'Serpent stones': myth and medical application

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Abstract: 'Serpent stones' have been credited with medical efficacy since antiquity. Likely having their root in ancient traditions from India, accounts are now widespread across much of the world. Serpent stones are known by many names and descriptions of their appearance and medical uses are diverse; however, they commonly have a legendary association with serpents and are most frequently considered efficacious in the alexipharmic treatment of snakebite. This work presents and details five broad categories of serpent stone: a round white stone (thought to be extracted from the head of a dragon), a smooth lens-shaped black stone (purported to be taken from the head of a snake, but artificially manufactured of burnt bone or horn), ammonites (the fossilized shells of extinct cephalopods), glass or vitreous paste in the form of rings or beads, and serpentinite.

Serpent stones have been used in lapidary medicine since ancient times. Descriptions of their appearance and medical uses appear with surprising frequency in Medieval and Early Modern literature; accounts are known from Europe, India, the Far East, Africa and the Americas. Serpent stones have a high level of nomenclatural diversity and have been termed adderstones, *clach na thrach*, *milpreve*, *lapis ophites*, *lapis serpentinus*, *lapis serpentis*, *pierres de cobra*, *piedra negra*, the poison attracting stone, the Belgian Black Stone and the Black Stone, among others. Accounts contain significant variation with regard to the appearance, generation, means of harvesting, identity and therapeutic virtues of serpent stones. English palaeoanthropologist Kenneth Oakley (1911–81), writing on the use of fossils as charms, addressed this plethora of conflicting identifications, stating 'Many quite different objects passed for adderstones, particularly fossils and stones whose markings suggested an intertwining of snakes' (Oakley 1978, pp. 234–235); to this we can add stones which were thought to have been generated by snakes. Using these broad initial criteria, a survey of the literature on serpent stones enables categorization into five main types of stone. The first of these categories, for the moment, defies definite scientific identification but the other four are verifiable geological or artificial anthropogenic items. The accounts consulted do not demonstrate that authors were aware of different types; most were under the impression that the stone they commentated upon was the only variety of serpent stone. A few were aware of two types of stone, and Gaius Plinius Secundus (Pliny the Elder, AD 23–79) in his compendious work, *Historia Naturalis* (*Natural History*), referenced four of the five types in disparate sections within its pages, although attempts at comparison were not made. These categories are broad and some accounts do not fit comfortably into one or the other, but they do provide a starting point for classification using key characteristics and hence a starting point for further investigation into this rich area of study.

Early references from the East

The earliest reference to serpent stones identified so far is in the Assyrian medical texts from Ashurbanipal's library at Nineveh. These clay tablets, written in cuneiform and dating to around the seventh century BC, give tantalizingly brief information; the stone itself is not described but is listed among 20 other stones credited with being effective against the supernatural affliction of 'hand of ghost' when tied to the painful area (Scurlock 2006, No. 176). 'Hand of ghost' was shorthand for seizure by the hand of a ghost, either a departed relative or an unquiet spirit, then thought to be the cause of a range of physical ailments (Scurlock 2006, p. 10).

Early Indian serpent stones were gemstones that were said to form naturally within the head or neck of a serpent. The Indian collection of fables *The Panchatantra*, thought originally to be composed around 200 BC although many stories themselves may have predated this (Ryder 1925, p. 4), mentions that 'gems proceed from the hood of snakes' (Ryder 1925, p. 38). This work being a *niti-shastra*, or textbook for a wise life (Ryder 1925, p. 5), seeks through this example to encourage the reader, in modern parlance, 'not to judge a book by its cover'.

The *Garuda Purana*, which may date to as early as *c.* AD 400 (Stietencron *et al.* 1992, p. 871, Item 5003), specifies that pearls are produced in several animals, including snakes; the serpent pearl is called *Nagmani*. The stones are described as round in shape with a 'dazzling effulgence'; the possessor of the serpent stone is said to 'meet with a rare

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good fortune, and becomes a pious and illustrious king in time, with a treasury full of other species of precious gems' (Dutt 1908, p. 187). Conversely, the Indian *Brihat Samhita of Varaha Mihira*, dating from AD 505–587, describes the serpent stones as black and glossy. Their effect is reportedly to 'make the wearer wise, wealthy, happy and renowned, free him from diseases and grief, and secure for kings the object of their desire' (Chindambaram 1884, p. 170).

These sources contain the genesis of the first two types of serpent stones, which see expansion and greater differentiation in Ancient Greek works.

Type 1: dragonstones

Ancient Greek sources describe further the perceived nature and uses of serpent stones, and form a legacy which is inherited and itself expanded upon in medieval European works. Early Greek accounts describe two types of serpent stones which became confused with each other: the dragonstone and the snakestone. Both the dragon and the snake were said to have a naturally occurring stone concealed within their cranium. To examine the first category of serpent stones we must consider dragons.

Recent scholarship suggests a Palaeolithic African origin for the concept of dragons which was then transmitted to the Far East, reaching Australia and the Americas before the Mediterranean area, and thereafter Indo-European areas (D'Huy 2013, p. 199, fig. 3; 2014–15, p. 125). However, in D'Huy's works and in *Python: A Study of Delphic myth and its Origins* by Fontenrose (1974), which provides an in-depth study of the dragon motif in ancient times, a dragonstone is not recorded as a key feature in defining a dragon. Based upon the early Indian accounts above, I am of the opinion that serpent stone lore has its origins in ancient traditions of Asia, particularly India.

Dragon lore of China and Japan seems to have been influenced by the Indian Buddhist concept of *Nāga* (de Visser 1913, preface), a serpentine deity.

> The *Nāga* of Indian mythology and folklore is not really the snake in general, but the cobra raised to the rank of a divine being...the *Nāga* in his animal form is conceived as the hooded snake (Vogel 1926, p. 27).

The dragon is 'closely allied to the Indian *Nāga*' according to Vogel (1926, p. 27).

The word 'dragon' comes from the Greek *drakon* for a serpent, hence frequent confusion of the two creatures. The word *drakon* itself is from the verb *derkesthai*, meaning 'to see clearly or strongly'. This is significant as one of the early Greek accounts employed the dragonstone as a rhetorical device connected with sight. In his *New History*, Ptolemaeus Chennus, a grammarian of Alexandria (dates unknown, but active sometime during AD 98–138), added the dragonstone to the famous tale of the ring of Gyges. *New History* itself is now lost but a summary of the contents, including the reference to the dragonstone, is preserved under the name of Ptolemy Hephaestion in the *Biblioteca* of Photius I of Constantinople (*c.* AD 810–893) as codex 190. Referencing Herodotus' (*c.* 484–425 BC) account of the rise of Gyges in *The Histories*, Ptolomaeus adds that the Queen of Lydia, the wife of King Candaules, possessed a dragonstone which enabled her to see Gyges, even though he had been rendered invisible by a magic ring: 'the wife of [Candaules]...had double pupils, and she was extremely sharpsighted, being the possessor of the dragon-stone. This is how she came to see Gyges as he passed through the door' (Shell 1989, p. 37). In combination, the dragonstone and Gyges' magic invisibility ring embodied the combined magical power to make things visible or invisible: the power of an archetypical tyrant (Shell 1989, p. 37).

However, Greek writings frequently treated the dragonstone as a real physical object and identified it by the name *draconitis* or *dracontias*. Pliny, drawing on the late third or early fourth-century BC Greek author Sotacus, commented on the dragonstone:

> The 'draconitis', otherwise known as the 'dracontias', the 'snake stone', is obtained from the brains of snakes, but unless the head is cut off from a live snake, the substance fails to turn into a gem, owing to the spite of the creature as it perceives that it is doomed. Consequently the beast's head is lopped off while it is asleep.
>
> Sotacus, who writes that he saw such a gem in the possession of a king, states that those who go in search of it ride in two-horsed chariots, and that when they see the snake they scatter sleeping-drugs and so put it to sleep before they cut off its head. According to him the stone is colourless and transparent and cannot subsequently be polished or submitted to any other skillful process (Pliny book 37, cap 57; Bostock & Riley 1857, p. 447).

Devoid of rhetorical nuances, Pliny, whose credulity was described as 'great in the extreme' by his biographers (Bostock & Riley 1855, p. xvii), reported many fantastical stories of contemporary folklore as fact. It is a great pity that Sotacus' work is lost, as it would have been interesting to learn whether or not he approached the dragonstone as a rhetorical device.

Following Pliny, Greek sophist author Philostratus (*c.* 172–250) added to the tale of the dragonstone in his *Life of Apollonius of Tyana*. Philostratus located dragons in India and described the capture of the stone thus:

