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JOHN WOODWARD AND A SURVIVING BRITISH GEOLOGICAL COLLECTION FROM THE EARLY EIGHTEENTH CENTURY

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John Woodward's collection of 'fossils' is unusual for its time in being not a miscellaneous assemblage of the rare and curious but a comprehensive, representative, and truly 'scientific' collection, carefully documented and used by Woodward as the basis for elaborate classifications. It was amassed between 1688 and 1724, and came to a total of around 9,400 specimens. Its continual growth led to a complex arrangement and numbering scheme for both specimens and catalogues. After Woodward's death the collection was transferred to the University of Cambridge in its four original cabinets. Though rearranged, it survives virtually intact. Roughly half comprises minerals and rocks, and half organic fossils. There is some recent shell and plant material, and there are a few artefacts. Its 'English' component covers most of England and parts of south and mid Wales. Foreign material comes from most of the known world of the early eighteenth century. There are specimens figured in early works of Agostino Scilla, Martin Lister and John Morton, and many others donated by Woodward's contemporaries.

Introduction: a Natural Historian of the Earth

John Woodward (1665–1728) is a figure who was long neglected by historians of science and who has only recently received the attention he deserves.[1] He is best known for the early ideas on geological processes contained in his theory accounting for the Diluvian origin of stratification and the distribution of mineral bodies and fossils within rocks,[2] for his early advocacy of the organic origin of fossils, and for his attempts to classify rocks and minerals[3] and organic fossils.[4] More recent assessments of Woodward, however, have highlighted his many other claims to historical attention; for Woodward was the epitome of the 'virtuoso' of his day, and energetically pursued a broad range of typically 'modern' activities and enquiries. He was also of a contentious character and seemed inevitably to become embroiled in all the medical, scientific, and cultural controversies of his time. Such activities brought him both celebrity and notoriety—particularly the latter. For Woodward's vain, affected, and arrogant manner made him many enemies and combined with his self-conscious 'modernity' to make him also the perfect target for the wits and satirists of the Augustan age in their fierce mockery of all 'modern' learning.

Prominent among those things for which Woodward (though appreciated by a few) was widely mocked and misunderstood were his activities as a collector—particularly of 'fossils' (geological specimens in general). Ironically, it is through his attitude to the systematic collecting of specimens, and through his practice as a curator, cataloguer, and interpreter of his own collection that Woodward now holds perhaps his strongest claim to be a pioneer of modern scientific practice. It is the collection too, through the steps taken by Woodward to ensure its preservation, which led to his most enduring achievement—the founding of the Woodwardian Chair of Geology at Cambridge. At Cambridge the collection itself endures, remarkably intact.

In building up his large private collection from 1688 onwards, Woodward was doing nothing unusual. Such private collections in the Britain of the late seventeenth and early eighteenth centuries were abundant. The collections of William Charleton (alias Courten), John Kemp, Richard Mead, James Petiver, the Revd William Stonestreet, and, of course, Hans Sloane are well known London examples. These private collections vied with that of the Royal Society, then housed at Gresham College. The large collection amassed by the Tradescants had only recently (1683) been moved from London to the specially built Ashmolean Museum in Oxford where Woodward's contemporary Edward Lhwyd was subsequently to amass his collection of 'figured stones'. In Edinburgh, Sir Andrew Balfour's collection had been acquired and augmented by Sir Robert Sibbald

before its presentation to the University in 1697. The collections of Robert Wodrow of Eastwood and of John Beaumont and William Cole of Bristol also deserve mention and there were many more. Most of these were dilettante collections—miscellaneous accumulations of antiquities and a variety of 'natural curiosities'—though they would usually include some 'fossils'. A typical, if small-scale, example built up by John Bargrave survives at Canterbury.[5]

So Woodward was not alone in collecting geological specimens. Nor was he at all immune to the passion then prevailing for collecting in general. He was, for instance, an avid collector of antiquities—statues, vases, inscriptions, amulets—and a great bibliophile. Even here, though, there is evidence that he was a more discriminating collector than many. For instance, though they were at the time the objects most prized and sought after by collectors in general, Woodward's collections when they came to auction contained no coins or medals. According to his neighbour Mr Miller, 'he did collect some Medals yet never kept them himself, but presented them commonly to Forreigners and others and had Fossils or other things in exchange for them'.[6] It was the 'fossils' that were his great and lasting preoccupation, their accumulation forming a major part of his life's work. And, whatever may be said of the rest of his collections, Woodward's geological collection differed fundamentally in nature from almost all other collections of the time.

