Nor was Piaget the only psychologist to notice that children actually believe that their own actions cause the moon and clouds to move.†

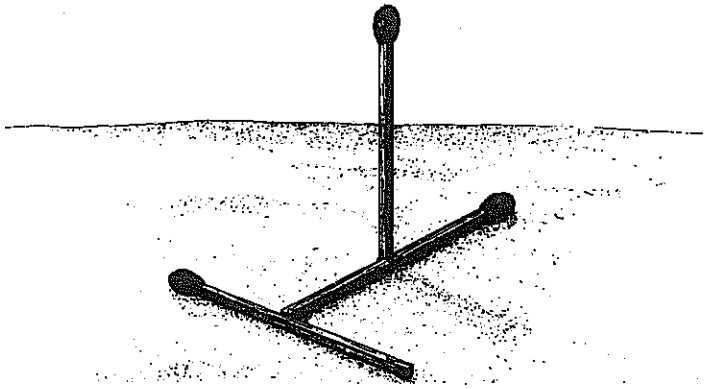
What distinguishes Piaget's approach is his persistence in carrying the questions posed by such simple observations as far as possible. Piaget's work in the 1920s led him to describe a period of childhood egocentrism, characterized by a multitude of examples such as the observation above. Eventually, these efforts led him to search for the origins of egocentric thought in an infantile period of solipsism, in which the baby does not even distinguish himself from the world, and consequently cannot yet have an idea of distinct and permanent objects: there is nothing but a flux of appearances. After his studies of infancy, Piaget carried his questions forward into later childhood. With the emergence of the logic of concrete operations, the child acquires the tools necessary to separate appearances from reality, or to distinguish perception from other forms of knowledge.

Almost fifty years later, one of Piaget's collaborators investigated the child's handling of a contradiction produced by a conflict between a visual illusion and the child's knowledge of the real situation. In this study, for example, two sticks are first chosen by the child from a set of sticks as appearing to be the same size, which they are. Then the experimenter puts one of them in a horizontal position and the other

*J. Piaget, *The Child's Conception of the World*, pp. 146–147.

†Piaget cites another author, Rasmussen, to this effect. And Anne Roe describes a young child, later to become a distinguished scientist, who sent his little brother down to the bottom of the garden as an experiment to find out whether the moon's movement generated by the child at point *A* can be perceived by another child at point *B*. So this is serious business. See Anne Roe, *The Making of a Scientist* (New York: Dodd Mead and Co., 1952), p. 95.

vertical, forming an inverted T; this produces the well-known vertical-horizontal illusion, in which the vertical stick appears definitely longer than the horizontal one. It has been established that children and adults are quite uniformly susceptible to this illusion.



When the middle matchstick is seen as bisecting the lowest matchstick, it is seen as longer. When it is seen as bisected by the topmost stick, it is seen as shorter. (You can do this with three matchsticks in one plane, too.) Since we know that all three are the same size, this illustrates a contradiction between knowledge and perception.

Experimenter: (Puts sticks in inverted-T position.)
Child (6;6):* They are both the same size.
Experimenter: But when you look at them, they are the same?
Child: Yes.
Experimenter: You see them the same, or you only know it? When you look at them, isn't there a big one and a small one?
Child: I see them the same.
Experimenter: What did you do?
Child: I saw that they were both the same size.
Experimenter: When did you do that? When you chose them, or now while looking?
Child: Before and now.†

Another child gives a much less common reaction. When the sticks are presented in the illusion configuration, she sees the illusion, but changes her belief as to their length: if it looks longer it is longer.

Although the two children seem quite different, they have an important point in common, an insensitivity to contradiction, an inability to deal with it. One eliminates the problem by denying the illusion, the other by sacrificing his previous judgment that the sticks were equal. By the time they are about 8–10 years old both children will be able to accept the apparent contradiction and deal with it in a more stable logical framework. In this later research it is not so much the child's grasp of the distinction among perception, action, and knowledge that

*Ages are given in parenthesis throughout. E.g., (6;6) is 6 years, 6 months old.

†J. Piaget and C. Gillièron, "Conservation des longeurs et illusions perceptives," in *Recherches sur la contradiction*: II, *Les Relations entre affirmations et négations*, Etudes d'épistémologie génétique, vol. 32, p. 73–85, Presses Universitaires de France, 1974. Translated by H. E. G. and J. J. V.

interested Piaget; rather it is the growth of awareness of contradiction, the will to search for ways of thinking that can eliminate contradiction, in short the growth of logic.

From these observations, the "movement" of the moon and the changing size of objects in visual illusions, we might conclude that perception is not a reliable guide to knowledge, that if we permitted ourselves to be guided by our direct perception of the world we would often fall into serious error. This might seem adequate to refute the empiricist view that knowledge originates in our perception of the world. Not so. The empiricist can and does readily answer: of course, perception is unreliable, knowledge fallible, and only the accumulation of experience helps to reduce error.

Piaget's critique of empiricism runs somewhat deeper. Distinguishing perception from other forms of knowledge is not enough. In some sense, perception is of no direct use at all in informing us about the world. It is our previously elaborated understanding that enables us to make any sense of what we perceive. Consider the following example, Piaget's celebrated experiment on the conservation of matter:

The child is given two containers *A* and *L* of equal height, *A* being wide and *L* narrow. *A* is filled to a certain height (one-quarter or one-fifth) and the child is asked to pour the same quantity of liquid into *L*. The dimensions are such that the level will be four times as high in *L* as in *A* for the same amount of liquid. In spite of this striking difference in the proportions, the child at this stage proves incapable of grasping that the smaller diameter of *L* will require a higher level of liquid. Those children who are clearly still at this stage are satisfied that there is "the same amount to drink" in *L* when they have filled it to the same level as *A*.*

Now the child can very well "see" that nothing has been added or taken away. But he cannot see it in a way that leads to the conclusion that matter has been conserved until he can carry out a certain group of mental operations on the events before him. Thus it is not through direct observation, but through the actions we carry out upon our perceptions, not so much the actions of the body but those of the mind, mental operations, that we come to know the world. It is not only our knowledge of the world, but even more important, mastery of these operations, that must be constructed in the course of cognitive growth.

Even after long study and reflection and immersion in the subject, it is astonishingly easy to slip into taking for granted that something obvious at one level of development is obvious at other levels. To get the full flavor of how tenacious and puzzling such problems can be, consider another example.

Piaget writes, "in a closed system of physical transformations nothing is created and nothing destroyed. . . ." Is this a statement of the principle of the conservation of matter? We put this question to a number of Piaget's advanced students and collaborators, all of whom answered in the affirmative. Yet the full quotation reads as follows, "Clearly, it is one thing to observe that in a closed system of physical transformations nothing is created and nothing destroyed, and quite another to infer from this a principle of conservation."† Piaget's mean-

*J. Piaget and A. Szeminska, *The Child's Conception of Number*, pp. 11–12.

