DRAWINGS OF FOSSILS BY ROBERT HOOKE AND RICHARD WALLER

by

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The drawings of fossils by Robert Hooke and Richard Waller that were the basis of the engravings in Hooke’s *Posthumous works* (1705) are published here for the first time. The drawings show that both Hooke and Waller were proficient draftsmen with a keen eye for the details of petrified objects. These drawings provided Hooke with a polemic edge in making the case for the organic origins of ‘figured stones’.

**Keywords:** fossils; Robert Hooke; Richard Waller; drawings; Hans Sloane

The status of ‘figured’ or ‘formed’ stones, what we would now call fossils, was a much debated topic among Fellows of the early Royal Society. Although his views were not readily accepted in his day, Robert Hooke (1635–1703) believed that these stones were petrified exuviae of animals deposited in various layers of the Earth by means of naturally occurring changes such as earthquakes. He expressed his views in *Micrographia* (1665) and in a series of lectures thereafter, which were published in his *Posthumous works* (1705). The ‘lectures on earthquakes’ were accompanied by intaglio figures, combining engraving and etching (figures 1b, 2b, 3b, 4b, 5b and 6b). Hooke’s friend, Richard Waller (d. 1715), who was entrusted with Hooke’s manuscripts and edited some of them for *Posthumous works*, explained that the original drawings, or designs, were

I know not by what means, not to be found amongst his Manuscripts; but by the Favour of Dr. Sloane, into whose Hands they happily fell, I procured them for the Graver, to whom the World and my self are obliged for this, as well as for other more valuable Communications. The Five first Tables were design’d by Dr Hook himself; and tho’ he has not perfected the Descriptions of them all, yet I have procured them all to be graved, supplying in some measure my self those Figures which were left undescribed by him. The Two last I drew my self from some figured Stones I happen’d to meet with, not far from Bristol, some years since.

Hooke’s drawings, together with the two by Waller, have survived among the papers of Sir Hans Sloane (1660–1753; PRS 1727–41) but seem to have escaped the attention of modern scholars. To the best of my knowledge, this is the first time these drawings have been published (figures 1a, 2a, 2c, 3a, 4a, 5a and 6a). We know that Sloane originally owned two albums containing ‘drawings and designs’ by Hooke, but since so many of

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Sloane’s albums were reorganized by Sloane himself as well as by later curators, it is at present unclear how Hooke’s drawings of fossils entered the Sloane collection. Waller’s drawings (figures 5a and 6a), which were added in Posthumous works to supplement Hooke’s description of fossils, are also found in the Sloane album right after Hooke’s, and because these were drawings that Waller had sent to Hooke from Bristol in the summer of 1687 they may well have entered Sloane’s collection at the same time as the other Hooke drawings of fossils, as part of a collection of Hooke’s own drawings.

The drawings are grouped together sequentially in a large folio album of natural historical drawings, mainly of marine animals, Ms Add. 5262, at the British Library. All the sheets in question have tears in the corners and/or the sides, indicating that they have been lifted from elsewhere at least once and pasted down in their current position. They are predominantly drawn in pen, brown ink and grey wash. A comparison of the dimensions of the figures in the drawings and the corresponding intaglio ones suggests that the latter were faithful copies of the former, within a millimetre of each other. Some of the drawings have faint traces of red powder (for example figures 2c and 5a), which suggests that the reverse of the drawing was covered with something like red charcoal and the figures were then traced onto the copper.
Figure 2. Images of nautilus shells and petrified echinoids. (a) Hooke’s drawing of nautilus shells, intended to demonstrate the morphological similarities with the ‘snake-stones’ in figure 1a. (British Library, Ms Add. 5262, no. 153. Paper size 169 mm × 196 mm. Copyright © British Library Board; reproduced with permission.) (b) Intaglio table of nautili and fossilized echinoids. ‘Fig. 10’ in the drawing (figure 2c) was moved next to ‘fig. 9’, allowing a direct comparison between petrified and non-petrified objects. (R. Hooke, Posthumous works (1705), Tab: IIa and Tab: IIIa, between pp. 284 and 285, plate size 324 mm × 211 mm. Copyright © The Royal Society.) (c) Hooke’s drawing of ‘helmet stones’ and ‘button stones’, which he described as filled ‘Echini shells’ (i.e. petrified echinoids). At ‘fig. 10’ Hooke showed a type of (contemporary) echinoids commonly found in Devon or Cornwall. Traces of red powder can be observed in the area around ‘fig. 6’ of the drawing. (British Library, Ms Add. 5262, no. 154. Paper size 231 mm × 190 mm. Copyright © British Library Board; reproduced with permission.) (Online version in colour.)

plate from the front. This was a standard way of transferring drawings to plates and also the reason for the reversal of the left and the right orientation of the image in the printed version.

