Professor Frijda is reported (by Gascon, 1969) to have said, in an unpublished conference that “Piaget’s theory is easier to program than any other existing theory of intelligence.” However, my impression is that Piaget’s central concepts are not sufficiently specified in their present form to be programmable. His experiments are programmable, but their simulation should only be considered as a means to elucidating the nature of these constructive processes. This is what I wish to submit to a discussion here.

Frijda goes on to say that “programming Piaget does not give rise to problems of principle, but only to practical ones.” His examples of practical problems are: how to simulate the processes of abstraction and equilibration; how to make the proper operation and concepts available to the program at the right time; how to formalize the child’s environment. If these represent practical problems for the programmer, they also happen to be fundamental problems in Piaget’s theory as it stands today. Furthermore, these types of problems would seem to arise whenever we try to convert a structural theory into an information processing one. I would like to add straightaway that I strongly agree with Frijda that all the problems he mentions are fundamental to this conversion. I would only add simulation of reciprocal assimilation (the process that coordinates schemes)
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to his list, and reorganize the list somewhat so as to make it reflect the interdependencies that exist between the problems it mentions.

Piaget himself has never explicitly formulated his views on simulation, so as a first approximation to coordinating his structural approach with simulation problems, I will try to relate this question to Piaget's general position on the nature of explanation.

In Piaget's view, to explain a physical phenomenon (say the expansion of a gas when it is heated) we first discover regular relations between selected properties (pressure, temperature, volume in this case). This is a problem in pattern recognition. Then we express these regularities in terms of our own operations (Boyle's equation). This is not an explanation, it simply recodes under the guise of a physical law, a great number of possible experimental situations. This description, however, is stronger than the first because the rule allows us to compute what the object will do. We have reconstructed the extension of our experiments and extended it hopefully to all possible experiments. Our new description now allows us to do pattern generation. It has, in some sense, captured the structure of the task environment—the structural constraints that force it, when it moves, to do so in certain regular paths.

If we now go on to inquire how the object manages to do this computation, we start to move in the direction of explanation. We generally try to discover elementary behaviors of the object (or of its parts) that can be said under some interpretation—again in terms of our operations—to do analog computation of our digital ones, or of their decomposition. Then we show that specific interactions or composition of these elementary behaviors—which may or not be verified experimentally—necessarily result in the observed laws and explain them deductively. We now have a process that implements and animates the structure defined by the laws, and we can attribute these lower level operations to the interaction of objects.

The first part of this process—the establishment of structural laws—would describe Piaget's central preoccupation in psychology. He has often compared his representation of the child's stabilized use of rules and concepts to the mathematician's axiomatic representation of an underlying intuitive theory. His succession of logicomathematical structures reflects the succession of implicit intuitive theories the child evolves about such concepts as space, time, number, and perhaps truth and its conservation in deduction. This sequence is open at both ends. At the lower end elementary logical operations have their root in psychologic actions on objects or concepts, these actions having their own roots in biologic adaptation. At the upper end the last of the child's structures merge with the first of the adult mathematician's. The child's largely implicit reflective abstraction evolves into the adult's explicit formalization procedures. More-