

North American Indian Effigy Mounds: An Enigma at the Frontier of Archaeology and Geology

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Abstract — Mounds created by North American Indian cultures about 700-3,700 years ago in the shapes of animals and humans are known today as Effigy Mounds. One of the unexplained features of these mounds is their large proportions. Effigy Mounds are found in Southern Wisconsin, in Allamakee County, Iowa (Effigy Mounds National Monument), in Adams County, Ohio (The Great Serpent Mound), and, the oldest known one, in Poverty Point, West Carroll Parish, Louisiana. The largest number of Effigy Mounds, about 5,000, has been located in southern Wisconsin. There is no generally accepted theory that explains the purpose of Effigy Mounds. We discuss the correlation of some Effigy Mounds with geophysical anomalies.

Introduction

It is assumed that some 18,000 years ago a landmass linked Siberia and Alaska. This was the Bering Land Bridge, believed to be the land route human beings first used to reach the Americas. At the end of the Ice Age, about 11,000 years ago, many big-game species became extinct. Humans survived by hunting small game and gathering nuts and fruits (Fagan, 1991).

It is thought that the Indians traveled in small bands of 8–10 individuals, which would have given them the flexibility needed to respond quickly to fluctuations in the food supply. However, mostly in the winter time, they stopped in caves and other natural shelters. There they created pictographs and petroglyphs, believed today to be for artistic and/or religious expression.

About 1,700–700 B.C. three important innovations took place in North America. The eastern Indian societies started the deliberate cultivation of native plants, pottery manufacture, and building of ceremonial and funeral mounds (Fagan, 1991). Some Indian groups, known today as Woodland Indians, were located in the areas now occupied by Wisconsin, Iowa, Minnesota, Illinois, Ohio, and Louisiana. They built mounds in the shapes of animals and humans. The first known Effigy Mound, a bird, was created at Poverty Point, Louisiana, about 1,400 B.C. and the last ones were built in Wisconsin and Iowa, around 700–1,300 A.D. (Fagan, 1991).

Archaeologists generally agree that these semi-sedentary hunter-gatherers moved in regular seasonal rounds and periodically constructed mounds. Effigy Mounds ceased to appear after 700–1,300 A.D. when permanent villages

were built and the inhabitants started to cultivate corn, and later beans, as their primary food supply.

Green, Stoltman and Kehoe (1986) remarked on the frustration of scholars with respect to the purpose of Effigy Mounds noting that such mounds were not built for burials. Mounds within the same group continued to be added over a period of a few hundred years. They are likely to have been ceremonial and used as markers for one tribe, thereby preventing territorial competition.

The idea of a strong link between American Indians and their environment has been discussed often in the past. Goldstein (1991) remarked that the location of Effigy Mounds was on ridges along rivers and around lakes, and was also associated with oak trees groves. She suggested that the mounds may represent "maps" to food resources. However, the possible relationship between the location of Effigy Mounds and underground geological inhomogeneities has not been discussed in North American archaeology studies. The present study is an exploratory effort in that direction.

Coe (1984) remarked that at Teotihuacan, in central Mexico, "an extraordinary cave underneath the Pyramid of the Sun provides an understanding of why this pyramid was constructed, perhaps even why Teotihuacan itself was built where it was." The underground cave is actually a natural lava tube enlarged on occasion in ancient times. The cave runs 300 ft in an easterly direction, at a depth of 18 ft beneath the pyramid. Another cave, this time located in coral limestone, was discovered under a Maya pyramid known today as the Tomb of the High Priest, at Chichen Itza, in the Yucatan peninsula of southern Mexico (Gallenkamp, 1987). The role of caves in the late classic Maya has been discussed by Bassie-Sweet (1991), based on the hieroglyphics of commemorative sculptures.

In the Guatemalan highlands, after the Maya civilization vanished, Indians continued to perform ceremonies in caves and along neotectonic faults with hot springs and fumaroles (Coe, 1993). Similar ceremonies still continue today.

Poverty Point State Commemorative Area, Louisiana

A possible relationship between the location of ancient Indian civilizations and their geological environment has been suggested by Stuart (1994) for the Olmecs, in Mexico: "Early this century prospectors found that vast pools of oil underlie many Olmec sites. La Venta, in Southern Mexico, for instance, is situated atop a salt dome (a geological structure often associated with oil deposits)." No explanation has been found for such a possible relationship, since oil fields and salt domes are located in general at significant depths and can be detected at the Earth's surface only as a result of geophysical and/or geological investigations.

Various Olmec sites, such as San Lorenzo in Mexico, are as old as 3,000 years (Coe, 1984), similar in age to the Poverty Point Indian culture in West Carroll Parish, Louisiana. All Olmec sites show an impressive symmetry. The

Poverty Point site (Figure 1), shows similar symmetry. More than that, according to Coe (1984), the gigantic construction of San Lorenzo looks like a huge Effigy Mound, possibly a bird flying east. A large bird, oriented east-west can be seen in Figure 1. Although there are similarities between Olmec sites and the Poverty Point site, archaeologists today agree on lack of contact between the two cultures (Jones, 1994).

Ford and Webb (1956) estimated that approximately 4000 man-years were involved in erecting the earthworks in Poverty Point, which cover an area of about one square mile. The layout of the earthworks can be described as six concentric semi-circular earthen ridges divided into segments 82 feet wide and 10 feet high, set about 130 feet apart from each other (Figure 1). The significance of these earthworks remains a complete mystery.