†J. Piaget, "Piaget's Theory," in *Carmichael's Manual of Child Psychology*, 3rd ed. p. 715.

ing is plain enough in its context. The identity operation (nothing added, nothing taken away) is not enough to establish the full idea of conservation of matter, because changing the shape of something (e.g., flattening a clay ball into a "pancake") might conceivably change its amount. Moreover, the inversion operation (changing the shape back again and noting that the original amount is regained) does not entirely solve the problem, because the amount might still have been different while the shape was changed. Only when these two operations are combined with the compensation operation (in changing shape, a decrease in height is compensated for by an increase in diameter, etc.) can a stable solution to conservation problems be found.*

Thus, observation alone does not open the way to correct inferences, or for that matter to any inferences at all. Mental operations must be carried out on observations, and these operations themselves develop in the life history.

An Ontological Question

In all this, does Piaget mean to say that there is a reality external to the behaving and experiencing person, to which the individual gradually and imperfectly attains, and that it is the steady presence of this reality that regulates and corrects the course of adaptive cognitive growth? This is a plausible interpretation of Piaget's position and seems to be strongly implied by much of his activity as a scientist. It is certainly part of the interpretation of Piaget that has led dialectical materialists to claim him as one of their own kind. But when asked questions to this effect, he is likely to reply, "Je m'en fous de la réalité." (I don't give a damn about reality.) Seemingly a strange response from a man who has written a book entitled *The Construction of Reality in the Child*.

What can he mean? One possible alternative is the following. The individual and the social group are constantly in the process of constructing and reconstructing their views of the world. At a given moment, the most advanced (complex, flexible, adaptive) achievements in the pursuit of knowledge may play a regulatory role with regard to other achievements still to be made. But this does not give either the most advanced, or for that matter, as some would have it, the most primitive, kinds of knowledge the status of an ultimate "reality." The main fruit of genetic epistemology is this discovery that the only way in which we get knowledge is through continual construction, and that we can have no enduring knowledge without actively maintaining this

*Another way of putting this: The identity operation refers to the *past*, because nothing has been added or taken away; the compensation operation is oriented toward a continuous *present*, during which changes of one kind correspond to changes of another kind; the inversion operation refers to a hypothetical or anticipated *future*, in which the preexisting situation is restored. Taken altogether, these operations thus provide an account of the uninterrupted existence of the property in question, i.e., conservation.

process. Something else, therefore, will surely be constructed, something that still lies ahead, that will replace whatever the naïve realist chooses to canonize today. And so on ad infinitum.

At this point the reader may wish to say, "Je m'en fous de la discussion. It is only philosophy and has nothing to do with psychology." We do not wish to provide a facile answer to the ontological questions posed above. But we do wish to stress the importance of Piaget's patient transformation of difficult philosophical questions into manageable psychological ones. In the particular instance, his lifelong strategy has been to transform seemingly unmanageable ontological questions (what is reality? what exists?) into manageable epistemological questions (how do we know? how do we get knowledge?).

The Concept of Stage in Piaget's Theory: Some Questions

That there are definite stages of development, which occur universally in a fixed order, is now probably the best known of Piaget's ideas, and seems to be central to his theory. But there are some important questions not easily answered by reading Piaget's work, because, although he has used it for a long time, in fact he has not written a great deal about the stage concept.

RANGE OF APPLICATION

Does the stage concept apply only to the three major "periods" of development (sensorimotor, concrete operations, formal operations), or does it also apply to the progressive steps or substages in the attainment of a cognitive structure within a stage? A repeated theme in his frequent brief discussions of the stage concept is the inclusion of attainments of earlier stages in the structures of later stages: an earlier stage is neither discarded nor displaced nor "grown out of"—rather, a later stage is "grown into," and depends on the prior attainment of earlier stages, hence the idea of necessary order. This is an easy enough point to establish convincingly if one considers the relations among the three major stages. It seems self-evident, for example, that the idea of the conservation of matter (attained between 6 and 10 years) rests on and includes the idea of object permanence (attained between 1 and 2 years). But it is not so self-evident that the substages described in the *Origins of Intelligence* (dealing with the first 1–2 years of life) necessarily follow in the order described, or just what attainments of the earliest substages are retained in the later ones. This point is of particular significance to teachers of children in the age range 5–11, the period in which concrete operations are being acquired. It is not very helpful to know that a 6 year old must some years ago have developed the semiotic function to the point where he can talk, or that some years later, in adolescence, if all goes well, he may reach the stage of formal operations. It is helpful to know that developments *within* the period of concrete

operations generally follow certain lines, display certain substages; and it would be important to establish that this is a necessary order. Piaget's own work in Geneva established the existence of the basic sequences under discussion; beginning one or two decades later, the work of various followers established that much the same sequence indeed occurs in widely varying cultures; the demonstration that this sequence is logically necessary remains to be done. It might be added here that experiments that attempt to accelerate the child's movement through a well-known sequence, whether they succeed or fail, do not touch the question of the immutability of the order itself.

When the period of formal operations is reached in adolescence, does stagewise development cease? If so, does this mean that all development ceases, or, alternatively, that later cognitive development is so individualized or has other properties such that it cannot be described in terms of an orderly progression of universal stages? Neither alternative is very satisfying. The one disposes of developmental change for the greater part of the life span; the other proposes that development need not be stagewise. To say either we can have life without development or we can have development without stages seems quite unlike Piaget.

EVIDENCE FOR STAGES

The one point that Piaget has made most insistently is that developmental stages occur in a *constant order*. On the empirical side, the main evidence for this is that the number of children displaying a certain way of thought or kind of behavior increases with age. To show that the sequence is *universal*, the same observations must be repeated under widely differing circumstances. When such cross-cultural studies were done, and were found in the main to support Piaget's views as to the universality of cognitive stages, he was not dissatisfied. To show that the sequence is *orderly* requires a kind of work that has not yet been done on any important scale; to show that any sequence is orderly means to show that the observed sequence corresponds in some way to another sequence which is deemed orderly. Thus, growth in stature is orderly in the sense that the observed sequence of heights corresponds to a sequence of increasing numbers, i.e., age. If children grew and shrank and grew again, the way snowbanks do, we would have to look elsewhere for a criterion of order. To show that the logical structures underlying thought grow in an orderly way, we must have a method for ordering logical structures that is independent of any observations we may make of children's growth. Piaget has concentrated much of his effort on showing that the thought of the child at a given age (or stage) corresponds to a given logical model; this is something less than showing orderly growth.

A thoroughgoing empirical defense of the stage concept would require an investigation of the stability and the coherence of any hypothesized stage. To demonstrate *stability*, we would have to show that the same child exhibits the same characteristics over the period of time presupposed in the definition of the stage. Piaget has done this very impressively even if nonquantitatively in his studies of his own three children, especially in *Origins of Intelligence* and in *Construction of Reality*. But in the vast panorama of his later works, nothing resembling test-retest reliability can be found because the same child is not seen twice in one study. On the other hand, a certain estimate of stability is built into testing procedures developed by Piaget and his group. The child's initial responses to a given task are not the only evidence adduced; the child's resistance to countersuggestions is routinely tested as well. Moreover, the decision that a given child is at a given stage in the development of a concept is often not based on one narrowly circumscribed task, but on her performance on a group of closely related tasks, so that even if there is no evidence for stability over periods of time such as a week or a month, there is a kind of evidence for consistency in performance.