In the first place it was not confined to rare, valuable, or 'curious' specimens. Woodward had only contempt for those who sought out the abnormal and unusual in the natural world to the exclusion of the commonplace. ''Tis not well,' he wrote, 'that Gentlemen that have not duly inform'd themselves of Things the most obvious and common, should take upon them to write of those that are the most abstruse and difficult. This is what has laid the foundation of Amusements in Natural History, and Errors without end.'[7] His collection was meant to be comprehensive and representative. Much of it was collected as a result of his own systematic field investigations in England, 'the far greatest part whereof I travelled over on purpose to make them'.[8] These investigations were supplemented and extended into many other parts of the world through a vast network of correspondents whom Woodward frequently badgered into sending him geological information and specimens.

In the second place, then, Woodward's was a collection with a purpose. It was part of his methodical attempt 'to get as compleat and satisfactory information of the whole Mineral Kingdom as I could possibly obtain'.[9] Collecting for him was not an end in itself and he characteristically pontificated against those for whom it was:

> ... Censure would be his Due, who should be perpetually heaping up of Natural Collections, without Design of Building a Structure of Philosophy out of them, or advancing some Propositions that might turn to the Benefit and Advantage of the World. This is in reality the true and only proper End of Collections, of Observations, and Natural History: and they are of no manner of Use or Value without it.[10]

His initial observations and collecting gave rise to his 'Essay towards a Natural History of the Earth ...' The collection and its catalogues are, in part, an important demonstration and reminder of just how empirically based this 'theoretical' work actually was. But while the importance of the 'Essay', its influence, and its centrality to Woodward's opinions throughout his life cannot be denied, it should not continue to distract attention as it has from Woodward's continuing work on his collections. It was the subsequent cataloguing and arrangement of these collections which became both the basis for and the illustration of his ideas on rock, mineral, and fossil classification. The collection was thus quite central to a major part of Woodward's life's work as, in the original Baconian sense, a natural historian of the Earth.

Being thus no mere accumulator of curiosities but a methodical and self-consciously 'scientific' collector, Woodward took great care to record exact localities and details of occurrence for his specimens, even distinguishing between those found *in situ* and those obviously transported.

> Found on the Shore, under Pendennis-Castle, Cornwall. There is among the rest, a Stratum of stone of this sort among the neighbouring Cliffs; whence this doubtless was beaten.[11]

He is, of course, outspokenly critical of those who did not take similar care. Of a specimen given him by William Charleton he says

> He told me it came from beyond the Seas, but could not tell me from what Country. 'Tis a pity a Gentleman so very curious after Things that were elegant and beautiful, should not have been as curious as to their Origin, their uses, and their Natural History; about which he was little sollicitous.[12]

The care taken by Woodward in such matters would, as F. J. North has noted, 'do credit to the curator of a modern museum'.[13] As a consequence, Woodward's

catalogues are much more than simple inventories of his collection. Along with the locality details (and the pungent comments on the shortcomings of his contemporaries!) are often measurements and detailed descriptions of specimens, notes on their significance, references to relevant literature, comparisons with specimens elsewhere in his catalogues, and, on occasion, relevant field observations. As a result they are full of information on sources (many otherwise now forgotten) and on the industrial, commercial, agricultural, and medicinal uses of rocks, minerals, and fossils at the beginning of the eighteenth century and on their local names. In places they even give the contemporary prices for particular ores of copper and lead.[14] All this, of course, within the framework of Woodward's elaborate classification. Overall the catalogues become, as Woodward's main title-page proclaimed (Fig. 1), an attempt at a comprehensive natural history of 'Fossils'.

AN
ATTEMPT
Towards a
Natural Hiſtory
OF THE
FOSSILS of ENGLAND;
IN
A CATALOGUE of the *Engliſh* FOSSILS
in the COLLECTION of
J. WOODWARD, M. D.
Containing
A DESCRIPTION and HISTORICAL ACCOUNT of each; with Obſervations and Experiments, made in order to diſcover, as well the Origin and Nature of them, as their Medicinal, Mechanical, and other Uſes.