Braunstein (1976) offered data on the geology of San Lorenzo, Mexico, and Poverty Point, Louisiana. Both archaeological sites are located in a similar geological setting of the Gulf basin. Poverty Point is situated in the "Smackover oil-producing trend", one of the largest oil-producing regions in the continental United States. Is Poverty Point, similar with Olmec sites, situated on a geological and/or geophysical anomaly related in some way to oil fields?

A detailed literature research concerning the subsurface geology of the Poverty Point Archeological Site area was carried out by Dr. Paul V. Heinrich, Geologist for the Department of Natural Resources, Louisiana Geological Survey. He concluded that "published detailed studies for such a small area are lacking." However, he was able to find a publication by Zimmerman (1994)

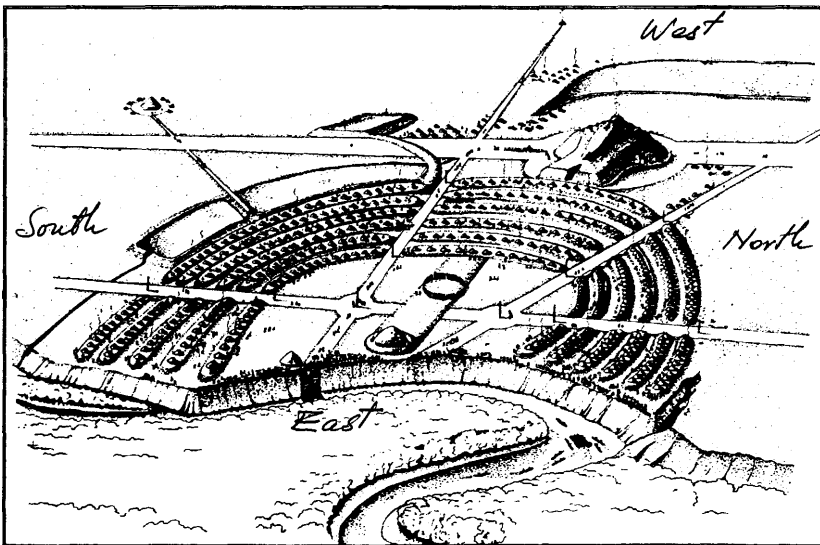


Fig. 1. Poverty Point, West Carrol Parish, Louisiana (1,700-700 B.C.). Drawing by Jon L. Gibson (Balthasar, 1992). An Effigy Mound with a bird shape can be seen in the upper right corner of the drawing. The river in the foreground is Macon Bayou. No scale was indicated, but the entire archaeological area is about one square mile.

containing some regional, medium-scale structural maps, and other geological and geophysical data in the area of interest. Additional information was provided by Mark D. Butler, a retired Mobil Oil geophysicist from Jackson, Mississippi.

Zimmerman (1994) remarked that the Poverty Point tectonic environment, following middle Jurassic rifting of the North America continental plate, was well suited for the development of divergent wrench faults. Such wrench faulting, and associated extension fracturing, facilitated hydrocarbon migration from deep mature source rocks to more shallow reservoirs. In Figure 2, the Bouguer Gravity Map of Northeastern Louisiana (1990), indicates a well defined regional positive gravity anomaly, centered at the Poverty Point Archaeological Site. This gravity anomaly, one of the largest in the State of Louisiana, is probably related to a rise in the geologic fundament of the Gulf sedimentary basin, associated with faulting.

The deep-seated zones of fracturing, suggested by the Bouguer Gravity Map in Figure 2, explained why in the Poverty Point area, and generally in northeastern Louisiana, Zimmernan (1994) mapped the largest concentration of upper Cretaceous igneous rocks, deposited in the form of stocks, pipes, dikes, sills, intraformational flows, and pyroclastics. A gas field has been discovered underneath the Woodland Indian site. The gas field, and the geologic structure, are associated with a positive gravity and magnetic anomaly.

The idea that Indian shamans were able to detect geological and/or geophysical disturbances has been discussed by Devereux (1992). He remarked that a part of the initiation of an Eskimo Indian shaman was a test to indicate, while blindfolded, the location of a cave. This phenomenon, known as biolocation, was studied by Betz (1990). An unconventional claim within biolocation research is that certain participants experience involuntary muscular contractions in their bodies while walking across particular geological inhomogeneities, such as caves, faults, or salt domes. The main attitude of the geological community toward such a claim has been denial (Williamson, 1993). Double-blind experiments with normal sensory channels blocked provide empirical evidence for the biolocation phenomenon known as site-dowsing (Betz, 1990).

In 1994, I applied Betz's methodology to the Poverty Point archaeological area (Figure 3). A biolocator was placed blindfolded in a car moving at a speed of 25 mph, crossing the area of interest on a country road oriented northeast-southwest.

In Figure 3 the biolocation data are indicated on an arbitrary scale, by the characteristic points of onset, extrema, and termination of the biolocation reaction. Maxima are related to a contraction of forearm muscles, and minima to a relaxation. It was important that the starting point of the biolocation measurement be far away from the initial point of the biolocation reaction. In this way a so-called zero of the biolocation sensor will be observed between the starting point of the measurement and the first reaction. The shape of the bi-