In the first sheet of drawing (figure 1a), next to ‘fig. 24’, is an inscription in Hooke’s hand, ‘neer Keinsham’. This tallies with his description in the accompanying text that objects
represented as Figures 24 and 29, and possibly others, were from Keynsham and sent by ‘Dr Beal’. Keynsham in Somersetshire was well known since William Camden’s *Britannia* (1586), for ‘snake-stones’ that wound round in the shape of a snake with the tail at the centre and a head at the end. John Beale (1608–83), the Somerset virtuoso better known for his interest in cider-making and agricultural improvement, had presented to the Society on 10 August 1664 a box of stones for investigating ‘what is the process of the plastic spirit in shaping perfect cockles, muscles, scollops, headless serpents, fishes, thunder-stones, etc.’ Two weeks later, Hooke read a paper on the topic of petrification as part of his ‘microscopical book, then in the press’. It is possible that Beale’s stones were studied at that time by Hooke: in *Micrographia*, Observation XVII, ‘Of Petrify’d wood and other Petrify’d Bodies’, there is a section on ‘some Observations I lately made on several kind of petrify’d shells, found about Keinsham, which lies within four or five miles of Bristol, which are commonly call’d Serpentine-stones.’

Hooke summarized his findings in *Micrographia* as follows: the ‘serpentine stones’ were formed of different substances as to hardness, transparency and colour; they looked like broken shells; some retained outward shells that were easily separable and could be dissolved in common vinegar; several retained suture patterns like leaves; these sutures indicated boundaries of the internal diaphragms; and the cavities of the diaphragms were sometimes filled with marl and other kinds of substances, while other cavities were partly

Figure 3. Images of belemnites, shark’s teeth and other petrified objects. (a) Hooke’s drawing of various fossils, for which he did not leave a textual explanation. The objects depicted included fossil bivalves, brachiopods, belemnites, shark teeth and possibly a reptilian tooth at ‘f. 15’. At bottom right, next to ‘f. 16’, Hooke’s note, ‘220 in a mouth’, has been deleted. (Ms Add 5262, no. 155. Paper size 270 mm × 192 mm. Copyright © British Library Board; reproduced with permission.) (b) Intaglio table of fossil bivalves, belemnites, shark teeth and other objects. (R. Hooke, *Posthumous works* (1705), Tab: IV, between pp. 284 and 285, plate size 320 mm × 195 mm. Copyright © The Royal Society.) (Online version in colour.)
covered with a tartarous petrified substance that had crystallized around the sides. He concluded that the formation and the figuration of these stones were not due to any ‘plastic virtue’, but were due to shells of shellfish that became filled with mud or clay or petrifying water and had over time rotted away, leaving their impressions ‘both on the containing and contained substances’. This must have disappointed the stones’ donor, Beale, who remained interested in the generative virtues of various waters for agricultural improvements. Although Hooke reported in Micrographia that he used the microscope to examine the suture patterns and the consistency of petrifying substances of snake-stones, he did not provide any illustrations in that book, perhaps because it was already in the press.

It is tempting to think that the first drawing (figure 1a) may have had its origins around the time that Micrographia was published: indeed, it shows the snake-stones composed of different substances, their different external forms, and the leaf-like suture patterns observed by a microscope shown at ‘Fig. 5’. There is, however, additional information on this sheet, in particular the figures of their transverse sections, marked Figures 2, 4, 7, 9, 11, 19, 21, 25 and 28, shapes of the diaphragm ends marked Figures 13, 15, 17 and 23, and details of the hollow groove around the back, marked ‘c’ and ‘b’ in the top left
Hooke named, in addition to Beale, Daniel Colwall (d. 1690) as the donor of the object shown as ‘Fig. 8’ whose back was ‘guttered and knobbed’ like a ‘Japan Nautilus’. In the lecture accompanying the drawing, Hooke pointed out that he possessed or knew of more varieties than were shown in this set of figures. This was an important point to make, to demonstrate that his generalizations were based on a wealth of specimens.