Another argument in favor of the stability of performance within stages emerged as a result of a series of experiments on the learning of cognitive structures, performed in Geneva in the late 1950s. A group of Piaget's collaborators conducted a series of experiments, often with great ingenuity, intended to show that the child could progress more rapidly in the development of certain cognitive structures if she were subjected to a carefully worked out training program. The results were disappointing: little or no such rapid change could be detected. But Piaget was not disappointed. These results supported his claim that the structures under discussion develop slowly and primarily through an internal process of construction, rather than representing direct and immediate copies of environmental events.

To demonstrate *coherence*, we would have to show that the same underlying logical model underlies the child's performance in widely differing tasks. Again, this requires testing the same child in different situations, which has not generally been done. Different groups of children are used in different studies, making such comparisons impossible. This leaves us with the plausible but not demonstrated inference that *if* we had tested the same child on a wide variety of tests she would have behaved in a way governed by the same logical model. If all children developed at the same rate we could, of course, substitute one child for another of the same age, and thus avoid testing the same child too often. But if, as is generally agreed, children develop at different rates or if each child shows a certain amount of unevenness in his development, such substitutions are invalid.

The unevenness of development, under the name of *horizontal décalage*, has entered Piaget's theory both as a matter of fact and of theory. On the factual side, although there has been no thoroughgoing systematic effort to define the amount of coherence a stage would need to have in order to qualify as a stage, or exhaustive empirical effort to study intertest correlations, there has been an accumulation of evidence showing that development is local, spotty, and uneven. A concept may appear in one form, but take a year or more to extend itself over its possible range. On the theoretical side, this unevenness, or *décalage*, has been used by Piaget as one explanatory principle for development: the very coexistence of the more highly developed and the less highly developed structures generates disequilibrium or conflict that leads to further growth. But how much unevenness is acceptable within a stage theory without undermining the very concept of stage?

FUNCTION IN THE THEORY

Is the stage concept an essential part of Piaget's theory? If it were essential, we would expect him, sometime in the fifty year period in which he used it, to have elaborated it at the same length and with the same care he has given to other ideas: this he has not done. It is reasonable to ask, what would remain undisturbed in Piaget's theory if the hypothesis of a single, orderly, and universal succession of stages of cognitive development were dropped? There is, of course, a great deal more to Piaget besides the stage concept, but it cannot be clear without a major theoretical effort how other parts of the theory would be affected. It seems plausible to suggest that Piaget's interactionism, his ideas of assimilation and accommodation, his recent equilibration model, the idea of progressive decentering, and his elaboration of the idea of intellectual operations—all these might stand without the stage concept. On the other hand, his search for a progression of different logical models underlying thought at different points in development and his emphasis, especially in later years, on the hierarchical growth of cognitive structures seem more closely linked to the stage concept.

Another possibility worth considering would be to weaken the definition of stage by dropping the idea of universality. Intellectual growth could be orderly and could correspond to series of logical models without following one universal developmental pathway. Piaget himself well understands that it takes a complex system of forces to maintain development on its observed course; he has borrowed Waddington's concept of homeorhesis to express this idea.* It takes only one further step, also proposed by Waddington, to recognize that development is eminently polymorphic, and that when the forces making for one choice of developmental pathway (*creode*) are not strong enough, the organism will develop in another way. This step can be taken without admitting that development is helter-skelter, subject to every wind of chance. The proposal that there is more than one *creode* available does not undermine the central idea of orderly growth.

If Piaget's stage concept be not essential to his theory, what role does it play? We propose two major functions. First, it is a descriptive tool. The biologist must first describe and classify the major forms of life before he can even raise the question, how does one form evolve into another? Piaget began his career as a biologist working in just this way. When he moved into psychology, he took this strategy along with him. Describing the stages of growth, even in a first approximation, gave him the point of departure he needed for raising the dynamic and genetic questions: how does the organism maintain its present structure and how does it change?

Second, Piaget's use of the stage concept is an expression of his remorseless anti-empiricism. During a given stage, the person does thus and so, and he can do no other. To change as a mere reaction to environmental pressure would be to violate the organized integrity of

*For a brief sketch of some of C. H. Waddington's ideas, see his chapter, "The Theory of Evolution Today," in *Beyond Reductionism: New Perspectives in the Life Sciences*, ed. Arthur Koestler and J. R. Smythies (Boston: Beacon Press, 1969).

the individual in his given stage of development. Change is a serious matter; to accomplish it the individual must reconstruct himself.

When we question the central role of the concept of a universal series of ordered stages in Piaget's theory, we do not mean to question the importance of the idea to Piaget's work. One looks in vain through his writings, all the way to 1955, for an extended discussion of the stage concept. (See Selection 43.) Even this paper is brief and does not go into very great detail. But Piaget takes the idea of stages for granted, and uses it vigorously as a framework on which to organize his findings during the whole of the 36 year period from 1923 (*"Language and Thought of the Child"*) to 1959 (*"The Early Growth of Logic in the Child"*). In the *Origins of Intelligence*, the opening chapter is a theoretical sketch of Piaget's views, recapitulated in the closing chapter of the companion volume, *The Construction of Reality*. In neither place does Piaget elaborate on the concept of stage as a theoretical idea. But throughout the body of these two great and seminal works, all of Piaget's observations are presented in the form of a series of stages. What shall we conclude: Theory is as theoretician says, or as empirical scientist does?

In the longer reaches of time over which science evolves, we may find a firmer basis for deciding whether there are fixed and universal stages of cognitive growth, whether these have sudden or gradual onsets and offsets, whether they are coherent and unitary characteristics of the intellect as a whole or uneven in their development over a rather disjointed intellect, whether they can be much modified by variations in experience, and what determines whether the individual remains in a stable phase or undergoes a period of change. Meanwhile, without our having firm answers to any of these questions, Piaget's work stands as a major landmark in the history of knowledge, because within the framework of the unexamined concept he has given brilliant description one after another of the changing intellect of the child.

Piaget's Theory of Intellectual Process

By this time the reader may well believe we are arguing that Piaget's theory is unimportant and only his observations matter.* Not at all. We propose only that other parts of Piaget's theory are far more important than the stage concept, and we hope to draw the reader's attention to them. Piaget offers a theory of *how* the intellect grows: at any point in its development, it may be described as a set of organized structures or schemes; as the individual encounters his world, he assimilates objects and events to these structures (thus they function and expand without structural change); when this is not possible because the existing structures are inadequate, they modify themselves or accommodate

*In Piaget's view this would be almost a mortal sin, since he has devoted so much of his energy to the struggle against just such an empiricist view of the growth of knowledge, both in the child and among scientists.

