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PENNSYLVANIAN INVERTEBRATES OF THE MAZON CREEK AREA, ILLINOIS

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INTRODUCTION

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Introduction

A series of several papers will describe the fossil invertebrates of the Middle Pennsylvanian Francis Creek shale in Will and Grundy counties, Illinois. Conclusions regarding the paleogeography and paleoecology will be presented following the description of the fauna.

The Francis Creek shale, a fine-grained gray micaceous siltstone, is a member of the Carbondale Formation (Moore et al., 1944) or of the Liverpool cyclothem (Wanless, 1939). In Grundy County it is exposed in the banks of Mazon Creek, south of Morris, the locality from which has come the celebrated Mazon Creek flora and fauna (Cady, 1915, pp. 33, 66); and in Grundy and Will counties a few miles to the east it has been further exposed in strip mining for the underlying Number 2 coal. The collections on which the descriptions in this series of papers are based have come principally from the strip-mine dumps.

These dumps, rising beside the abandoned, water-filled mine-pits, constitute a collecting locality far larger than the small exposed area in the bluffs along Mazon Creek, and fossils are as plentiful and varied in the one as in the other. Strip mining in the area, the oldest coal-producing district in Illinois, began in 1927, following a long period of production from small underground mines, and was discontinued in 1951 (G. H. Cady, personal communication).

The Francis Creek shale is as much as 50 or 60 feet thick above the Number 2 (Wilmington or Colchester) coal in the old underground mining area south of the line from Coal City to Braidwood, but no more than 25 feet thick, and generally much less, in the stripping area. In part of this area it is absent, owing to the existence of a channel cut into it and filled with the Pleasantview sandstone (Waupecan sandstone, Culver, 1922, pp. 49–56). A system of channels occupied by this sandstone is discussed by Eckblaw (1930). Fossil-bearing concretions occur throughout the thickness of the shale but are most plentiful on Mazon Creek in two bands, known as the Upper and Lower beds.

Richardson

The concretion-bearing shale, lying directly upon the coal, is the last material to be dumped on the spoil heaps during mining. There it disintegrates in a year or so, and the hard, resistant concretions are found lying on the slopes or buried within the weathered clay. The concretions exposed to weathering on the surface of a spoil heap oxidize and turn red, but those still buried are gray or brown. Moodie (1916, p. 15) states that concretions from Mazon Creek have been collected since 1857; a few came from the underground mines during the period of their activity, but in the last generation the greater part of the collections has come from the strip-mine dumps.

The strip-mine area is indicated on the map (fig. 3). Concretions are most abundant in the northern part of the stripped area and east of the Will–Grundy county line, as the Francis Creek shale is apparently replaced in the rest of the area by channels containing the Pleasant View sandstone. Most of the fossils found in the concretions are plant remains. In certain limited localities within the spoil heap area, one or another type of plant may predominate in the flora. Though fossil invertebrates occur at all fossil-yielding spots, collections are made principally in the spoil heaps characterized by a varied flora. Animal remains are relatively rare (see Table, p. 9).

OCCURRENCE OF FOSSILS

Within the Francis Creek shale, fossils occur both on bedding planes and in concretions. Since collections are made from spoil heaps in which the shale has disintegrated, most of the specimens recovered are those in concretions. Specimens on bedding planes are preserved only if the shale happens to have been locally indurated.

Commonly the concretions are smooth and symmetrical, elliptical in any axial section, the three axes being of unequal length, but some have a spheroidal shape. Others are irregular, lacking symmetry in one or more directions, or they may be formed of two adnate concretions. In size, they range from very small to about two feet across; the larger ones occasionally encountered are almost invariably septaria without fossils. The old mine pits are now filled with water and with slumped material from the adjacent spoil heaps, so that the occurrence of the concretions in place may no longer be observed. However, from the recollection of those who saw them in place, and from observation of the concretions exposed in the banks of Mazon Creek, it is clear that they lay with the two longer axes parallel to the bedding.

