marks that appear on the proximal surfaces of the spores.

Several coal balls also containing invertebrates were found in the collection from the Berryville locality in Illinois. These differ from the Kansas material in several aspects and serve to enhance the general interest of this problem.

Although invertebrates are homogeneously scattered through the matrix of the Kansas coal balls, the animal content of the Berryville material is restricted to a clearly defined mass of marine limestone located at or near the center of the coal ball. The limestone is in the form of elongate, more or less rounded, rod-shaped masses and is lithically and faunally similar to the marine limestone immediately overlying that part of the coal seam where the coal balls occur. The contact between the included limestone mass and the remainder of the coal ball is generally sharp, but an occasional plant axis may extend about 1 cm into the limestone. Scattered bits of plant debris are present within the limestone masses, but the organic content is predominantly of invertebrate origin.

With the exception of some pyritized bryozoans, the invertebrate remains in the Berryville material are calcareous and hence not adapted to the hydrochloric acid treatment. They have been studied by mechanical preparation. Unlike the Kansas specimens, they are not readily determinable to the generic level.

The faunal assemblage in the Berryville coal balls is somewhat different from that of the Kansas balls. The following invertebrate remains have been tentatively identified:

Foraminifera: calcitarnellid forms.
Coelenterata: lophophyllid coral.
Echinodermata: crinoid stems, seemingly all of one type.
Bryozoa: rhomboporoid forms.
Gastropoda: Three shell types observed in various sectional planes.
Pelecypoda (or Brachiopoda): Small biconvex sections and scattered shell fragments.

Pellets similar in size, shape, and content to those found in the Kansas material are present in the Berryville coal balls. Some of the Berryville specimens, however, are unusual in that they contain an abundance of small spores, all apparently of the same kind. It is difficult to explain such concentrations of spores outside the sporangium itself, unless one considers them as having been concentrated in the intestines of herbivorous animals and preserved as coprolites. Occasionally the diets of these herbivores included fertile foliage; this would explain the presence of many spores in some of the pellets and their complete absence in others.

Although the primary purpose of this communication is to report this unique plant-animal association in American coal balls, we wish briefly to mention the outstanding problems posed by this material.

The occurrence of invertebrate-containing coal balls among normal plant-bearing coal balls and the inclusion of marine limestone masses within otherwise normal individual coal balls is difficult to explain. That some transportation of material was involved is suggested by the swirled or rolled structure of the invertebrate-containing coal balls as contrasted with the bedded structure of normal coal balls, as well as by the fact that occasional spores, cuticles, and other terrestrial plant structures bear adherent tests of marine Foraminifera. It is hoped that distances and modes of transportation involved may be determined by further field observations, formulated to test alternative hypotheses suggested by laboratory studies.

The chemical processes involved in the preservation of the fossils is perplexing. One might assume that differences in mineral replacement of these fossils by and large reflect differences in the original composition and structure of the organisms. This alone, however, does not explain the occurrence, in the same coal ball, of both silicified and pyritized specimens of gastropods that obviously belong to the same species, or the fact that internal molds of the same species of spores may be calcareous, pyritic, or siliceous.

The origin of the carbonates that form the matrix of the coal balls needs explanation. This calls for studies of the associated sediments and considerations of chemical relationships between marine and coal swamp waters.

An investigation of this problem is now being carried out, with a view to publication in a forthcoming paper. In addition to discussions of the questions mentioned, it is intended that this paper will include a systematic analysis of the fauna and flora associated in these coal balls.

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Bilateral Interaction in the Lateral Geniculate Body[1]

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In the higher vertebrates the lateral geniculate body is the only synaptic center on the direct path between retina and cerebral cortex. With the partial decussation that occurs in the optic chiasma, it might be expected that the preliminary mechanisms concerned in binocular fusion would be located in the lateral geniculate body. It is widely believed (*1, 2*), however, that the pathways from each eye retain their separateness both anatomically and physiologically through the synapses in the lateral geniculate up to the visual

