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FOSSIL LORE IN GREEK AND LATIN LITERATURE

EUGENE S. McCARTNEY

The word fossil, which is of Latin extraction, is a derivative of the verb *fodio*, *fodere*, 'to dig.' The Latin form *fossile* is a translation of the Greek *orukton*, which means 'dug.' The Greek original seems to have no technical atmosphere about it, so that in rendering Greek authors who speak of fossil fish translators sometimes use the expression 'underground fish.' In a lake near Ruscino in Gallia Narbonensis people caught mullets (?) by digging down two or three feet and then plunging in a trident. The fish caught in this way were called 'dug mullets.'[1] The adjective is the same as the one in use for fossil fish. The Roman could speak of 'fossil salt' in the same way that he spoke of fossil animals.[2]

The Greeks and Romans naturally had many opportunities to examine fossils. Several of their temples are built of a shelly limestone and of course the beauty of many of their marbles, of which they were very

fond, was greatly enhanced by fossils replaced by crystals.[3] In the classical countries fossils at times obtrude themselves upon one's notice. Just outside of Rome on Monte Mario I found many fine specimens of bivalves as large as the palm of one's hand. At Corneto one can still see in the fields shells as large as the crown of the head.

Along the Anio River in the deposits of travertine left by the overflow of the stream there are countless impressions of twigs and leaves. The water is so saturated with calcareous matter that one can almost make impressions to order. The quarries below Tivoli, which were used to provide building stone for ancient Rome, are still being worked. Here it takes but a few days for an incrustation of lime to form about a twig placed in slowly trickling water.

So strange an occurrence as the finding of mineralized remains of animals would naturally stimulate any imaginative people to speculate about their origin. The discovery of impressions of fish in the earth led the Greeks to formulate some peculiar theories about them. Aristotle says that many kinds of fish live in the ground, but without moving, and that they are found by digging.[4] We learn from Aristotle's literary executor, Theophrastus, that fossil fish occurred in Paphlagonia. Since there was no water in the neighborhood and since the fish could not have had access to one another, he concludes that they were generated spontaneously.[5] According to him, these fish have their own habitat and their own peculiar nature, just as do the species found in sea and river.[6] The idea that fish were born spontaneously required no stretch of the imagination for a Greek. There were many kinds of fish, small animals and insects whose origin was accounted for in this way. Pliny[7] comments in regard to these fish that unless they have the same nature as creatures that live in the earth they make much less wonderful the subterranean existence of the mole.

We are told that fossil fish were found in a plain between the Pyrenees and the Narbo.[8] In Heraclea and in Pontus there were 'dug' fish which were unearthed along rivers especially and in moist places. Their presence in the earth was resourcefully explained. As some regions were drying up, the fish gradually followed the moisture down into the mud; when the earth had become dry, they remained in the moisture of the mud, in a lair, as it were. But whenever they were excavated before the return of the water, then they would move.[9]

On one occasion when the Romans were expecting a war with Macedon, there were several prodigies, among them the emergence of fish from the ground as the furrows were being turned.[10] There were ancient stories about people going fishing with mattocks, but our informant is careful to add that not every one believed that fish were dug instead of being caught.[11]

Peoples other than the Greeks have concluded that animals might live under the ground. During his travels in South America Darwin was shown some bones of mastodons in a cave. From the position of the fossil remains, the natives had conjectured that they belonged to burrowing animals.[12]

In northern latitudes of eastern Asia, teeth and bones of mammoths have been found embedded in cliffs and banks of rivers. Local geologists (or mythographers) formulated their own theory to account for them. They concluded that the earth was the natural habitat of certain creatures, and they tell of having seen the surface of the earth disturbed when the creatures - moved beneath it. If by any misadventure the animals broke through and saw the light of day, at that very moment they died.[13] Some Siberians believed that the horns and teeth of elephants belonged to colossal rats which unawares broke through the surface and died on coming in contact with the air.[14]

A fossil that makes appeal to the popular imagination almost everywhere that it is found is the ammonite. Pliny[15] makes mention of *cornua Ammonis*, 'horns of Ammon,' that were found in Ethiopia,[16] and adds that they resemble horns of rams. They had the magic virtue of bringing to one dreams of things that were to happen.[17] In India "he who possesses a black *Salagrama* keeps it wrapped in white linen, washes and adores it daily. A draught of the water in which the shell has been washed is supposed to purge away all sin and to secure the temporal and eternal welfare of the drinker."[18]

Ammonites bear a closer resemblance to coiled snakes than to rams' horns and hence are frequently called 'snake-stones.'[19] The likeness is so real that attempts have been made to supply the missing heads and even to account for their loss. At Whitby they served as the coat of arms of the town.[20] Local tradition told how at the prayer of St. Hilda, the abbess of the convent, the snakes that inhabited the precincts not only suffered capital punishment, but were petrified.[21] A novel use for ammonites was made by the Glastonbury lake-village, of pre-Roman age, which has yielded several that were pierced as spindle-whorls.[22]

The 'deer-horn' stone, which so closely resembled horn that one could not readily tell whether it was horn or stone,[23] may have been a petrifaction.

