GEOLOGY AND GEOGRAPHY

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ABSTRACTS

The Darrow Mastodon.[1] William J. Wayne, Indiana Geological Survey.—Many individual specimens and fragments of *Mastodon americanus* have been removed from boggy areas of Indiana and adjacent states since the first collections were made at Big Bone Lick about 1739. Even though the bones of these extinct mammals have long attracted attention, little has been published on the geology of the places from which such fossils have been taken.

Part of a mastodon was exposed by dragline in a small peat bog on the Frank Darrow farm near Oliver Lake, LaGrange County, in 1957. When it was removed in August 1959, the sediments and surroundings of the boggy area in which the bones had been preserved were studied in detail.

The surface material in this area is glacial till, but gravel underlies it at a shallow depth. Springs issue from the gravel at many places along the ditch that leads away from the mastodon site. The small bog in which the mastodon bones were discovered was filled with 1.8 meters of olive brown sedge peat containing wood fragments and spruce(?) cones. The lower half of the peat is silty and overlies gray sandy till. The skull lay on a mat of Sphagnum peat that is similar in appearance to a 5 centimeter bed of Sphagnum peat about a half meter above it in the rest of the bog. A pollen diagram of the enclosing sediments shows that spruce was dominant in the forest vegetation while the peat was being deposited. A single dart point was found in the decomposed peat above the Sphagnum layer and probably was not contemporaneous with the mastodon.

Inasmuch as only part of the skeleton was present and the upper side of the skull had weathered away, the bog probably was nearly filled with sediment by the time the animal became mired and died. The Sphagnum beneath the skull may have been carried down from the surface when the head and shoulders sank into the peat, but was strong enough to have supported the rest of the skeleton until it disintegrated. Downward movement of the bones probably was stopped by the higher penetration resistance of the silty peat at a depth of 75 centimeters beneath the surface.

Coal Geology of Gibson, Posey, and Vanderburgh Counties, Indiana.[1] S. A. Friedman, Indiana Geological Survey.—A preliminary study shows that the rocks of Pennsylvanian age in Gibson, Posey, and Vanderburgh

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Counties contain 13 bituminous coal beds. Coals III, V, VI, and VII have been mined commercially from these beds.

Coal V is the thickest and most extensively mined coal; it underlies most of the area and ranges from 4 to 8 feet in thickness. Coal V crops out only in the extreme eastern part of Gibson County. Because of its southwesterly regional dip, it is 160 feet below the surface in southeastern Vanderburgh County, 400 feet in central Gibson County, and 700 feet in southwestern Posey County.

In Gibson and Vanderburgh counties, 25 mines, all but 2 of which have been abandoned, have produced 45 million tons of Coal V and 2 million tons of Coals III, VI, and VII. These two counties still contain 3.4 billion tons of recoverable coal reserves, and Posey County, from which no coal has been produced commercially, contains an additional 2.7 billion tons. Fully a third of the total recoverable coal reserves in Indiana lie in Gibson, Posey, and Vanderburgh Counties. Most of this coal would require underground mining.

Posey County has recently attracted the attention of mining interests that prefer to mine coal in an area that is close to the inexpensive transportation provided by the Ohio River. Mining difficulties would be encountered in this county as well as in western Gibson County and western Vanderburgh County because of faults. High-angle normal and reverse faults in these areas have produced a series of grabens and horsts. The faults apparently have no expression on the present land surface. Any coal company interested in this area would need to locate the exact position of the faults by a series of closely spaced boreholes.

Unusual Mineral Assemblage Associated with Lower Pennsylvanian Conglomerate.[1] JACK A. SUNDERMAN and SEYMOUR S. GREENBERG, Indiana Geological Survey.—Hydrated and dehydrated halloysite, allophane, crandallite, gibbsite, kaolinite, iron oxides and manganese wad occur in an abandoned quarry north of State Road 451, about 1½ miles west of Williams, Lawrence County, Indiana. This unusual combination of minerals is found within the poorly consolidated quartz conglomerate in the Mansfield Formation, which probably lies directly on the Mississippian-Pennsylvanian unconformity.