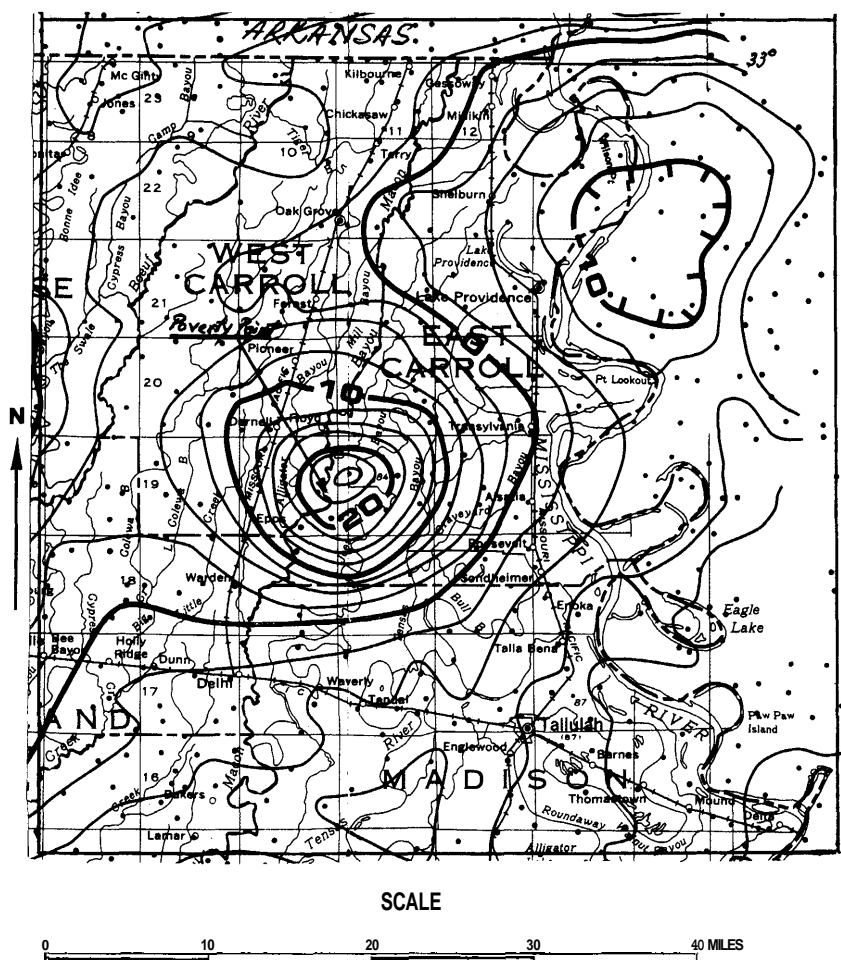


Fig. 2. The Bouguer Gravity Map of Northeastern Louisiana, after the Louisiana Geological Survey. Contour intervals are 2.5 milligals. The Poverty Point archaeological area is indicated by an arrow. In order to highlight only subsurface effects, it was important to account for all obvious near-surface masses that can affect gravity and to make a correction. This correction for near-surface masses is called Bouguer correction, and was applied for the Gravity Map of Louisiana.

olocation reaction seen in Figure 3, and the distance of a few km between the starting and finishing points of the signal, was obtained in other regions with extensional faults, oil fields, and/or salt domes (Apostol, 1992). However, the pilot test described in Figure 3 needs to be repeated under well controlled conditions.

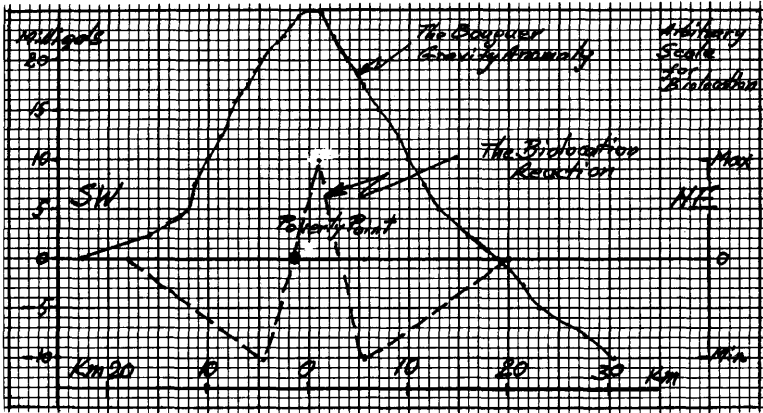


Fig.3. Biolocation measurements on a southwest-northeast line, located across the Poverty Point positive gravity anomaly. The biolocation reaction is indicated at an arbitrary scale, by the characteristic points of onset, extrema, and finishing of signal. The Bouguer Gravity anomaly cross-section is indicated in milligals. Gravity data after the Louisiana Geological Survey. The biolocation data have been obtained by using Betz (1990) methodology with normal sensory channels blocked.

The Serpent Mound of Ohio

Squier and Davis (1848), published the first drawing of the Serpent Mound in Adams County, Ohio (Figure 4). Later, Putnam (1889|1890) performed the first archaeological research of the area.

Hansen (1994) remarked that "archaeologists have long thought that the mound was constructed by the Woodland culture known as Adena, between 800 B.C. and 100 A.D. Ohio Historical Society archaeologist Dr. Bradley T. Lepper indicates that recent calibrated radiocarbon dates from the Effigy Mound are about 1070 A.D.

Many topographical and geological features might be related to the location of the serpent mound at the particular site. In Figure 5, near the serpent mound cliff, an entrance to a cave can be observed. The cave, a few feet long, is located just under the spot where the serpent's mouth touches an egg-shaped mound. Caves have been related in all ancient cultures with the idea of Earth-mother and creation.

A topographical anomaly is suggested also in Figure 4. The Ohio Brush creek, on the west side of the serpent, flows south, and the creek on the east side of the serpent flows north. This topographical anomaly can be explained by the geology of the Serpent Mound area, and might have impressed ancient Indians.