The geographer Strabo[24] saw at the foot of the pyramids heaps of stones some of which resembled lentils in size and shape. They contained substances like grain half peeled. The local explanation was that they were remnants of workmen's food converted into stone.[25] Strabo refutes this by saying that in his country, Amasia, a long hill in a plain abounded in pebbles of a porous stone resembling lentils.

Fossilized echini have long had popular ideas associated with them. In the Romano-British village of Rotherly, Wiltshire, many of them have been found.[26] It would seem that their presence in graves is to be ascribed to some supposed amuletic property. The Essex laborer believes that while a fossil sea-urchin is kept in his home he and his family will never lack

bread.[27] These fossils are known as thunderstones in certain parts of Europe. They are believed to have fallen from the sky during thunderstorms and to act as a protection against lightning. If kept in an unfrequented part of the house, they make good substitutes for lightning-rods.[28]

A fossil which Pliny[29] describes as a kind of egg had the most wonderful powers ascribed to it in the land of Gaul. It was said to be formed from the saliva and slime of numerous snakes coiling together. The Druid version was that it was ejected into the air and had to be caught in a cloak before it touched the ground. The person catching it took to horse and was not safe until he put a stream between himself and the pursuing serpents. The test of its genuineness was its floating against the current, even when it was in a setting of gold.

The Druids praised it as bringing success in law-suits and gaining one access to kings. One specimen failed, however, with the Emperor Claudius, who put to death a Roman knight for no other reason than his having possession of it. Pliny saw one that was rounded and about as large as a small-sized apple. The shell was cartilaginous and was remarkable for the number of its cup-shaped formations like those of the arms of a polypus.

The fossil described by Pliny is generally taken to be the echinus, but one dissenting voice[30] says that the passage "seems to point to some fossil covered with *Ostrea sigillina*, such as are common in British greensands."[31]

There was a Greek story to the effect that the Arimaspi, one-eyed men whom the Greeks assigned to the northern branches of the Ural, were in the habit of seizing gold from beneath griffins.[32] According to a traveler, the inhabitants in the Siberian tundras attribute the huge fossil bones they find to a colossal bird. He conjectured that the Greek tale originated from the excavating of "gold-sand lying under the formations of earth and peat, which are filled with fossil remains."[33]

In Pliny's *Natural History*, Book 37, there are classed as stones many geological specimens which would seem to be fossils: e.g., *hammitis*, like the spawn of fish (167); *lepidotis*, like the scales of fish (171); *meconitis*, like poppies (173)[34]; *brontea*, like the head of a tortoise (150)[35]; *nipparene*, like the teeth of a hippopotamus (175); *syringitis*, like reeds (182); *phoenicitis*, like dates (180); *phycitis*, like sea-weed (180); *spongitis*, like sponges (182).

Pliny (36. 139)[36] notes that there were several varieties of ostracites, which are evidently fossil shells. They were used as a substitute for pumice stone in smoothing the skin. Applied topically with honey, they arrested discharges of the blood and cured pains and ulcerations of the breasts. 'Idaean fingerstones,' which resembled thumbs, are probably belemnites[37] (37. 170). *Cochlides*, probably petrified shells, were used in Arabia as pendants for the trappings of horses (37. 194). Pliny (36. 134) speaks at second hand[38] of a white and a black fossil ivory. This would seem to be fossil teeth of mammals. The "osseous" stones that he mentions (36. 134) are apparently stones containing fossil bones.

An interesting fossil is the *glossopetra*, which resembles the human tongue, according to Pliny (37. 164).[39] It does not originate in the earth, but falls from heaven during the wane of the moon. It was requisite for selenomancy. Pliny distrusted the extravagance of the powers ascribed to it because of the claim that winds could be lulled by it. Among the modern names of *glossopetrae* are 'tongue-stones,' 'bird-stones,' 'swallow-stones,' and 'snake-stones.' In the seventeenth century the learned Dane, Nicolaus Steno, spoke of them as *Glossopetrae Melitenses*, 'tongue-stones of Malta.'[40] *Glossopetrae* have been identified as sharks' teeth.[41]

The ancients, too, had thunderstones (*ceraunia*,[42] *brontea*[43]). It was said that they were found only in places that had been struck by lightning.[44] They had various magical properties ascribed to them. A chaste person carrying the *lapis ceraunius* would never be struck by a thunderbolt, nor would the house or villa in which he might happen to be. One carrying it at sea was safe from bolts and squalls.[45] By means of it cities and fleets could be captured.[46]

There are several pieces of presumptive evidence which lead one to conclude that among these thunderstones were belemnites.[47] It would seem that some of the superstitions about such fossils in widely scattered regions of Europe[48] have an unbroken tradition from antiquity.