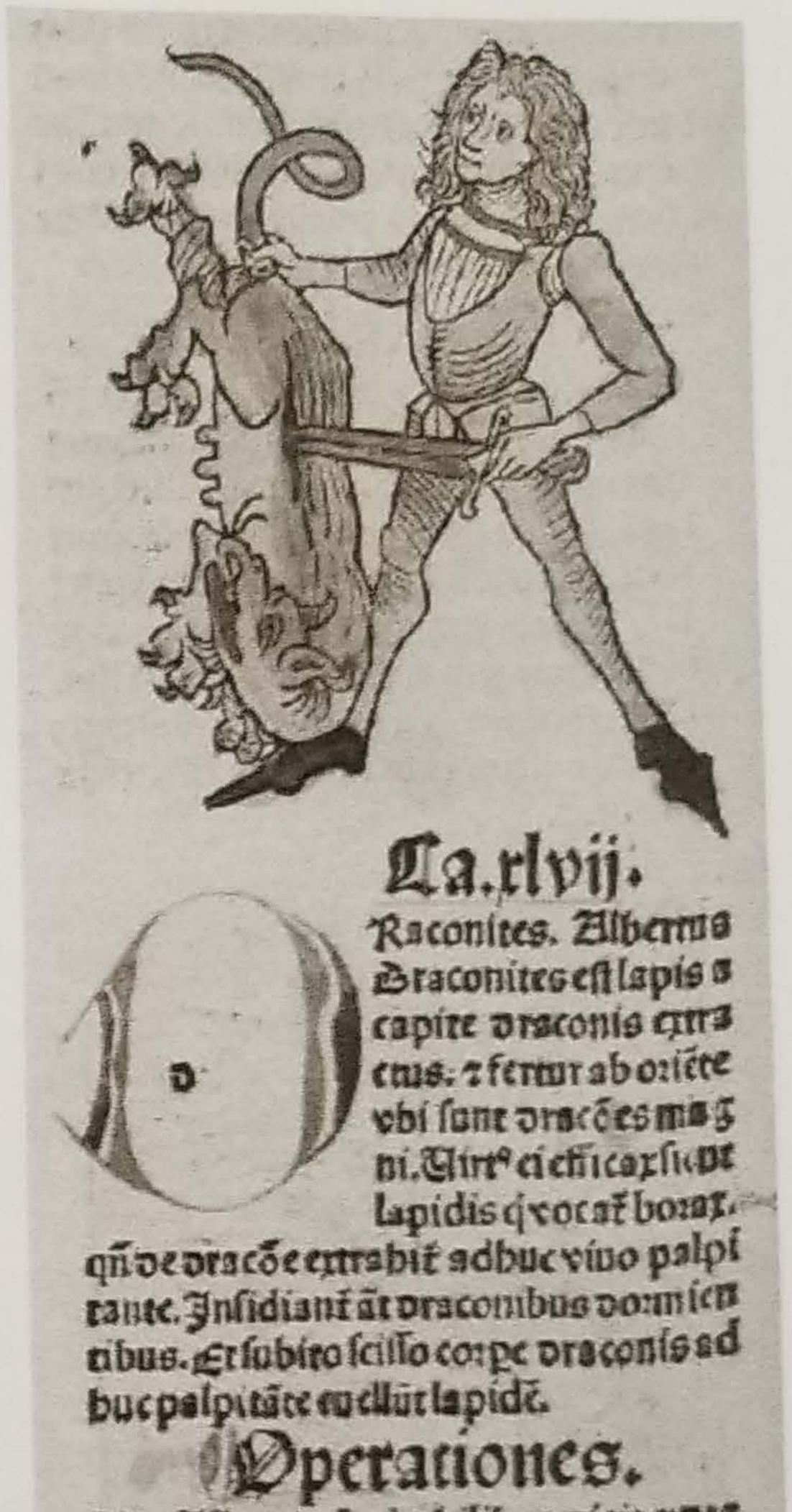
> These dragons . . . are conquered by the Indians in the manner following; they spread a scarlet coat before

their holes, embroidered with golden letters, which being charmed, bring on a sleep, that at last subdues those eyes, which would be otherwise invincible. Other spells, consisting of many words, extracted from their occult philosophy, are used, by which the dragon is so fascinated, that he puts his head out of his hole and falls asleep over the letters. Whilst he remains in this situation the Indians rush upon him with pole-axes, and after cutting off his head, strip it of all its precious stones. The stones found in the heads of these mountain dragons, are said to have a transparent lustre, which emit a variety of colours, and possess that kind of virtue attributed to the ring of Gyges. But it often happens that these dragons seize the Indian in spite of his pole-axe and carry him off into his den ... (Philostratus cap 8, Berwick 1809, p. 133).

The forcible extraction of the stone from its supposed host has an extensive tradition; it was believed that stones were held within the crania of toads and fish and the stomach or gizzards of various birds (Duffin 2007*a*, *b*, 2010, 2012, 2013*a*, *b*). The need to lure the animal to sleep to win the stone, and thereby take it while it was still 'living', was rarer and reserved for animals thought to be poisonous such as the toad. If the stone was not taken from a 'living' dragon, then the attempt would be in vain and the stone would not appear. Johannes de Cuba, in his 1491 work *Hortus Saniatis* (*Garden of Health*), included a rare and striking illustration of an attempt to capture a dragonstone (Fig. 1).

Following Philostratus, references to the dragonstone are found in the *Collectanea rerum mirabilium* (*Collection of Curiosities*) of Latin grammarian Gaius Julius Solinus (third century AD) and the *Etymologiae* (*Etymologies*) of Isidore of Seville (*c.* 560–636). Like Philostratus, both accounts stress that the stone must be taken from the brain of the dragon and that it has a 'translucent' or 'natural' whiteness (Solinus cap 42, Golding 1587; Isidore book 16, cap 15, 7, Barney 2006, p. 326); note the similarity to the description in the Indian *Garuda Purana*. This is also a key criterion for distinguishing between dragonstones (Type 1 serpent stones in this work) and snakestones (Type 2); the dragonstone is usually referred to as a white or transluscent gem, whereas the snakestone is usually black.

Searches for extant specimens of dragonstones, or those labelled as such, in collections have resulted in only one example: the famous Lucerne Dragonstone (Fig. 2). Reportedly discovered by a farmer named Stampfli in 1420 in a clot of blood after he awoke from a faint, brought on by the surprise of being proximate to a crash-landing dragon (Fig. 3). The stone was sold to surgeon Martin Schriber in 1509 and used to perform miraculous healings. It is now housed in the Natur-Museum Luzern in Switzerland. This brown and white



Ca.xlviij.

Draconites. Albertus Draconites est lapis a capite draconis extractus. & fertur abortiēte vbi sunt dracōes magni. Virtutē efficacissimā lapidis q̄ vocat borax, q̄n̄ de dracōe extrahit adhuc vivo palpitante. Insidiant ātē draconibus dormientibus. Et subito scisso corpe draconis adhuc palpitāte eu dūt lapidē.

Operationes.

A Albertus in mirabilibus dicit q̄ dracones devincunt inimici ꝫ venena valēs si de vivo extrabat & dz ferri in sinistro brachio. Anime eñ actibus multa ꝓfert bona ētia supfluitatibus q̄ generant in animalib⁹ & morbis corruptio. Alterat ea q̄n̄ naturalī morte corruptis humoribus moriunt. & q̄n̄ mortua vel corrupta occisa lacerant.

B Ego ātē in pribus animalibus vidi lapidē sup̄ q̄ē ꝓcerant plusq̄ serpentes inter mōres in q̄dā ꝑte & cū ētia fissum facerent. inde dīs tenuibus ginalis gladius scinderūt ꝑtes in multa frusta. & in fundo ū q̄dā magn⁹ iacuit serpens in multas ptes incisus. & sub capite

Fig. 1. Draconitis (de Cuba 1491).

stone, approximately the size of a tennis ball, has an interesting pattern as can be seen in Figure 2, in the sketches on the lower right-hand corner of

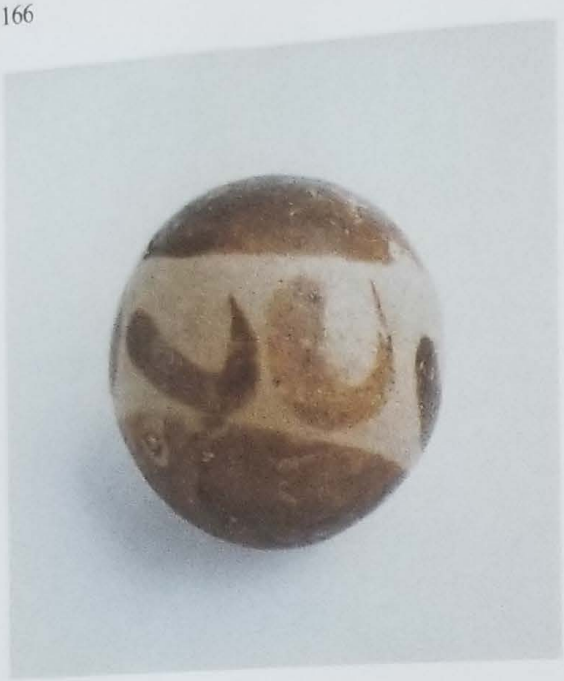


Fig. 2. The Lucerne Dragonstone. Copyright: Natur-Museum Luzern, Switzerland.

Figure 3 and in Figure 4. At one time thought to be a meteorite, recent investigations have concluded that the stone is probably made completely of clay (http://www.naturmuseum.ch/home.php?sL=dau&sA=erdw&action=drac).

This example, while clearly being considered a dragonstone, was not harvested in the manner described by Pliny and Philostratus, nor could it be considered a white or translucent gem as in the subjects of these accounts. This exemplifies that, while helpful as broad criteria, these five categorizations or types of serpent stones are not catch-all definitions. The lack of a white or translucent example of a dragonstone makes positive identification of the scientific composition impossible, although in theory pearls as described in Indian texts, balls of quartz (Belcher 1948, pp. 244–245) and tabasheer (a white or translucent substance naturally forming in the joints of bamboo; Kunz 1891, pp. 286–287) could be possibilities, as might uncut diamonds. Many of these suggestions are contra-indicated by the Indian *Brihat Samhita*, which shows that the authors of early Indian literature were aware of oyster-pearls and tabasheer (bamboo-pearls) as distinct from serpent pearls; however, the *Brihat Samhita* also describes serpent pearls as black. It is possible, of course, that confusion arose in the transmission of the legends to the west. None of the European authors claims to have seen or captured a

Fig. 3. The Lucerne Dragonstone (Cysat 1661).