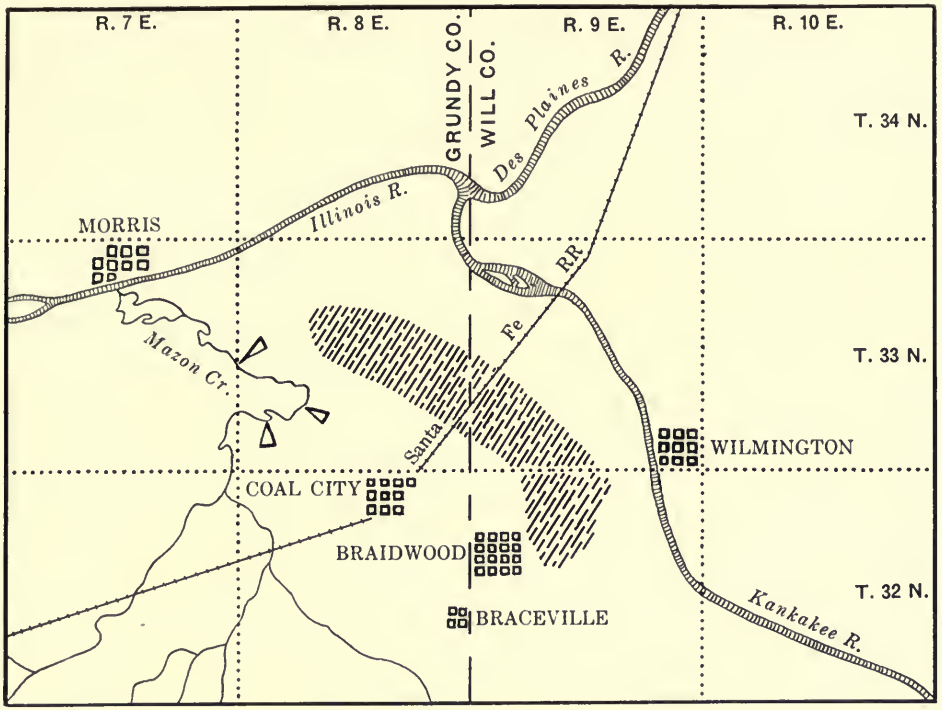


FIG. 1. Map of adjacent portions of Will and Grundy counties, Illinois, showing the area of coal strip-mining operations. Arrows point to well-known collecting localities on the banks of Mazon Creek.