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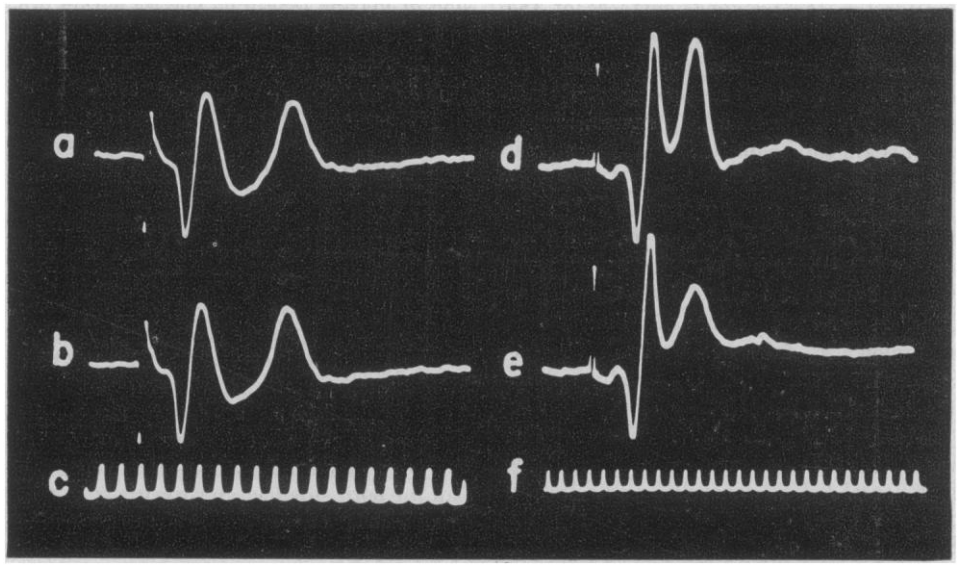

FIG. 1. *a* and *b*: responses recorded in the optic tract to maximal contralateral optic nerve stimulation; *a*, before, and *b*, 6 msec after, 6 maximal stimuli (at 380/sec) applied to the homolateral optic nerve. *c* and *d*: responses recorded in lateral geniculate to stimulation of large diameter fibers in the contralateral optic nerve; *a* and *b*, parameters of stimulation as for optic tract recording. *e* and *f*: time intervals 0.2 msec.

cortex. Anatomically, fibers from each eye terminate in separate layers in the geniculate and there is no evidence that the layers are interconnected (*2*). Physiologically, in 1941 Talbot and Marshall (*3*) briefly reported the unexpected finding of binocular interaction at the geniculate by applying conditioning shocks to one optic nerve and test shocks to the other. Later, however, in a more detailed report Marshall (*4*) "never observed any specific interaction at the geniculate level." Nevertheless Marshall found a reduction in all components of the test response for conditioning shock—test shock intervals up to about 10 msec. Both the presynaptic and postsynaptic responses were equally diminished by about 5% regardless of which nerve was stimulated first. He regarded this as due to interfiber interaction in the optic chiasma and tract.

Work in progress in this laboratory has now provided clear evidence that interaction does occur in the lateral geniculate leading to both facilitation and depression of the geniculate response. The interaction process has been studied through the recovery cycle of the geniculate cells in the cat under intraperitoneal Dial (Ciba) (0.6 ml/kg) anesthesia by applying conditioning shocks to one optic nerve and test shocks to the other. A microlectrode inserted into the brain by means of a stereotaxically directed micromanipulator has recorded the response of the optic tract and of the lateral geniculate against an indifferent electrode placed in the temporal muscle. Despite Marshall's finding to the contrary (*4*), no evidence has been obtained which would indicate that impulses set up in the tract fibers from the one eye are affected by impulses in the tract fibers from the other eye. The response to a maximal stimulus applied to the contralateral optic nerve as recorded in the optic tract is shown in Fig. 1a. The two negative going spikes correspond to the two groups of fibers in the optic nerve (*5*). In Fig. 1b the same test response has been conditioned by a train of six maximal shocks at 380/sec applied to the homolateral optic nerve, commencing 24 msec before the test shock. The conditioned and unconditioned responses are identical and indeed remain so whatever the conditioning shock—test shock interval.

The response as recorded within the lateral geniculate following stimulation of the group of fibers of larger diameter in the contralateral optic nerve is shown in Fig. 1d. The first positive-negative spike is the large fiber tract spike and this is followed by a negative spike representing the discharge of impulses up the optic radiation. In Fig. 1e the same test shock as for Fig. 1d was preceded by a train of maximal conditioning shocks applied to the homolateral nerve with parameters identical with those used for the response in Fig. 1b. It will be seen that the tract spike remains unaffected by the radiation spike suffers a reduction of 41% of its unconditioned amplitude. Almost as marked a degree of interaction is revealed if the test response to the contralateral nerve is conditioned by a single shock to the homolateral nerve. The response of Fig. 2a is similar to that of Fig. 1d. In Fig. 2b the same contralateral test response has been preceded by a homolateral response of approximately similar size at a conditioning shock—test shock interval of 20 msec. Again the tract spike is unaffected but the radiation spike is reduced by 38%. The radiation spike is even more affected if a maximal homolateral conditioning shock is used. By varying the conditioning shock—test shock interval, an

early phase of interaction facilitation is shown to be succeeded by a prolonged phase of interaction depression. A similar result is obtained if the test shock is applied to the homolateral nerve, and the conditioning shock to the contralateral nerve.