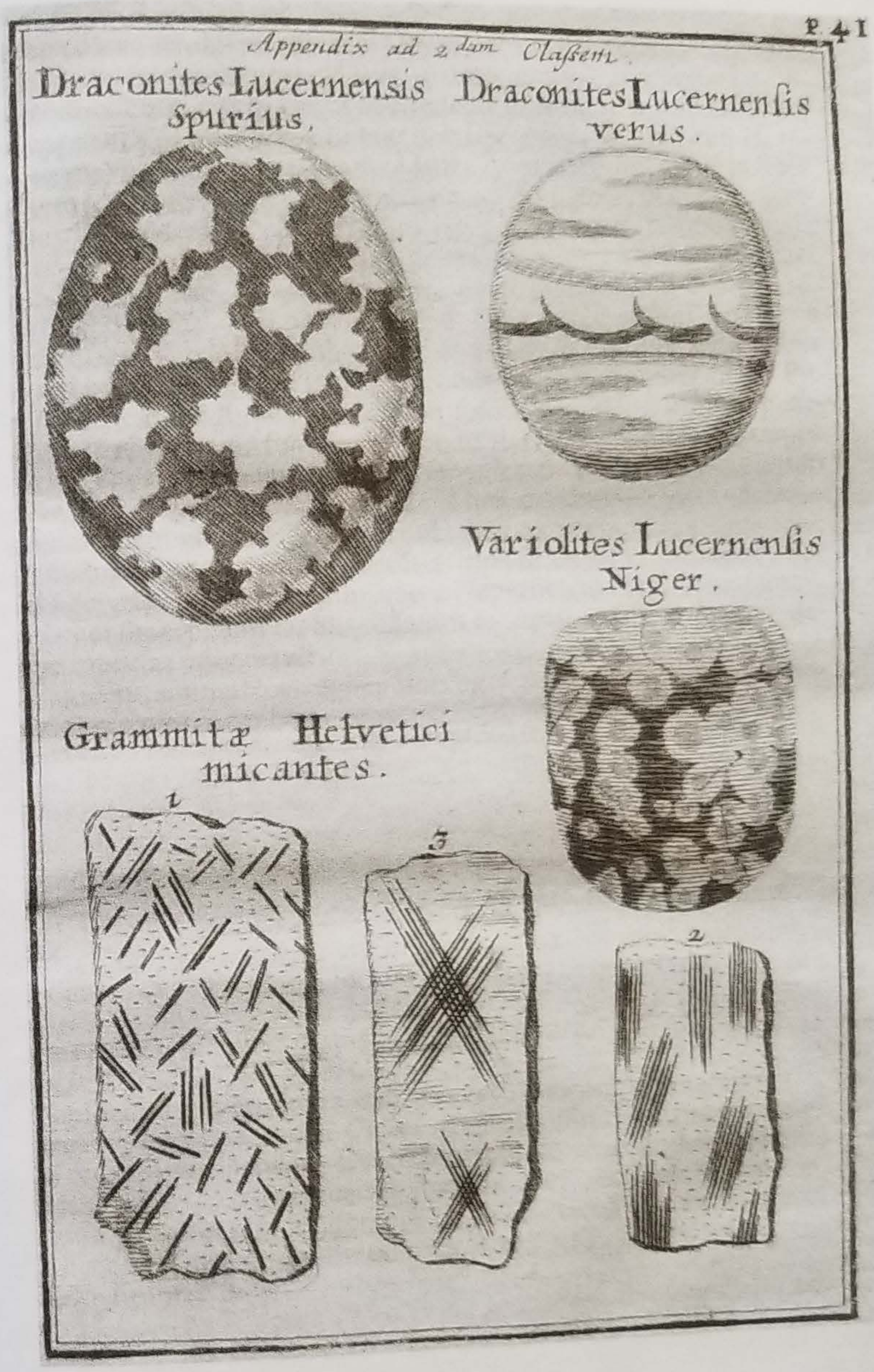


Fig. 4. The Lucerne Dragonstone (Lange 1798, p. 41.)

dragonstone themselves so they are less likely to be able to identify the objects. It is also possible that this stone might be fictitious.

Medicinal uses for dragonstones are not given by ancient authors. Philostratus' account implied that the stone may make the bearer invisible, by likening its virtue to that of the ring of Gyges. Solinus and Isidore of Seville, drawing on Pliny's *Historia Naturalis*, suggested its primary value was in ostentatious display. In the European tradition it was Albertus Magnus (born between 1193 and 1206, died 1280), writing *c.* 1250 in *The Book of Secrets*, who recorded the first pharmaceutical application of the dragonstone, advising 'it is good against all poisons, and he that beareth it on his left arm shall overcome all his enemies' (Wyckoff 1967, p. 86). This efficacy against poison was repeated by Konrad von Megenburg (1309–72) in his 1350 work *Das Buch der Natur* (*The Book of Nature*) (Pfeiffer 1994, cap 29) and by Camillus Leonardus in his 1502 *Speculum lapidum* (*Mirror of Stones*) (Leonardus 1750, p. 95). Most subsequent references to the dragonstone in European manuscripts up to the late seventeenth century address

the method of capture of the stone; few comment any further regarding its pharmaceutical uses.

Type 2: snakestones

Alongside the dragonstone and likely from the same root – tales of serpentine creatures with stones within their skulls – Europe saw the development of the snakestone tradition. In his *Historia Naturalis*, Pliny reports two instances of small stones within the heads of snakes; in one the stone is said to aid teething in infants when attached to the neck, presumably as an amulet (Bostock & Riley 1856, book 29, cap 21, p. 396 & book 30, cap 47, pp. 466–467). Occasionally texts advised that the stone must be taken from a 'living' snake in the same way as the dragonstone, although many authors gloss over the details; surely, however, it would have been easier to kill the snake first and then search for the stone. This manner of capture is strikingly portrayed in the *China illustrata* (*China illustrated*) by Athanasius Kircher (1602–80) (Fig. 5) which shows a man preparing to attack cobras, possibly surprising them by leaping out from behind a tree, with a sword in his hand.

Eleventh-century Persian author Al-Biruni (Abu al-Rayhan Muhammad ibn Ahmad al-Biruni, also known as Alberonius, 973–1048) provides an alternative description of how to obtain the stone:

> when the stone has formed in the neck of the snake, its forehead is pressed between two iron rods. The snake begins to have tremors and its skin, having been cut with a knife, is squeezed until the stone manifests itself (Said 1989, p. 179).

More fantastically the fourth-century Greek work known as *Kyranides* advises that the stone can be obtained from *Ydros*, a water-snake which can be found swimming atop ponds. The snake should

Fig. 5. Capturing the snakestone. *Source*: Kircher (1667), courtesy of the Stanford University Libraries, Dept of Special Collections.

be hung up by its tail and suffumigated with laurel smoke; specified wording should be used to exhort the snake in the name of God to surrender the stone, and the snake promised a safe release if it complies (Anon. 1685, pp. 151–152). The 1175 translation provided by Gerard of Cremona (*c.* 1114–1187) includes permission for the captor to split the snake's head to take the stone by force if the snake should refuse (Evans 1922, p. 19).

Kyranides credits the stone with absorbent properties, alleging that it can absorb two pints of water each day (Anon 1685, p. 152). The ailments treated with the snakestone were based on humorism. Being absorbent, the stone was considered useful for complaints caused by an excess of phlegm, the humor considered wet and cold. *Kyranides* therefore advocates the use of the stone in the treatment of dropsy (swelling of soft tissues), in defluxion (a downward flowing of fluids) and of rheum (excess water).

Serpent stones of ophidian origin also featured in the works of Islamic alchemists who were influenced by Greek thought and civilization following the conquest of Alexander the Great as well as by Indian, Christian and Jewish sources. Their works evidence a different perceived medical application of the snakestone. Rhazes' (Muhammad ibn Zakariya Razi, 854–925) book *Shukuk 'ala alunusor* (*Doubts about Galen*) discredited the theory of humorism. Ninth-century Iraqi alchemist Ibn-Wahshiyya (Abu Bakr Ahmed Ibn 'Ali ibn Qays al-Wahshiyah) in his *Book on Poisons* notes that snake beads (*kharaza*) can be found in the necks of vipers who have lived for hundreds of years (Kuehn 2011, pp. 180–181). Their primary use was as amulets, tied about the upper left arm or around the middle of the body to ward away snakes and their anger (Kuehn 2011, pp. 180–181), presumably on the principle of sympathetic magic. Al-Biruni, in his *Kitab al-Jawahir* (*Book of Jewels*) also credits the snakestone with amuletic power against snakebite (Said 1989, pp. 178–179) and expands upon Ibn Wahshiyya's suggestion that it is also a useful treatment for a victim of snakebite. He advises that the stone should be rubbed and the resultant slough given in milk to the victim to drink (Said 1989, p. 179).

Thereafter references to snakestones of this type appear infrequently in European manuscripts until the seventeenth century, when references to snakestones exceed those of dragonstones. This may have been a consequence of the Renaissance since this new generation of European explorers, particularly when travelling east from Europe to India and other Asian countries, would often encounter snakes and may have believed the tales of snakestones, whereas searches for dragons tended to prove fruitless! Martha Baldwin (1995, p. 396, n. 3) suggested that in 1652 the return to Rome of Michał Boym (*c.* 1612–59), Polish Jesuit Missionary to China, may have played a key role in re-introducing the European world to snakestones. Boym's book *Flora sinensis* (*Chinese Flora*) was published in Vienna in 1656, and his text regarding the snakestone saw heavy plagiarism by subsequent authors. As quoted by Kircher, Boym wrote of the snakestone:

> In India and the kingdom of Quamsi, a stone can be found in the heads of the type of serpents which the Portuguese call Cobras de Cabelo, which means hairy serpents. This stone can be used as an antidote for the serpent's bite, and without this one would die within twenty-four hours. This round stone (usually lentil-shaped) has a white middle and blue or brown edges. When placed on the wound, it adheres by itself, draws the poison, and falls off when full of the poison. When placed in milk, it will gradually return to its natural state. This stone, not found everywhere, will adhere if the wound has not been completely drained. If it falls away, the natives congratulate the sick person that the danger of death has been overcome (Van Tuyl 1987, p. 73).

Quamsi is roughly equivalent to the modern-day Chinese province Guangxi, located in the far south of the country. Although the snakestone was known in this kingdom according to Boym, it appears it was not necessarily common medicinal treatment throughout China. When Flemish Jesuit missionary Father Ferdinand Verbiest (1623–88) was present at the Beijing-based Court of the Emperor Kangxi in the 1680s he wrote a treatise on snakestones, thought to be in response to Kangxi's request for information regarding 'Western medicine' (Hanson 2007, p. 2). Hanson notes that snakestones were not recorded in either Ming or early Qing *materia medica* (Hanson 2007, p. 2), suggesting these stones were not widely known or used throughout China.