This was of course not the first time that ‘snake-stones’, also known at the time as *cornua ammonis*, had been depicted. The name, the horn of Ammon (or Jupiter), derives from Pliny the Elder’s description of it (*Natural history*, book 37, chapter 60) as an Ethiopian gem in the shape of a ram’s horn. Before the publication of *Micrographia*, the *cornua ammonis* had been discussed with accompanying images in Conrad Gessner’s *De omnium genere fossilium* (1565), Francesco Calzolari’s *Musaeum Calceolarianum* (1622), Francesco Stelluti’s *Trattato del legno fossile minerale* (1637), Anselmus de Boodt’s *Gemmarum et lapidum historia* (1647) and Ulisse Aldrovandi’s *Musaeum Metallicum* (1648). Hooke’s drawing of what we now call ammonites is different from these earlier representations in the number of specimens he collated to show the variety of sizes, shapes and suture.
patterns, and the attention he devoted to the shape of each stone with the use of transverse diagrams and figurative representations.

It is difficult to determine the date of this drawing or any of the others on stylistic grounds, mainly because of Hooke’s well-known graphic versatility. Hooke had worked under Sir Peter Lely (1618–80), but not for long because the smell of oil paint disagreed with him. Hooke’s surviving drawings are predominantly done in pen and brown ink, as in his study of human heads and figures discussed by Matthew Hunter. Meghan Doherty has recently shown how Hooke’s drawing of an insect modelled entirely with inked lines with the parts catching light left untouched echoes the use of lines in contemporary portrait engravings. He also used ink and grey wash for some of the drawings for Edward Tyson’s *Phocaena* (1680).

In this drawing of snake-stones (figure 1a), grey wash is used to model the object numbered ‘Fig. 10’ and brown ink is used to indicate the suture patterns. In ‘fig. 26’, top right, grey wash is used to model the snake-stone as well as the stone in which it is embedded; although Hooke says that both are made of the same substance, he uses brown ink lines and brown wash to give better definition to the embedded stone. The top left specimen (labelled ‘Fig 12’ in figure 1b) is modelled lightly in grey and brown wash, and then worked over with parallel curved brown lines to indicate the indentations of the ribs and the hollow groove running around the edge. For ‘Fig. 27’, Hooke used grey and darker wash to model the stone, with virtually no part

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Figure 6. Images of a petrified nautilus shell. (a) Drawing by Waller of a petrified nautilus shell (figs 1–4) found at Keynsham, and samples of petrified wood (figs 5–8) taken at St Vincent’s Rock. At the top, ‘Tab. 2’ has been changed to ‘VII’. (British Library, Ms Add. 5262, no. 158, paper size, 305 mm × 219 mm. Copyright © British Library Board; reproduced with permission.) (b) Intaglio table of petrified objects found by Waller in 1687. (R. Hooke, *Posthumous works* (1705), Tab. VII, between pp. 286 and 287, plate size 305 mm × 218 mm. Copyright © The Royal Society.) (Online version in colour.)
left untouched, which gives the impression that the surface does not reflect light, and no parallel lines are used for modelling. All objects cast shadows, which are expressed using wash; some have parallel or hatched lines added. Taken as a whole, this sheet of drawing is an excellent indication of Hooke’s ability to deploy a variety of techniques to convey the details and the three-dimensionality of the samples. The different techniques are levelled out somewhat in the corresponding engraving (figure 1b), because all shadows are produced in cross-hatched lines, and the modelling is achieved with a combination of parallel or hatched lines of varying density.

The second drawing (figure 2a) was meant to ‘parallel’ the first drawing and shows fewer objects because Hooke had ‘no greater variety’ by him. The drawing is of nautilus shells: the first figure in the centre shows a cross section of the nautilus shell with its curved diaphragms; the second shows the outside shell of a small nautilus, with the dotted lines indicating where the diaphragms joins the outer shell; the third figure shows a Japan nautilus, ‘crenated on the sides, and knobbed on the back, much in the manner as several of the Snake-stones are’, thus recalling Hooke’s earlier description of Colwall’s specimen in the first drawing; the fourth figure shows a coiled nautilus ‘whose conical body is divided by small diaphragms under each black circling lines and is coiled so as its roundness is kept, and the parts do not touch one another’. Taken together with the first drawing, the second forms part of an argument about the morphological similarity between ‘snake-stones’ and nautilus shells. The modelling in this second drawing is achieved mainly by the use of grey wash, with the use of lines in black ink to add definition to various structures and contours. In comparison with the first drawing, Hooke here devotes less attention to showing or describing the shape of these objects comprehensively, probably because they were commonly found objects. The corresponding engraving (figure 2b) is a fair rendering of this drawing, although the end part of the snake-stone labelled ‘Fig. 4’ appears less concave than is shown in the drawing.

