

due of the auditory impression serving as the name of the object taken to have caused the visual impression. There are notorious problems in working any of this out, crucially, the problem of how we can have sensory experience uninformed by conceptual judgment.⁴⁴ That this is possible has often been denied, by seventeenth-century Cartesians for example. Schopenhauer, who develops a post-Kantian version, attributes this view to "the ancients," citing for example "the famous verse of the philosopher Epicharmus": "Only the mind can see and hear; everything else is deaf and blind."⁴⁵ But suppose that we put these problems aside. Then the empiricist paradigm can serve as an example of the shaping effect of the environment on knowledge, furthermore a case in which there is some sort of "resemblance" between what is in the mind and what it perceives.

Suppose, in contrast, that certain environmental conditions are required to set in operation an intrinsically determined process, as nutrition is required for cellular growth to take place in predetermined ways. It has been reported, for example, that handling of rats induces lateralization for spatial and affective processes.⁴⁶ In such cases, the processes that take place are not shaped by the environment; they do not reflect the course of interchange with it or somehow "resemble" the stimulus, any more than a child is a reflection of the food he eats. When external conditions are necessary for, or facilitate the unfolding of, an internally controlled process, we can speak of their "triggering" effect. If institutionalized children do not learn a language, the reason may be that a crucial triggering factor, appropriate social interchange, is lacking, as in the case of Harlow's deprived monkeys; but we would not therefore say that attention, care and love shape the growth of language in the sense that a schedule of reinforcement shapes the behavior of a pigeon. The

distinction between the two kinds of effects of the environment is not sharp, but it is conceptually useful. My own suspicion is that a central part of what we call "learning" is actually better understood as the growth of cognitive structures along an internally directed course under the triggering and partially shaping effect of the environment. In the case of human language, there evidently is a shaping effect; people speak different languages which reflect differences in their verbal environment.⁴⁷ But it remains to be seen in what respects the system that develops is actually shaped by experience, or rather reflects intrinsic processes and structures triggered by experience.

Returning to the analogy to the physical body, we take for granted that the organism does not learn to grow arms or to reach puberty—to mention an example of genetically-determined maturation that takes place long after birth. Rather, these developments are determined by the genetic endowment, though the precise manner in which the genetic plan is realized depends in part on external factors, both triggering and shaping. For example, nutritional level can apparently affect the time of onset of puberty over a considerable range. As the biological plan unfolds, a system of interacting organs and structures matures—the heart, the visual system, and so on, each with its specific structures and functions, interacting in largely predetermined ways.

Our biological endowment determines both the scope and limits of physical growth. On the one hand, it permits the growth of a complex system of highly articulated physical organs, intrinsically determined in their essential properties. Were it not for this highly specific innate endowment, each individual would grow into some kind of an amoeboid creature, merely reflecting external contingencies, one individual quite

unlike another, each utterly impoverished and lacking the intricate special structures that make possible a human existence and that differentiate one species from another. Our biological endowment permits a vast potential for development, roughly uniform for the species. At the same time, it in fact narrowly limits what each individual can become; the human embryo presumably cannot become a bird by modification of the external environment. Scope and limits of development are intimately related. Innate factors permit the organism to transcend experience, reaching a high level of complexity that does not reflect the limited and degenerate environment. These very same factors rule out many possible courses of development and limit drastically the final states that can be attained in physical growth.

Now all of this should be transparent and hardly controversial. Apparently very little is known about how any of it happens, but no one really doubts that something of this sort is roughly true. If it were proposed that we "make" our physical constitution, or are "taught" to pass through puberty, or "learn" to have arms rather than wings, no one would take the suggestion very seriously, even in the present state of ignorance concerning the mechanisms involved. Why is this so? Presumably, the reason derives from the vast qualitative difference between the impoverished and unstructured environment, on the one hand, and the highly specific and intricate structures that uniformly develop, on the other. In essence, this is a variant of a classical argument in the theory of knowledge, what we might call "the argument from poverty of the stimulus." Socrates' success in eliciting knowledge from the slave boy is a classical example. To take a variant of this argument that seems to me quite relevant to contemporary concerns, consider Descartes's

argument for innate ideas in the perceptual domain. Descartes argues in the *Dioptrics* that

there is no need to suppose that anything material passes from objects to our eyes to make us see colors and light, nor that there is anything in these objects that is similar to the ideas or the sensations that we have of them: just as nothing moves from the objects that a blind man senses that must pass along his stick to his hand, and the resistance or the movement of these bodies which is the only cause of the sensations that he has of them, is in no way similar to the ideas that he conceives of them. And in this way, your mind will be freed of all those little images flying through the air, called *intentional species*, which so exercise the imagination of the philosophers.⁴⁸