The Greek and Latin literatures are replete with stories of the finding of huge bones. The remains have been disclosed as a rule through the action of rain, landslips and earthquakes, although other forces of Nature and the hand of man have aided. The theories that were framed ascribed them to remote ancestors of the human race who were exalted both literally and figuratively, to idealized heroes of a few centuries prior, to giants, and even to monsters. It would seem that whenever the accounts have any foundation in fact these huge bones are the remains of prehistoric animals.[49]

Aulus Gellius[50] asks what conclusion is to be drawn from such remains except that the bodies of remote ancestors were larger than those of contemporaries. The Christian writer Arnobius[51] is impatient with those who refused to regard the bones that were dug up in various places as convincing proof that in days of old men were demi-gods and heroes with bodies huge and vast. Virgil[52] recounts the prowess of an ancient warrior who picked up and hurled as he ran a large landmark (boundary stone) which twelve men of later mould could scarcely have sustained. St. Augustine[53] says that these discoveries prove the great size of the bodies of the ancients even to ages far later. Juvenal[54] regretted that in his day the earth brought forth only wicked and puny men.[55]

When stories record the finding of huge bones in coffins or tombs, it would seem that peasants or other persons had found the bones of prehistoric animals and had

given them the rites of burial.[56] It may not be amiss to recall that there is a tombstone to Pithecanthropus in Java, although the remains no longer repose on the island. In view of the respect the ancients paid to the dead and their insistence upon proper burial rites, this does not seem at all strange. Some of the accounts, if they have any basis in fact, have been greatly enlarged upon.

Several interesting discoveries are recorded by Philostratus.[57] He says that the Lacedaemonians found in Nemea the corpse of Orestes,[58] which was seven cubits long; that when the sea destroyed the mound of Ajax, there were found bones belonging to a body eleven cubits long[59]; that during excavations on the island of Cos the earth opened exposing a body of twelve cubits, the head of which was inhabited by a dragon; that the body of Aryades, an Ethiopian or an Indian, whose resting-place was exposed by a landslip on the Orontes, was thirty cubits long. There is also a story to the effect that in digging the foundations of their city the Carthaginians came upon two skeletons, one of twenty-three cubits, the other twenty-four.[60]

On the prehistoric site of Phlegra in Macedonia there occurred a terrible fight with the giants for world dominion. Proof of the encounter was seen in the finds of enormous bones too large to be those of human beings. These were exposed whenever there was an unusually heavy deluge of rain. Ammunition dumps, so to speak, consisting of huge rocks for the storming of heaven were likewise pointed to in support of the story of the encounter.[61]

In describing the sanctuary of the boy Aesculapius at Megalopolis, Pausanias[62] says: "Here, too, are preserved bones of superhuman size; they were said to be the bones of the giants whom Hoplodamus mustered to defend Rhea."[63] Frazer comments as follows on this passage: "They were probably bones of mammoths. In the museum of Dimitsana in Arcadia there is a large partially-fossilized bone which was brought from Megalopolis and which the collector . . . calls the shoulder-blade of an elephant." Frazer thus comments on Pausanias, 8. 29. 1: "The localisation of the legend [of the battle of the gods and the giants] in the plain of Megalopolis may have been due to the prevalence of earthquakes, the burning earth, and especially to the finding of mammoth bones. Many such bones are still found by the peasants in this neighborhood, and some of them are now preserved in the museum at Dimitsana."[64]

Mention is frequently made of the discovery of remains of giants or of beings of gigantic stature. In the trunk of a brazen horse which was exposed by an earthquake in Lydia, the peasants found a corpse which seemed too large to be that of a human being. On a promontory of Sigeum there was brought to light the body of a giant that Apollo slew for defending Troy. It was twenty-two cubits long and so much of a curiosity that people made voyages to see it. A portion of a skeleton with the vertebrae of the backbone disjointed, presumably by an earthquake, was found in Lemnos. The skull was large enough to hold two Cretan amphorae of wine. In Cos bones of the 'earth-born' were discovered. So numerous were the bodies of giants that were found in Pallene exposed by rains and earthquakes that our informant speaks of them as bivouacking there.[65]

Doubting a Libyan tradition that Antaeus was buried in the city of Tingis,[66] Sertorius[67] had a tomb opened in that place. On finding a body sixty cubits long, he was dumbfounded, and after sacrificing he filled up the tomb again and joined in magnifying its traditions and honors.[68]

An interesting piece of folklore grew up about what seems to be another tomb of Antaeus. Peasants in Mauretania pointed out a hill in which he was supposed to be buried. When any portion of it was dug out, rains began to fall and continued until the earth was replaced.[69] Ten feet longer than the skeleton of Antaeus was one which was said to have been found on an island near Athens. It measured 100 feet.[70] The honor of being the resting-place of the monster Geryon was claimed by both Lydia and Thebes.[71]

When an earthquake near the Strait of Messina had exposed enormous bones, the peasants were afraid to move them. A tooth over a foot long was sent to Tiberius, who was asked if he wished to have the other remains brought to him. He avoided the impiety of disturbing the dead by having a geometrician construct a face proportioned to the size of the tooth.[72] It is not strange that in Sicily, with its Homeric traditions of the Cyclopes and the Laestrygones, bones of prehistoric animals should be ascribed to the giants that were supposed to have inhabited the island.[73] It is said that Empedocles, too, accounted for them in this way.[74]

In a passage in *The City of God*[75] St. Augustine used the evidence of fossil bones to prove the existence of a race of giants: "But with regard to great size of body sceptics are very often convinced by the exposure, through lapse of time or the violence of streams or by various chances, of tombs in which incredibly large bones of the dead have come to light or from which they have fallen out. Not only I myself but several men with me on the shore of Utica saw a molar so large that if it were cut up into small teeth the size of ours it seemed it could have made a hundred. But that, I believe, belonged to some giant."[76]

There were stories likewise of huge monsters. Marcus Scaurus exhibited during his consulship bones of a monster that were brought from a town in Judaea. It was said that Andromeda had been exposed to this creature. It was forty feet long; the ribs were longer than those of Indian elephants; and its spine was a foot and half thick.[77] In the same passage Pliny tells of a monster that was driven from the shores of Gades. Between the two wings at the end of its tail there was a spread of sixteen cubits; it had 120 teeth, the largest of which were nine inches long, the smallest, six inches.