(thus they undergo structural changes). At first the child is unaware of himself or the world or the distinction between them, but he becomes increasingly aware, and finally conscious of and capable of reflecting upon his own intellectual processes; thus he gains a new level of command over his thought and its growth. There is much more to the theory, but we refrain from expanding on it here. Throughout this volume there are theoretical passages which we have not slighted in our selection.

Here we wish only to stress the point that for Piaget the growth of the intellect, rather than something that happens to the child from the outside, is a process of self-construction, governed by existing formations of cognitive structures. To be sure, it happens in relation to the world, and it is a process that has evolved in such fashion that its results are biologically and socially adaptive; the world plays its regulative function. But it is not a matter of stimulus and response, push and pull. Rather, environmental events are assimilated as well as they can be to existing structures, chewed over and digested, and, finally, only occasionally do they result in fundamental changes in such structures.*

Piaget is not the only case in the history of science where great theoretical interest attaches to the interplay between the description of fixed entities, such as species or stages, and the process of change. Darwin, in developing the theory of evolution, had to use as his point of departure whatever was already known about species, especially as organized in a masterly array by his great predecessor, Linnaeus, a century before. Marx, in developing his theory of social change and the functioning of the capitalist system, drew on what was known of the major stages in the evolution of economic forms. Both Darwin and Marx had to argue against earlier theories of change in which a fixed order was given in a metaphysical law of progress. There were evolutionary theorists before Darwin who believed that the explanation of evolutionary change lay simply in a tendency toward progress inherent in the natural order (and perhaps preordained by the Creator). Darwin's alternative was that change grows out of the functioning of the system of living things as it is.†

Similarly, there was a current among nineteenth-century social theorists to explain history as a series of necessary and foreordained economic stages (such as food gathering, pastoral, slavery, feudal, bourgeois, socialist, and so on). Like Darwin, whom he greatly admired, Marx argued that social change grows out of the struggles inherent in the existing social order: "*History* does *nothing*, it possesses no immense wealth, it wages no battles. It is *man*, real living man, that does all that, that possesses and fights; 'history' is not a person apart, using

*There is some room for discussion as to whether Piaget believes that change is continuous or sporadic. In our view he makes a distinction on this score between assimilation and accommodation: "assimilation, the fundamental fact of psychic development," he writes in his theoretical introduction to the *Origins of Intelligence* (p. 42); we believe he treats assimilation more thoroughly than accommodation and regards it as more fundamental. Maybe it is true that in some sense it is more characteristic of an organism to go on functioning as it has done, to preserve its identity, than it is for it to change.

†See Howard E. Gruber, *Darwin on Man: A Psychological Study of Scientific Creativity together with Darwin's Early and Unpublished Notebooks*, transcribed and annotated by Paul H. Barrett (New York: E. P. Dutton, 1974).

man as means for its own particular aims; history is *nothing but* the activity of man pursuing his aims."*

Freud, in developing his theory of the growth of personality, postulated a series of psychosexual stages (oral, anal, phallic, latent, genital), which he then proceeded to explain by a group of psychodynamic principles. It is instructive in Freud's case that one can separate his stage theory from his psychodynamics. We have been suggesting that the same is true of Piaget. But there is a difference. Freud's theory of psychosexual stages was a rather long-range inference about children, based on his work with adult patients.† Piaget's theory of cognitive stages is based on years of work with the children to whom it refers. We may also note that Darwin did not have to assemble the evidence for the existence of species or to construct a taxonomy *de novo*, nor did Marx have to demonstrate the existence of different social forms and classes. Thus, Piaget had a truly Herculean labor to perform: he had to discover and describe the very rudiments of the course of cognitive growth at the same time as he developed a theory to explain it.

One has only to compare Piaget's efforts with others of similar intent to see how much needed to be done. Piaget succeeded in transforming each of the Kantian categories of knowledge from a first principle into a subject of scientific investigation to which he contributed the first significant monograph. Enormous energy, persistence, and the privileged position of a university professor were important requirements, but by no means enough to explain his feat. Piaget was guided by certain abiding philosophical and biological concerns that gave him the sense of abiding purpose that was indispensable for the task.

Structures and Operations

It is the great task of science to search for unifying descriptions and explanations, to illuminate likenesses that underlie apparent differences in the manifold of nature. There are three great stategies of search: to look for laws, elements, or structures. Our knowledge of the laws of physics, the elements of chemistry, and the structures of biology represents the fruits of such efforts. Of course, the three strategies are not kept in separate portfolios, to be brought out exactly as needed. As we begin to explore a domain of nature, we do not know what to expect or how to proceed, what strategy or combination of strategies will be most helpful. There is, moreover, a constant interplay of strategies. For instance, the gas laws (relating pressure, volume, and temperature) are general laws that describe the behavior of quantities of gas in closed

*Karl Marx, *The Holy Family*. Quoted in *Marx in His Own Words*, ed. Ernst Fischer (Harmondsworth, Middlesex, England: Penguin Books, 1970), p. 87.

†This is not intended as a deep criticism of Freud, since he was not primarily interested in children, and wanted mainly to use the stages to help develop his psychodynamic ideas.

containers, but these quantities are made up of elementary particles or molecules, and when we understand the nature of these elements, we understand why the gas laws must be modified in significant ways. But what do we mean by the "nature" of an element? In good part, its internal structure.*

In the social sciences, nothing is as familiar as Adam Smith's law of supply and demand. This is quite similar to the gas laws in that it describes the reciprocal relationships between variables that determine the form of a complex event, the fluctuation in price of a commodity. But the elements in this process are the individual buyers and sellers, and their social and psychological characteristics must be examined if we are to understand the conditions under which the law operates. Furthermore, these individuals are not isolated human particles who just happen to be brought together in a container called the market place; they are part of a complex social structure, a class system with a certain distribution of rights of property and exploitation, institutions of education and law enforcement to ensure that individuals play their roles within the system. Without all this the market would not function as it does. Thus, law, element, and structure are indissociable.

Nevertheless, in the work of an individual scientist or of a group in a particular epoch, we may find a penchant for one or another strategy. Piaget is widely known as a structuralist, but his structuralism takes a specific and interesting form. To understand it, it will be helpful to examine the theoretical scene in psychology and to distinguish Piaget's concern for structures from others.

Psychology as an organized science got its start in the middle of the nineteenth century and was less than a century old when Piaget began his psychological studies in Paris in 1921. During the period about 1875–1925 one of the dominant currents of thought was an introspective variety of elementarism: first find the elementary sensations of which experience is composed, then see how more complex structures are built up from these elements.