Contemporaneously with Boym, European travellers to India and the East were also returning with tales of serpent stones. The earliest of these is that of Frenchman Jean de Thévenot (1633–67) who in 1666 encountered the snakestones at the Indian town of Diu in the west of the country (Thévenot 2008, p. 100). In addition to written accounts, snakestone specimens also began to circulate in Europe. Grand Duke Ferdinando II De Medici of Tuscany was sent snakestones by Boym personally before 1658 (Baldwin 1995, p. 396, n. 3); Kircher possessed some before 1662 (Baldwin 1995, p. 397, n. 6); and the Royal Society of London had received a specimen sent from Philiberto Vernatti, an employee of the Dutch East India Company in Java Major (modern-day Indonesia) in 1665 or 1666 (Anon 1665, p. 102).

The snakestones themselves are frequently described as oval and lentil-shaped, thicker in the

middle and thinner at the edges. Encountering a stone in Goa, India in around 1676, seventeenth-century traveller Frenchman Jean-Baptiste Tavernier said it was nearly the size of a doubloon (Ball & Crooke 1925, pp. 120–121) and therefore just under 3 cm in diameter. When described they are almost always said to be black, some with a white centre, similar to the black stone recorded in the *Brihat Samhita*. Specimens labelled *Pedra de Cobra* (cobra stones) in the Royal Pharmaceutical Society's collection provide clear examples of each of these features (Figs 6 and 7).

By the Early Modern period, the primary medical virtue of the snakestone was more than just as an amulet acting prophylactically against the attacks of snakes, as recorded by earlier Islamic authors. The stones were used to treat patients when a snakebite had occurred; the stone was applied to the bite and adhered to the wound, ostensibly extracting the poison. When either finished or sated, the stone would drop from the wound of its own accord and should then be steeped in milk where it would bubble and turn the milk green, thought to be evidence of the poison being expelled from the stone. The stone was then dried ready for re-use. It could be used on the same patient until it no longer adhered to the wound, indicating that the poison had been fully extracted.

Since the mid-1600s the effectiveness of the snakestone in this manner of treatment has incited debate among scientists. Most famously, Jesuit scholar Athanasius Kircher (1602–80) claimed his experiments vindicated the snakestone as an effective remedy for snakebite, but Italian physician Francesco Redi (1626–97) vociferously contested Kircher's findings (Baldwin 1995). Further experiments were subsequently undertaken, notably by French apothecary and member of the French Academie des Sciences Moyse Charas (1616–98) in 1669 and by Italian Physicist Felice Fontana (1730–1805) in 1781. These experiments involved the use of pigeons which were bitten by poisonous snakes and then treated with the snakestone. Both Charas and Fontana concluded the stones were ineffectual. Fontana pointedly described that many pigeons, guinea pigs and rabbits died with the stone still adhering to the wound (Fontana 1795, pp. 77–92) and he therefore considered the experiments 'not only did not prove the stone useful against the bite of the viper, but gave the clearest evidence of the contrary, of its being totally inefficacious' (Fontana 1795, p. 87).

Nonetheless, tales of the miraculous cures and lives saved through the use of the stone continued to arrive and circulate in Early Modern Europe, and popular opinion proved difficult to change. Further experiments were undertaken in the 1800s by English scientist Michael Faraday (1791–1867) and British doctor, amateur chemist and Fellow of the Royal Society, John Davy (1790–1868) in 1820. These experimenters sought to analyse the stones themselves and concluded they were composed predominantly of calcined bone or hartshorn (Tennent 1859, pp. 199–200; Davy 1820, p. 318). Davy unreservedly denounced them as 'worse than useless' (Davy 1820, p. 320) and stated that the 'sooner such a belief is exploded the better' (Davy 1820, p. 322).

Fig. 6. 'Pedra de Cobra' from the Royal Pharmaceutical Society Museum. Reproduced by kind permission of Dr C. J. Duffin.

Fig. 7. 'Pedra de Cobra' from the Royal Pharmaceutical Society Museum. Reproduced by kind permission of Dr C. J. Duffin.

Distinguishing the material composition of the snakestones had, in fact, been of interest to the more sceptical of the European travellers to the east, who had themselves identified the stones as artificial creations of bone, sometimes mixed with earth or charred roots. Nonetheless, snakestones retained a persistent and tenacious hold on popular opinion and tales of effectiveness continued to circulate, probably to a greater extent than the published results of the experiments. Further experiments were undertaken and reported in the *British Medical Journal* in 1895 and 1904. In 1905 one English author, following a winter visit with her son in Ceylon, wrote of the snakestone: 'twice I have seen its efficacy proved. I only wish that doctors would not be too proud to study the subject' (Steuart 1905, p. 245).

It has been documented that snakestones have been used in Peru, Brazil, Nigeria, East Africa and India in the twentieth and twenty-first centuries. Nine analyses of the snakestone and/or surveys of regional medicine in which the snakestone has been used have been published between 1996 and 2014, all but one of which have implied or explicitly concluded that the snakestone is medically ineffective.

Type 3: ammonites

A prized stone within a dragon or snake's skull is referred to in early British and Irish sources as early as the seventh century, although references within the UK are sparse until the fifteenth century. In Great Britain 'serpent stones' are more readily identified as ammonites (Fig. 8). Within England, ammonite folklore is predominantly centred around two specific areas: Whitby in Yorkshire and Keynsham near Bristol. Both areas were reputed to be the scenes of miracles performed by female Celtic Christian saints who rid the area of troublesome serpents by turning them into stone.

In Whitby the saint was seventh-century abbess St Hilda, whose name was given to the locally abundant genus *Hildoceras*, a zonal fossil of the Jurassic (Lias). In the 1610 expanded edition of his *Britannia*, English antiquarian William Camden (1551–1623) writes of the ammonites found in Whitby:

> Here are found certain stones fashioned like serpents folded and wrapped around as in a wreathe . . . A man would think verily that they had beene sometime serpents, which, a coat or crust of stone had now covered all over. But people to credulous ascribe this to the praiers of saint Hilda, as if shee had thus transformed and changed them (Camden 1610, p. 718).

Some ammonites from Whitby – occasionally *Hildoceras*, but more commonly *Dactylioceras* specimens – now sport the addition of a carved head, intended to add credence to the tale of St Hilda's miracle (Fig. 9). This practice was particularly prevalent in the seventeenth and eighteenth centuries. In 1784 it was alleged that a paper titled *A Description of Whitby Abbey, monumental Instructions, &c.* was being sold in Whitby. This paper detailed a poem, purportedly composed by St Hilda, which had

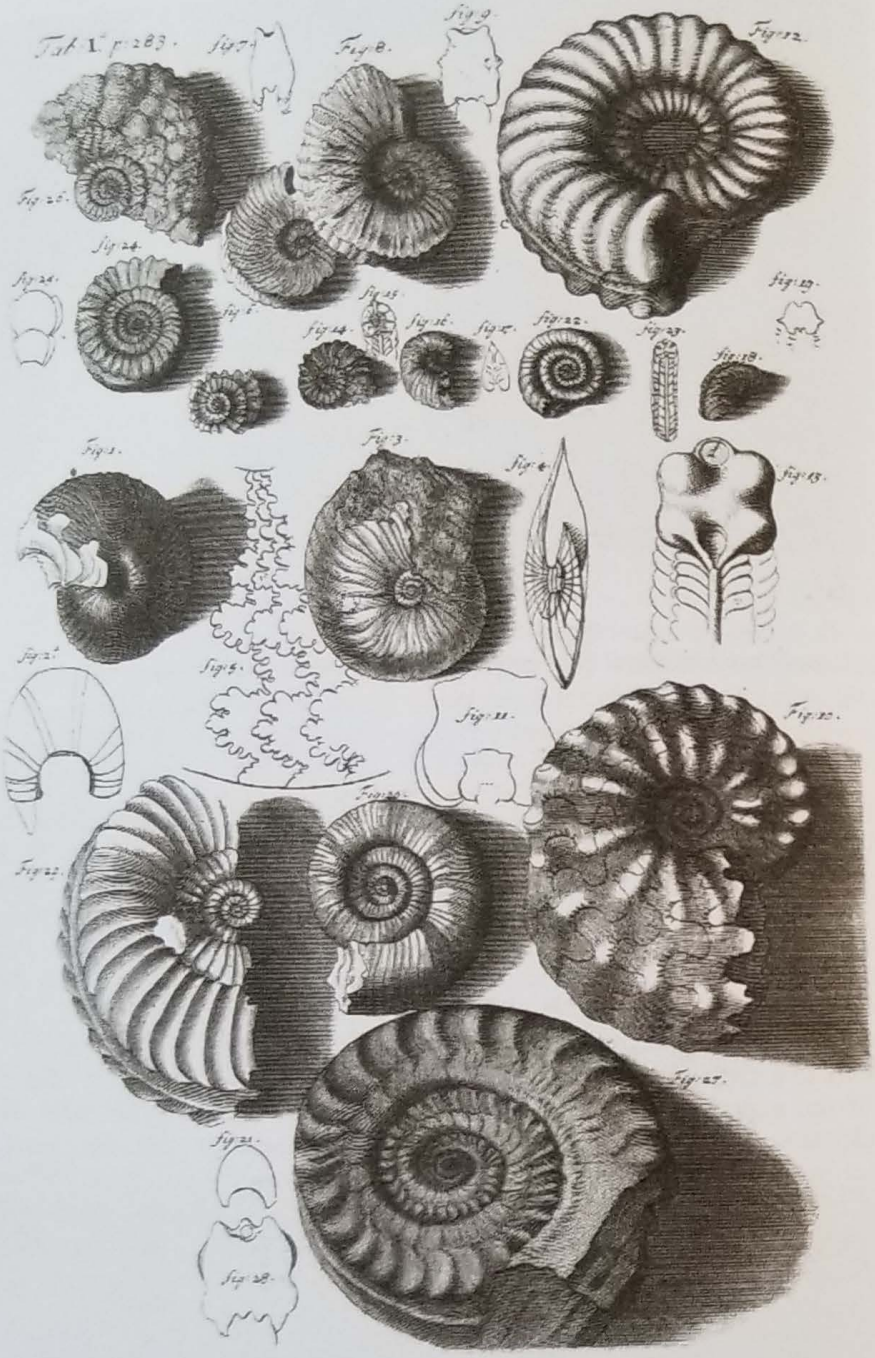


Fig. 8. Ammonites. Snakestones also called 'Cornua Ammonis' or 'Sceleta Serpentum'. *Source*: Hooke (1705), courtesy of the University of Bordeaux.

been carved into one of the pillars of the abbey, denouncing the snakes with the carved head thus:

> When Whitby town with snakes was fill'd
> I to my God pray'd, and them kill'd;
> And for commemoration sake,
> Upon the scar, you may them take,
> All turn'd to stone, with the same shape,
> As they from me did make escape;
> But as for heads, none can be seen,
> Unless they've artificial been (Grose 1784, p. 162).