Hooke next tackles a group of ‘helmet stones’ and ‘button stones’ (figure 2c). Objects marked ‘Fig. 1’ to ‘fig. 3’ are examples of ‘button stones’ made out of flint, and they have five sections and two holes or vents (one of which is marked ‘a’); ‘fig. 4’ to ‘fig. 6’ are ‘helmet stones’, also with five parts and two vents. ‘Fig. 4’, Hooke explains, looks on the stone ‘almost directly’, whereas ‘fig. 5’ and ‘fig. 6’ show the stone from the bottom and the side so that they show ‘more plainly’ the vents, sutures and joints. ‘Fig. 8’ and ‘fig. 9’ show the same helmet stone from the top and the bottom, with its vents marked ‘a’ and ‘b’. Unlike the first drawing of ammonites, which were depicted more or less from the same angle and supplemented by diagrams of their cross sections to provide information about the three-dimensional object, here Hooke rotates the fossilized echinoids to show the positions of the vents and the configuration of the five-part tests. Hooke noted that the object shown in ‘fig. 8’ and ‘fig. 9’ was much like the ‘Echini-shells’ found in Devon and Cornwall, and drew an example of the (contemporary) shell at ‘fig. 10’. In the corresponding engraving (figure 2b), this object was moved up closer to ‘fig. 9’, probably to fit on the plate, but it inadvertently allows a more direct comparison between the fossilized and contemporary shells. Hooke emphasized that he had many more examples of helmet stones and button stones that he did not have the time to draw; he also mentioned that he wished to draw another set of images of the ‘Echini-shells’ to make a similar argument about morphological correspondences as in the first two drawings, but he wrote that he would do it ‘elsewhere’. If Hooke did follow through with his promise to draw a set of comparable echinoids, they cannot be found among the set of drawings discussed here. There is perhaps a hint that such a drawing was almost unnecessary in this case:
any one that will diligently and impartially examine both the Stones and the Shells, and compare the one with the other, will, I can assure him, find greater reason to persuade him of the Truth of my Position, than any I have yet urged, or can well produce in Words; no Persuasions being more prevalent than those which these dumb Witnesses do insinuate.  

Hooke’s argument for the organic origin of helmet or button stones was thus to be completed by the readers themselves by consulting the objects, the ‘dumb Witnesses’. First-hand comparison of objects would render his point so obvious that it would not require another picture or textual explication to draw out the analogies.

The next two drawings (figures 3a and 4a) are different from the first two in that they show various types of petrified objects, rather than varieties of the same type. Waller inferred from the fact that the objects were not numbered that Hooke never wrote a textual description to accompany them, and Waller’s identifications were vague. According to Dan Pemberton, the fourth drawing (figure 3a) shows the following objects: bivalves such as *Gryphaea arcuata* (top left), *Gryphaea ?dilobotes* (‘fig. 2’), *Trigonia* sp. (‘fig. 3’) and *Lopha* sp. (‘fig. 4’); belemnites such as *Belemnittinga indet.* (guard) (‘f. 6’ and ‘f. 8’), *?Neohibolites minimus* (guard) (‘f. 7’), *Belemnittinga indet.* (guard with phragmocone) (‘fig. 10’), and *?Actinocamax plenus* (guard) (‘f. 20’); a gastropod, *?Cerithiodea indet.* (mouldic fossil) (‘fig. 5’); possibly reptilian teeth such as *?Reptilia indet.* (‘f. 11’) and *?Pliosauridae indet.* (‘f. 15’); brachiopods such as *Terebratulida indet.* (‘f. 18’ and ‘f. 19’); and shark teeth such as *?Lamniformes indet.* (tooth central cusp) (‘f. 9’ and ‘f. 12’), *?Carcharodon carcharias* (‘f. 13’), *?Carcharocles megalodon* (‘f. 14’), *?Galeocerdo sp.* (‘f. 16’) and *?Lamniformes indet.* (‘f. 17’). Next to ‘f. 16’ in the drawing, Hooke’s inscription, ‘220 in a mouth’ is crossed out, and Waller duly reported that ‘Upon the 16th and 17th figure Dr Hooke makes this Remark, that they are 220 of them in the Fishes Mouth’. Hooke reported in 1668 that he had ‘vitriolated’ some petrified bodies to show that they were the teeth of shark, and a week later presented to the Society several petrified shark teeth found in Sheerness (Isle of Sheppey), Kent, but it is not possible to link these positively to the objects drawn here. The objects are drawn in a combination of pen, grey wash and some brown ink, although not all objects on this sheet cast shadows. The corresponding engraving (figure 3b) is fairly faithful in copying the drawing and does not attempt to supplement the shadowing missing from the original.