By far the most dramatic feature around the Serpent Mound is the explosion structure (Hansen, 1994). Such an event is recorded in the rocks around the

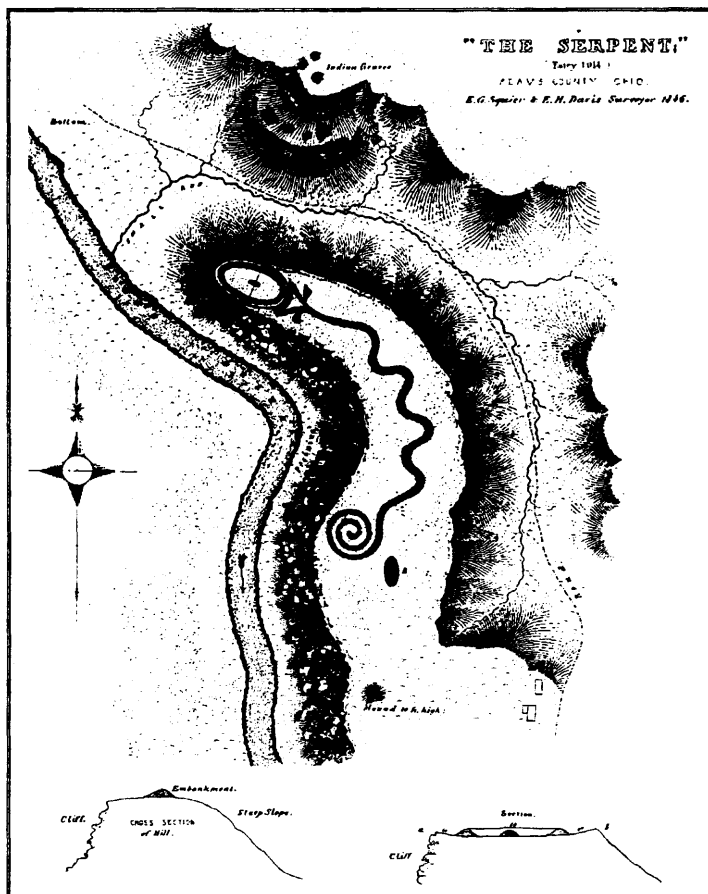


Fig. 4. The Serpent Mound, Adams County, Ohio, after Squier and Davis (1848). The serpent mound lies on a 150-foot-high cliff overlooking the Ohio Brush creek. The serpent is about 1,400 ft long, and 4 to 5 ft in height, built by clay placed over a base of local fragments of dolomite. No scale was indicated in the original picture.

Serpent Mound. A circular area of more than 12 square miles was affected. The southern Ohio rock formations that lay quietly one over the other have been uplifted on a central area with a diameter of about one mile, and down-dropped on a circular area with a diameter of five miles. The Serpent Mound can be seen in Figure 6, in the down-dropped region, southwest of the central uplifted area (Hansen, 1994).

