0.45 mg. As/kg. daily for 15 days were effective (Table 1). The comparative series is admittedly small, but it is supported by similar experience with the same drug in cotton rats infected with *L. carinii*. More work is needed to determine whether or not the effective dose is lower than 0.23 mg. As (1.15 mg. drug)/kg. daily for 15 days or even to state with certainty that this dose would always be effective. However, 0.23 mg. As/kg. doses of this drug for 15 days appear to be feasible for man. Thus, for the first time, so far as we know, a chemical compound has been shown to kill all the adults of *D. immitis* in doses which appear to be feasible for man.

As pointed out in our brief summaries (*6*, *7*), this compound has approximately the same toxicity for laboratory animals as Mapharsen; it is tolerated by monkeys in doses of 0.9 mg. As/kg. for 20 days. It contains 20 per cent arsenic and is stable either as a powder or as a 2 per cent solution (*5*). Studies are accordingly now in progress to determine its possible value when used against both canine and human filariasis under conditions of routine practice with these infections.

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The Development of Visual Perception in Man and Chimpanzee

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The study of innate visual organization in man is not open to direct observation during early infancy, since a young baby is too helpless to respond differentially to visual excitation. A first attack on this problem has been made by investigating the visual responsiveness of persons born blind and later made able to see by cataract removal. To evaluate the apparent contradictions between these clinical reports and experimental findings with lower mammals and birds, chimpanzees were reared in darkness until sufficiently mature for the testing of visual responsiveness. The results, which corroborate and extend data reported for man by Senden (*3*), may require changes in current theories of learning and perception.

Two chimpanzees were reared in darkness to the age of 16 months.[1] The animals were then brought periodically into the light for a regularly repeated series of observations. By the time of the first observations the animals had developed postural and locomotor skills roughly comparable to normally reared chimpanzees of the same age or approximating in a general way those of a two-year-old human child. At this time the total light experience, received in half a dozen brief (45-second) episodes daily, as required by the routine care of the animals, was approximately 40 hours. At 21 months of age the female was brought permanently into normal indoor illumination. At the present writing the animals are 26 months of age. A full account of their behavior will appear in future publications.

The first tests of visual reactions with both subjects demonstrated the presence of good pupillary responses to changes in light intensity, pronounced startle reactions to sudden increases of illumination, and a turning of the eyes and head toward sources of light. In the darkroom there was pursuit of a moving light with both eye and head movements. The eyes, however, did not fixate steadily on a light. During all tests episodes of a resilient "spontaneous" nystagmus occurred, the quick phase usually toward, and the slow phase away from, the light source. With the subject sitting stationary at the center of a rotating drum marked in alternating black and white stripes, tests for optokinetic responses were made. Characteristic pursuit eye movements with quick jerks in the opposite direction were obtained.

Aside from the reflexes just described, and the pursuit of a moving light, the two animals were, in effect, blind. The acquisition of visually mediated responses proceeded very gradually, with no evidence of any sudden increased responsiveness such as might be expected if, for example, the failure to respond was at first due to a general lack of attention to visual stimulation. No fixation of any object, still or moving, could be elicited in any of the early tests. For a long time there was no eye blink when an object was brought rapidly toward the eyes. An object brought slowly toward the face produced no response until contact was made, when the animal reacted with a quick jerk in the typical startle pattern. With the female this was observed for the last time on the 30th day after she was moved into the daylight room. Her first blink to a threatened blow in the face occurred on the 5th day, but occurred consistently only after 48 days, at which time she had been in the light for a total of 570 hours, was $22\frac{1}{2}$ months old, and had for a month received some pushing around daily in short play periods with a younger but visually sophisticated chimpanzee.

Many repetitions of experience with objects presented visually were necessary before any recognition of such objects appeared in either subject. The feeding bottle, for example, was thoroughly familiar tactually and kinesthetically. If the bottle or nipple touched the hand, arm, or face, either animal promptly seized the nipple in its mouth. First signs of *visual* recognition occurred in the female when she protruded her lips toward the bottle on the 33rd meal, or the 11th day, following her shift into the daylight room. The first reaching for the bottle with the hand (done before 12 months of age by normally reared animals) appeared on the 48th meal, or 16th day in the light. With the male, whose visual experience was limited to mealtime, many more feedings were required before these responses appeared. The first reaching responses of both animals were grossly inaccurate.