These, of course, were not the words of St Hilda herself, the extant thirteenth-century ruin of the abbey may not occupy the same site as the seventh-century original (Kracher 2012, p. 54) which would have borne the alleged original carving, and the verse is not recorded in sources before 1784. Rather, this poem demonstrates that by 1784 certain individuals were keen to make it known that the carved heads found on ammonites were artificial additions. Nevertheless, the ammonite with a snake's head proved an enduring image connected with the area. The coat-of-arms of Whitby Town Council features

Fig. 9. *Dactylioceras commune* with the addition of a carved snakes head. Likely sourced from the Alum Shale Member, Whitby Mudstone Formation in Whitby, Yorkshire. Copyright: Horniman Museum and Gardens.

three coiled snakes – or ammonites sporting snake's heads – in memory of St Hilda's miracle (Fig. 10), as does the college at Oxford that bears her name, and also a copper token dated 1667 (Lovett 1905, p. 334).

The other principal source of ammonite 'serpent stone' lore, Keynsham, credits fifth-century Welsh princess St Keyna with the miracle of snake petrification. It has been suggested that Keyna resided in Cornwall and the ammonite legend attributed to Keynsham on the basis of the similarity of the place name to the name of the saint (Kracher 2012, p. 61). However, the earliest source regarding St Keyna, John of Tynemouth's *Nova Legenda Anglie* composed in the fourteenth century and likely based upon a longer eleventh-century version (Orme 2000, p. 162), does not name the area in which Keyna performed her snake petrification miracle. The Keynsham area is rich in Lower Liassic (Hettangian to Sinemurian, lowermost Jurassic) ammonites including *Arietites bucklandi*, *Caenistes* and *Coroniceras*; the absence of ammonites throughout Cornwall would seem to suggest that Keynsham has a stronger claim to the legend. However, it may be that the better-known legend of St Hilda of Whitby and the association of the Whitby ammonites with snake petrification is that which suggests that ammonites are the proof of petrified snakes, thereby skewing the undisclosed location in favour of the ammonite-bearing Keynsham. Since the earliest extant work referencing the fossil ammonites of both Whitby and Keynsham in association with the legend of snake petrification is Camden's *Britannia*, further comment can only be speculation. It has been suggested that these legends themselves are the result of Early Modern romanticization of Britain's Celtic past (Kracher 2012, p. 62).

Fig. 10. Whitby Town Council coat of arms, used by kind permission.

As in Whitby, Keynsham is proud of its serpent stone legend and its heritage; some buildings within the town include ammonites in their masonry which can still be seen to this day. Modern art installations taking the form of ammonites have been erected on several occasions, most recently a 1.8 m sculpture at

Abbott's Wood for the Millennium celebrations by artist Carol Peace (Fig. 11) and a smaller sculpture housed in Keynsham Memorial Park by artist Jeff Body, erected in 2007.

In terms of medicinal efficacy ammonites are the 'poor cousin' of the snake and dragon-extracted stones. The ammonite was typically credited with magical effects or religious significance. Pliny, Solinus and Leonardus advised that ammonites will generate prophetic or heavenly dreams when placed under the pillow (Pliny, book 37, cap 60; Golding 1587, cap 39; Leonardus 1750, 110; Bostock & Riley 1857, 451).

The fourth-century poem 'Lithica' by Psuedo-Orpheus includes a description of the 'ophites' which is suggestive of an ammonite:

> Black, hard and weighty, a portentous ball.
> Around the stone, in many a mazy bend,
> In wrinkles deep the furrowed lines extend.

It credits the stone with the power to itself speak out prophecy (King 1860, pp. 456–457).

In a rare account of medicinal use in *The Western Islands of Scotland*, Martin Martin reported that ammonites were called 'cramp-stones' because they were used for curing cramp in cows; the afflicted area was washed in water in which the ammonite had been steeped for several hours (Martin 1703, pp. 133–134).

In 1702 Dr H. Behrens (1662–1712) reported that ammonites were used in Germany as a magic remedy for healing cows afflicted by witches:

> a fossile shaped like a Ram's Horn...call'd *Drake-stone* by the Inhabitants because (they say) 'tis a charm against, and cures, Witchcraft and the Enchantments of the Drake, as they express it; for when the Cows lose their Milk or void Blood instead of it, they put these Stones into the Milk-pail, and by that means expect a due quantity of Milk from those Cows again (Behrens 1730, p. 159).

Ammonites hold religious significance to Buddhists who 'regard them as a symbol of enlightenment and, as such, they function as meditation objects' (Van der Geer *et al.* 2008, p. 76). Stones bearing ammonites taken from the Gandaki River, named *saligrams* by Hindus, are worshipped and revered as symbols of Vishnu. It is thought that the ammonites are symbols of his discus or chakra, which is believed to be 'the invincible weapon that was given to him (Vishnu) by Indra'. It has been suggested that this is due to the suture patterns of the ammonite being similar to the ribs on the discus (Taylor 2012, p. 41). Legends also tell of how Vishnu was transformed into a *saligram* and also of how river-worms called *Vajra-keeta* bore into the ammonites, creating the suture patterns, at the behest of Vishnu (Taylor 2012, p. 41), thus reinforcing the association of the ammonites with Vishnu. *Saligrams* have many functions and are believed to have various effects which, although not medical in nature, include ensuring success in all earthly endeavours and effecting purification of sins when water in which the *saligram* has been soaked is drunk by the dying, thus ensuring transcendence and nirvana (Taylor 2012, pp. 41–42).

It has been reported that nineteenth-century Icelandic peasants used ammonites in bags filled with flour as amulets (Kunz 1915, p. 198). The Blackfeet Indians of North America would keep them in a sacred bundle along with other marine fossils, all

Fig. 11. Ammonite sculpture Abbotts Wood, Keynsham. Reproduced by kind permission of Craig J Sinclair.

coated with red pigment 'for luck, healing and other powers' (Mayor 2005, p. 228). Mayor describes and includes a figure of a medicine pouch owned by Charlie Crow Eagle, a Blackfeet of Canada, dated to around 1880, which includes an *Acanthoscaphites* ammonite (Mayor 2005, pp. 228–229). Ammonites also featured in the medicine bundles of the Hopi Indians of Tusayan, south of the Grand Canyon, who called the ammonites *koaitcoko*, and also of the Crow Indians, whose medicine men occasionally wore ammonites as medicinal amulets. One example, held in the Peabody Museum of Natural History in New Haven, was worn by the famous Sioux chief Gall who helped defeat Custer at the battle of Little Bighorn (Mayor 2005, pp. 268–270). Further details about the specific functions and application of these medicine pouches and amulets seem to either be jealously guarded or to have passed out of memory (Mayor 2005, p. 137, 156, 169).

Type 4: snake 'beads'

Pliny referred to a third type of serpent stone in his compendious *Historia Naturalis*: the Gallic snake-stone or *ovum anguinum*. He described this as an egg the size of an apple with a cartilaginous shell surrounded by cupules similar to the suckers of an octopus. However, he also recounted that 'numberless snakes become artificially entwined together and form rings around their bodies with the viscous slime which exudes from their mouths, and with the foam secreted by them' (Bostock & Riley 1856, pp. 288–290), a generation process that seems at odds with the 'egg-like' example that Pliny claimed to have seen.

Swiss botanist and naturalist Conrad Gessner (1516–65) and Belgian mineralogist Anselmus Boetius de Boodt (*c.* 1550–1632) believed that Pliny's description – presumably that of the egg with the cartilaginous shell – was of a fossil cidaroid echinoid (Gessner 1565, pp. 6 & 168; De Boodt 1647, pp. 347–349). The capture of the egg, depicted as an echinoid, is vividly portrayed in Figure 12, purportedly a woodcut from 1497. However, I have investigated the identification of the *ovum anguinum* as an echinoid within the context of the folklore of Great Britain which, it has been argued, has a shared Celtic cultural heritage with the inhabitants of Gaul. In doing so, I have found not one reference to a fossil echinoid both being identified as a serpent stone and used medicinally or for the uses ascribed to it by Pliny, namely 'ensuring success in lawsuits and a favourable reception with princes' (Bostock & Riley 1856, pp. 228–290). Additionally, in Kenneth McNamara's extensive survey of echinoid folklore in England, no

Fig. 12. Capture of the ovum anguinum, woodcut from 1497. After Bassett (1982).

evidence is presented that demonstrates that, subsequent to Pliny, echinoids were identified as serpent stones and used medicinally, or in the manner described by Pliny (McNamara 2007, 2011).