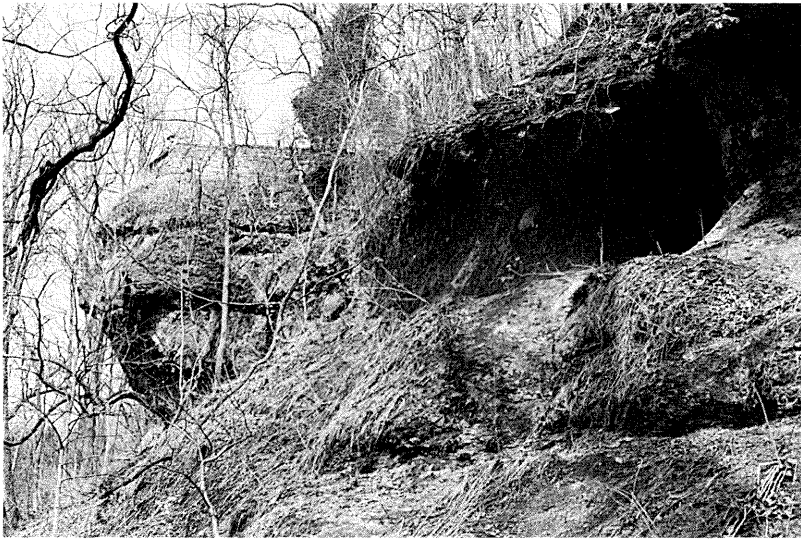


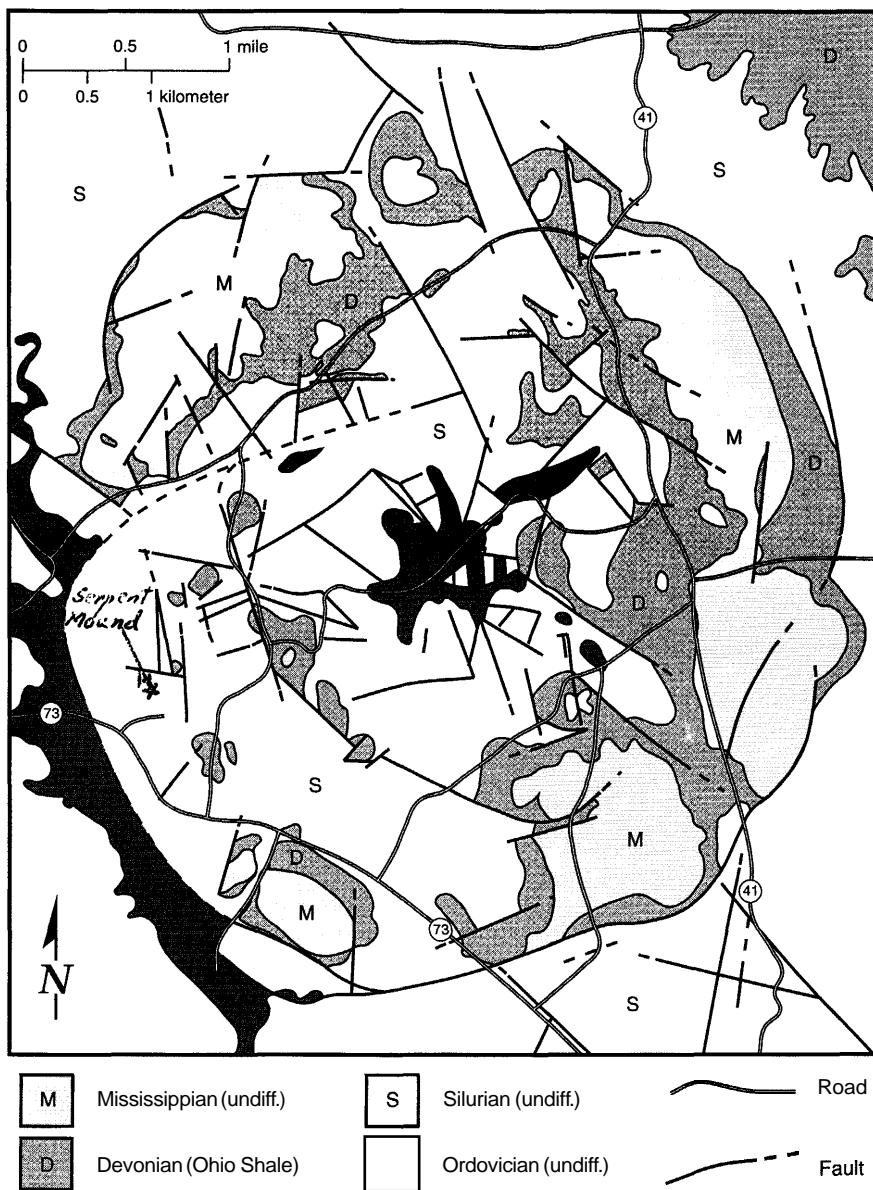
Fig. 5. The Serpent Mound Cliff seen toward East from the Ohio Brush creek. A cave entrance can be observed in the dolomite.

As for the nature of the explosion, some geologists suggest a massive eruption of explosive gases associated with molten rock coming from the Earth's mantle. Others think the explosion was caused by a small asteroid.

It is interesting to note that the explosion region can be correlated with a positive magnetic, gravity, and uranium concentration anomaly. These data suggest a deep igneous intrusion.

The geology and tectonics of the Serpent Mound archaeological area indicates that the serpent itself is encircled by a fault line to the north, a syncline axis to the south, a fault to the west, and another fault to the east. Due to the erosion generated by the Ohio Brush creek, the western fault was mapped only near the serpent's head. It is difficult to imagine a more complicated tectonic setting for the serpent. A biolocator walking around the Effigy Mound may experience reactions in all directions. More than that, the large number of visitors most of the time make a blind biolocation experiment impossible in the archeological area.

It is fair to say that many different factors might have influenced the ancient Indians in locating the Serpent. Among such factors might be visual cues, such as topographical and geological features, and/or biolocation reactions experienced by the shaman. It was decided to view a large number of ancient petroglyphs and mounds in Ohio, Wisconsin, and Iowa to look at the possible geological correlations as a first step toward a statistical approach. It was important to choose ancient Indian sites situated in parks and other areas not altered by recent development.



Greatly generalized geologic map of the Serpent Mound cryptoexplosion structure (modified from Reidel, Koucky, and Styker, 1982).

Fig. 6. A geologic map of the Serpent Mound explosion structure in Adams County, Ohio, after Hansen (1994). The Serpent Mound archaeological site, marked by a cross, can be seen Southwest of the central area.

Adena Mounds And Ancient Petroglyphs in Ohio

The Williamson Mound, Greene County

The Williamson Mound (located in Greene County, one mile south of Cedarville, on Route 42) is a conical burial mound, 28 feet high and 156 feet in circumference, built sometime between B.C. 200 and A.D. 100 by the Adena Woodland Indians on a limestone ridge, situated about a thousand feet north of the Massies creek gorge.

The most evident feature around the mound are three springs, situated about 500 feet south of the mound. There are no reports on these springs in the literature which describe the archaeological area. However, the three springs near the mound are the only ones that can be observed along the Massies creek limestone gorge about one mile in length. It is suggested that the presence of the springs is the reason for the site of Williamson mound.

Leo Petroglyphs, Jackson County

Similar to the Williamson mound archaeological area, the most evident feature around the sandstone slab with petroglyphs in Leo (northwest of Leo, in Jackson County, Ohio) is a natural spring. The spring can be seen about 100 feet north of the petroglyphs. Here too it is suggested that the natural spring might be the explanation for the siting of the Leo Petroglyphs. Many other sandstone slabs scattered in the region have no such petroglyphs, and no natural springs nearby.

There is no mention of the natural spring in archaeological papers that describe the Leo Petroglyphs.

Archaeologists believe that ancient native Americans built the petroglyphs sometime before the arrival of the first Europeans.