A training procedure employing electric shock showed that the learning of avoidance responses was also an extremely slow and gradual process.

These results can best be interpreted in conjunction with the data of Senden. Lacunae in each set of findings, clinical and experimental, are in many respects filled by the other.

[1] The early rearing in the darkroom was arranged by H. G. Birch, whose part in this experiment is gratefully acknowledged.

In the first place, there is no question that the chimpanzee subjects were well motivated. Sufficient hunger to produce whimpering, and shock severe enough to bring vocal protests, did not alter the fact of failure to "see." The similar slowness of learning of the human patients therefore cannot be accounted for merely by a defect of motivation. The emotional disturbances would seem to have been the result of slow learning, just as Senden concluded, rather than its cause; that is to say, the patient lost some of his enthusiasm when he found how difficult it was to make effective use of the new and at first interesting sensations.

Secondly, the verbal assistance given the human patients make it clear that the difficulty is not simply a failure to attend to visual sensations. With attention successfully directed to a newly-introduced stimulation, as attested to by the patient's partial success in describing it, learning to identify remained a tediously slow process, with the notable exception of color naming. Since color names were learned easily, it cannot be said that "visual attention" was absent.

The prompt visual learning so characteristic of the normal adult primate is thus not an innate capacity, independent of visual experience, but requires a long apprenticeship in the use of the eyes. At lower phylogenetic levels the period of apprenticeship is much shorter. The chick makes effective use of vision immediately upon hatching and shows further improvement of efficiency with the practice afforded by a dozen pecks (*1*). Rats reared in darkness, when first exposed to light, show no clear utilization of vision but learn to jump in response to visual cues within 15 minutes and after an hour or two may be indistinguishable from the normally reared animal (*2*). The chimpanzees of the present study received 50 hours of exposure before the first visually mediated learning was evident; and man, to judge by some of Senden's cases, may require an even longer exposure.

The comparative data conform to the generally recognized principle that organisms whose potential adaptations to the environment are most complex, *i.e.* those that show the greatest intelligence at maturity, also require the longest period of development. This has generally been regarded as a period of maturation. The clinical and experimental data discussed here, however, show that this long period is also essential for the organization of perceptual processes through learning.

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IN THE LABORATORY

Intestinal Perfusion in the Treatment of Uremia

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Interest in the removal of nonprotein nitrogenous constituents of the blood by "artificial" means in cases of renal failure has been stimulated greatly by the recent work of Kolff (*1*), Fine and his associates (*3*), Murray (*2*), and others. It has been suggested (*1*) that perfusion of a loop of bowel, isolated surgically, might prove superior in some respects to other methods presently used. It occurred to one of us (J. W. R.) that a specially designed intestinal tube with three lumina might make it possible to perfuse the intestine *in situ*, thus rendering surgical intervention unnecessary. Furthermore, aseptic technique would not be required.

By using a thin, triple-bore rubber tube, with a small balloon on the tip, it has been possible experimentally to perfuse any desired length of intestine without resorting to surgery of the bowel. However, in the dog it is necessary to manipulate the tube into position through an abdominal incision. This would be unnecessary in the human. Warmed perfusion fluid of physiological type has been introduced above the inflated balloon and withdrawn through another lumen of the same tube several feet higher up.

In experiments to date the blood nonprotein nitrogen of nephrectomized dogs has been reduced consistently and materially. For example, a lowering of the azotemia from 198 to 126, 198 to 112, and 231 to 145 mg./100 ml. of blood was observed in successive trials using 12–18 l. of perfusion fluid over a period of about 6 hours. The rinsing fluid after perfusion contained 4.3–5.4 grams of nonprotein nitrogen.

A more detailed experimental study of the method is now in progress and investigation of its clinical application is being undertaken.

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