Beginning about 1912, Gestalt psychologists, challenging the very existence of such elementary sensations, argued that experience occurs as structured wholes and that the task of psychology is to study the properties of such wholes. The properties to search for are those underlying invariants that help to explain why experience is not a chaos of diversity, but has organization, unity, stability. Consider the problem of spatial orientation: why does an object ever appear stable and upright? At any one moment, depending on the position of the head, it may stimulate this or that set of retinal receptors, or "elements," which may or may not be aligned with a major bodily axis. Yet the object does not seem to change its orientation with every movement of the head. What remains *invariant* is the relation of the object to its background, in

*The approach which we have called *introspective elementarism* has sometimes been called *structuralism*; among its leading exponents were Wundt at Leipzig and Titchener at Cornell; it is not to be confused with the contemporary movement known as Structuralism, with which we deal below. The latter began its rise to prominence early in this century and includes such figures as Ferdinand de Saussure in linguistics, Nicolai Bourbaki (pseudonym for an intellectual collective) in mathematics, and Claude Lévi-Strauss in anthropology.

particular to the major lines of the visual field. Such invariants are structural properties of the total perceptual configuration, not any localizable element or set of elements. There is no need to invent elements out of which structured experiences are built; experience is structured in the first place.

Piaget, in his interest in psychological structures, has much in common with Gestalt theory. Indeed, his summaries of it are sympathetic, full, and accurate. But he has one central criticism: the lack of concern for the genesis of the structures under discussion. Thus, in the example given above, Piaget's research has focused on the emergence in the child's thought of the operation of a coordinate system or frame of reference with respect to which things may have an invariant orientation. There would be no necessary contradiction between these two approaches, if these perceptual invariants did not change with age; we might simply have two independent systems of knowledge, conceptual and perceptual. But Piaget has given considerable effort to show that the developing concepts do indeed control the perception of space. In this sense, Piaget is not merely concerned with structures, he is structural*ist:* he wants to show the general regulative functions of structures, their pervasiveness in controlling experience and action, and the psychological coherence of the individual as the expression of a few very general structures.

To sum up this historical movement of ideas, the elementarists said, "from elements, structures," the Gestaltists answered "no elements, only structures," and Piaget rejoined, "out of structures, new structures."

In spite of his kinship with Gestalt psychology, there are some important differences. Piaget's structures are not things or beliefs, but coherent sets of mental operations which can be applied to things or beliefs or to anything else in the individual's psychological space. For example, the belief in the conservation of matter when shapes are deformed is not, in this sense, a "structure." Rather, the set of operations by which this belief is arrived at is a structure. Piaget does not claim that 8-year-old children all over the world spontaneously discover the conservation of matter; rather, they develop a set of operations that permits them to make this discovery when presented with a problem that can be solved if they do so. What matters is not a particular set of beliefs but a general set of operations.

A second special character of Piaget's structuralism is concern for change. He is not only interested in showing that, at each stage of development, a great variety of acts express the same structure; he is also interested in the way in which structures are transformed from stage to stage. He has given fuller attention to and been more successful at the first of these tasks. But there is no questioning that his aim is a developmental or genetic structuralism. In this respect his intentions are quite distinct from the contemporary structuralist movement that explicitly avoids genetic or historical explanations, choosing instead to elaborate ahistorical analyses of structures as they are at a given moment or period.

If the introspective elementarists were attacked from "above" by Gestalt psychologists, they were at the same time attacked from "below" by behaviorists. Behaviorism is in its own right an outstanding form of elementarism, hoping to explain complex behavior as the chaining to-

gether of simpler habits. The introspective elementarists were mentalists in the highest degree: the task of psychology was to explain mental life, and the method was to examine it directly with the tool of mentation itself, trained introspection. The Gestaltists were also interested in mental life and certainly used a type of introspection, or direct examination of experience as one of their tools. But they were also prepared to study the functioning of the intellect by the observation of behavior. One of the great classics of Gestalt psychology is a study of the problem-solving behavior of primates who could not at that time report to psychologists about their inner lives.*

The behaviorists, as is well known, would have none of this. The whole project of describing inner experience seemed unscientific to them: science deals with observable events, all we can observe and study directly is overt behavior, therefore scientific psychology must restrict itself to the study of behavior. "Inner experience," "consciousness," and all other subjective phenomena have no place in science.

Piaget has rarely bothered to criticize the introspective elementarists. He had no quarrel with their mentalistic aims, and, besides, by the time his career in psychology began, the importance of this school of thought had faded considerably. Why then has he often stopped to criticize the claims of behaviorists? Not to defend his interest in mental life. On the pragmatic American scene that might have seemed necessary, but not in the heart of Europe. We think there are two reasons for Piaget's interest in behaviorism, its focus on action, which Piaget shares, and its empiricism, which he loathes.

First, Piaget's own theory and behaviorism both begin with interest in action. Theoretically, both begin with the simple reflexes of the newborn and aim at explaining development by studying the developmental fate of these reflexes. From this point on, the theoretical differences are profound. Behaviorists aim at explaining all behavior as the modification of simple reflexes through the formation of habits, and the chaining together of these elements to form more complex units of behavior. It would be incorrect to say that behaviorists are not interested in structures, since chains and simple hierarchies are certainly structures; but they are structures of such primitive kind as practically to bypass the problem of organized, complex behavior.†

In Piaget's approach, the units of behavior, or schemes of action, are always seen as evolving structures. Thus complex behavior is not built up out of simple elements that retain their identity; instead, structures grow and change. Insofar as they are hierarchically organized, lower structures are governed and regulated by higher ones: rather than the primordial dominating the more highly evolved, the reverse is the case. Finally, Piaget's concern has always been to show how action is interiorized, transformed into mental life, and he insists that in the course

*W. Köhler, *The Mentality of Apes* (London: Routledge and Kegan Paul, 1925).

†This description of behaviorism is somewhat oversimplified and does not do justice to certain modern trends. See, for example, D. Berlyne, *Structure and Direction in Thinking* (New York: Wiley, 1965) for an explicit attempt to integrate behaviorism and Piagetian theory. See also Piaget's commentary on Berlyne's efforts in D. Berlyne and J. Piaget, *Études d'Épistémologie Génétique XII: Théorie du comportement et opérations* (Paris: Presses Universitaires de France, 1960).

of this transformation action becomes qualitatively distinct from its primitive origins. As actions become operations, they form structured groups that give to thought its flexibility, its versatility, its ability to deal with novelty, its creativity.

In some sense everything has a structure. If we wanted to develop a theory pertaining to a unique structure, unlike any other, it would have to be an analysis of the elements composing the structure or an account of the laws linking the variables within the structure. The third alternative, comparing the given structure to some ideal structure, necessarily admits the existence of more than one structure. Piaget's way has been the structuralist way, comparing structures with each other, in the first place to show the underlying similarities among seemingly different intellectual acts, and in the long run hopefully to discover the laws of transformation governing the relationships between structures.