The halloysite occurs as lenses and as discrete particles up to pebble size, whereas the allophane occurs only in lenses that exhibit columnar and botryoidal structures. The crandallite has formed at the expense of allophane and possibly at the expense of halloysite. Manganese wad occurs both as coatings on quartz pebbles and as lenses up to 2½ inches thick. Most lenses of wad are intimately associated with hydrated halloysite and gibbsite. Very well- to poorly-crystallized kaolinite occurs as discrete particles between quartz pebbles. Iron oxides occur as irregular bands and stainings throughout the quarry.

About 200 yards southwest of the quarry, two layers of well-crystallized barite occur just above a Mississippian limestone. The layers of barite are each half an inch thick and are separated from each other by a half-inch thick layer of iron oxides.

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The Lowly Nonmetallics.[1] DUNCAN J. MCGREGOR, Indiana Geological Survey.—No branch of geologic science has attracted more interest than that of economic geology. Looking back over the past several years one cannot fail to note, however, the unequal attention which the major subdivisions of economic geology, the metals, nonmetals, and fuels have received. The nonmetals rank at the bottom of the list. Probable reasons for this are:

(1) The metallics are worth more per unit weight and possess a stronger attraction than the less glamorous nonmetals, exclusive of the fuels.

(2) Certain principles have been set forth relating to ores as a class which cannot be or has not been done for the nonmetals.

(3) Each nonmetal offers a series of separate and distinct problems which may or may not be applicable to nonmetals in general.

(4) Geology departments of colleges and universities commonly overemphasize the metals in their curriculum, even to the exclusion of courses in nonmetallic minerals.

(5) Solution to the industrial geologic problems of the nonmetals becomes critical only when sudden demand dictates a need for scientific help.

(6) Little geologic research is supported by industry who use the nonmetals. Nor are many industries aware of the importance of a geologist in their organization.

In the study of the use and availability of the nonmetallic minerals, the dividing line between economics and geology is vague. Commonly non-geologic problems such as exploration and exploitation costs, market, transportation, and fuel surveys are the most important items to be considered.

It is suggested that a critical review be made of the nonmetallic minerals in the curriculum of the Geology departments of colleges and universities. More emphasis should be given the economic aspects of the nonmetallics. Students should be made aware that concentrated study in the field of the nonmetallic minerals can be most rewarding both in terms of geologic interests and future employment.

Recent Geologic Work in Antarctica. N. B. AUGHENBAUGH, Purdue University.—The International Geophysical Year opened a new period of geologic exploration in the Antarctic. Previous investigations were confined to the Ross Sea region, Palmer Peninsula and certain accessible coastal areas. Field parties from several nations have made traverses into many parts of the interior. Some of the findings are reported.

A Paleontological Viewpoint on a Poor Misunderstood Ostracode from Indiana.[1] ROBERT H. SHAVER, Indiana Geological Survey.—A review of

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the historical and philosophical approaches to the paleontological species recalls that our formal typological method dates from 200 years ago at the time of Linnaeus when species were thought of as discrete entities without relation or gradation to other species. Especially since Darwin's time of about 100 years ago, most paleontologists have accepted the fact of imperceptible time-geographic gradation among species. The practice of the discrete-species approach continues beyond the requirements of the Rules of Nomenclature, and this pours fuel on the controversial fire among paleontologists. The traditional type method and other reasons commonly given for practicing the discrete species are overworked crutches which often do not result in the most useful species.

A study of the Pennsylvanian ostracode *Bairdia oklahomaensis* is presented in defense of above views. Confusion resulting from the traditional approach to *Bairdia* does not permit safe acceptance of any of the numerous concepts of *B. oklahomaensis* except the all-inclusive one. The species therefore is said to range nearly throughout the Pennsylvanian System and to have little or no stratigraphic value.