Ancient Indian Effigy Mounds in Wisconsin

Devils Lake Mounds, Sauk County

The largest number of Indian Effigy Mounds at Devils Lake are situated on the north shore. The red quartzite can be seen on the east shore, and a shelter, named the Elephant Cave is situated nearby. Not far from the Elephant Cave, is an Effigy Mound with a bear shape. The shape of the Bear Mound can be seen better from the air. It is interesting to note that the level of Devils Lake can be maintained with water discharged from an aquifer situated on the north shore. The Bear Mound is located above the aquifer. Of course, the correlation between the Bear Mound and the pocket of aquifer might be a coincidence.

The Effigy Mound National Monument, Allamakee County, Iowa

This group of mounds is situated on a high ridge above the Mississippi River,

at its junction with the Yellow River. The place has an extraordinary natural beauty that is increased by the presence of eagles circling the ridge most of the time.

Geologically, the mounds are placed on a limestone formation, from the so called Prairie du Chien group, of the Ordovician age, which is about 500 million years old.

In the Great Bear Group in Figure 7, the baby bear in the lower right corner was created about A.D. 500, but the cone shaped mounds in the upper right are younger, from A.D. 1,000 to A.D. 1,400.

A biolocation investigation indicated no reactions for the conical mounds. A clear reaction has been recorded in the baby bear area (in the lower right corner of Figure 7) Small holes in the limestone with strong air flow were found a few hundred feet southeast of the baby bear. This observation suggests the possible presence of a natural cave in the baby bear area. Geophysical investigations are necessary, to support the hypothesis of an underground cave.

Another group of mounds, with birds and bears, is situated on a ridge south of the Yellow River. This site has not yet been investigated.

Speculations on the Origin and Purpose Of Woodland Effigy Mounds

The present study is a starting point in trying to decipher the meaning of certain Effigy Mounds, with help from geology. New data on the purpose of Woodland ceremonial places might be obtained from ethnographic accounts of present-day hunter-gatherer groups throughout the world (Milton, 1994).

In 1992, Joseph Kirschvink announced the discovery of crystals of the mineral magnetite in human brain tissue (Barina, 1992). It has been speculated that the presence of magnetite in human brain tissues might be related to the controversial biolocation phenomenon (Betz, 1990). However, in spite of a

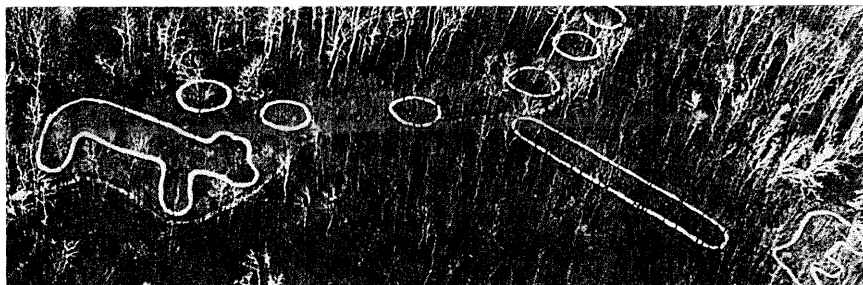


Fig. 7. The Great Bear Group, the Effigy Mound National Monument, Allamakee County, Iowa. The baby bear is situated in the lower right corner, and the mother bear in the lower left corner. After Folsom (1993).

large number of scientific experiments, no precise biological mechanisms for animal migration and human biolocation has been discovered.

The site of Woodland Indian Effigy Mound, in Poverty Point, Louisiana, and the location of other mounds along the Mississippi, Ohio and Wisconsin River valleys, can be correlated with wetlands and the migratory route of birds. Various ideas have been proposed in the past to explain the navigation and orientation ability of migratory animals and birds (Long, 1991). **Biolocation** based on a sensitivity of some sort to the Earth's magnetic field is favored by biologists for migratory birds, fish, and marine mammals (Seachrist, 1994). For humans, biolocation is generally rejected, in spite of positive results obtained by Betz (1990). The methodology used by Betz (1990) has been applied in a pilot test at the Cave of the Mounds, Dane County, Wisconsin.

The Cave of the Mounds was accidentally discovered on August 4, 1939, on the **Brigham Farm**, by workers removing limestone from a blast in a quarry. From that day on, quarrying was never resumed. In the year 1988 the cave was designated a National Natural Landmark by the United State Department of the Interior, and was opened to the public.

The cave was created in Ordovician dolomite that formed about 400 million years ago. The cave is about 400 feet long. It started to be cut in the dolomite about one to two million years ago, by an underground river that infiltrated a major fissure oriented north-south. Later, other levels were formed above the underground river.

Woollard and Hanson (1954), performed 279 gravity stations above the Cave of the Mounds. A gravity cross-section can be seen in Figure 8. The authors plotted the measured gravity anomaly, and the expected gravity anomaly. Their calculation was based on the limestone density of 2.71 g/cm^3 , and the geometrical dimensions of the underground cave. The gravity anomaly has been reduced, in order to obtain the Bouguer anomaly showing the underground inhomogeneities only. The biolocation reaction indicated in Figure 8 has been obtained by a participant biocator walking with eyes covered.

The pilot test described in Figure 8 needs to be repeated with more participating biolocators, using blind trials and performed with the normal sensory channels blocked. The experiment suggests that caves might be detected from the Earth's surface by using biolocation. Other geological inhomogeneities also generate biolocation reactions.

Apostol (1992), proposed a possible geobiological stimulus-reaction model for biolocation. Tiller (1993) suggested that biolocation phenomena can be regarded as a biological detection of "subtle energies." Magnetic crystals, synthesized by humans in the brain, may play a role in the mechanism of converting subtle energies into observable phenomena at the biological level. Betz (1990) indicates that magnetic anomalies alone cannot explain biolocation. An electromagnetic basis for biolocation remains a possibility.

