yielded the other compound plus glutamic acid and glycine in equimolar amounts. Mass-spectroscopic analysis showed that the two radioactive compounds were *S*-carboxymethylglutathione and *S*-carboxymethylcysteine.

It appears that lettuce can remove fluorine from fluoroacetate in much the same way that animals remove halogens from some halogenated aliphatic compounds (Thomson *et al.*, 1963). Unlike fluoropyruvate, fluoroacetate does not react directly with cysteine or glutathione; a catalyst such as an enzyme is required.

- Canvin, D. T. & Beevers, H. (1961) *J. Biol. Chem.* **236**, 988-995
 Thomson, A. E. R., Barnsley, E. A. & Young, L. (1963) *Biochem. J.* **86**, 145-152
 Ward, P. F. V. & Huskisson, N. S. (1966) *Biochim. Biophys. Acta* **115**, 515-517
 Yu, M. & Miller, G. W. (1970) *Environ. Sci. Technol.* **4**, 492-495

Effects of Early Visual Experiences on the Metabolism of Adenosine 3':5'-Cyclic Monophosphate in Chick Brain

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As part of a programme of work trying to elucidate the biochemical events occurring when an organism adapts to a new environmental situation, we have been looking at the effects of exposing 1-day-old dark-reared chicks to an imprinting stimulus. Previous work in our two laboratories (Bateson *et al.*, 1969; Rose *et al.*, 1970) has shown an increase in the incorporation of precursors into both RNA and protein in the forebrain roof 76 and 160 min respectively after onset of the stimulus (a flashing light). Before these effects, after 30 min stimulus exposure, an increase in RNA polymerase activity can be detected in the same region (Haywood *et al.*, 1970). In considering what biochemical events possibly precede this activation, we have measured the concentrations of cyclic AMP (adenosine 3':5'-cyclic monophosphate) in brain regions after short periods of exposure to the stimulus.

A protein-binding assay (Brown *et al.*, 1971) has been used to measure cyclic AMP. The binding protein used was isolated from bovine adrenal cortex. Cyclic AMP was extracted by homogenizing brain tissue in 5% (w/v) trichloroacetic acid and extracting the acid supernatant three times with 10 vol. of water-saturated ether.

As reported for other species (Breckenridge, 1964; Schmidt *et al.*, 1970), there were rapid post-mortem increases in the concentration of cyclic AMP in chick brain, and values as high as 350 pmol/mg of protein have been recorded. Consequently in this study animals were killed by immersion in isopentane, maintained near its freezing point in liquid N₂.

Unexposed dark-reared animals killed by freezing yielded the following values for the concentration of cyclic AMP in various brain regions (means $\pm$ S.D.): forebrain roof, 84.8 ± 20.9 pmol/mg of protein; forebrain base, 57.6 ± 23.7 pmol/mg of protein; midbrain, 59.2 ± 24.3 pmol/mg of protein.

After 15 min exposure to the flashing light there were significant changes in the concentration of cyclic AMP in the forebrain roof and midbrain of experimental animals. The forebrain base showed only a slight increase in cyclic AMP. In the forebrain roof there was a decrease of 55.0 ± 20.0 pmol/mg of protein relative to dark-exposed controls, whereas the midbrain, showed an increase of 33.0 ± 14.6 pmol/mg of protein. These differences are significant at the 0.05 level (*t* test).

This enhancement of the concentration of cyclic AMP in the midbrain was also shown by birds receiving only diffuse overhead light for the same length of time (light-exposed controls). Moreover both light-exposed controls and experimental birds showed increased concentrations of cyclic AMP in the midbrain after only 5 min of stimulation. It would seem that there is a rapid non-specific accumulation of this cyclic nucleotide in this brain region in response to visual activity after the birds had been reared in the dark. The optic tectum is associated with the midbrain. The results for forebrain roof show a different time-course. This, as well as differences between experimental and light-exposed control animals, will be discussed.

- Bateson, P. P. G., Horn, G. & Rose, S. P. R. (1969) *Nature (London)* **223**, 534
 Breckenridge, B. McL. (1964) *Proc. Nat. Acad. Sci. U.S.A.* **52**, 1580
 Brown, B. L., Albano, J. D. M., Ekins, R. P., Scherzi, A. M. & Tampion, W. (1971) *Biochem. J.* **121**, 561
 Haywood, J., Rose, S. P. R. & Bateson, P. P. G. (1970) *Nature (London)* **228**, 373
 Rose, S. P. R., Bateson, P. P. G., Horn, A. L. P. & Horn, G. (1970) *Nature (London)* **225**, 650
 Schmidt, M. J., Palmer, E. C., Dettbarn, W. D. & Robison, G. A. (1970) *Develop. Psychobiol.* **3**, 53