These results indicate that there is interaction between the separate cell layers (A and B) of the contralateral eye and layer (A_1) of the homolateral eye in the dorsal nucleus of the lateral geniculate body of the cat, and not between the presynaptic fibers to these layers.

Possible explanations for these findings are: (1) The presynaptic fiber endings synapse on the cells in the layer or layers of the other side. The anatomical evidence is clearly to the contrary. (2) Flows of current associated with the activity of one cell layer pass through and affect cells in the adjacent layer or layers of the other side.

That flows of current associated with the activity of cells and fibers may influence the excitability of adjacent normal resting cells and fibers is now a well-attested experimental finding (*6*), but the situations in which this phenomenon has been studied in the central nervous system have usually involved techniques such as antidromic activation, which make the assessment of the findings in terms of normal function somewhat uncertain. If the explanation suggested above is accepted, interaction in the geniculate is an example of the probable importance in normal function of flows of current in determining excitability at a distance. It may well be that the layering in the geniculate, a feature which is carefully preserved through the vicissitudes of phylogenetic development, is of importance in allowing these flows of current to assume an influence that they possibly would not have in a more random arrangement of nervous elements. This phenomenon may also be of importance within a particular layer of cells. The early phase of facilitation which is seen in the recovery cycle of geniculate cells following unilateral conditioning and testing has been explained (*4*) on the basis of reciprocal overlap of optic tract fiber endings. It is possible, however, that some of this facilitation may be due to flows of current within the layer where the stimulated fibers actually terminate. The relationship of the phenomenon of interaction to the excitability cycle and to the after-potentials of the geniculate cells has also been studied and these and other findings will be published in detail later.

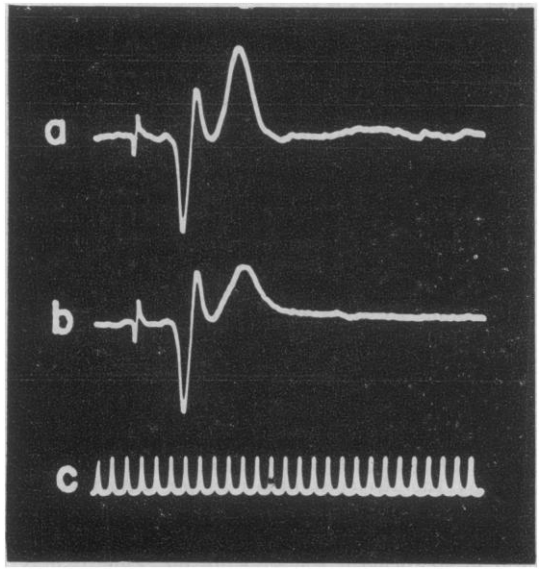

FIG. 2. *a* and *b*: responses recorded in laterial geniculate to stimulation of large diameter fibers in contralateral optic nerve; *a*, before, and *b*, after, a stimulus to the homolateral optical nerve similar in strength to that applied to the contralateral nerve. *c*: time intervals 0.2 msec.

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Stimulation of Rubidium Absorption by Auxins

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Among the more immediate and direct effects of auxins on plant cells are their stimulation of water uptake (cell enlargement) and of respiration (*1*). The effects of auxins on ion uptake are less clear, owing to the fact that both stimulation and depression have been found. The present report[2] definitely confirms the important conclusion of Commoner and Mazia (*2, 3*) that auxin may stimulate ion uptake in excised tissues. The results reported here outline more clearly the conditions associated with auxin-induced ion uptake and indicate some correlation between respiration and absorption of both ions and water. The conclusion that the mechanism of auxin action lies in stimulating water uptake through increased osmotic salt concentration in the cell sap (*2, 3*) has been previously criticized (*4–6*) on the basis that auxin-induced water uptake does not require the presence of salts in the external solution, and that auxin results in lowering the osmotic concentration in the cell, rather than increasing it. The present results also do not support the conclusion that the

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[2] More detailed manuscripts of these studies are in preparation for publication elsewhere.