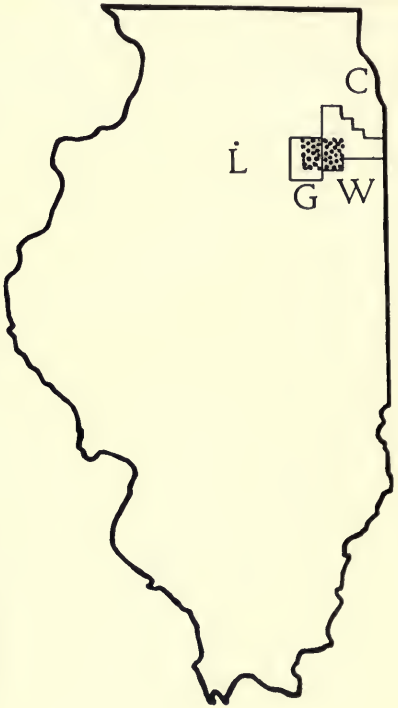
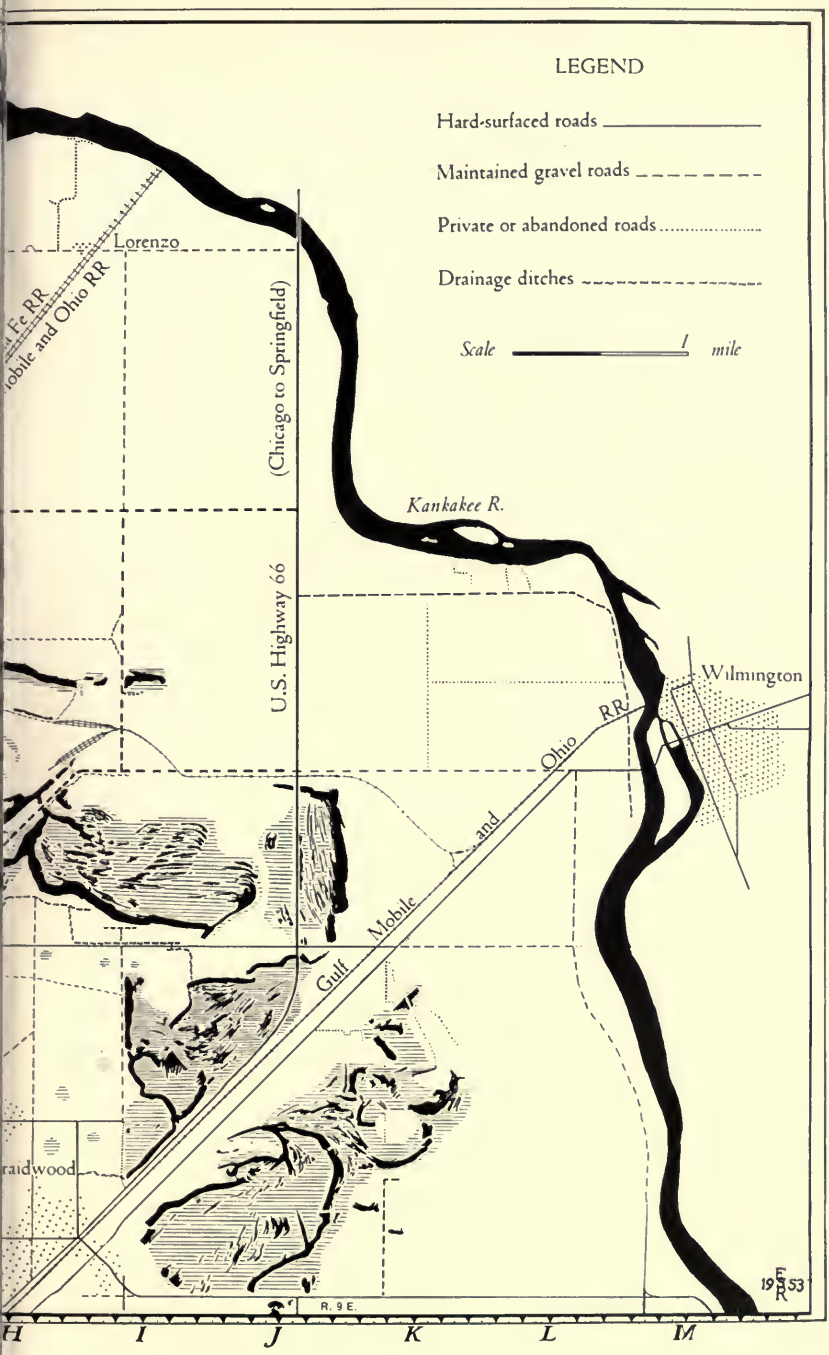


FIG. 2. Map of Illinois, locating the area shown in larger scale in figure 1. C, Chicago; L, LaSalle; G, Grundy County; W, Will County.

FIG. 3. Map of strip-mining pits and spoil heaps in Will and Grundy counties. Solid black indicates water bodies, including water-filled mine pits; horizontal



shading indicates spoil heap areas. Map drawn from aerial photographs made in March, 1953, by Chicago Aerial Survey Company, and from the United States Geological Survey maps of Wilmington and Morris quadrangles.

The concretions were formed autochthonously, as is shown by their random distribution in the shale and by the continuation of bedding planes through concretions seen in place at Mazon Creek. Concretions from the two nearby localities have different aspects: those from Mazon Creek show the bedding planes clearly, the edges of the layers resembling the edges of stacked saucers, while the concretions from the strip mines are smoothly round, with no external trace of bedding. In weathering, concentric shells a few millimeters thick separate from the strip-mine concretions.