The fifth drawing (figure 4a) is a little worn, and some of its details are better preserved in the engraving (figure 4b). Given how the engravings have been faithful renderings of the earlier drawings, there is no reason to believe that the details no longer clearly visible on the drawing were added by the engraver, whose identity we do not know. According to Dan Pemberton, the objects shown include a proboscidcean, *?Anancus arvernensis* (molar tooth) (‘Fig. 1’), a crab, *Brachyura indet.* (‘Fig. 2’), solitary corals, *Rugosa indet.* (unnumbered object underneath the crab, ‘Fig. 9’, and the bottom right object), spines of the sea urchin, *?Tylocidaris* sp. (‘Fig. 10’ to ‘Fig. 13’), and various parts of crinoids, such as *Crinoidea indet.* (stem fragment) (‘Fig. 3’ to ‘Fig. 7’), *Crinoidea indet.* (ossicle) (‘Fig. 14’), *Pentacrinites sp.* (stem fragment?) (‘Fig. 15’) and *Pentacrinites sp.* (ossicle) (‘Fig. 16’). Although we know that the Society’s repository had a sample of a petrified crab, it is not possible to identify it as the object depicted in ‘Fig. 2’. Further research into the sources for fossilized objects in this period will be required to narrow down current identifications. This drawing uses similar techniques to those deployed earlier, of
combining pen and grey wash, with the inked lines used effectively to add details and enhance contours of each object.

We cannot know for certain what kind of argument Hooke had in mind when he drew these objects, although it is very likely that he would have made the point that all these petrified objects were originally animals; nor is it obvious whether the last two drawings (figures 3a and 4a) were ever shown at the Royal Society. The lectures on earthquakes that include these images end with a note, ‘End. Sept. 15 1668’, although, as noted by Rappaport, the Royal Society was at that time still adjourned for the summer. It is not clear at present whether all five drawings by Hooke had been completed by then, or whether Hooke had added and worked on some of them, especially on the fourth and fifth drawings, over some years.

Waller added two sheets of drawings of his own (figures 5a and 6a) to the five by Hooke, and these, as Waller explained, date from 1687. In 1685 Waller had married Anne Blackwell, a daughter of Jonathan Blackwell (d. 1676), an affluent vintner who is better known for his endowment of lighting at St Michael’s Steps in Bristol. In the summer of 1687, Waller was staying with his mother-in-law, who lived near St Michael’s Steps. From Bristol he ventured out to Keynsham, St Vincent’s Rock, Stowey, the Mendip Hills and Wookey Hole, and visited other Fellows of the Society, namely the physician John Beaumont (d. 1731) at Ston Easton and the diplomat Sir Robert Southwell (1635–1702) at King’s Weston; he also called on William Cole, a naturalist, collector and customs official, at Bristol. Waller wrote to Hooke about what he had found there.

After the publication of *Micrographia*, Hooke’s views had been questioned by newly elected Fellows such as Martin Lister (1639–1712) and Robert Plott (1640–96), who argued that these were ‘formed stones’ or *lapides sui generis*, spontaneously produced by the formative powers found in seeds and salts. Furthermore, Paolo Boccone’s view on the organic origin of *glossopetrae* and Nicolaus Steno’s theory of stratigraphy became known to the Society, although the latter was accused of stealing Hooke’s ideas. Earlier in 1687 Hooke had been rebutting John Wallis’s criticisms of his view that the Earth’s axial shift accounted for large-scale geological displacements. Thus, it is at a time when Hooke was feeling besieged that Waller wrote from Bristol.

