ferent type of lesion produced in the present experiment caused a more vigorous response in intact forebrain regions.

In conclusion, although the specific causes of the enhancement of forebrain catecholamines by the neocortical ablations cannot be given at present, the effect exists. These observations indicate that surgical ablation of neocortex produces changes in the brain which are not predictable simply from the knowledge that brain tissue is lost. For this reason these results are relevant to interpretation of possible changes in behavior and mentation following neurosurgical removal of brain tissue in animals and humans.

ACKNOWLEDGEMENT

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CONCRETIONS FROM THE EOCENE SANDS OF WESTERN KENTUCKY AND TENNESSEE

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ABSTRACT

Study of concretions from 41 sites in the Wilcox and Claiborne Formations (Eocene) in a 1400 square mile area in western Kentucky and Tennessee indicates that they are remarkably diversified in form and have a common origin. The concretions are epigenetic chemical structures formed by filling pore spaces in the sands with iron concentrated by diffusion and precipitated from ground water. The concretions are composed of hematite and limonite. Qualitative chemical analyses of the concretions for manganese yielded only the possibility of trace amounts despite its geochemical similarity to iron.

INTRODUCTION

This investigation concerns itself with determination of the origin and mineralogic compositions of concretions that occur in the Wilcox and Claiborne Formations (Eocene) in adjacent parts of southwestern Kentucky and northwestern Tennessee. The study area includes parts of Calloway and Graves counties in Kentucky and parts of Henry, Weakley, and Carroll counties in Tennessee (Fig. 1). Located in the northeastern part of the Mississippi embayment on the east limb of the southward-plunging Mississippi embayment syncline, the Eocene formations strike approximately north-south and dip about 30 feet per mile to the west.

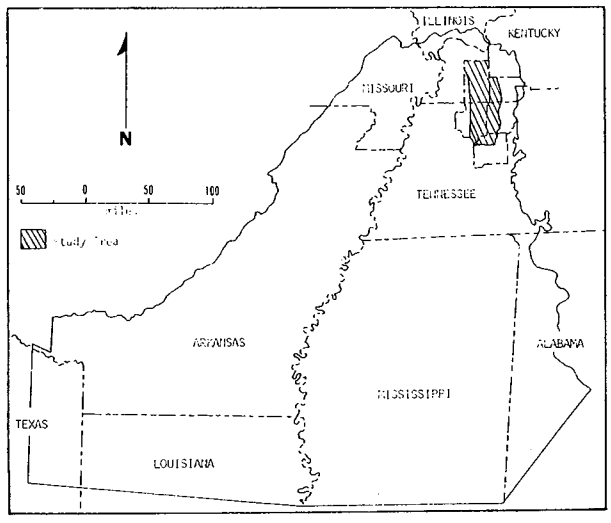

FIG. 1. *Location map of study area.*

Stratigraphy

The Wilcox and Claiborne Formations in the study area are varicolored, moderately well-sorted, fine-grained, unconsolidated fluvial quartz sands that contain subordinate, discontinuous clay lenses at various horizons within the formations (Clark, 1977, p. 105). The Wilcox Formation, however, is more silty than the Claiborne Formation (Clark, 1978, p. 126) and contains the lithologically distinctive "sawdust sand" (Whitlatch, 1940) in widely scattered outcrops, 5 to 10 feet thick, at or near its base in the easternmost part of the study area. The Claiborne Formation contains more and thicker clay lenses. Lignite beds, which range in thickness from several inches to several feet, separate some of these clay lenses from the overlying sands. Lignite in the Wilcox Formation occurs in thinner lenses than those in the Claiborne Formation.

Collection

Concretions were obtained from road cuts and overburden faces in clay pits. More resistant to erosion than the enclosing sands, they form piles at some outcrops. Collections were made at 33 sites in the Claiborne Formation and 8 sites in the Wilcox Formation. The concretions collected at each site were bagged, numbered, and their location and bag number recorded on the topographic map. The concretions appear to be randomly distributed throughout both formations and reflect local changes in grain size or permeability of the sands. Above clay lenses, iron plate up to several inches thick commonly forms.

Composition

Megascopic and microscopic studies of the concretions indicate that they are composed of hematite or limonite with hematite being much more common; quartz is also present. Hematite and limonite color the concretions red, yellow, brown, and purple. Color banding, developed either during or after growth, is a feature of some concretions. Some of the concretions may have been originally composed of siderite, formed in a swamp on the coastal plain; and later oxidized by ground water that penetrated them and altered the siderite to limonite.

Since the manganese minerals pyrolusite and manganite form in the same sedimentary environment under essentially the same chemical conditions as hematite and limonite, they may also compose part of the concretions. A semimicro qualitative chemical analysis procedure (Welcher and Hahn, 1955, p. 386-387) capable of detecting small amounts (0.1-1.0 per cent) of manganese was used on the concretions. Manganese was not found, but may be present in trace amounts.

Most of the concretions consist of quartz grains cemented by hematite or limonite to form an outer shell that encloses loose grains of quartz and hematite or limonite in the center. Some concretions, however, are cemented throughout. None contains fossils or organic matter. Cylindrical or icicle-shaped concretions, however, may have formed around plant roots. No significant differences were observed between concretions found in the Wilcox Formation and those found in the Claiborne Formation.