Experience in the strip-mine dumps has shown that the concretions with the best-developed symmetry, based on three unequal axes, with a smooth surface free of pyritic excrescences, are the ones most likely to yield good fossils. In some localities within the general area, even perfectly formed concretions may be barren; in others, even poorly formed ones yield fossils. Once the character of a locality has been recognized by opening a representative number of concretions, the external appearance may be taken as a safe guide in that immediate vicinity.

To expose the fossil, the concretion is struck with a hammer on the axis of intermediate length. In productive localities very few concretions lack a fossil at the core. The fossil, in the form of a mold or impression, provides a plane of weakness on which the hammer blow breaks the rock. Concretions that have weathered break more easily than fresh ones, as the weathering penetrates along the bedding. After several years of exposure to weather, the concretions break spontaneously in the plane of the enclosed fossil.

The thin cavity of the fossil mold may be partly or entirely filled with mineral. Plant impressions may have a thin coating of coal, kaolin, siderite, sphalerite, marcasite, or calcite. Animal impressions may be covered with any of those materials except coal, though siderite and sphalerite are rarely seen on the animal fossils. Many concretions, both barren and fossiliferous, are septarian, the cracks usually being filled with crystalline calcite. The material cementing the concretions is probably iron carbonate.

ASSOCIATED FLORA AND FAUNA

The concretions reveal an abundant and varied flora and fauna. Concretions from all levels within the shale are mixed in the spoil heaps, so that no indication of vertical change or fluctuation in the biota is preserved. Moodie (1916, pp. 14, 15) reported that certain species of *Neuropteris* and *Pecopteris* were particularly abundant in

certain levels of the exposure on Mazon Creek, and undoubtedly there were similar differences in the strip-mine area.

Among the plants are about 500 named species and form-species, ranging from fungi to large trees. Since, following paleobotanical practice, dissociated parts of plants were given different names before their common origin was known, the number of true biological species is much less than the roll of names; there are perhaps no more than a hundred true species in the flora. The fauna includes about two hundred species of animals, more than half of them insects.

Moodie (1916, pp. 14, 15) has made an estimate of the relative abundance of the various kinds of animals occurring in the Mazon Creek concretions; from this it appears that terrestrial vertebrates and insects were probably more abundant at Mazon Creek than in the spoil heaps farther east. Somewhat less than 2 per cent of the concretions in the latter locality contain invertebrate animal remains, chiefly pelecypods, xiphosures, and syncarid crustaceans, which appear to be relatively more common than at Mazon Creek. About as many concretions reveal traces of vertebrate life, chiefly in the form of fish scales and supposed coprolites; complete fishes or amphibians are extremely rare.

In spite of the relative scarcity of animal remains, intensive collecting has brought to light many hundreds of specimens. As an

VERTEBRATES

Amphibians	3
Fishes	
Dipnoan teeth	1
Dipnoan scales	77
Crossopterygian scales	3
Xenacanth teeth	1
Palaeoniscoid fishes	4
Undetermined scales	2
Coprolites[1] (masses of variable size and shape, probably coprolites, are usually discarded in the field).	

INVERTEBRATES

Insects	19
Arachnids	5
Crustaceans	
Not separated (Chiefly *Acanthotelson*)	202
Acanthotelson	92
Palaeocaris	29
Anthrapalaemon	4
Ostracodes (concretions, each with many individuals)	45
Xiphosures	
Prestwichianella	309
Arthropleurids	2
Myriapods	45
Annelids (concretions, many with numerous individuals)	19
Pelecypods (concretions, some with several individuals)	298

[1] Seven spiral specimens, probably dipnoan coprolites, will be described in a paper by Zangerl and Richardson.

indication of the relative abundance of the various animal groups, the above list is presented (see p. 9). The quantities of specimens listed are from the Chicago Natural History Museum collection, which is derived principally from the strip-mine area. More than half of the count of vertebrates, however, is due to the amalgamation with the Chicago Natural History Museum collection of the Walker Museum (University of Chicago) collection; the vertebrates are principally from Mazon Creek.