Experience conforms to our mode of cognition, as his immediate successors, and later Kant, were to say. This mode of cognition must, Descartes argued, involve such innate ideas as geometrical figures, as well as all the "common notions," since the stimulus does not resemble what the mind produces on the occasion of stimulation. As he suggested elsewhere, we take a presented figure to be a distorted triangle, not a perfect example of what it is, presumably because the mind is organized in terms of principles of geometry.⁴⁹ Hume, in contrast held that we have no concept at all of regular geometrical figures, indeed that it is absurd to imagine that we have any such concept beyond what the senses convey,⁵⁰ a conclusion that should be interpreted, I think, as a *reductio ad absurdum* argument against empiricist beliefs as to the shaping effect of stimulation on the mental structures they evoke. Descartes's argument, in effect, relies on the observation that the stimulus does not contain the elements that constitute our knowledge, though it may serve as the occasion for the mind to produce an interpretation of experience in terms of conceptual structures drawn from its own inner

resources. "The book of nature is legible only to an intellectual eye," as Cudworth wrote.⁵¹

While the argument is controversial in the case of the mind, more so than I think it should be, it is not discussed at all in the case of the physical body, but rather assumed without notice as the basis for scientific inquiry. There have, however, been intriguing discussions of similar issues in other domains of biology. I will return to some of these later, in discussing the question of learning and growth. Note that the argument is of course nondemonstrative. It is what is sometimes called an inference to the best explanation, in this case, that what the stimulus lacks is produced by the organism from its inner resources; in other words, organisms endowed with different modes of cognition might interpret the stimulus quite differently, so that our attention is directed to these modes of cognition and their origin, if we are concerned to understand the organism-environment interaction and the essential nature of the organism involved.

Descartes's arguments for innate ideas, when they are considered at all, are generally regarded as somehow missing the point or as "a ludicrous failure" if understood as offering "a general causal principle."⁵² But I think the objections miss the point. It is quite true, as Roy Edgley says in an interesting discussion of the issues, that "An idea in the mind would be attributable entirely to an external object only, so to speak, if there were no mind there at all." This is, in effect, Hume's position, as expressed, for example, in his image of the mind as "a kind of theatre, where several perceptions successively make their appearance; pass, re-pass, glide away, and mingle in an infinite variety of postures and situations," though "The comparison of the theatre must not mislead us" since there is no stage: "They are the successive perceptions only, that constitute the mind."⁵³

It would be quite wrong, then, to suggest that no empiricist would deny that ideas "must be in part attributable to the nature of experience and the mind, and the external item is at most a necessary condition of having the idea," except in a very special sense: namely, the limiting case, in which the contribution of the mind is null, since the mind is simply constituted of a succession of impressions and faded impressions.⁵⁴ As for Hume's "instincts," which compel us to expect the future to be like the past, there is a very serious empirical question as to whether these are characterized in a way that is anywhere near correct. The import of these questions comes out clearly in the contrary positions held by Descartes and Hume with regard to geometrical objects. I think it is reasonable to interpret the issue as at its core an empirical one, and to conclude that Descartes's use of the argument from poverty of the stimulus is not at all "ludicrous" or "trivial," but rather a substantive (though we would say, nondemonstrative)⁵⁵ argument with regard to the actual character of the mind. Similarly, when Edgley says that "not even the meagre framework of explanation proposed in stimulus-response theory violates [the] principle" that the nature of the mind in part determines the effects produced by a stimulus, he is not wrong, but is again missing an important point: nontrivial stimulus-response theories do have something to say about the structure of the mind, or can be so construed, but what they say is wrong, in that they do not postulate specific structures adequate to the task of explanation. Descartes, furthermore, went well beyond the "general causal principle" that Edgley dismisses as "a ludicrous failure."

It may turn out in fact that a variant of Descartes's conclusion is not only not ludicrous but in fact correct, when understood essentially in his terms rather than those of contemporary philo-