The triangular graph is used to infer vertical speciation from a progressively gradational series as represented by 12 populations of *B. oklahomaensis* s. l. taken from throughout the vertical and lateral range of the species in Indiana. Among the four names that have been applied to this group, two should continue to be suppressed as synonyms, while *B. oklahomaensis* s. s. and *B. dornickhillensis* are recognized separately with respective ages of post-Atoka and pre-Des Moines. Further refinements in each of their stratigraphic ranges are recognized beyond the limits of practicality of application of new names under the type method.

The triangular graph shows further that geographic speciation apparently did not occur in Indiana within the broader concept of the species and that the considerably different mean sizes among the several populations are of no genetic or taxonomic significance.

A "Fossil" Cave-filling in the St. Louis Limestone in Putnam County, Indiana.[1] GARY R. GATES and NED M. SMITH, Indiana Geological Survey, and WILTON N. MELHORN, Purdue University.—Recent excavations at the Harris quarry in the SE¼NW¼ sec. 15, T. 15 N., R. 4 W., Putnam County, have revealed an unusual example of solution and refilling in the St. Louis Limestone.

In the west wall of the quarry is a mass of poorly crossbedded shale and sandstone containing carbonized wood and other organic fragments of Pennsylvanian age. This fill is at least as thick as the present 15-foot depth of the quarry. The beveled surface of the sandstone-shale fill was covered by 5 to 10 feet of glacial till prior to stripping.

Sandstone or shale fillings in Pennsylvanian stream channels cut into Mississippian rocks are not uncommon in Indiana. In the Harris quarry, the fill does not occupy a stream channel because it has finite boundaries against limestone in all observable directions. The boundaries are steep and irregular. Small, wedge-shaped solution openings extend laterally

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along bedding planes, and some of these openings contain unconsolidated, fine-grained sand.

It is suggested that post-St. Louis solution developed a small cavern in limestone. Two possible methods of cavern-filling are postulated. (1) Post-Mississippian erosion removed any younger Mississippian rocks and unroofed the cavern. Submergence beneath a shallow Pennsylvanian sea filled the unroofed cave with sand and shale containing inwashed plant fragments, and subsequent post-Pennsylvanian erosion removed all Pennsylvanian deposits of the area except in the cavern where the fill was protected by surrounding limestone. (2) Cavern collapse, perhaps aided by weight of overlying Pennsylvanian sediments, downdropped a wedge of sand and shale into the cavern, where it was preserved in the same manner suggested in (1). The exact answer to this problem must await exposure of the base of the fill. The unconsolidated sands filling lateral solution openings may be residual cave deposits left by water flowing through the cavern prior to unroofing or collapse, and are therefore older than the cave fill.

This feature is considered a "fossil cave," unrelated to recent and current cavern development in Mississippian limestones in Putnam County and elsewhere in southern Indiana.

Petrology of Sandstones from the Big Clifty Formation of Indiana.[1] SEYMOUR S. GREENBERG, Indiana Geological Survey.—Sandstones from the Big Clifty Formation of late Mississippian age are well to extremely well sorted and have median sizes that range from 0.20 mm. to 0.10 mm. Younger Big Clifty sandstones are finer grained than older Big Clifty sandstones, and the cumulative curves of the former have higher skewness values $\left(\frac{\text{1st quartile} \times \text{3rd quartile}}{\text{median}^2}\right)$ than those of the latter.

Quartz constitutes 85 to 95 percent of most Big Clifty sandstones; feldspars, clay minerals, and micas each constitute less than 5 percent of these sandstones. The total percentage (by weight) of the heavy minerals (specific gravity greater than 2.95) is less than 0.5. Iron oxides, leucoxene, tourmaline, zircon, brookite, rutile, and apatite are the significant heavy minerals (in decreasing order of abundance).

