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2 August 1965

Uncrossed Visual Pathways of Hooded and Albino Rats

Abstract. *The uncrossed visual pathways to the principal primary optic centers of hooded rats are substantially larger than those of albino rats. This provides an anatomical basis for the results of a recent study on behavior which showed differences in interocular transfer in the two varieties.*

There are differences in the visual systems of gray and albino rats. The eyes of the albino rat are larger (*1*), the optic nerves are smaller and have more unmyelinated fibers (*2*), and the visual cortex is thinner (*3*). In anatomical studies on the central projection of the optic nerves, no differences have been described between varieties of rat. The anatomical study of Hayhow *et al.* (*4*) on both albino and hooded rats revealed no difference between them. However, in his recent work on interocular transfer, Sheridan (*5*) found that albino rats showed less successful transfer after monocular training on brightness and pattern problems than hooded rats. He interpreted the difference as being due possibly to a reduced uncrossed pathway in the albino rat compared with the hooded. My study on the uncrossed pathway stems from some earlier data which confirm this suggestion.

One eye was removed from each of 4 hooded rats and 12 albinos of the strains Glaxo, Sprague-Dawley, and Wistar. After 8 days the animals were perfused with 10 percent neutral formal-saline; they were then cut either transversely or parasagittally and were stained either by the Nauta-Gygax method (*6*) or with its paraffin modification (*7*).

The pattern of uncrossed degeneration in the hooded rats largely confirms that described by Hayhow *et al.* (*4*). There is a substantial amount in the lateral geniculate nucleus pars dorsalis, largely restricted to the dorsomedial part, and there is a smaller amount in the pars ventralis. A small amount occurs in the pretectal region, and a significant band is found in the intermediate region of the stratum opticum of the superior colliculus (Fig. 1). Comparing this with Lashley's map of crossed retinotectal fibers, it would appear that the binocular area of distribution of fibers is from the central region of the retina, extending medially and laterally in a band.

In the albino rats studied, the pattern of ipsilateral degeneration is different, particularly in the Glaxo strain which was studied in most detail. A small amount of passage degeneration can be detected in the optic tract and the brachium of the superior colliculus. None of this can be traced into the ventral part of the lateral geniculate body, but in the dorsal part there are a few degenerating fibers in some animals. There is no indication of an organized uncrossed terminal distribution of the kind found in the hooded rat. No uncrossed degeneration can be found in the pretectum. In most of the brains cut in a parasagittal plane, a few degenerating fibers can be traced into the stratum opticum of the superior colliculus. As in the geniculate, these are few in number in comparison with the uncrossed degeneration in the hooded rats, and again show no definite area of termination (Fig. 2). The three Wistar rats studied showed a pattern similar to that found in the Glaxo rats, but slightly more degeneration was found in the Sprague-Dawley strain. However, this is still much less than that found in the hooded rats.

The results, while showing the pattern (suggested by Sheridan, *5*) of reduced uncrossed input in albinos, do not agree with the results of Hayhow *et al.* (*4*). It is possible that the strain of albino rat that they used may resemble the hooded rat more closely in the central projection of its optic fibers. However, Wistar rats were used by Sheridan (*5*), and my results are, therefore, relevant to his work. It would appear, then, that the corpus callosum and other midline commissures of rats are not as effective in establishing a bilateral memory trace, or using one established on one side only, as they appear to be in cats and monkeys (*8*). A direct pathway from the retina to the visual center used in training, whether crossed or uncrossed, appears important for the rat to show good retention.

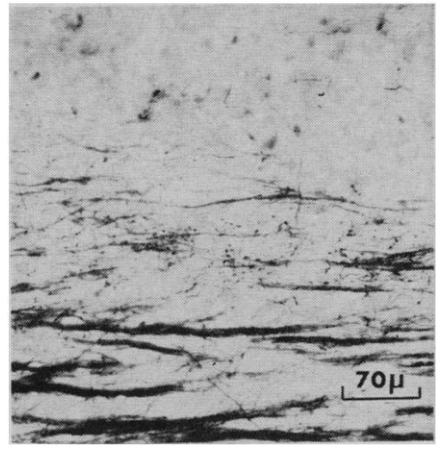

Fig. 1. Area of maximum degeneration in the stratum opticum of the superior colliculus on the side ipsilateral to the lesion in a hooded rat; stained by the Nauta-Gygax method.

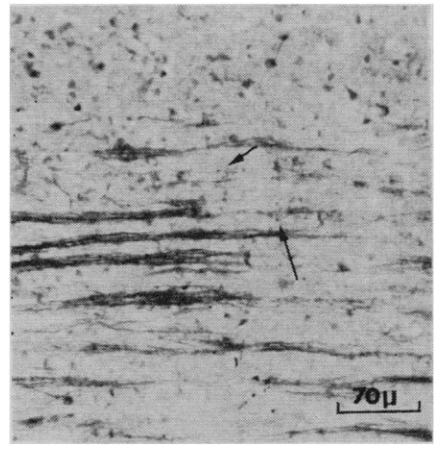

Fig. 2. Region similar to that in Fig. 1, but in an albino rat, showing the maximum density of uncrossed degeneration. The few degenerating fibers are indicated by arrows; stained by the Nauta-Gygax method.