Some of the ancients knew the significance of these finds of bones. Though remains found on the island of

Capri were generally said to have been the bones of giants or the weapons of heroes, Suetonius knew they belonged to beasts and wild animals.[78] There was a tradition that huge bones found on Samos were those of the Amazons who were slaughtered while fleeing from Bacchus.[79] Later writers explained them as bones of animals.[80]

In the valley of the Arno there have been found remains of elephants and extinct animals which crossed from Africa on a land-bridge in Tertiary times. Nicolaus Steno, a Dane who lived in the seventeenth century, examined some of these bones and made some interesting if inaccurate deductions. We are told that the Carthaginian army entered Italy with thirty-seven elephants, but that they found the climate too rigorous for them. Livy (22. 2) represents Hannibal as riding the sole survivor when he rached Arezzo in the early spring of 217 b.c. Steno noted that the skulls, the huge femurs and the scapulae did not belong to animals native to Italy, and concluded that they were the elephants which Hannibal had brought with him into Italy.[81]

A recent article on the part played by fossils in mythology holds that the creators of the ancient cosmogonies with their giants and monsters had in mind mineralized remains which they had seen.[82] Furthermore, one finds not entire animals, but a tooth, a limb or a few bones. The conclusion is drawn that this is the basis of the ancient theory that in the original creation parts of bodies were formed separately in a more or less haphazard fashion, heads without necks, arms without shoulders, and so on, until fortuitous combinations of parts produced perfect bodies.[83]

Fossil lore is to be found in the early Christian writers also. They ransacked all branches of ancient science in order to find material to confirm the claims of the Bible. Just as they took the traditional notions of spontaneous generation to prove the possibility of the virgin birth of Christ, so they used the evidence of fossils found in the interior and on mountains as convincing testimony of Noah's flood. Eusebius[84] says that he confirmed with his own eyes the truth of the story that the deluge exceeded the height of the highest mountains. When building stone was taken from the highest quarries on Mount Lebanon, there were found in a perfect state of preservation various species of sea fish as large as hats,[85] patent testimony of the ancient flood.[86] He adds that persons who hear of these things interpret them each one according to his own pleasure. He is referring evidently to pagans who used fossils as evidence of the flood of Deucalion.[87]

There are fashions in theories. The latest one is, not that fossils are proof of a deluge or of the deluge, but that they are in themselves the basis of the creation of stories of floods.[88]

References to fossilized vegetation and to petrifactions are comparatively infrequent in the classical literatures. Certain stones in the vicinity of Munda in Spain were described as being *palmati*,[89] a word that refers not to their size, but to the impressions of leaves within them, which were revealed when the stone was broken. *Dryitis*, 'oak-stone,' which resembled the trunk of a tree, burned like wood.[90] It has been conjectured that this was fossil coal. The isle of Samothrace gave its name to a heavy black stone resembling wood in appearance.[91] Among the metals of Scaptesula there was a stone closely resembling rotten wood. When one poured oil on it, it burned, but when the fire went out, it seemed to have been unaffected.[92]

An interesting passage in Pausanias runs as follows:[93] "I have heard a Cyprian, who was skilled in simples, say that the ebony-tree does not put forth leaves, and that there is no fruit on it — nay, that it is never seen in the sunlight, but consists of underground roots, which the Ethiopians dig up; for there are men among them who know how to find the ebony."[94] This is supposed to have been a fossilized wood.[95]

Along the whole coast of the Persian Gulf there grew trees resembling the laurel and the olive. When the tide ebbed, whole trees were visible above the water, although at high tide they were sometimes entirely covered. This seemed strange to Strabo because there were no trees back from the coast.[96]

Strange to say, the earliest speculation about fossils that I can find evinces a fairly clear understanding of their geological significance. By appealing to the evidence provided by shells and the petrifactions of marine life discovered on mountains and in quarries, Xenophanes, a philosopher of the sixth century b.c., endeavored to prove that the surface of the earth had once been beneath the waters of the sea. In the quarries of Syracuse he noticed the impression of a fish and of sea-weed(?)[97]; in Paros, that of a small fish called *aphua*[98]; in Malta, impressions of many kinds of sea life. He held that these changes took place when there was a stream of mud which later dried and kept the stamp or the imprint, so to speak, of the animals it overwhelmed. All humankind was destroyed when the land was thus carried into the sea; after this calamity man had to begin life anew.[99]

The finding on Delos and Anaphe of pebbles, shells and other things that are commonly washed up along shores was regarded as proof that these islands had once been under the sea.[100]

The ancients theorized about deposits of shells at great distances from the sea. Along a road three thousand stadia in length that led to the temple of Ammon, there was a great profusion of mussel-shells, oyster-shells, and scallop-shells. In Armenia, Matiene and Lower Phrygia, there were observed stones in the shape of bivalves, shells of the pecten order, impressions of scallop-shells. From the presence of sand and fossil shells in the extensive salt-lands of Egypt, the conclusion was drawn that the land had once been submerged.[101] Diodorus[102] says that all Egypt was 'river-deposited.' Herodotus[103] and Plutarch[104] call

attention to fossils upon the tops of mountains and conclude that Egypt was once sea.[105]

Most of the authors quoted in this paper are Greek. Roman curiosity was not so much aroused by fossils; in fact, their interest seems to have been rather bookish, since many of the Latin passages hark back to the Greek.