Waller included in *Posthumous works* an ‘Abstract’ of his letter to Hooke of 17 August 1687 to accompany his two drawings. A longer draft related to this letter has survived at Trinity College, Cambridge. In this draft, Waller refers to the two sheets of drawings as ‘Tab 1’ and ‘Tab 2’, and we can see on the drawing (figure 6a) at the top that an attempt has been made to erase ‘2’ from ‘Tab 2’, next to which ‘VII’, the number of the plate in *Posthumous works*, is added in a different ink. Waller’s draft begins thus:

Not to enter into the dispute whether in nature there is or can bee petrified substances like parts of animals & vegetables which yet never had any relation to either but are as some term them Lapides sui generis, I shall only give you an account of some observables I mett with in several places of sommersetshire this last summer, especially at Kainsham upon the Avon.

One could applaud this attitude as expressing precisely the Society’s caution at forming hypotheses too quickly, but in the context of Hooke’s *Posthumous works* this could have been read as a criticism of Hooke’s views, which is probably why it was excised in the printed edition. It must be for similar reasons that references to Robert Plott’s *Natural history of Oxfordshire* and to Lister in Waller’s draft were suppressed in the printed version.
Waller drew the petrified objects he found on his trip, such as a petrified mussel shell found at Wookey Hole (‘fig. 1’ in figure 5a) and another petrified shell from St Michael’s Hill in Bristol (‘fig. 7’ in figure 5a). His draft at Trinity College contains information not included in the printed letter. For example, according to the draft, the belemnite at ‘fig. 3’ was found in whitish clay and the diameter of its larger end was seven-tenths of an inch, which is indeed so: the diameter on the drawing measures 19 mm, or 0.74 inches, according to Waller’s draft. The dimension of the corresponding belemnite in the engraving (‘fig: 3’ in figure 5b) is the same, so it is justified that the printed text in Posthumous works describes it as ‘of true bigness’, although it omits that it was found in whitish clay. The cornu ammonis at ‘fig. 4’ in the centre is described in the printed edition as found in Keynsham, 18 inches across, showing foliage patterns of the diaphragms and containing small petrified shells in the centre. In his draft, Waller described it as 19 inches across, its centre being filled up with stone, embedded with bits of shell and showing impressions of shells. The snake-stone at ‘fig. 8’ is a broken specimen but conveniently shows the unfilled spaces between the diaphragms. In the draft, Waller explained further that the depression of the hole in the diaphragm was marked at ‘a’, clearly visible in the drawing (figure 5a) and in the corresponding engraving (figure 5b), but the accompanying printed text is silent about this legend. In the printed text, the object at ‘fig. 9’ is described as having three turns of coil; in his draft, Waller added that its centre also rose. In both versions, Waller noted that he had come across examples of no more than six turns of the coil, but that both Beaumont and Cole had ones with seven turns.

Waller was trained in limning (painting portraits in water-colour), most probably by his mother, Mary Moore (d. 1716), a miniaturist. John Evelyn (1620–1706) praised his other graphic skills: ‘Painting both in Oyle and Miniature to a great perfection, ... Ingraves rarely in Brasse.’ Waller’s modelling is also achieved almost entirely by grey wash, but his style is quite different from Hooke’s: he does not make use of inked lines to define shapes or add features, closely placed curved lines to create undulations, or cross-hatching or parallel lines to indicate shadows. Indeed, Hooke’s drawing of an ammonite (top left of figure 1a) and Waller’s (‘fig. 4’ in figure 5a) look very different. Although both successfully depict how the coils of the ammonites gradually sink towards the centre and both use a monochromatic scheme, Hooke’s ammonite jumps out to the viewer in contrast with Waller’s, which softly nestles on the page. The difference is perhaps less visible after their transformation into intaglio prints (figures 1b and 5b).

In the seventh drawing (figure 6a), Waller drew samples of petrified wood that he had picked up at St Vincent’s Rock (‘fig. 5’ to ‘fig. 8’). ‘Fig. 1’ showed a petrified nautilus found at Keynesham. In Posthumous works it is described as weighing ‘near 30 pound’, although Waller’s draft says it was about 26½ pounds, with the circumference of the greater end measuring 21 inches. The parts marked ‘a’ in this figure indicate the diaphragms inside the shell; ‘d’ identifies the diaphragm marks visible on the outside; ‘b’ is where the innermost coil would be; the pricked line ‘c’ indicates the outline of stone, had the stone been complete; and the sections marked ‘e’ show the shells still sticking to the stone. In Waller’s draft, ‘fig. 2’ is described as a piece of the outside of this stone that was taken off, with ‘d’ showing the diaphragm marks and ‘e’ the remnant of the shell, but in Posthumous works the legend explains that it is ‘another piece of the same sort found at another Place’.

