

In the case of  $(-)[\text{Co penten}]$ , it appears that the order of levels is  $A > B$ . The virtual disappearance of the Cotton effect due to the  $A$  transition arises because the  $A$  and  $B$  levels are so nearly degenerate. The total negative rotational strength of the  $B$  levels is (in this case) greater, and  ${}^1A \leftarrow {}^1A$  appears only as a residual wing absorption. The similar situation for  $[\text{Co}(\text{EDTA})]^-$  is more clear-cut, because the components  ${}^1A + {}^1B + {}^1B$  are more distinctly split.

It now seems clear that the assignment<sup>6</sup> of configurations to complexes of  $C_2$  or lower symmetry on the basis of alterations in Cotton effects due to ion-pairing with anions such as selenite may be unreliable. (It was on this basis that  $(-)[\text{Co penten}]^{3+}$  was incorrectly assigned to the same configuration as  $(-)[\text{Co}(\text{en})_2]^{3+}$ .)

Finally, the problem of the relationship between spectroscopy and configuration arises in an important way in the complexes  $[\text{Co}(\text{L-dipeptide})_2]^-$ , which we have recently investigated. These complexes, formed stereospecifically, all have strong negative circular dichroism for Band I ( ${}^1A + {}^1B + {}^1B$ ). If this Cotton effect arises, as we have assumed, from  ${}^1A \leftarrow {}^1A$ , then the configurations are  $S(C_2)[\text{Co}(\text{L-dipeptide})_2]^-$ . If, for some reason, one of the  $B$  transitions had a larger rotational strength than  $A$ , however, this assignment could be in error. Work on the configuration of complexes of polydentate ligands is being continued.

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<sup>1</sup> Gillard, R. D., *Proc. Roy. Soc., A*, **297**, 134 (1967).

<sup>2</sup> Gollgoly, J. R., and Hawkins, C. J., *Chem. Commun.*, 873 (1966).

<sup>3</sup> Gillard, R. D., *Nature*, **198**, 580 (1963).

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## PHYSIOLOGY

### Site of the Visual Suppression Effect

THERE is no general answer to the question of the possible existence and function of a centrifugal pathway to the retina. Evidence for the presence of such a system in mammalian species is controversial, but Holden<sup>1</sup> has pointed out that in the case of the pigeon there is substantial anatomical and physiological evidence for a centrifugal system. He goes on to suggest possible functions for such a pathway in mammals mediating known visual phenomena although Brindley<sup>2</sup> has argued that there is little behavioural evidence for the necessity of such a pathway.

Holden suggests that retinal rivalry and saccadic suppression are two phenomena which may be mediated at a retinal level by a centrifugal pathway. In both phenomena vision is suppressed by some intervening state, this being accompanied by a reduction or alteration of the visual evoked response produced by stimuli delivered to the suppressed eye<sup>3-5</sup>. The retina is suggested as the site of this suppression by the fact that in both phenomena there is a reduction of the pupillary reflex during suppression<sup>6</sup>. There are, however, good reasons for believing that this is not the case.

The first reason is that the reduction in the visual evoked response accompanying retinal rivalry occurs with no concomitant reduction in the electroretinogram<sup>4</sup>, so that there is no gross change in retinal activity during suppression. Secondly, an interaction between eye movements and vision analogous to saccadic suppression has been observed in the cat; during eye movements visual evoked responses at the cortex<sup>7,8</sup> and the lateral geniculate<sup>8</sup> are reduced, although there is no change in the response in the optic

tract<sup>8</sup>. This, of course, suggests that suppression is occurring at the lateral geniculate. (Such a phenomenon could be mediated over a pathway described by Bizzi and Brooks<sup>9</sup> from the medial reticular formation to the lateral geniculate body.)

Finally, if saccadic suppression is related to the corollary discharge, as has been suggested by Michael and Stark<sup>7</sup>, it is difficult to imagine that a centrifugal pathway, which in the mammal would be small if present, could carry out the intricate data processing involved in the transformation of the spatial co-ordinates of retinal activity. Saccadic suppression is more likely to occur at a higher level in the central nervous system, possibly at a site where monocularly oriented data processing can occur<sup>10</sup>.

The experimental results referred to here have all been obtained at the level of the evoked response, and it is possible that at the level of the single neuronal events are occurring that are not reflected in the gross electrical activity being monitored. Direct recording of single cell activity in the retina during suppression is necessary to eliminate completely the retina as the active site in suppression phenomena. Nevertheless, it seems unlikely that visual suppression, whether the result of retinal rivalry or saccadic eye movements, occurs at the retinal level.

This is, of course, not an argument against the presence of a centrifugal pathway either in the pigeon or in mammals, but it would seem to remove one possible function for such a pathway, and thus weaken the argument that such a pathway is necessary to explain known visual phenomena.

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<sup>1</sup> Holden, A. L., *Nature*, **212**, 837 (1966).

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<sup>7</sup> Michael, J. A., and Stark, L., *EEG Clin. Neurophysiol.*, **21**, 478 (1966).

<sup>8</sup> Bizzi, E., *J. Neurophysiol.*, **24**, 861 (1966).

<sup>9</sup> Bizzi, E., and Brooks, D. C., *Arch. Ital. Biol.*, **101**, 666 (1963).

<sup>10</sup> Michael, J. A., thesis, Mass. Inst. Technol. (1965).

### Disconjugate Eye Movement Patterns during Optokinetic Stimulation of the African Chameleon, *Chameleo melleri*

OPTOKINETIC nystagmus can be elicited in humans and in many animals by presenting a moving optic pattern, for example, of vertical stripes moving horizontally at constant velocity. The eyes follow ("pursue") the pattern at an angular velocity that may approach or equal that of the moving stripes: this ocular pursuit movement (the "slow phase" of the optokinetic nystagmus) tends to stabilize the position of the image on the retina<sup>1-3</sup>. Each pursuit movement is terminated by a rapid, "saccadic" ocular return movement (the "fast phase") that transports the image to a new retinal location<sup>1-3</sup>. Alternation of slow-phase movements in one direction with fast-phase movements in the opposite direction results in an oscillatory eye movement pattern called a nystagmus. Mammalian optokinetic nystagmus is normally conjugate<sup>4,5</sup>, that is, the two eyes move in unison, as if yoked; however, we do not think the extent to which the pattern of optokinetic nystagmus is conjugate in the infra-mammalian vertebrate has been clearly determined.

Discussions of inter-ocular motor co-ordination at different levels of vertebrate evolution have generally