Instead, serpent stone accounts, found mostly in Scotland, Wales and Cornwall, find their serpent stones more suggestive of 'rings formed around snakes bodies' from this same passage by Pliny. These serpent stones are usually glass beads, but have also included holed stones and spindle whorls (Figs 13 and 14). Accounts addressing the generation of these serpent stone beads tend to describe the formation in the following ways: by snakes repeatedly passing through a shed skin; snakes blowing a stone formed from their spittle into the air or down the body of one of their number; or snakes working it into shape by their teeth. These accounts are most numerous from the early seventeenth to the nineteenth century, which coincides with the Early Modern romanticization of British Druidic heritage. This led to the glass bead serpent stones being called Druid's Beads, Druid's Eggs

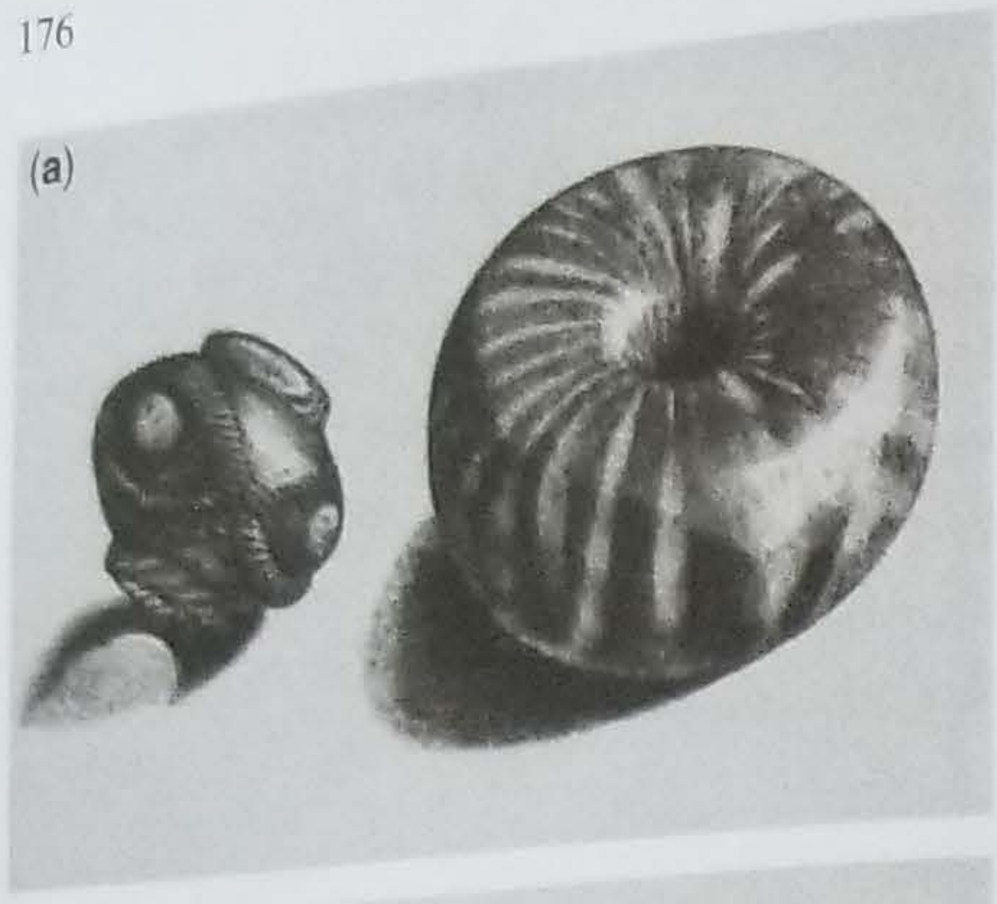


Fig. 13. Beads found in burial tumuli, held by the Museum of Scottish Antiquaries (Wilson 1851). Courtesy of the National Library of Scotland.

or Druid's Glass. Several accounts however, particularly those from Scotland and Wales, often omit any reference to Druids; this raises the possibility (but certainly does not prove) that the folklore of the serpent stones might have their origin in oral tradition predating the Early Modern period. Instead of Druid-related names, in these accounts serpent stones have alternative and region-specific appellations; in Scotland they are called *adderstones* or in Gaelic *clach-na thratch*; the Cornish name is *milprev*, which is the term for both the unique congregation of the snakes and the resultant bead; and in Welsh they have been termed *glain neidr*, *glain naddroed* or *maen magl*. *Glain naddroed* means 'adder's stone' whereas *glain neidr* indicates 'snake stone'; '*maen*' is stone and '*magl*' is either 'knot' or a 'web in the eye' (Pughe 1832, p. 318, 320). This malady is the development of a membrane which spreads from the corner of the eye to coat the cornea and pupil; the afflicted person is sensitive to light and the eye looks red. The web is described as 'thin and white, sometimes thicker and more fleshy, rough, obscure and painful' (Crooker *et al.* 1766, 'Unguis Pannus'). Treatment consisted of washing the eye in water in which the stone had been steeped (Brown & McNeil 2009, p. 188).

The medicinal uses of the serpent stone bead are the subject of another paper in this volume (Pymm, this volume, in press) but can be summarized here: the treatment of eye diseases; to relieve the pain of childbirth; employed against childhood diseases including whooping cough; and against malaria. Working on the principle of *similia similibus curantur* (like cures like) they were used in the treatment of snakebite and as an amulet to prevent the same. These stones were used to treat livestock, particularly cattle, in the event of snakebite, elf-shot and other afflictions. These stones were also thought to be 'lucky' and have magical powers to protect the owner against witchcraft.

Type 5: serpentinite

The fifth and final type of serpent stone is *ophites*, usually called serpentinite. This is a mineral complex formed by serpentinization, a metamorphic process altering peridotites of the upper mantle that have since been obducted on to continental crust. Ultramafic minerals including olivine and augite are oxidized and hydrolysed to form serpentinite; the colours and patterns in the rock have been considered reminiscent of snakeskin (Fig. 15).

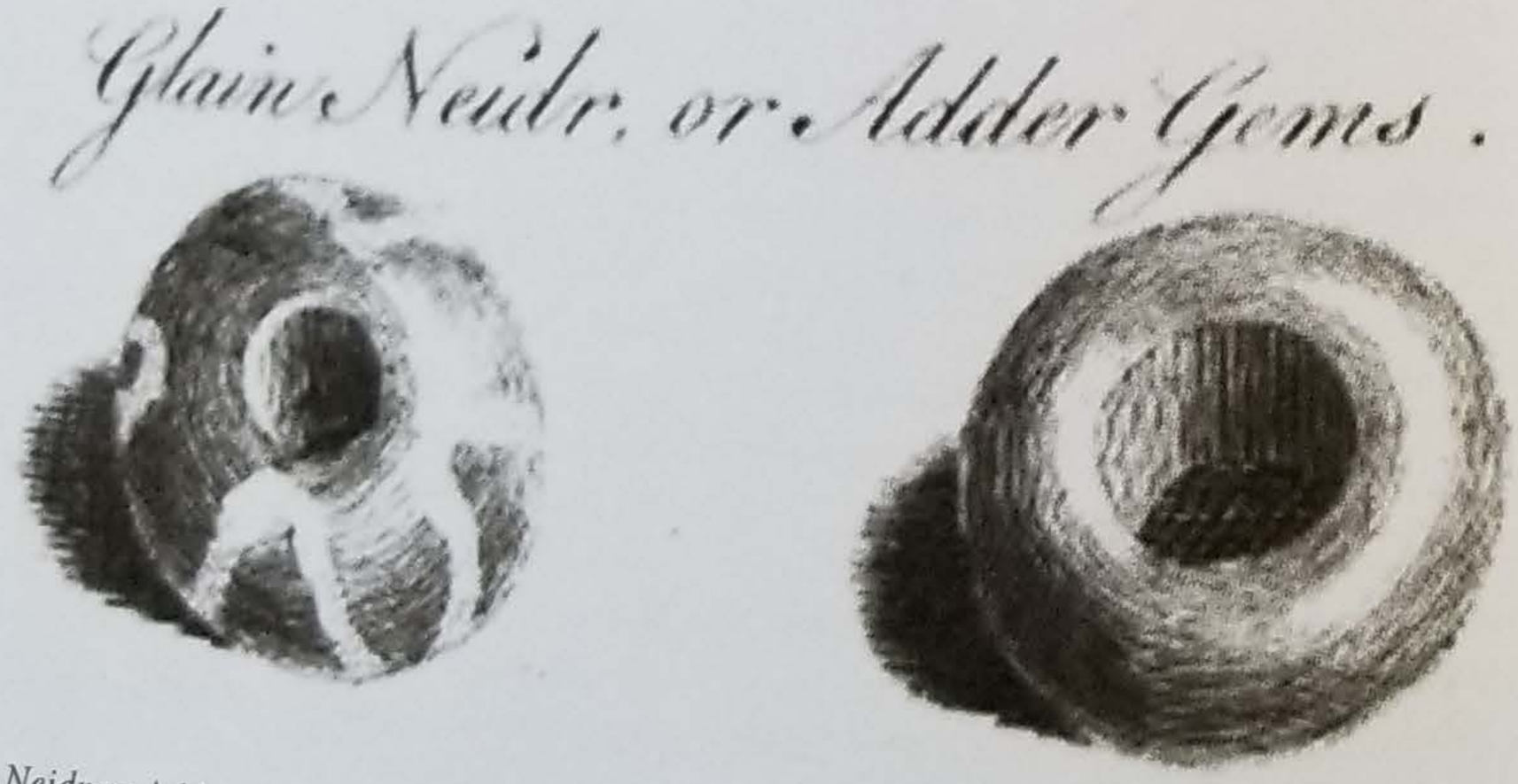


Fig. 14. *Glain Neidr* or Adder Gems (Pennant 1769). Courtesy of Göttingen State and University Library.

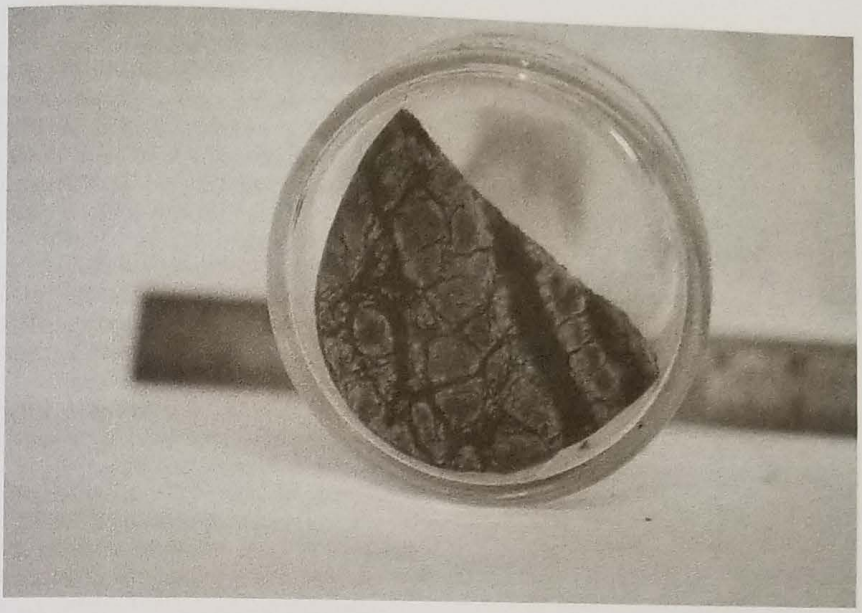


Fig. 15. Ophites. Royal Pharmaceutical Society Museum. Reproduced by kind permission of Dr C. J. Duffin.