The stage concept is necessarily linked to the idea of structure. Whatever we mean by a stage in the development of anything must be a set of relations prevailing at one time. But this is not enough to separate stage from flux. The set of relationships must be stable.*

Since we are talking about mental operations, or an activity of an organism that is always changing, we mean something more general than a single, frozen structured act. We mean the similarities or correspondences among different acts. That is why we can speak of the structure as underlying or regulating the acts in question.

A key feature of the kind of structure we are discussing is its coherence and unity: there is one set of rules for passing from state to state, and any transformation or series of transformations that follows these rules is an expression of the structure. Unless the intellect as a whole is completely coherent at each stage of development, we cannot expect to find a clearcut set of stages (series of structures) without delimiting the domains to which the structures apply.

This leads directly to another consideration, the distinction between structure and system. Suppose we find that there are a number of distinct structures coexisting at any moment of development. These coexist in one individual, and they must have some relation to each other. One possibility is to search for a more general structure, of which each of the seemingly distinct ones is but an expression. The effort to exhaust this strategy, to carry it as far as possible, is the heart of the movement known as *structuralism*.

An alternative strategy is to accept the structures as different and to search for ways of understanding their interconnections; this approach is characteristic of a movement known as *systems theory*. As we discussed above in another context, scientific theories are rarely pure cases of any one strategy. Moreover, the approaches in question are not contradictory but complementary, and we may expect to find an individual scientist using first one then the other. But it is fair to describe Piaget as a structuralist rather than a systems theorist. To take only one example, when Piaget turned his attention to mental imagery and

*This might be enough to say if we could restrict ourselves to a series of stages of long duration. The notion of a brief stage (the measure of brevity depending on the time scale we are using, which is not the same for the life of both a subatomic particle and a child) really depends on our ability to show that it appears reliably within a series of more stable structures.

memory, he did not delight in showing how different these are from logical thinking, and then seek to understand the relations among these functions. Rather, he sought to demonstrate that at each stage the child's imagery and memory express the same logical structures as had been found earlier in his studies of the child's thinking.*

It might reasonably be objected here, that Piaget did not seek to demonstrate, but attacked a problem objectively, and these were his empirical findings. This objection is not entirely available to Piaget himself, since he has strenuously criticized the empiricist view of science. The finding of some similarities, of course, does not conflict with the finding of some differences. The similarities in question were genuine discoveries, and this work is a good example of the fruitfulness of Piaget's approach. At the same time, it should be noted that he did not seek out whatever differences may exist between these functions precisely because he is a structuralist rather than a systems theorist.

The suggestion that a general point of view, such as structuralism or systems theory, may be a causal agent affecting the work of a scientist is compatible with either of the approaches under discussion. Put more generally, the two have one key point in common, the idea of self-regulation; this applies as much to the mind of a scientist as it does to the behavior of any other living system.†

Interaction, Construction, and Logical Determinism

No issue touches the thinking person more deeply than the relation of the individual to the world. Discussion takes many forms and gives rise to a number of questions, the answers to which never quite seem to stay put. The role of the individual in history, the individual's place in the family, and the relative contributions of heredity and environment in determining intelligence—all these raise questions that bear on one's general conception of the relation of organism and environment.

Piaget's approach to the general issue has been open to some misunderstanding. His insistence on the slow development of fundamental concepts and operations has sometimes been interpreted as meaning that the child "learns" these things primarily through commerce with the environment: stimulus evokes response, and, depending on the outcome, future response tendencies are altered, habits built up, but slowly. This is the position Piaget labels "empiricism," and he is very far from agreeing with it. To return to the example of the conservation of matter, what evidence could the child possibly have that amount remains the same when shape is deformed? No one talks about it, or

* A similar point can be made with respect to Gestalt psychologists, who have stressed the likenesses among different mental functions, such as perception, memory, and thinking. For them, perception plays the role of the central metaphor; for Piaget, logic plays that role.

†As will be especially evident in the final section of this volume, Piaget lays great stress on the idea of self-regulating systems. But systems theories aim to do more than that.

tells her, or asks her about it, or rewards her for giving the right answer. Even more implausible is the suggestion that the child learns the reasons she gives to defend her answer; if we could believe that the child learned the right answer, how would we explain where she had gotten the wrong answer and reasons, only a few months before? When we turn to the history of science, as Piaget is fond of doing, we see many examples of resistance to evidence because it does not fit into previously constructed ways of thought. Why, then, credit the child with a facile empiricism, readily fitting thought to experience?

If Piaget has been persistent and relentless in his criticism of empiricism, how does it happen that he remains open to this interpretation? The plain fact is, as he admits, that he has never succeeded in giving a satisfactory explanation of the production of a novel response. This leaves an opening for the application of an old and almost intractable thought-form: if a pattern of responses changes slowly, it must be due to learning.

Piaget has not only insisted on the slowness of development, but on the universality of its main stages. Since children grow up in such varied environments, the question arises, how can they all develop in the same way unless they are impervious to environmental influences, in other words, unless development is determined by hereditary factors? This is the position Piaget labels *preformism* when it refers to matters of general biology, and *apriorism* when it refers to the growth of intelligence.

Every study Piaget has ever made of children's concepts and mental operations shows how far the child's mentality is from being preformed in adult ways of thought, how he must during his own lifetime reinvent these ways. What the child brings to the world makes this growth possible, but the child himself must accomplish it through his own activity.

Nevertheless, if children everywhere do this in much the same way, does it not support the idea that development is an unfolding of inherent structures that are incipiently present in the germ plasm? And is this not a sort of apriorism, only extended over time?*

Piaget has been vulnerable to this interpretation of his work because of his insistence on the universality of stages. It would seem incumbent on the interactionist to produce evidence that commerce with the environment does affect the course of development. For this reason, in the 1950s, studies of the learning of Piagetian concepts and operations came to occupy an important place in the theoretical discussion. We have already mentioned the first group of such studies. To say the least, they demonstrated that it is not easy to invent a way of accelerating the child's movement through the stages of cognitive growth, existing structures resist change, the child's mind is no direct copy of the external reality presented to him by experimenter or teacher.

Insofar as this result supported Piaget's anti-empiricism, it seemed quite satisfactory. But it did leave the way open to the "unfolding" interpretation. In recent years, there has been a concerted effort in many quarters to show that Piagetian concepts and operations are indeed

*For an account of the vicissitudes of the same kind of question in another discipline, during the eighteenth and nineteenth centuries, see J. Needham, with the assistance of A. Hughes, *History of Embryology*, 2nd ed. (Cambridge: Cambridge University Press, 1959).

amenable to change through learning experiments. And modest results have now been achieved. So long as the experiment is planned in ways that respect the child's existing structures and elicit the child's own intellectual activity, some acceleration of growth can be achieved.* Since no one actually believes that it is possible to transform a young child overnight into an adult, modest effects are theoretically satisfactory. It should be added, however, that acceptance of this point implies a tacit acceptance of much of the structuralist approach.