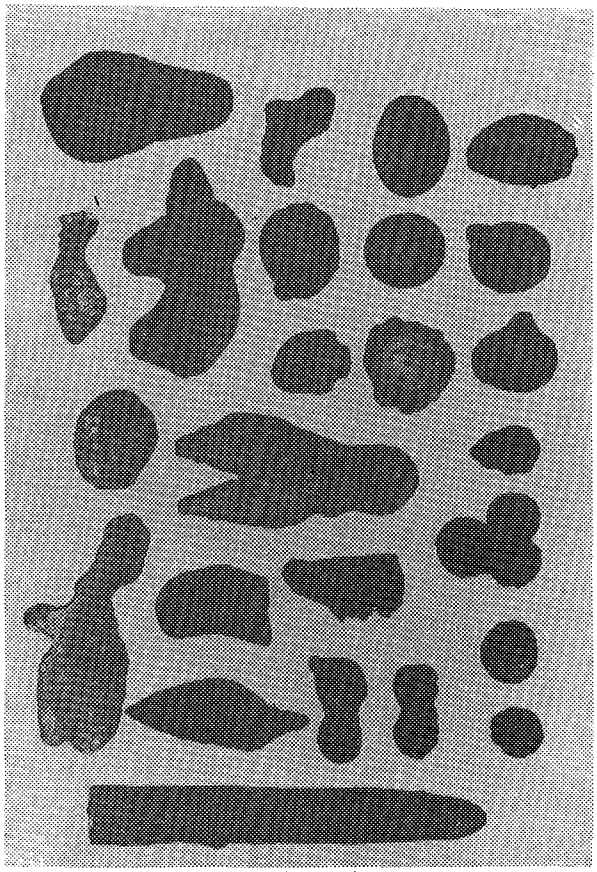

FIG. 2. *Concretions from the study area.*

Description

Concretions in the Wilcox and Claiborne Formations are remarkably diversified in form and may be simple, compound, or complex in shape (Fig. 2). Some are spherical or ellipsoidal, others are flat, and still others present extraordinarily odd and fantastic shapes. Spherical concretions generally range from 1 to 3 inches in diameter and are the most common in the Eocene sands. Simple symmetrical forms like the sphere, then, are a result of growth by additions around a point in a homogeneous, porous, and permeable medium under uniform conditions of deposition. Concretions with shapes other than spherical generally range from 1 to 10 inches in longest dimension and reflect a local condition of non-uniform permeability of the sands. Bilaterally symmetrical forms probably result from the union of two simple forms growing near each other. Union is initiated by development of a node on each concretion. Excess material is attracted through crystallization to the two sides adjacent to each other. The connecting bar grows wider by further additions of material and double concretions develop. Subsequent growth can greatly modify many of the simple and compound forms and produce concretions of a bewildering complexity of forms. A factor of some significance in the origin of complex forms is the movement of iron-bearing ground water through a layer. Where movement is dominantly in one direction, more material is added to concretions on the sides facing the oncoming ground water.

ORIGIN

Concretions in the Wilcox and Claiborne Formations formed chiefly by filling pore spaces in the sands. They are concretions formed by cementation, most frequently in unconsolidated sands that have generally high porosity and permeability. Since the Wilcox and Claiborne Formations are predominantly quartz sands, and thus are little soluble, formation by replacement is unlikely.

Iron originally dispersed within the sediments became concentrated into concretions due to ground water flow, local supersaturation, diffusion, and local chemical precipitation. The initial deposit of iron was probably due to local supersaturation; additional deposition reduced the concentration of iron about the initial deposit and more iron was brought in by diffusion. Once initiated, deposition of iron would continue by the diffusion of more and more material to that already deposited until either the supply of iron was exhausted, or the sands were compacted and the permeability and porosity substantially reduced; or the chemical aspects of the ground water changed. As supersaturated water flowed past the growing concretion, dissolved iron was added to it not only by diffusion but also by mass flow (Berner, p. 107). The rate of growth depended on the amount of iron available in the source area and the ability of the ground water to dissolve it, the rate of movement of the iron-bearing ground water to the depositional site, and the activity of the precipitating agent. A concretion might grow indefinitely to any size, limited chiefly by the amount of iron available.

CONCLUSIONS

Concretions from the Wilcox and Claiborne Formations in western Kentucky and Tennessee are remarkably diversified in form and have a common origin. They are epigenetic chemical structures formed by filling pore spaces in the sands with iron concentrated by diffusion and precipitated from ground water. The concretions are composed of hematite and limonite. Geochemically similar pyrolusite and manganite are not present; manganese, if present in the concretions, can only be present in trace amounts.

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TAS COLLEGIATE DIVISION REGIONAL MEETINGS SET

A call has been sounded for student papers to be presented at the Annual Spring Regional Meetings sponsored by the Tennessee Academy of Science. Meetings will be held in April at Knoxville College (East), MTSU (Middle) and MSU (West). For more information, contact the appropriate regional chairman listed below.

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