Letters

Experimental Phenylketonuria

Waisman and Harlow ("Experimental phenylketonuria in infant monkeys," 12 Feb., p. 685) are to be commended for having initiated experimental studies on mental retardation which are sorely needed. The production of "mental retardation" in animals also promises to be an important tool for investigators concerned with the relations of behavior, development, and biochemistry. It is difficult, however, to accept their statement that phenylketonuria "almost identical in all respects to the clinical disease" has been produced in monkeys. Even if the biochemical criteria employed (serum phenylalanine levels and excretion of phenylpyruvic acid) are assumed to be sufficient, the demonstration of an "intellectual deficit" is questionable. The authors report that "the most outstanding behavioral finding in the phenylketonuric animals is their low motivational level during testing," and acknowledge that "low motivation played some role" in the animals' impaired performance. They nevertheless prefer to emphasize the part presumably played by an "intellectual deficit" similar to that seen in PKU.

The authors report that the experimental monkeys often rejected the milk-phenylalanine diet. It is well known that animals reduce their food intake when there is an imbalance of amino acids in the diet. This reduction is in addition to that based upon taste, which the authors acknowledge. To overcome this reduced intake, the experimenters resorted to hand-feeding, even to the point where "vomiting during hand-feeding was common in some animals." Such experience with food (and with the experimenter) by a young, developing animal, coupled with the effects of the amino acid imbalance on food-seeking behavior, is certainly not conducive to good performance on tasks where food is the reward. Since the relations between motivation and intelligence are far from clear, it is difficult to determine if their experimental monkeys mirror the intellectual deficit seen in PKU.

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That we are in essential agreement with Karrer is evident in our cautious summary conclusion: "The observed slowness in adapting to testing procedures, or even failure to adapt, and the inadequate performance *suggest* an intellectual deficit" (italics added).

In the behavioral sections of the paper, including method, results, and discussion, we deliberately emphasized the motivational problems and the negative aspects of the feeding of these subjects because we concur that one cannot establish an intellectual deficiency under conditions of inadequate testing, and testing is necessarily inadequate if motivation is low. On the other hand, we quite legitimately raised the question that motivational deficits can also stem from intellectual inability to meet the demands of a testing situation. Thus, we faced the insoluble problem presented by the objective data: To what extent were the performances low because of poor motivation, and to what extent was motivation low because of inability to perform the tasks?

The psychologist must to some extent take a clinical approach in diagnosing mental deficiency in animals, just as he must in diagnosing mental deficiency in human subjects. Thus, the clinician looks to qualitative factors to distinguish the aphasic child or the schizophrenic child from the mental retardates, although they may all show the same overall score on an intelligence test. We also looked to qualitative factors in the behavior of the experimental monkeys in this study, especially in the latter months when their physical conditions seemed stabilized and forced feeding had ceased, and when they were accepting food rewards with more consistency. We noted their general failure to avoid physical obstacles, the immaturity of their play in exposures to each other in regular play sessions, and the greater tendency to show progressive deterioration in performance of complex tasks than of simple ones. In our comparisons with normal monkeys on tasks known to be correlated with increasing age in the first 2 years of life, we tended to use control data of animals younger than the experimental subjects, and, because of the augmented number of sessions required by the experimental animals, the age discrepancies (stated in terms of age at the start of the tests) increased as the tests progressed. Our overall evaluations led us to the conviction that these animals were severely retarded intellectually, but, because of the motivational questions, we took the conservative stand in this paper and understated our case, concluding only that it looked "probable that mental retardation did play a major role in the generally depressed performance of the phenylketonuric animals on the more complicated tasks. . . ." We are currently engaged in developing tests using motivational conditions other than food reward so that we may evaluate phenylketonuric animals under less ambiguous conditions.

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Marine Biology and a New Canal

In recent months the possibility of a new canal across the isthmus region of Central America has been discussed with increasing frequency. Although no definite site has been selected from the three or four possibilities, there does seem to be agreement that the canal would not have locks—in other words, it would be a sea-level canal.

In my opinion, this aspect is of particular interest to marine biologists and oceanographers. Although the new canal might be 70 to 150 miles long, depending upon location, it seems likely that there would be mixing of Atlantic and Pacific waters within it. Land run-off would, of course, affect the resultant salinity, but, except during times of extremely heavy rainfall, estuarine conditions probably would be