The immediate source for the Big Clifty sandstones contained abundant reworked sedimentary rocks; igneous and metamorphic rocks provided little detritus in the latest cycle. At the last depositional site, reworking was extensive and burial was slow. Ilmenite was altered to leucoxene in early sedimentation cycles, and brookite grew at the expense of leucoxene in recent cycles. Iron oxides (the chief cement) and quartz overgrowths (a minor cement) were precipitated in the most recent cycles.

Petrology of the Bethel Formation (Lower Chester) in Indiana. GARY E. HENRY and JOHN B. DRUSTE, Indiana University.—Mixed layer minerals and illite are the most abundant clay minerals in the argillaceous Bethel sediments. Lesser amounts of kaolinite are present. The ratio of their relative abundances is 4:4:2. Quartz is the most abundant mineral

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in the shales and underclays, but the clay minerals as a group are slightly more plentiful than quartz in the smut steraks. Feldspar, calcite, and dolomite are also present in the argillaceous rocks. A 14Å component ranging from chlorite to vermiculite is present in a few samples. In the arenaceous units kaolinite predominates followed by mixed layers and illite. Their ratios are 5:2½:2.

The sandstones are well-sorted and orthoquartzose. Heavy minerals are leucoxene, magnetite-ilmenite and zircon in abundance, and minor amounts of garnet, tourmaline, rutile, iron oxides, pyrite, and muscovite. Quartz is the dominant light mineral; chert, potassium feldspar, and plagioclase occur in very small amounts. The limestones in the formation are clastic and fossiliferous.

The depositional environment probably varied from slightly brackish to normal marine waters; local accumulations of coal represent nonmarine deposition. The heavy minerals in the sandstones indicate that they are reworked sediments.

The clay minerals are largely products of their diagenetic environments rather than of their source areas. The kaolinite is considered partly detrital, but circulating acid ground-water probably provided a favorable environment for forming kaolinite diagenetically. Illite apparently formed from "degraded illite" through adsorption of potassium ions. Mixed layers are considered to have formed by montmorillonite and/or degraded illite adsorbing potassium and magnesium ions upon entering the marine environment.

Some Engineering Problems Associated with the Preglacial Marietta River Valley. K. B. WOODS, Purdue University.—During the course of an engineering investigation of the soil conditions in the valley floor and adjacent tributaries of the preglacial Marietta River in the general vicinity of Jackson, Ohio, several important problems were encountered. This paper covers a short review of the geological literature on the preglacial Teays River and the Marietta River tributary, together with a report on the engineering characteristics of the foundation materials at several sites in the Marietta River Valley both above and below Jackson, Ohio. It is concluded not only that geologic information can be used as a basis for planning engineering investigations but also that engineering data can be used in many instances to detail or even modify geologic concepts. The need for both geologic information and engineering investigations for design purposes is emphasized in certain situations.

The Forces Which Shift the Earth's Crust. J. A. REEVES, West Terre Haute.—In the 1890's I worked in my father's lead and zinc mines in Joplin, Mo., during vacations. The lead and zinc ore was imbedded in hard flint rock which had been vulcanized millions of years ago by molten lava rising from deep in the earth. This layer of flint rock was over 700 feet thick and was laid down millions of years ago at the bottom of a shallow sea which covered the country. The hot lava melted the limestone and also raised the entire Ozark Range out of the sea to 700 feet above. Natural curiosity helped in seeking ways of explaining this act of nature. All available books on Geology were read and it was learned that all mountain ranges are formed the same way. A dozen or more of the world's geologists advocated the "migration of the poles." This theory utilized the only gigantic source of power that was required to lift our mountain ranges to their present heights and lower others. Details of the many forces which rotate the earth's crust on its plastic center in the north-south direction are given and shows how the shifting of the earth's crust raises some of the mountain ranges and lowers others.