One will readily understand how difficult it was to form correct ideas about fossils in days before the theory of the evolution of plant and animal life had been formulated. Paleontology had to remain in the background until some of the other sciences were more fully developed. It is not so much to the discredit of the Greeks that superstitions existed among the rank and file of the people as it is to their credit that so many great men could cast aside traditional lore. It is remarkable that they were able to achieve so much without the microscope and other instruments and aids now regarded as indispensable. They were pioneers in many fields of thought and research, and it is the Greek spirit of scientific inquiry, the Greek endeavor to supersede a religious by a natural interpretation of the universe, that forms the basis for the attainments of modern science.

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[1] Strabo, 4. 1. 6. Cf. Lucian, *Vera Historia*, 2. 2.

[2] *Fossile sal*, Plin., *Nat. Hist*., 37. 143.

[3] For ancient references to fossils in buildings, see Xen., *Anab*., 3. 4. 10; Aristophanes *ap. Poll*., 7. 100; Philostratus, *Vit. Apoll*., 2. 20; Hesychius, s. v., Κογχυλίας λίθος.

[4] *De Respiratione*, chap. 9.

[5] Pliny (*Nat. Hist*., 36. 134) tells us that Theophrastus believed that there were stones which brought forth young, that bones were born from the earth, and that 'bone stones,' *lapides ossei*, were found. Darwin was amused to find people in South America discussing whether the fossil shells he had been collecting were "born by nature." See *The Voyage of the Beagle* (*Everyman's Library*), p. 338.

[6] *Frag*. 171. 11-12: cf. Pseudo-Aristotle, *De Mirab. Ausc.*, 74.

[7] *Nat. Hist*, 9. 178.

[8] Polyb., 34, 10: cf. Athen., 8. 4.

[9] Pseudo-Aristotle, *De Mirab. Ausc*., 73. For other references to 'dug' fish, see Athen., 8. 2; Strabo, 3. 42; 4. 16.

[10] Livy, 42. 2. 5: cf. Juv., 13. 65-66.

[11] Sen., *Nat. Quaest*., 3. 16. 5-3. 17. 3.

[12] Darwin, *op. cit.*, p. 120.

[13] Page 54 of Von Olfers, *Die Ueberreste vorweltlicher RiesentMere in Beziehung zu ostasiatischen Sagen und chinesischen Schriften, Abhandlungen der koeniglichen Akademie der Wissenschaften* (1839), 51-79.

[14] Von Olfers, *op. cit*., p. 64.

[15] *Nat. Hist*., 37. 167.

[16] Isid., *Orig*., 16. 4. 29, tells us that they occurred in Arabia as well as in Egypt.

[17] Cf. Solinus, 27. 46.

[18] Frazer, *The Magic Art*[3], II. 26 and note. See also *Lectures on the Early History of the Kingship*, pp. 157-158.

[19] On ammonite lore see pages 49-60 of an article by W. W. Skeat *"Snakestones" and Stone Thunderbolts as Subjects for Systematic Investigation, Folk-Lore*, 23. 45-80. See also W, R. Halliday, *Snake Stones, Folk-Lore*, 32. 262-271.

[20] *Folk-Lore*, 17. 7.

[21] In *Marmion*, 2. 13, Scott thus refers to the story:

". . . of thousand snakes, each one
Was changed into a coil of stone,
When holy Hilda pray'd;
Themselves, within their holy bound,
Their stony folds had often found."

[22] Johnson, *Folk Memory*, p. 149.

[23] *Orphei Lithica*, p. 141 (Abel's ed.).

[24] 17.1. 34.

[25] It is said that "that at the base of the pyramids a variety of calcareous stone is found in detached masses, exactly such as Strabo has described, and appear to be the petrified remains of some unknown animal." See Falconer, *The Geography of Strabo*, III. 252, note 1.

[26] A. L. Pitt-Rivers, *Excavations in Cranborne Chase*, 2. 68, 78-85.

[27] Johnson, *Folk Memory*, p. 149.

[28] Blinkenberg, *The Thunderweapon in Religion and Folklore*, pp. 77-85, 95.

[29] *Nat. Hist*., 29. 52-54.

[30] Conybeare, *Roman Britain*, p. 70.

[31] See also Brand, *Popular Antiquities*, s. v., *ovum anguinum*.

[32] Herodotus, 3. 16.

[33] *Erman's Travels* in Siberia (translated by W. D. Cooley), II. 87-89.

[34] Cf. Isid., *Orig*., 16. 15. 20.

[35] Cf. *op. cit*., 16. 15. 24.

[36] Cf. *op. cit.*, 16. 4. 16.

[37] The name 'fingerstone' is still applied to them in modern Europe. See C. Blinkenberg, *The Thunderweapon in Religion and Folklore*, pp. 76-77.