The fourth-century poem 'Lithica' gives the advice that powdered serpentine spread on a dragon-bite or snakebite, will provide relief:

> ... Let him who
> by the dragon's fang hath bled.
> On the dire wound
> Serpentine powdered spread,
> And in the stone his sure
> reliance place,
> For wounds inflicted by the reptile race.
> ('Lithica', King 1865, lines 336–338, p. 384).

Pliny credits *ophites* as a cure for headache and for snakebite when worn as an amulet (Bostock & Riley 1857, p. 327). He also notes that the 'white ophites' (possibly a sericite-rich serpentinite) has been recommended as an amulet for lethargy and phrenitis (Bostock & Riley 1857, p. 328), an inflammation of the brain causing fever and delirium.

A particularly interesting locale to highlight in respect of the medicinal use of serpentine is Zoblitz in the province of Saxony, Germany. This town was a major producer of serpentine and was home to a serpentine-turners guild. According to Sundin (2010, p. 1): 'Written sources referring to the serpentine craft are known from the fifteenth century, and the earliest known dated object is from 1590'. The people of Zoblitz hung serpentine around the necks of children since it was believed it had healing powers; powdered serpentine was drunk to assist in diseases of the stomach and intestines, and it was thought that the healing effect was greater when drunk from vessels of serpentine (Seyfarth 1913, p. 260). While the Zoblitz serpentine was not used exclusively for medical treatment or fashioning of vessels with the sole purpose of aiding recovery of health, in 1750, a year before the Zoblitz serpentine-turners guild reached its peak (Sundin 2010, p. 1), Magister Steinbach of Zoblitz declared that the stone was effective against gout, tearing, venom, consumption and pains in the lungs and liver. Additionally, it was thought to ward poisonous creatures away from the area (Seyfarth 1913, p. 261). Although the guild declined thereafter, belief in the healing powers of the serpentine seemed to remain; quack doctors peddled the stone until the end of the nineteenth century and the Christian Pastor Hering of Zoblitz was sufficiently convinced of its efficacy to praise it as a 'probable' preventative against cholera in 1831 (Seyfarth 1913, p. 260).

Belief in the medical efficacy of serpentine to neutralize poison spread throughout Europe during the Middle Ages. It is likely this stemmed from the theory of *similia similibus curantur* (like cures like) on account of the snake-like markings on the stone. The *Lapidary* of Thomas Nicols, dated 1652, summarizes that serpentine would 'secure the person wearing it, from stingings of serpents' as well as from 'phretics, and lethargies, and from plagues, pox, and poysonings, and the like', including breaking down bladder stones and mitigating pain (Nicols 1652, p. 222).

The belief in serpentine protecting against snakebite in particular has persisted until more modern times; it was reported that nineteenth-century Italian peasants still believed serpentine would provide protection from snakebite and also draw out the poison from a bite (Kunz 1938, p. 108). Even today, serpentine is considered by some New Age spiritual

practitioners to have the same properties, as well as crediting it with the ability to awake kundalini (an energy believed to be located at the base of the spine), enhance meditation and clear chakras (energy points of the non-physical body).

Conclusion

Five broad types of serpent stones have been presented. The first is an unidentifiable round white stone believed to have been taken from the head of a dragon. The second, a smooth lenticular black stone was thought to be taken from the head of a snake, but was actually manufactured of burnt bone or horn. Third are fossilized ammonites, fourth are glass beads and fifth are *ophites* and serpentinite. Serpent stones in their various forms were known in ancient times and have a strong Medieval and Early Modern history. Type 1 stones, dragonstones, seemed primarily prized for ostentatious display until they began to be credited with power against poison from 1250. Type 3 serpent stones, ammonites, were typically considered to have religious or magical significance and were infrequently put to medical uses. Type 4 serpent stones, glass beads, were employed for a variety of ailments in the UK which included snakebite, whereas the principal use of types 2 and 5 was as a prophylactic against snakebite and also as a snakebite treatment, although they were also used in the treatment of other ailments. Although medicinal employment of serpent stones declined from the nineteenth century, serpent stones are still used in some parts of the world today. For example, in 2011 the Sisters of Charity of Nazareth newsletter describes how scorpion-stung patients in Rajgir, India are treated with the Type 2 snakestone. The persistence of this practice in developing areas has led to the necessity of nine separate analyses of the Type 2 serpent stone being conducted between 1996 and 2014. Some branches of New Age spiritualism still consider that the Type 5 serpent stone, serpentine, protects against snakebite.

Serpent stones have had a tenacious hold on the popular imagination in their many forms; footprints of older beliefs can be found in modern fiction and video games. Most strikingly, one only has to look as far as *YouTube* in order to view Type 2 snakestones ostensibly being extracted from the snakes, in scenes which may have been similar to those witnessed by our seventeenth-century ancestors.

References

Anon 1665. On the Nature of a Certain Stone, Found in the Indies, in the Head of a Serpent. *Philosophical Transactions of the Royal Society*, **1**, 102–103.

Anon 1685. *The Magick of Kirani, King of Persia, and of Harpocration Containing the Magical and Medicinal Vertues of Stones, Herbes, Fishes, Beasts and Birds: A Work much Sought for by the Learned but Seen by Few: Said to have been in the Vatican-Library in Rome but not to be Found there nor in all the Famous Libraries of the Empire/Now Published and Translated into English from a Copy Found in a Private Hand*. London.

Baldwin, M. 1995. The snakestone experiments: an early modern medical debate. *Isis*, **86**, 394–418.

Ball, V. (ed.) & Crooke, W. (trans.) 1925. *Travels in India by Jean-Baptiste Tavernier, Baron of Aubonne*. Oxford University Press, London, **2**.

Barney, S., Lewis, W.J., Beach, J.A. & Berghof, O.(trans.) 2006. *The Etymologies of Isidore of Seville*. Cambridge University Press, Cambridge.

Bassett, M.G. 1982. *'Formed Stones', Folklore and Fossils*. National Museums and Galleries of Wales.

Behrens, H. 1730. *The Natural History of Hartz-Forest, in His Majesty King George's German Dominions: Being a Succinct Account of the Caverns, Lakes, Springs, Rivers, Mountains, Rocks, Quarries, Fossiles, Castles, Gardens, the Famous Pagan Idol Pustrich Or Spit-fire, Dwarf-holes, Pits, Moving Islands, Whirlpools, Mines, Several Engines Belonging to Them; Ores, the Manner of Refining Them; Smelting Houses; Several Sorts of Ovens, Hammer-mills, Vitriol and Glasshouses, &c. in the Said Forest: With Several Useful and Entertaining Physical Observations*. J. Andree (trans.). T. Osborne, London.

Belcher, E. 1948. *Narrative of the Voyage of the HMS Samarang, during the Years 1843–46*. Reeve, Benham and Reeve, London, **1**.

Berwick, E. (trans.) 1809. *The Life of Apollonius of Tyana*. T. Payne, London.

Bostock, J. & Riley, H.T. (eds) 1855. *The Natural History of Pliny*. Henry G Bohn, London, **1**.

Bostock, J. & Riley, H.T. (eds) 1856. *The Natural History of Pliny*. Henry G Bohn, London, **5**.

Bostock, J. & Riley, H.T. (eds) 1857. *The Natural History of Pliny*. Henry G. Bohn, London, **6**.

Brown, S. & McNeil, G. (eds) 2009. *Grandparents: A Celebration*. Ebury Press, Chatham.

Camden, W. 1610. *Britain, or a Chorographicall Description of the Most Flourishing Kingdomes, England, Scotland, and Ireland, and the Ilands Adioyning, out of the Depth of Antiquities: Beautified With Mappes of the Severall Shires of England: Written first in Latine by William Camden Clarenceux K. of A. Translated Newly into English by Philemon Holland Doctour in Physick: Finally, Revised, Amended, and Enlarged with Sundry Additions by the Said Author*. Georgii Bishop & Ioannis Norton, London.

Chindambaram, I.N. (trans.) 1884. *The Brihat Samhita of Varaha Mihira*. South Indian Press, Madura.

Croker, T.H., Williams, T. & Clark, S. 1766. *The Complete Dictionary of Arts and Sciences. In which the Whole Circle of Human Learning is Explained, and the Difficulties of Attending the Acquisition of Every Art, Whether Liberal or Mechanical, are Removed, in the Most Easy and Familiar Manner*. J. Wilson & J. Fell, London, **3**.

CYSAT, J.L. 1661. *Beschreibung dess berühmbten Lucerner- oder 4. Waldstaetten Sees und dessen fürtrefflichen Qualiteten und sonderbaaren Eygenschafften. Darinnen gemeldet wirdt Der Ursprung dess Flusses Ursa oder Reuess, dessen Lauff jnn- und auss dem See: dess Sees Länge, Breitte, Tieffe und wie mancherley herrlicher guter Fisch in demselben zufinden.* David Hautten, Lucern.

DAVY, J. 1820. Analysis of the Snake-Stone. *Asiatick Researches; or Transactions of the Society, Instituted in Bengal, for enquiring into the History and Antiquities, the Arts, Sciences and Literature of Asia*, **13**, 317–328.

DE BOODT, A.B. 1647. *Gemmarum et lapidum historia.* Joannis Maire, Lugduni Batavorum.

DE CUBA, J. 1491. *Hortus Sanitatis*, Jacob Meydenbach, Mainz.