If human biolocation is a reality, humans and animals may use it for their orientation in time of migration, and/or the location of watering places. Some

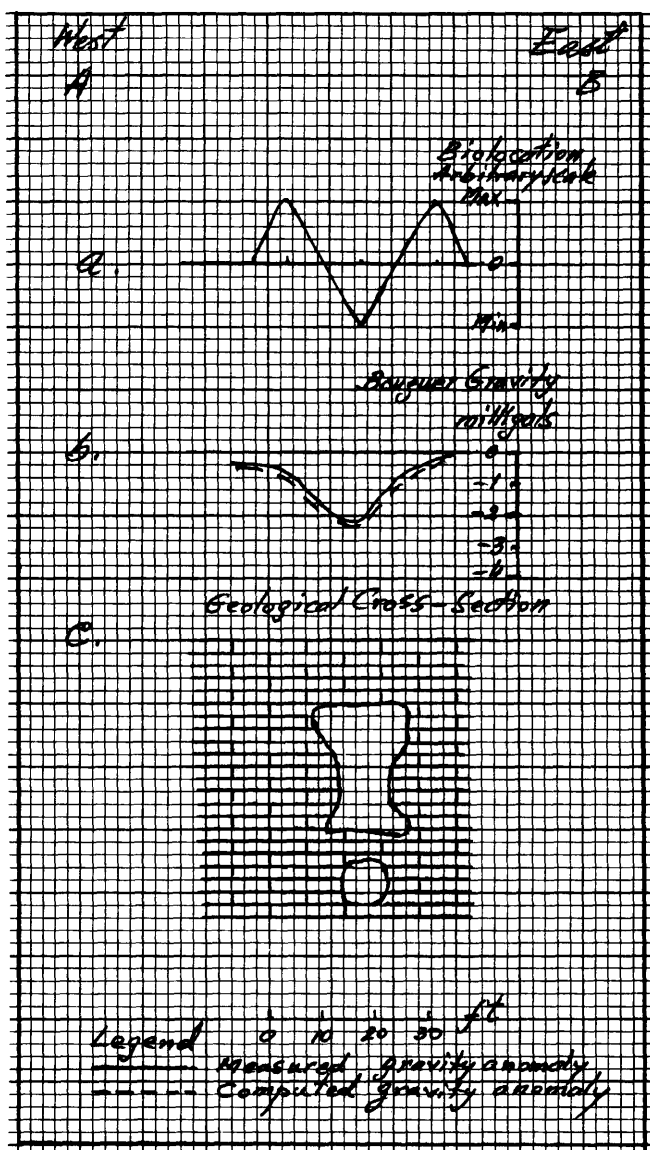


Fig. 8. A cross-section oriented west-east, over the Cave of the Mounds, Dane County, Wisconsin. The Bouguer gravity anomaly is indicated in milligals. The dashed line indicates the computed gravity anomaly. The biolocation reaction is indicated with an arbitrary scale. Gravity data after Woollard and Hanson (1954).

- Biolocation cross-section with an arbitrary scale.
- Bouguer Gravity Anomaly cross-section.
- Geological cross-section through the Ordovician dolomite. The caves are indicated in white.

of the Effigy Mounds created by Woodland Indians are situated in areas with biolocation reactions and geophysical anomalies. The site of Poverty Point, Louisiana, the Ohio Serpent Mound, and the Baby Bear Mound in the Effigy Mound National Monument, Iowa, are good examples in this regard. These places might have been used by ancient Indian shamans as healing or vision quest-sites (Krippner, 1992, Devereux, 1993)

The possible relationship between geology, geophysics, biolocation, biosystem behaviour, and Woodland Effigy Mounds, is one aspect of the deep communion and harmony of ancient North American Indians with nature. Another aspect, and perhaps the most important for the Indians, was the "magical nature" of the Effigy Mounds, as a vision-quest site (Eliade, 1983, Devereux, 1993).

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References

- Apostol, A. (1992). Applications of biolocation for the detection of certain geological inhomogeneities. Correspondence. *Frontier Perspectives*, The Center for Frontier Sciences at Temple University, Philadelphia, Pennsylvania, 3, 1, Fall, 5.
- Attig, J., W., and Clayton, L. (1990). Geology of Sauk County, Wisconsin. *Wisconsin Geological and Natural History Survey*. Information Circular No. 67, Plate 1, Map 90-1a.
- Balthasar, R. (1992). *Remember Native America ! The Earthworks of Ancient America*. Santa Fe, New Mexico: Five Flower Press.
- Barina, M. (1992). Giving personal magnetism a whole new meaning. *Science*, 256, May 15, 96.
- Bassie-Sweet, K. (1991). *From the Mouth of the Dark Cave: Commemorative Sculpture of the Late Classic Maya*. University of Oklahoma Press.
- Betz, H.-D. (1990). *The Biolocation Mystery* (Published in German: *Geheimnis wiinschelrute*). Frankfurt, Germany: Umschau.
- Bouguer gravity map of Northeastern Louisiana. (1990). *Louisiana Geological Survey*. Baton Rouge, Louisiana.
- Braunstein, J. (1976). *North American Oil and Gas Fields*. Tulsa, Oklahoma: American Association of Petroleum Geologists.
- Burenhult, G., ed. (1993). The megalith builders of Western Europe. In *People of the Stone Age: Hunter-Gatherers and Early Farmers*. American Museum of Natural History. San Francisco, California: Harper.
- Butler, D., T. (1994). Introduction to the meteor impact process. *The Leading Edge*, 13, 3, 188.
- Coe, M., D. (1993). *The Maya*. Fifth Edition. London, England: Thames and Hudson Ltd.
- Coe, M., D. (1984). *Mexico*. Third Edition. London, England: Thames and Hudson Ltd.
- Dalziel, D., W., I., and Doll Jr., R., H. (1970). Geology of the Baraboo District, Wisconsin. *Wisconsin Geological and Natural History Survey*. Madison, Wisconsin.
- Devereux, P. (1992). *Earth Memory: Sacred Sites — Doorways into Earth's Mysteries*. St. Paul, Minnesota: Llewellyn Publications.