[38] See Theophrastus, *De Lopidibus*, 6. 37.

[39] Cf. Solin., 37. 19; Isid., 16. 15. 17.

[40] See Winter, *The Prodromus of Nicolaus Steno's Dissertation* (*Univ. of Michigan Studies, Humanistic Series*, XI, part 2), p. 211.

[41] See *Die Kultur der Gegenwart* (*dritter Teil, vierte Abteilung*), IV. 344.

[42] Pliny, *Nat. Hist*., 37. 132, 134-135.

[43] *Op. cit*., 37. 150.

[44] *Op. cit*., 37. 135.

[45] Damigeron, 12.

[46] Pliny, *op. cit*., 37. 135.

[47] See Eugene S. McCartney, *On Fossil Thunderstones and Fingerstones, The Classical Journal*, 18 425-426.

[48] See Blinkenberg, *loc. cit*.

[49] "Such stories probably sometimes originated in the discovery of the fossil bones of large animals."—Frazer, *Pausanias*, 11.483. See also Frazer, *Attis, Adonis and Osiris*. I. 157-158, and Von Ofers, *op. cit*.

[50] Noct. Att., 3. 10. 11.

[51] 2. 75.

[52] *Aen*., 12. 899-900.

[53] *De Civ. Dei*, 15. 9.

[54] 15.65. Cf. Solinus, 1. 87. Mayor, *Juvenal*, II. 374, gives other references.

[55] Not all the ancients were imposed upon by these huge bones. A certain Phoenix says that the size of the men of his day is sufficient evidence that heroes ten feet tall never existed (Philostratus, *Her*., 1.1).

[56] See Mayor, *Juvenal*, II. 376.

[57] Philostratus, *Heroica*, 1. 2-3. See also Plut., *Thes*., 36. 4.

[58] Cf. Herod., 1. 68; Plin., *Nat. Hist*., 7. 74; Gell., *Noct. Att*., 3. 10. 11; Solinus, 1. 90.

[59] Compare Pausanias, 1. 35. 5, where it is said that the knee-caps were about the size of the quoits used by boys in practising for the pentathlon.

[60] Phlegon, *Mirab*., 18.

[61] Solinus, 9. 6-7. Herodotus, 7, 123, says that Phlegra is the ancient name of Pallene, the westernmost of the headlands of Chalcidice. See the text to note 65.

[62] 8. 32 .5.

[63] Cf.: " . . . certain huge jaws and teeth, found in excavating on the Hoe at Plymouth, were recognized as belonging to the giant Gogmagog, who in old times fought his last fight there against Corineus, the eponymic hero of Cornwell." — Tylor, *Primitive Culture*[3] (1888), 1.387.

[64] For other tales of monsters and giants associated with the finding of huge fossil bones, see Tylor, *Researches into the Early History of Mankind*, pp. 314-315. See also pages 525-529 of Ernst von Lasaulx, *Die Geologie der Griechen und Roemer, Abhandlungen der philosoph.-philologischen Classe der koeniglich bayerischen Akademie der Wissenschaften*, 6: 515-566. Interesting notes are to be found in Mayor, *Juvenal*, II. 376.

[65] Philost. *Her*., 1. 2-3.

[66] Strabo, 17. 8, says Lynx.

[67] Plut., *Sert*., 9. 3.

[68] Barbarians in the Cimmerian Bosporus treated differently bones exposed by an earthquake. In their superstitious fear they threw them into the Maeotis marsh. Phlegon, *Mirab*., 19.

[69] Pomp. *Mela*, 3. 10. 5.

[70] Phlegon, *Mirab*., 17.

[71] Paus., 1. 35. 7; Luc., *Adv. Ind*., 14.

[72] Phlegon, *Mirab*., 14.

[73] Holm, *Geschichte Siciliens im Alterthum* (1870-1874), I. 57, 356.

[74] *Die Kultur der Gegenwart* (*dritter Teil, vierte Abteilung*), IV. 304. I have been unable, however, to find authority for this statement in the fragments of Empedocles.

[75] 15. 9.

[76] On huge bones in general see also Pliny, *Nat. Hist*. (cf. Solinus, 1. 91); Josephus, *Ant. Iud*., 5. 23; (Pseudo-) Clemens, *Recog*., 1. 29.

[77] Pliny, *Nat. Hist*., 9. 11.

[78] *Aug*., 72.

[79] Plut., *Mor*., 303 E.

[80] Eugaion *ap. Phot.*, s. v., *νῆίς*, cf. Euphorion, *ap. Ael., De Nat. Anim*., 17. 28.

[81] Winter, *op. cit*., p. 258.

[82] M. Louis Siret, *Le Rôle des Fossiles en Mythologie, L'Anthropologie*, 32: 203-213.

[83] Such was the view of Empedocles. Compare and contrast Lucretius, 5. 837-854.

[84] *Chron*., 1. 16. 12. Cf. Cedrenus, *Hist. Compend*., vol. 35, p. 27, of *Corp. Script. Hist. Byz*.

[85] The *petasus*, a flat-brimmed hat.

[86] Cf. Tert., *De Pallio*, 2: Adhuc maris conchae et bucinae peregrinantur in montibus. See too Isidore, *Origines*, 13. 22. For the employment in rather modern times of the evidence of fossils to prove the reality of the flood of Noah, see Frazer, *Folk-Lore in the Old Testament*, I. 338-339.