The associated fossil plants are principally parts of ferns and seed ferns, with scale trees, sphenophyllids, and lycopods. The typical scale tree, *Sigillaria*, is very rare in this flora; stems of *Lepidophloios* and *Lepidodendron* occur as fragments, probably carried in from an upstream habitat.

LIFE ENVIRONMENT

The problem of the environment of the fauna and flora of the Mazon Creek and Braidwood exposures requires a consideration of not only the biota and the physical characters of the shale itself, but of the contemporary Middle Pennsylvanian beds in Illinois and neighboring states. It is proposed to devote a later paper in this series to the ecology and paleogeography revealed in these deposits.

The most significant aspect of the deposition during this time is its cyclically repeating character (Wanless and Shepard, 1936, and works there cited). In western Illinois the succession of beds forming the Pennsylvanian cyclothems is of the type that Wanless and Shepard (op. cit., p. 1184) called "deltaic," typically including above the coal a hard black fissile shale with inarticulate brachiopods, pelecypods, conodonts, and fish. In the Liverpool cyclothem, however, the Francis Creek shale is locally an anomalous member above the coal.

The Number 2 coal is "more widespread than any other in the Eastern Interior basin" (Wanless, 1939, p. 25), extending, with its correlates, over all of Illinois and into the adjoining states. Indeed, Wanless considers it probably continuous "with the Lower Kittanning coal of the Appalachian coal field because of its position in the section, and David White suggested the same correlation on the basis of the flora of its roof shales. Probably this coal was deposited at the time of most extensive Pennsylvanian coal accumulation in North America."

Lying above the Number 2 coal in western Illinois, southern Illinois, western Indiana, and adjoining states, are a marine lime-

stone and black shale of characteristic lithology. Wanless remarks (1931, p. 186): "This series of limestone bands provides the most striking evidence of widespread uniformity in sedimentation . . . . The only irregularity in the succession of strata is a gray shale member which locally separates Coal Number Two from its overlying hard black laminated shale." This irregularly placed gray shale is the Francis Creek member, containing the fossil-bearing concretions. In western Illinois the Francis Creek shale itself is marine (Wanless, 1929, pp. 86, 89, Appendix A).

The fossils in the Francis Creek concretions in Will and Grundy counties are, with very few exceptions, non-marine, indicating that conditions there were different from those farther west. Deposition evidently occurred above sea level during the accumulation of almost the entire thickness of the member. Since this deposition took place during the marine invasion farther west, the land surface was evidently being built up by accumulating sediments at a faster rate in this area than the rising sea could match in advancing across it. The fine texture of the shale does not indicate more rapid deposition here than in other exposures of the same member; thus, particularly in view of the great extent of the coal swamp represented by the Number 2 coal, it seems reasonable to picture the Braidwood area as having been a relatively high portion of the coal swamp, to be inundated by the advancing sea later than the marginal areas. The presence of a few marine fossils in the vicinity of Braidwood indicates that the sea did indeed briefly cover the area, but, because of the mingling of all stratigraphic levels in the spoil heaps, we do not know whether this occurred during or at the end of Francis Creek time.

The fossils described in the succeeding papers represent the fauna that lived on an aggrading plain, above sea level but not far above it, and near a shore. The regional picture is of a land of low relief, in effect a coastal plain covered with a thick layer of peat beneath a swamp forest; the sea had advanced across most of the coastal plain in Francis Creek time, covering all but its highest parts. On the high portion, flat and only a few feet above sea level, a stream complex deposited silt among the vegetation of a coal swamp. The flora consisted of seed ferns and tree ferns with an under story of small lycopods and sphenophyllids. There was no peat layer and probably rather little litter on the surface beneath them, for frequent overflow of the stream distributaries maintained a cover of river silt that included pieces of trunks and roots of scale trees carried

in from farther upstream. In this delta-like environment lived more than two hundred species of small animals, including insects, arachnids, mussels, and amphibians. With each increment of silt, portions of this assemblage were buried and some of the plant and animal remains so preserved are now recoverable as fossils.

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