It is not clear why Waller decided by 1705 that ‘fig. 2’ was not part of the first object, because its placement on the drawing seems to suggest that it was...
a part taken off from the grey, shaded area marked ‘a’. ‘Fig. 3’ and ‘fig. 4’ indicate a piece of the diaphragm from the first specimen from two sides, showing the holes in the diaphragm at ‘a’ and ‘c’, protruding on one side and depressed on the other. This, Waller had explained, was

A Cornu ammonis such as hath not yet that I know of been described and possibly never seen. It in all particulars agrees with the shell of the common Nautilus such as we have some of in the Repository: in this the Diaphragmes and holes by which they communicate with each other are conspicuous exactly like those of the real shell rising on the one side & depressed on the other.55

Hooke seems to have been very pleased with Waller’s findings, which he reported to the Society as soon as it met after the summer recess, on 26 October 1687.56 The following is most probably Hooke’s preamble on that occasion:

Having failed of finding the Diaphragmes in the large cornu ammonis which I here produced and caused to be split, and observing thereupon/ [the marks \ and / indicate insertions, typically above the line] that this failuer/ became a prevalent argument against the explication of the Reason of the figure and the generation Thereof from some preceding shell of that shape which I had indevouer to prove by many arguments, one whereof was that the some parte of/ very shell it self which was the mould of the said large cornu ammonis were yet remaining about the same which by all sensible examinations proved to be the same substance with/ of other shells, and by several other shells which were found bedded in the same stone, which by their make & substances seemed also/ to be some kinds of Oyster shells or muscle shells thought of very larges sises. Yet finding that not withstanding all these arguments/ because the values which I looked for, could not be discovered in that stone/; and because I could not now produce the shells of some present living Animalls that might be of the same shape and figure, and of as great a bignesse as this which I supposed such/; It was concluded by some/ y these were groundlesse conjectures, and that the figure of those kinds of stones must be ascribed to a plastick faculty or some other I know not what cause. This made me desirous to be able to produce some further proof of this matter, that truth might at length prevale and not be born down by an Ipse Dixit of the most Positive Dogmatists. And thereupon Mr Waller being about to take a journey to Bristoll and being soe obleiging as to promise to take some paines in the search and examination of all kinds of Naturall Curiositisys which were thereaboute to be mett with I desired him particularly to inform himself concerning these figured stones which I was formerly assured were to be found about Keinsham in great numbers which I judged supposed lay not far from the place wither he was going. He accordingly has with great Curiosity and exactness surveyed the place and examined the figured stones there to be found in those particular which I had requested him to doe/ and as I did earnestly Request/ him \ he/ hath brought up some specimina of those his Discoverys. Which will speak for themselves much more than I can by any present description.57

The discovery of the holes in the diaphragms was a significant addition to the argument for the organic origin of snake-stones, and Waller, too, felt it significant enough to notify John Ray of his discovery in the following February.58 Waller’s inclusion of his own drawings in this section of Hooke’s *Posthumous works* is thus appropriate and justified, even though they were drawn almost 20 years after Hooke’s drawings.

Petrified objects were part of a much larger debate about Earth’s history in that period, and the drawings by Hooke and Waller convey the care and attention with which they
studied these objects. The drawings demonstrate the graphic proficiency of both as well as their contrasting styles, which may not be so obvious from their intaglio counterparts, however faithfully the latter were made. They are also an indication of their interest in fossil evidence sustained over a period, and the continuing importance of Keynsham as a location for such evidence. Most importantly, these drawings constituted an important part of Hooke’s argument for the organic origins of fossils.