[87] A sentence in Apuleius, *Met*., 41, "Me non negabunt in Gaetuliae mediterraneis montibus, ubi pisces per Deucalionis diluvia reperiuntur," has been taken as referring to fossil fish, but it is evidently a piece of sarcastic humor accounting for the presence of real fish in inland regions.

[88] See Siret, *op. cit*., 32: 210.

[89] Pliny, *Nat. Hist*., 36. 134.

[90] *Op. cit*., 37. 188.

[91] *Op. cit*., 37. 181.

[92] Theophrastus, *De Lapid*., 17.

[93] 1.42.5; cf. *Hist. Plant*., 4.4.6.

[94] Frazer's translation.

[95] Parkinson, *Organic Remains of a Former World*, I. 53.

[96] Strabo, 16. 3. 6.

[97] The word 'seals' appears in the Greek text, but it has been held that seals are a paleontological impossibility for this region. A slight emendation of the Greek text gives 'sea-weed.' Fucoids have been found in great numbers in Sicily. See Gomperz, *Greek Thinkers*, I. 551.

[98] Whether rightly or wrongly the word was popularly interpreted as meaning 'not born.' It was generally believed that the fish originated from froth or foam.

[99] Diels, *Die Fragmente der Vorsokratiker*[3] (1912), I. 51.

[100] Theophrastus, *frag*., 30. 3.

[101] Strabo, 1. 3. 4; Pomp. Mela., 1. 6.

[102] 1. 39. 7.

[103] 2. 12.

[104] *Mor*., 367.

[105] The poet Ovid, *Met*., 15. 262-272, saw in the vicissitudes of the earth's surface a theme for poetic treatment.

THE PRESENCE OF CATARACT STRATA IN MICHIGAN SUPPORTED BY FOSSIL EVIDENCE

G. M. EHLERS

So far as known, no exposures of Cataract strata, which are regarded as being of Lower Silurian or Oswegan age, occur in Michigan. Cataract strata are probably present in the eastern part of the Northern Peninsula, and would be exposed except for a covering of glacial deposits. The outcrops nearest to Michigan occur on Manitoulin Island, Ontario; other exposures are present at several places along the Niagara escarpment between Manitoulin Island and Niagara Falls.

In recent years, certain strata, penetrated in drilling deep wells in Michigan, have been assigned to the Cataract by the Michigan Geological and Biological Survey, because they have the same lithological character as the rocks of this formation and occupy a similar stratigraphic position. The Cataract age of these unexposed strata, based on similarity in lithological character and stratigraphic position, is, however, open to question, because a younger or older age than the Cataract may very readily be postulated for these beds.

Fortunately, fossils, which were found in drillings brought to the surface in sinking the Henry Ford well at Dearborn and well Number 9 of the Diamond Crystal Salt Company at St. Glair, indicate beyond question the presence of Cataract strata in Michigan. These fossils, which were kindly identified by Dr. E. O. Ulrich of the United States Geological Survey, are noted in the tables below. The kind of rock and depth in feet below the surface, from which they were obtained, and their stratigraphic occurrence in other regions are also indicated.

An examination of these tables shows that *Sceptropora fustiformis* Ulrich and *Dalmanella aff. eugeniensis* Williams have thus far been found only in the Cataract and that *Phaenopora expansa* Hall & Whitfield has been reported from the Brassfield, a very close correlate with the Cataract in time. The other species, which, with the exception of *Phaenopora constellata* Hall, were first noted as occurring either in the Cataract or Brassfield, seem to have a slightly greater stratigraphic range. Considered as a group, however, the fossils represent a typical Cataract assemblage. They indicate beyond question that the greenish-gray shale penetrated in the Ford well between depths of 2405 and 2420 feet and the red and greenish-gray shales encountered in well Number 9 of the Diamond Crystal Salt Company between depths of 2770 and 2800 feet are of Cataract age. Furthermore, these fossils lend support to Mr. R. A. Smith's assignment to the Cataract of 140 feet of strata, penetrated in the Ford well[1] between depths of 2320 and 2460 feet and 170 feet of rock, encountered in well Number 9 of the Diamond Crystal Salt Company[2] between depths of 2700 and 2870 feet.

TABLE I

FOSSILS FROM HENRY FORD WELL, AT DEARBORN, MICHIGAN

Names of Species	Depth and Rock Matrix	Stratigraphic Occurrence
Bryozoa		
Hallopora magnopora (Foerste) (small variety)	2415′ and 2420′ Greenish-gray shale	Brassfield (Ohio) Rochester (Ontario)
Helopora fragilis Hall	2415′ and 2420′ Greenish-gray shale	Cataract (New York and Ontario) Lower Clinton (New York)
Phaenopora constellata Hall	2415′ Greenish-gray shale	Clinton (New York) Cataract (Ontario)
Phaenopora ensiformis Hall	2415′ Greenish-gray shale	Cataract (Ontario) Rochester (New York and Ontario) Osgood (Indiana) Brassfield (Ohio) Ellis Bay and Becsie River (Anticosti) Borkholm drift (Gotland)
Phaenopara expansa Hall & Whitfield	2405′ Greenish-gray shale	Brassfield (Ohio)
Brachiopoda		
Dalmanella aff. eugeniensis Williams	2415′ and 2420′ Greenish-gray shale	Cataract (Ontario)