- Devereux, P. (1993). Acculturated topographical effects of shamanic trance consciousness in archaic and medieval sacred landscapes. *Journal of Scientific Exploration*, 7, 1, 23.
- Diamond, J. (1994). Spacious skies and tilted axes. *Natural History*, 103, 5, May, 16.
- Eliade, M. (1983). *The history of beliefs and religious ideas* (Published in French: *Histoire des Croyances et des Idees Religieuses*), Paris, France: Payot.
- Fagan, M., B. (1991). *Ancient North America: The Archaeology of a Continent*. London, England: Thames and Hudson Ltd.
- Folsom, F. (1993). *America Ancient Treasures*. Fourth Edition. Albuquerque, New Mexico: The University of New Mexico Press.
- Ford, J., A., and Webb, C., H. (1956). Poverty Point: A late archaic site in Louisiana. American Museum of Natural History. *Anthropological Papers*, 46.
- Gallenkamp, C. (1987). *Maya*. Third Edition. U.S.A.: Penguin Books, Inc.
- Goldstein, L., and Paulus, E., G. (1994). A nomination for a multiple property listing: The Lake Koshkonong effigy mound groups. *Produce National Register Nominations*. State Historical Society of Wisconsin.
- Goldstein, L. (1984, 1985, 1986 and 1987). The Southeastern Wisconsin archaeology project: 1983-1984, 1984-1985, 1985-1986, and 1986-1987. *Reports to the historical preservation division*, State Historical Society of Wisconsin. Archaeological Research Laboratory, Report of Investigations No. 77, 81, 85, and 88. University of Wisconsin, Milwaukee.
- Green, W., Stoltman, J., B., and Kehoe, A., B. (1986). *Introduction to Wisconsin Archaeology*. State Historical Society of Wisconsin, and the Wisconsin Archaeological Society.
- Hansen, M., C. (1994). Return to Sunken Mountain: The serpent mound cryptoexplosion structure. *Ohio Geology: A quarterly publication of the division of geological survey*. Winter.
- Huffman, A., R. (1994). Impact versus terrestrial processes: Separating fact from the fiction. *The Leading Edge*, 13, 5, 311.
- Jones, D. (1994). *Personal Communication*. Louisiana Historical and Archaeological Society.
- Krippner, S. (1992). The shaman as healer and psychotherapist. *Voices*, Winter, 12.
- Long, M., E. (1991). Secrets of animal navigation. *National Geographic*, 179, 6, June, 70.
- Milton, K. (1994). No pain, no game. *Natural History*, 103, 9, September, 44.
- Powell, C., A., Bollinger, G., A., Chapman, M., C., Sibol, M., S., Johnston, A., C., and Wheeler, R., L. (1994). A seismotectonic model for the 300 - kilometer-long Eastern Tennessee seismic zone. *Science*, 264, 29.
- Putnam, F., W. (1889/1890). The Serpent Mound of Ohio. *Century Magazine*, Vol. XXXIX (new series Vol. XVII).
- Reidel, S., P., and Koucky, F., L. (1981). The Serpent Mound cryptoexplosion structure, Southwestern Ohio. *Field Trip No. 6/16*. Cincinnati, Ohio: G. S. A.
- Rikitake, T. (1978). Biosystem behaviour as an earthquake precursor. *Tectonophysics*, 51, 1.
- Roehl, P., O., and Choquette, P., W. (1985). *Carbonate Petroleum Reservoirs*. New York, New York: Springer-Verlag.
- Seachrist, L. (1994). Marine biology: Sea turtles master migration with magnetic memories. *Science*, 264, April 29.
- Squier, E., E., G., and Davis, E., H. (1848). Ancient monuments of the Mississippi Valley. *Smithsonian Contributions to Knowledge*. Washington, D. C.
- Stevens, V., K. (1990). Monarchs' migration: A fragile journey. *The New York Times*, Science Times, C1, Tuesday, December 4.
- Stuart, G., E. (1994). New light on the olmec. *National Geographic*, January.
- Thomas, D., H. (1993). Farmers of the world. In *People of the Stone Age: Hunter-Gatherers and Early Farmers*. Editor Goran Burenhult. American Museum of Natural History. San Francisco, California: Harper.
- Tiller, W., A. (1993). What are subtle energies? *Journal of Scientific Exploration*, 7, 3, Fall, 293.
- Williamson, T. (1993). *Dowsing: New Light on an Ancient Art*. London, England: Robert Hale.
- Woollard, P., G., and Hanson, G., F. (1954). Geophysical methods applied to geologic problems in Wisconsin. *Wisconsin Geological Survey*, Bulletin No. 78, Scientific Series No. 15.
- Zimmerman, R., K. (1994). Evidence of wrench faulting in North and Central Louisiana. *Basin Research Institute Bulletin*, April, 53. Louisiana State University Center for Coastal, Energy & Environmental Resources.