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NOTES

5 My attention was drawn to a set of incompletely catalogued albums on natural history, including this volume, at a meeting of ‘Sloane’s Treasures’, http://www.britishmuseum.org/research/research_projects/all_current_projects/sloanes_treasures.aspx.
7 These ‘heads’ were artificially carved onto the end of ammonites; see an example in R. Fortey, *Fossils* (Natural History Museum, London, 2009), p. 15. For Keynsham snake-stones, see


9 Birch, *op. cit.* (note 8), vol. 1, p. 463.


13 See, for example, his paper, ‘Concerning the use may be made of vaults, deep wells, and cold conservations, to find out the cause, or promote the generation of salt, minerals, metals, crystals, gems, stones of diverse kinds, and helps to conserve longer; or to hasten putrefaction, fertility of our land’, *Phil. Trans. R. Soc. Lond.* 4, 1135–1141 (1669).


15 Hooke, *op. cit.* (note 3), pp. 283–284. A ‘formed stone’, a large snake-skin and several ‘natural things’ belonging to Hooke were given to the Society after his death; see RSA, JBO 11/18 (14 April 1703) and 20 (28 April 1703).


18 Hooke, *op. cit.* (note 3), p. i.


Drawings of fossils by Hooke and Waller

26 Ibid.
27 Ibid. For a list of ‘button stones’, ‘thunder stones’ and ‘helmet stones’ in the repository, see Grew, op. cit. (note 14), pp. 258–260.
29 Ibid.
34 Jonathan Blackwell’s will, The National Archives, PROB 11/352; his son, the younger Jonathan Blackwell (1671–1754), was elected FRS in 1692.
36 Two of Waller’s letters from Bristol to Hooke have survived at Trinity College, Cambridge (Ms O.11a.125–26). They are written in Waller’s hand, folded and addressed to Hooke with postmarks; Hooke’s draft replies (dated 20 July and 1 August, respectively) can be found on their blank sides. These (and the other papers by Hooke in the same collection) must once have been in the hands of William Derham (his draft preface to the third edition of John Ray’s Three physico-theological discourses (1713) is O.11a.124), whose annotations on Waller’s letters suggest that he may have contemplated including them in his edition of Ray’s Philosophical Letters (1718). See also Derham’s possession of Hooke’s papers in F. Henderson, ‘Unpublished material from the memorandum book of Robert Hooke, Guildhall Library MS 1758’, Notes Rec. R. Soc. Lond. 61, 129–175 (2007), at p. 134.
40 Hooke, op. cit. (note 3), p. 287.
41 Ms O.11a.127v (undated and without a postmark), Trinity College, Cambridge. This is very close to the paper read at the Society later in the year, LBO 11i/67–70, RSA, although the latter lacks
references to images. The Trinity copy may be Waller’s draft of a letter sent to Hooke (although at Hooke, op. cit. (note 3), p. 281, Waller says that he did not keep an ‘exact’ copy of the letter) or, more probably, a revised version of the original letter prepared to be read at a meeting of the Royal Society. I have been unable to locate the original letter of 17 August 1687.

Ms O.11a.1\(^{27A}\), Trinity College, Cambridge. The text here is identical with that at LBO 11i/67, RSA, which suggests that this preamble was probably aimed at the Fellows of the Society in general.

Waller had recorded his sentiment, however, in the margin for the description of the fifth drawing: ‘‘Tis true these have by former Writers been thought *Lapides sui genera* and call’d Belemnites. I shall wave the Dispute.’ Hooke, op. cit. (note 3), p. 285.


Ms O.11a.1\(^{27A}\), Trinity College, Cambridge.


Ibid.

Ms O.11a.1\(^{27A}\), Trinity College, Cambridge.


Ibid.


Ms O.11a.1\(^{27A}\), Trinity College, Cambridge; Hooke, op. cit. (note 3), p. 287.

Ms O.11a.1\(^{27A}\), Trinity College, Cambridge. Compare the central figure of the cross section of the nautilus shell (figure 2\(a\)) in which protrusions of the holes for the siphuncle are depicted.

Birch, op. cit. (note 8), vol. 4, p. 549.

Ms O.11a.1\(^{22B}\), Trinity College, Cambridge. I thank Felicity Henderson for correcting my transcription.

This letter, reporting that ordinary snake-stones have ‘shelly diaphragms’ and holes, is dated 4 February 1687 in John Ray’s *Miscellaneous discourses concerning the dissolution and changes of the world* (S. Smith, London, 1692), p. 124, but it seems more likely that it was February 1687/8. Ray’s evolving attitude towards Hooke’s views are summarized in Poole, *op. cit.* (note 1), pp. 130–133.