DE VISSER, M.W. 1913. *The Dragon in China and Japan.* J. Muller, Amsterdam.

D'HUY, J. 2013. Le motif du dragon serait paléolithique, mythologie et archéologie. *Préhistoire du Sud-Ouest*, **21**, 195–215.

D'HUY, J. 2014–15. Statistical methods for studying mythology. Three peer reviewed papers and a short history of the Dragon Motif. *The Retrospective Methods Network Newsletter*, **9**, 125–127.

DUFFIN, C.J. 2007*a*. Fish otoliths and folklore: a survey. *Folklore*, **118**, 78–90.

DUFFIN, C.J. 2007*b*. Alectorius: The cock's stone. *Folklore*, **118**, 325–341.

DUFFIN, C.J. 2010. The Toadstone: a rather unlikely jewel. *Jewellery History Today*, **8**, 3–4.

DUFFIN, C.J. 2012. A survey of birds and fabulous stones. *Folklore*, **123**, 179–197.

DUFFIN, C.J. 2013*a*. Porcupine stones. *Pharmaceutical Historian*, **43**, 13–22.

DUFFIN, C.J. 2013*b*. Chelidonius: the swallow stone. *Folklore*, **124**, 81–103.

DUTT, N.N. (ed.) 1908. *The Garuda Puranam.* Society for the Resuscitation of Indian Literature, Calcutta.

EVANS, J. 1922. *Magical Jewels of the Middle Ages and the Renaissance.* Clarendon Press, Oxford.

FONTANA, F. 1795. *Treatise on the Venom of the Viper; on the American Poisons; and on the Cherry Laurel, and Some Other Vegetable Poisons. To which are annexed, observations on the Primitive Structure of the Animal Body; Different Experiments on the Reproduction of the Nerves' and a Description of a New Canal of the Eye.* Joseph Skinner (trans.), 2nd edn. John Cuthell, London, **2**.

FONTENROSE, J. 1974. *Python: A Study of Delphic Myth and its Origins.* Biblo & Tannen, New York.

GESSNER, C. 1565. *De omni rerum fossilium lapidum et gemmarum maximé, figuris & similtudinibus Liber: non solúm Medicis, sed omnibus rerum Naturae ac Philologiae studiosis, utilis & incundusfuturus.* Iacobus Gesnerus, Tiguri.

GOLDING, A. (trans.) 1587. *The Excellent and Pleasant Worke of Iulius Solinus Polyhistor. Contayning the Noble Actions of Humaine Creatures, the Secretes & Prouidence of Nature, the Description of Countries, the Maners of People: with Many Meruailous Things and Strange Antiquities, Seruing for the Benefitt and Recreation of all Sorts of Persons.* Thomas Hacket, London.

GROSE, F. 1784. *The Antiquities of England and Wales.* Hooper & Wigstead, Bloomsbury Square, London, **6**.

HANSON, M.E. 2007. *Jesuits and Medicine in the Kangxi Court (1662–1722)*, Pacific Rim Report **43**, 1–12.

HOOKE, R. 1705. *The posthumous works of Robert Hooke, M.D. S.R.S. Geom. Prof. Gresh. etc. containing his Cutlerian lectures & other discourses, read at the meetings of the Illustrious Royal Society . . . illustrated with sculptures. To these discourses is prefixt the author's life, giving an account of his studies & employments, with an enumeration of the many experiments, instruments, contrivances & inventions, by him made & produc'd as curator of experiments to th Royal Society publish'd by Richard Waller, R.S. Secr.* BabordNum. Available at http://www.babordnum.fr/items/show/160 (accessed October 2016).

KING, C.W. 1860. *Antique Gems, their Origin, Uses and Value as Interpreters of Ancient History; and as Illustrative of Ancient Art: With Hints to Gem Collectors.* John Murray, London.

KING, C.W. 1865. *The Natural History, Ancient and Modern, of Precious Stones and Gems and of The Precious Metals.* Bell and Daldy, London.

KIRCHER, A. 1667. *China monumentis qua sacris qua profanis, nec non variis naturae & artis spectaculis, Aliarumque rerum memorabilium Argumentis illustrata.* Joannem Janssonium a Waefberge & Elixeum Weyerstraet, Amstelodami.

KRACHER, A. 2012. Ammonites, legends and politics. The Snakestones of Hilda of Whitby. *European Journal of Science and Theology*, **8**, 51–66.

KUEHN, S. 2011. *The Dragon in Medieval East Christian and Islamic Art.* Brill, Leiden, The Netherlands.

KUNZ, G.F. 1891. Madstones and their magic. *Science*, **18**, 286–287.

KUNZ, G.F. 1915. *The Magic of Jewels and Charms.* J. B. Lippincott, Philadelphia & London.

KUNZ, G.F. 1938. *The Curious Lore of Precious Stones.* Halcyon House, New York.

LANGE, C.N. 1798. *Historia Lapidum figuratorum Helvetiae, ejusque viciniae.* J. Tomasini, Venice,

LEONARDUS, C. 1750. *The Mirror of Stones: in which the Nature Generation, Properties, Virtues and Various Species of more than 200 Different Jewels, are Distinctly Described. Also Certain and Infallible Rules to Know the Good from the Bad, how to Prove their Genuineness, and to Distinguish the Real from the Counterfeit. Extracted from the Works of Aristotle, Pliny, Isiodorus, Dionysius Alexandrinus, Albertus Magnus etc. . . / by Camillus Leonardus; Now First Translated into English.* J. Freeman, London.

LOVETT, E. 1905. The Whitby snake-ammonite myth. *Folklore*, **16**, 333–334.

MARTIN, M. 1703. *A Description of the Western Isles of Scotland.* Andrew Bell, London.

MCNAMARA, K.J. 2007. Shepherds' crowns, fairy loaves and thunderstones: the mythology of fossil echinoids in England. *In*: PICCARDI, L. & MASSE, W.B. (eds) *Myth and Geology.* Geological Society, London, Special Publications, **273**, 279–294, https://doi.org/10.1144/GSL.SP.2007.273.01.22

McNamara, K.J. 2011. *The Star-Crossed Stone: The Secret Life, Myths and History of a Fascinating Fossil.* University of Chicago Press, London.

Nicols, T. 1652. *Lapidary or, The History of Pretious Stones: With Cautions for the Undecieving of all those that Deal with Pretious Stones.* Thomas Buck, Cambridge.

Oakley, K.P. 1978. Animal Fossils as Charms. *In*: Porter, J.R. & Russell, W.M.S. (eds) *Animals in Folklore.* The Folklore Society, Cambridge, 208–240.

Orme, N. 2000. *The Saints of Cornwall.* Oxford University Press, Oxford.

Pennant, T. 1769. *British Zoology.* Eliz Adams, Chester, **3**.

Pfeiffer, F. 1994. *Konrad von Megenburg. Das Buch der Natur. Die erste Naturgeschichte in deutscher Sprache.* Georg Olms, Hildesheim.

Pughe, W.O. 1832. *A Dictionary of the Welsh Language*, **2**. Thomas Gee, Denbigh.

Pymm, R. In press. 'A charm to impose on the vulgar': the medicinal and magical applications of the snake-stone bead within the British Isles. *In*: Duffin, C.J., Gardner-Thorpe, C. & Moody, R.T.J. (eds) *Geology and Medicine: Historical Connections.* Geological Society, London, Special Publications, **452**, https://doi.org/10.1144/SP452.13

Ryder, A.W. (trans.) 1925. *The Panchatantra of Vishnu Sharma (c. 1199).* University of Chicago Press, Chicago.

Said, H.M. (ed.) 1989. *Al-Beruni's Book on Mineralogy: The Book Most Comprehensive in Knowledge on Precious Stones.* Pakistan Hijra Council, Islamabad.

Scurlock, J.A. 2006. *Ancient Magic and Divination III: Magico-Medical Means of Treating Ghost-Induced Illnesses in Ancient Mesopotamia.* Leiden, Boston.

Seyfarth, C. 1913. *Uberglaube and Zauberei in der Volksmedizin Sachsens.* Berlag von Wilhelm Heims, Leipzig.

Shell, M. 1989. The Ring of Gyges. *Mississippi Review*, **17**, 21–84.

Steuart, M.E. 1905. *Every Day Life on a Ceylon Cocoa Estate.* Henry J. Drane, London.

Stietencron, H.v., Gietz, K.-P., Maliar, A., Kollman, A., Schreiner, P. & Brockington, M. (eds) 1992. *Epic and Puranic Bibliography (up to 1985): Annotated and with Indexes: Part I: A-R, Part II: S-Z, Indexes.* Otto Harrassowitz, Wiesbaden.

Sundin, G. 2010. *For Princes or Maids? Provenance, form and value of serpentine at Skokloster castle.* Master's thesis, Department of Art History, Stockholm University, http://su.diva-portal.org/smash/get/diva2:387867/FULLTEXT01.pdf

Taylor, P.D. 2012. Saligrams and Vishnu: ammonites in Hinduism. *Batalleria*, **17**, 39–44.

Tennent, J.E. 1859. *Ceylon, An Account of the Island, Physical, Historical and Topographical with Notices of its Natural History, Antiques and Productions.* Longman, Green, Longman & Roberts, London, **1**.

Thévenot, J. de. 2008. *Les Voyages aux Indes Orientales.* Editions Champion, Paris.

Van der Geer, A., Dermitzakis, M. & de Vos, J. 2008. Fossil Folklore from India: the Siwalik Hills and the Mahabharata. *Folklore*, **119**, 75–96.

Van Tuyl, C.D. (trans.) 1987. *Athanasius Kircher: China Illustrata Translated from the Latin by Charles van Tuyl.* Indiana University Research Institute for Inner Asian Studies, Bloomington.

Vogel, J.P. 1926. *Indian Serpent-lore: Or, The Nagas in Hindu Legend and Art.* Arthur Probsthain, London.

Wilson, D. 1851. *The Archaeology and Prehistoric Annals of Scotland.* Sutherland and Knox, Edinburgh.

Wyckoff, D. 1967. *Albertus Magnus Book of Minerals.* Clarendon Press, Oxford.