To contrast it with empiricism and apriorism, Piaget has sometimes labeled his own position *interactionism.* But this term has often been used in a sense which does not quite fit Piaget. Hardly anyone who considers the subject goes to either extreme: it is widely accepted that the child's mentality is neither entirely inherited nor entirely determined by environmental forces. A compromise seems in order, and the question is then transformed: what are the proportionate contributions of heredity and environment in the determination of intelligence?† Someone formulating the issue in this way may well call himself an interactionist.

This formulation has at least two aspects that are entirely unacceptable to Piaget. First, the idea that intelligence is an "amount" that can be measured, rather than a structure which must be described and whose functioning must be understood. Second, the idea that heredity and environment are, for each individual, fixed components that determine the intellectual outcome without affecting each other, rather than vectors whose developmental significance changes incessantly, depending on the structures already achieved.

There are two features of Piaget's approach to the environment that, although not unique in Piaget, are characteristic of him and worth pointing out. The environment is not conceived as something that "happens" to the child, not a stimulus that elicits a response. Rather the child seeks out those features of the environment to which he can meaningfully respond, both by assimilating them to existing structures and by accommodating those structures to make continued assimilation possible. The initiative belongs to the child.

The ordinary conception of the environment as determining behavior rather than behavior determining the environment is an extreme expression of a commonplace adult achievement, that highly cultivated paralysis summed up in the phrase, "I only followed orders." We must admit that this is a state that can be attained, but it is not typical of childhood.

For Piaget, moreover, the environment is "nonspecific." One does not need clay balls or jars of water to learn about conservation. The materials are everywhere and unavoidable; clenching and unclenching the fist is just as good as flattening out a ball of clay. But even such simple events are so rich, so open to varied logical structurings that it is the child who sees in each experience that which he can draw upon for his growth as it must be at that moment.

Piaget has sometimes labeled his position *constructivism*, to capture

*For an account of work in this vein conducted in Geneva see B. Inhelder, H. Sinclair, and M. Bovet, *Learning and the Development of Cognition* (Cambridge: Harvard University Press, 1974).

†More precisely, what are the proportionate contributions of *variations* in heredity and in environment to variations in intelligence.

the sense in which the child must make and remake the basic concepts and logical thought-forms that constitute his intelligence. Piaget prefers to say that the child is inventing rather than discovering his ideas. This distinction separates him both from empiricism and from apriorism. The ideas in question do not preexist out there in the world, only awaiting their discovery by the child: each child must invent them for himself. By the same token, since the ideas have no a priori external existence, they cannot be discovered by simple exposure; rather, they must be constructed or invented by the child. Thus, Piaget's book dealing with the growth of the concepts of object, space, time and causality in the first year of life is not called *The Discovery of Reality*, but *The Construction of Reality in the Child.*

But we do not think the term constructivism goes far enough in characterizing Piaget's position. It is possible to believe that the child constructs his own mentality through his own activity without any preoccupation whatsoever with the development of logical structures underlying intellectual life. Indeed, this describes the romantic ideal of many progressive educators. There is something more austere in Piaget's constructivism. It goes beyond mere logicism, or the attempt to characterize each stage of development by a logical model. He proposes that the functioning of the logic of each stage determines the structure of the stage that follows. Without wanting to engage in a neologistic tournament, we suggest that the term *logical determinism* captures this essential aspect of Piaget's thinking. Interactionism, constructivism, logical determinism—to summarize the entirety of his position Piaget has come to call it *genetic epistemology.*

If learning were very fast and our resulting image of the world a very accurate copy of an unambiguous reality, we would all be empiricists. If there were no learning at all, whatever intelligence we possessed could be due only to preformed structures, and we would all be apriorists. The conception of learning therefore occupies a strategic role in discussions of the relation between organism and environment, and it is important to understand what Piaget has done with it. First, he has defined learning as having only a limited role within a larger process of the functioning and growth of structures. Second, he insists that learning of specific behaviors or contents can only take place within existing structures: the individual's action upon the world is itself the operation of a structure, and in the process he assimilates new information to that structure, which sometimes requires changing the structure. Third, structures grow according to laws which are not given in the behavioristic associationism of stimulus-response psychology, or in the Gestalt laws describing the direct perception of an organized world. The function of cognitive growth is not to produce schemes that are more and more veridical copies of reality, but to produce more and more powerful logical structures that permit the individual to act upon the world in more flexible and complex ways.

Having said this much, let us reexamine a problem that has suffused and troubled this whole discussion. To arrive at a comfortable alternative to preformism, is it really necessary to demonstrate empirically that Piagetian stages are affected by variations in the environment? Biologists do not need to raise some children in an oxygen-deficient environment in order to demonstrate that the blood carries

oxygen all over the body, and that the complex of mechanisms for the formation of blood and assimilation of oxygen is indispensable for normal development.

Similarly, it is at least possible that there are some aspects of intellectual growth that are both indispensable for normal functioning and dependent for their development on properties of the environment that are to be found everywhere on earth. It is hard to imagine a planet that could support life that did not have permanent objects, and it is equally hard to imagine a high level of intelligent functioning (e.g., mammalian?) without the idea of the permanent object.*

If you were a scientist interested in studying the growth of ideas, generally speaking it would make sense to begin by studying fundamental ideas rather than trivial ones. What is a fundamental idea? Indispensability would seem to be one of its more evident characteristics. Piaget followed an almost unique path in choosing what he hoped were fundamental concepts and operations for study, stepping outside of psychology and relying heavily on a certain philosophical tradition for guidance.† To the extent that he was successful in his choices, it would be difficult to demonstrate that the variables of growth he has chosen are accessible to environmental manipulation.

This is not to say that confirmed interactionists, Piaget among them, do not ultimately face the task of specifying the way in which the environment influences development. But one can imagine two quite different strategies for attacking this problem. At a primitive stage of science, techniques of measurement are crude, and it may be extremely difficult to detect variations in fundamental organs, concepts, operations: the basic requirements of development make such variations small. If we insist on searching for small and subtle effects in such fundamental variables, we must expect many failures.

An alternative strategy is to choose as objects of study things that obviously vary, even if they are not so fundamental. At first sight, this approach looks trivial (like the story of the drunk who looks for his keys under the lamp post, where the light is, rather than twenty yards away where he dropped them in the dark). Yet in biology it has yielded high rewards. Geneticists interested in mutations were willing to study *any* detectable mutation; one that could be produced at will by environmental manipulation would be a geneticist's dream (and would have no simple bearing on the nature-nurture dispute!) whether it affected the formation of the blood itself or only the most trivial morphological characteristic.

No psychologist worth his salt would use the preceding remarks to justify entirely abandoning the study of the interplay of organism and environment with regard to fundamental intellectual characteristics. Certainly Piaget has not done so. Only, at the present stage of scientific knowledge it may be that such study can best be pursued at a theoretical level. In any event, it must be admitted that the variational method that has characterized all empirical efforts thus far, while it has produced a

*See Selection 20 for Piaget's examination of object permanence.