TABLE II

FOSSILS FROM WELL NUMBER 9, DIAMOND CRYSTAL SALT COMPANY AT ST. CLAIR, MICHIGAN

Names of Species	Depth and Rock Matrix	Stratigraphic Occurrence
Bryozoa		
Hallopora magnopora (Foerste)	2800′ Greenish-gray shale	Brassfield (Ohio) Rochester (Ontario)
Helopora fragilis Hall	2785′ Red shale	Cataract (New York and Ontario) Lower Clinton New York
Helopara fragilis Hall	2800′ Greenish-gray shale	Same as above
Sceptropora fustiformis Ulrich	2775′ Greenish-gray shale	Cataract (Ontario)
cf. *Sceptropora fustiformis* Ulrich	2770′ Greenish-gray shale	Same as above
Phaenopora expansa Hall & Whitfield	2785′ Red shale	Brassfield (Ohio)

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[1] The description of the Cataract strata of the Ford well is given by Mr. Smith in Figure 7, opposite page 248, of *Publication 24, Geological veries 20, Michigan Geological and Biological Survey*, 1917.

[2] The record of this well has not been published. Mr. Smith's provisional record, which the writer was given permission to examine, is on file in the office of the Geological Division of the Department of Conservation at Lansing, Michigan.

A DRILL CORE SECTION OF THE SALINA BELOW THE SALT BED OF THE DETROIT ROCK SALT COMPANY MINE

JOHN W. VANDERWILT

THE Salina formation of upper Silurian age in Michigan consists of beds of salt, shale, dolomite and anhydrite. The salt beds are the chief source of salt in Michigan.

At Oakwood, Detroit, Michigan, a bed of salt 30 feet in thickness, whose base is 1140 feet below the surface, is mined by the Detroit Rock Salt Company. A geological section above and below this salt bed was published by Albert H. Fay[1] in 1911. A columnar section based on the geological section by Fay was subsequently published by Prof. W. H. Sherzer.[2] These sections indicate that the Salina above the salt bed now being mined consists of 263 feet of alternating beds of salt and dolomite. It is interesting to note that the salt bed being exploited is the thickest single bed of salt of this part of the Salina section.

The Detroit Rock Salt Company, by means of a diamond drill, has penetrated the Salina to a depth of 558 feet below this salt bed, from which the salt is now being mined. Through the kindness of Mr. G. W. Hain, manager of the company, the writer has received permission to study the drill core. The writer's interpretation of this core is embodied in the columnar section shown in Figure 6. At this time the writer wishes to acknowledge his appreciation of the assistance of Mr. G. M. Ehlers in carrying out this work.

The quantity of salt, dolomite and anhydrite in this section is of considerable interest. If the very few thin beds of shale of the section are included with the dolomite, a considerable part of which is argillaceous, the section is seen to consist of 268 feet of salt, 219 feet of dolomite and 71 feet of anhydrite. Although salt forms a considerable part of the section, no single bed of salt attains very great thickness.

Mr. Fay is incorrect in showing a bed of salt 369 feet in thickness at the base of his geological section. An examination of the drill core shows beyond question that the material of the upper 263 feet of the supposedly thick bed of salt consists of salt with thin beds of anhydrite and dolomite. This part of the bed occupies a position corresponding to the lower portion of the Upper Salina of the Henry Ford Well[3] at Dearborn. The lower 106 feet of Mr. Fay's supposedly thick bed of salt occupies a position corresponding to the upper part of the Lower Salina of the Henry Ford Well. Since this part of the Salina consists entirely of dolomite, it seems very likely that the lower 106 feet of Mr. Fay's geological section may also be composed of dolomite instead of salt. The facts adduced above prove that Professor Sherzer was correct in stating in his columnar section that the 369 feet of salt would be found to be divided by beds of dolomite.

The section given in Figure 6 is also interesting in showing that most of the beds of anhydrite occur in the lower part of the drill core. This distribution of anhydrite may prove to be of significance to the order of deposition, and more especially in regard to the determination of the conditions under which the Salina formation of Michigan was deposited.

It seems probable that this rather detailed section may serve as the type for the part of the Salina formation indicated. Many beds of the section are probably of wide areal extent and very likely will be easily recognized in records of deep borings in adjacent regions. Several beds of this section are unquestionably represented in the section of the Henry Ford Well at Dearborn.

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[1] Fay, Albert H. Shaft of Detroit Salt Company. Eng. and Min. Jour., 91, 565. 1911.

[2] Sherzer, W. H. Geological Report on Wayne County. Mich. Geol. and Biol Surv., Pub. 12, Geol. Ser. 9, Fig. 21. 1911.

Sherzer, W. H. Detroit Folio, No. 205. U. S. Geol. Surv., Fig. 19. 1917.

[3] The excellent and important section of the Henry Ford Well was published by Mr. R. A. Smith, director of the Michigan Geological and Biological Survey. Smith, R. A. Deep Well Borings. Mich. Geol. and Biol. Surv. Pub. 24, Geol. Ser. 20, Pt. 3, pp. 247-248, Fig. 7. 1916.