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α-Hydroxy Acid Oxidase: Localization in Renal Microbodies

Abstract. *Differential and density equilibrium centrifugation have established the presence of α-hydroxy acid oxidase in microbodies of the kidney of the rat. The enzyme has been demonstrated in cells of the distal convoluted tubule by a microscopic cytochemical method. This enzyme, like certain others in microbodies, produces hydrogen peroxide.*

Microbodies are subcellular particles characterized biochemically by their content of D-amino acid oxidase, urate oxidase, and catalase (*1*). While the metabolic function of microbodies is unknown, it seems significant that two of these enzymes, D-amino acid oxidase and urate oxidase, produce hydrogen peroxide, while the third, catalase, breaks down this product. We have identified a fourth enzyme in microbodies derived from renal tissue of the rat. This enzyme, α-hydroxy acid oxidase, like D-amino acid oxidase and urate oxidase, produces hydrogen peroxide (*2*). Thus the suspicion that microbodies are engaged in the metabolism of hydrogen peroxide is further strengthened (*1*). A detailed account of these studies will be presented elsewhere.

α-Hydroxy acid oxidase was characterized biochemically (*3*) with the supernatant fluid obtained by brief blending of homogenates prepared in 0.1*M* Sörenson's phosphate buffer of *p*H 7.5 followed by centrifugation at 35,000*g* for 30 minutes at 4°C. These preparations, which contained over 90 percent of the enzyme in the soluble phase, were also used in electrophoretic studies. The enzyme oxidized a variety of α-hydroxy acids (Table 1). Neither flavin mononucleotide, flavin adenine dinucleotide, nicotinamide adenine dinucleotide, nor nicotinamide adenine dinucleotide phosphate increased the rate of substrate oxidation. However, inhibition by quinacrin (Table 1) suggests that the enzyme may utilize a flavin cofactor (*4*). The enzyme was inhibited by appropriate α-keto acids (Table 1).

α-Hydroxy acid oxidase could be identified after electrophoresis in acrylamide gels (*5*), since the enzyme was able to transfer electrons from substrate to nitro blue tetrazolium, thereby reducing this material to an insoluble blue pigment. The rate of tetrazole reduction was accelerated by phenazine methosulfate. The enzyme occurred as

Table 1. Properties of α-hydroxy acid oxidase.

Reaction mixture containing:	Relative activity of enzyme in crude supernatant	Relative activity of enzyme by photometric scanning after gel electrophoresis	Relative activity of enzyme by visual estimation of cytochemical reaction*
0.1*M* D, L-α-hydroxy valeric acid	1.00	1.00	++
0.1*M* D, L-α-hydroxy butyric acid	1.30	0.98	++
0.5*M* L-lactic acid	0.99	.46	+
0.5*M* D-lactic acid	.00	.00	—
0.1*M* D, L-α-hydroxy iso-butyric acid	.01	.00	—
0.1*M* D, L-α-hydroxy valeric acid, 0.1*M* D, L-α-keto valeric acid	.25	.34	±
0.1*M* D, L-α-hydroxy valeric acid, 10 m*M* quinacrin	.75	.72	+

* ++, maximal activity; +, modest activity; ±, just-detectable activity; —, no detectable activity. All estimations based upon evaluation of slides incubated for equal lengths of time.

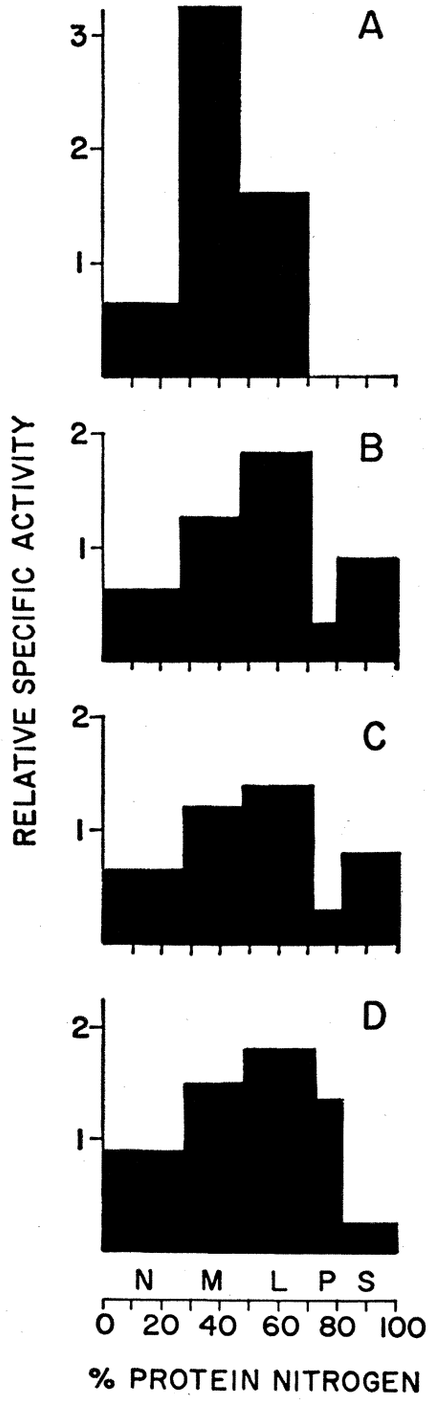

Fig. 1. Distribution of succinic dehydrogenase (*A*), α-hydroxy acid oxidase (*B*), D-amino acid oxidase (*C*), and acid phosphatase (*D*) after differential centrifugation. *N*, nuclear fraction; *M*, mitochondrial fraction; *L*, lysosomal fraction; *P*, microsomal fraction; *S*, soluble. Relative specific activity equals the percent of total enzyme activity divided by percent of total protein nitrogen (Biuret).