†No one can read Piaget without thinking of Kant. He is not, of course, Kantian in his solutions, but a very considerable portion of his work has gone into studying the development of just those fundamental ideas that Kant identified and claimed were given a priori.

few interesting results in these last twenty years, has nothing staggering to show.

To take one last leaf from the biologist's notebook, what sort of approach could we hope for in studying organism-environment relationships with regard to well-protected fundamentals? A method that produced some very easily detectable effect *without* disturbing normal functioning or development would be ideal. The use of isotopic tracers comes to mind as a plausible analogy. Thus far, psychologists have not approached the subject in this way and have no similarly subtle tools at their disposal.

In closing this introduction we return to a point made in the Preface, the collaborative aspect of Piaget's work. From a very early age, even as an adolescent in *Le Club des Amis de la Nature*, Piaget presents the double aspect of the lonely intellect going his own way and the social being, seeking out others for real collaboration, and still others on whom to try out his ideas. His first psychological book, *Language and Thought of the Child*, was accomplished with the aid of 6 collaborators. The pursuit of discussion has often led to public controversy with other scientists; a few well known names that come to mind are Vygotsky, Wallon, Michotte, and Bruner—a Russian, a Frenchman, a Belgian, and an American.

As Piaget's career developed, or rather, as he constructed it, he evolved a characteristic style of working with assistants and other collaborators. This is most evident in the functioning of the Centre International d'Epistémologie Génétique, founded in 1955. Each year Piaget selects the topic to be investigated. Through a process of discussion, involving a large amount of give and take, the details of up to 20 specific experiments are worked out. These are discussed incessantly while being executed throughout the year by the resident members of the Centre, working in small groups which report frequently to the larger group and even more frequently to "Le Patron." At the end of the academic year, at an annual Symposium, the same work is once more presented, now in nearly finished form, and discussed with a group of invited participants. Most of these visitors are habitués, who return to Geneva periodically—not only for the Symposium, but for their own purposes, to help think through some of their own intellectual problems in fields as varied as biology, philosophy, education, physics, psychology, logic, mathematics, and the history of science.

It is this complex, multi-layered process of socialized reflection and explanation that gives the work we call Piaget's its full complexity, its somewhat involuted character, its extraordinary variety. After the Symposium, Piaget retires to a mountain retreat for a summer of writing. It is he who produces the final synthesis of all this discussion and empirical research. This too takes a double form. On the one hand, it is a factual account of the research. On the other hand, it is an exploration of ideas, a restructuring of the *problematique* as Piaget sees it. The research has not necessarily produced any definite answers, but it has certainly changed the questions.

Summary

There are at least three Jean Piagets. There is the austere theoretician, turning the thought of children into formal constructions of logic. There is the playful empirical scientist, who led a whole generation of psychologists into a new way of listening to children. There is the doubter, driven onward to new research by the feeling that he has not yet explained the emergence of novelty, which must lie at the core of any account of the growth of thought.

To know only one of these is not to know Piaget. One must persevere through the logical and other theoretical difficulties, listen to the children, and let some of the same questions take hold. And in reading Piaget, it is important to stop often and try to work out some of the ideas for yourself: ". . . real comprehension of a notion or a theory implies the reinvention of this theory by the subject."*

Note: In citing Piaget's works, we have used a shortened reference form. For complete citations the reader should consult the Bibliography of Piaget's works at the end of this volume.

*J. Piaget, "Comments on Mathematical Education," in *Developments in Mathematical Education, Proceedings of the Second International Congress on Mathematical Education.*

CHRONOLOGY

Our introduction to this volume is a discussion of issues, rather than a biographical sketch of Piaget's life. The reader can, however, easily discover that the book as a whole *is* such a sketch. As a life-long intellectual, all the important events in Piaget's life are intellectual acts. The table of contents of this volume, and the introductions to the selections, add up to a tolerably full account. For more biographical detail the reader should turn to Piaget's own brief autobiography.*

1896: August, 9: birth in Neuchâtel (Switzerland) of a first child and only son, Jean, to Arthur and Rachel Piaget. He has two younger sisters.
1907: First article on an albino sparrow.
1918: Doctor of Natural Sciences with a thesis on molluscs presented at the University of Neuchâtel.
Publication of *Recherche*, a novel.
1919–1920: Studies in psychology in Zürich under Lipps and Wreschner for experimental methodology and measurement and under Bleuler for psychiatric clinic.
Studies and practicum in Paris at the Alfred Binet Institute.
Publication of a paper on psychoanalysis.
1921: Director of studies (Chef de travaux) at the Jean-Jacques Rousseau Institute in Geneva.
First articles on cognitive child psychology.
1923: Married to Valentine Châtenay.
Publication of *The Language and Thought of the Child.*
1924: Publication of *Judgment and Reasoning in the Child.*
1925–1929: Professor of psychology, sociology and philosophy of sciences at the University of Neuchâtel.
1925: Birth of daughter Jacqueline.
1927: Birth of Lucienne, the second daughter.
Publication of *The Child's Conception of Physical Causality.*
1929–1939: Associate Professor of History of Scientific Thought at the University of Geneva.
1929–1967: Director of the International Bureau of Education.
1931: Birth of Laurent, a son.
1932: *The Moral Judgment of the Child.*

*See bibliography, this volume, pp. 447–450.

1933–1971: Director of the Institute for Educational Sciences of the University of Geneva.
1936: *The Origins of Intelligence in Children.*
1937: *The Construction of Reality in the Child.*
1938–1951: Professor of Psychology and Sociology at the University of Lausanne.
1939–1952: Professor of Sociology at the University of Geneva.
1940–1971: Professor of Experimental Psychology at the University of Geneva.
1941: *The Child's Conception of Number* with Alina Szeminska.
1942: *The Child's Construction of Physical Quantities* with Bärbel Inhelder.
1945: *Play, Dreams and Imitation in Childhood.*
1946–1948: Books on the child's representation of movement, speed, time and space.
1949: *Traité de logique.*
1950: *Introduction à l'épistémologie génétique.*
1952–1963: Professor of Developmental Psychology at the Sorbonne.
1955 to present: Director of the International Center for Genetic Epistemology (University of Geneva).
1967: *Biology and Knowledge.*
1971: Professor Emeritus of the University of Geneva.
1975: *L'Equilibration des structures cognitives.*

The idea of equilibrium first appeared explicitly in Piaget's writings in *Recherche* (1918). Much later, it became the subject of a monograph, *Logique et Equilibre* (1957). Still later, dissatisfied with his previous efforts, Piaget reworked the whole subject in *L'Equilibration des structures cognitives: problème central du développement* (1975). The following year, he proposed to present this volume as his thesis for a doctorate in psychology, which he had never received. The officials of the University of Geneva refused him this privilege, but graciously, on the grounds that a man of Piaget's breadth should not be classified in any one discipline. Nevertheless, in honor of his eightieth birthday, it was arranged that the new volume on equilibration should be the theme of a day of reflection.

PART I

Early Biology