PART I.
Of the FOSSILS that are real and natural: *Earths*, *Stone*, *Marble*, *Talcs*, *Coralloids*, *Spars*, *Cryſtals*, *Gemms*, *Bitumens*, *Salts*, *Marcaſites*, *Minerals*, and *Metals*.

TOME I.

LONDON:
Printed for F. FAYRAM, at the *Royal Exchange*; J. SENEX, in *Fleet-ſtreet*; and J. OSBORN and T. LONGMAN, in *Paternoſter-Row*. M.DCC.XXIX.

FIG. 1. Title-page of Woodward's published catalogues. For the structure of the catalogues see Appendix 1.

The Collection in Woodward's Lifetime

Woodward began his collecting with the discovery of a specimen in London in 1688:

> I found it in a Gravel-Pit amongst the New Buildings by Dover Street, St. James's, in the Year 1688. And 'twas the first Stone I ever took notice of, or gather'd.[15]

His interest developed and induced him to examine the stone-quarries around the Sherborne (Gloucestershire) estate of Sir Ralph Dutton, son-in-law to Dr Peter Barwick, Woodward's early tutor and patron. There he first noticed fossil shells:

> Jan. 13, 1689/90. The first Fossil Shell I ever found.[16]

He was particularly intrigued by the abundance of weathered-out fossils in the ploughed lands there.

> This was a Speculation new to me; and what I judged of so great moment, that I resolved to pursue it thorough the other remoter parts of the Kingdom; which I afterwards did, made Observations upon all sorts of Fossils, collected such as I thought remarkable, and sent them up to London.[17]

This early field-work must have been completed before the latter part of 1693 when Woodward settled into Gresham College as Professor of Physic. It might be thought that by then, or certainly after the establishment of his own medical practice in 1695, he had done all, or virtually all, the collecting he was to do himself. There is some evidence that this was not the case, but it will be easier to adduce that evidence after considering the other means by which he continued to acquire specimens.

Chief among these means was by donations from his many acquaintances and correspondents. Woodward took every opportunity to cultivate overseas travellers such as diplomats, merchants, and the captains and surgeons of ships, and his range of correspondents at home and abroad was quite astonishing: according to Lhwyd, the Doctor once boasted of having five hundred.[18] Exchange with other collectors further increased the scope if not the absolute size of

his collection. Woodward also seems to have had the means to purchase specimens and to pay other people to collect for him. In the early 1700s he sent Mr T. Lower to the Cornish tin mines,[19] and Messrs Groome and Meulis to the north of England.[20] The latter were dispatched especially to look for fossils on high hills such as Pendle and Ingleborough, where the naturalist Richard Richardson had asserted that none occurred.[21] At about the same time John Hutchinson was assisting the Doctor and was certainly sent on geological expeditions to Cumberland, North Yorkshire, Gloucestershire, Somerset, Wiltshire, Dorset, South Wales, and Cornwall.[22]

By all these means Woodward's collection grew, and by the end of 1705 he was able to show William Nicholson a collection which, according to the latter, included 1,760 English specimens alone.[23] If this figure is reliable then even by 1706 the collection was still very much in its infancy for it was eventually to contain over 6,800 English specimens (Table 1). This seems to represent too much growth to be accounted for by donations or by the collecting of paid agents. Woodward was punctilious in recording such sources for specimens in his collection, but for some 93% of his English specimens there is no such data and the implication must be that he himself continued very actively to collect. Certainly, he records a 'voyage' made to Sheppey Island in 1709,[24] and appears to have been collecting from Hampstead Heath as late as 1716.[25]

His foreign material came exclusively by donation. Here one major later acquisition was the collection of the Sicilian naturalist Agostino Scilla which Woodward purchased in 1717.[26] We also know that as late as 1721 Woodward was soliciting material from John Winthrop and Cotton Mather in North America.[27] Unfortunately, there are very few dates within Woodward's catalogues from which to chart accurately the rate of growth of the collection. One such date, however, does show that the collection includes specimens acquired as late as 1724.[28]

Woodward's catalogues can be seen to have grown piecemeal in just the same way as his collections. When, on the occasion referred to above, William Nicholson saw the Doctor's collection he was shown two associated catalogues. Both of these may well have related to Woodward's English fossils, for he catalogued separately his 'native fossils' (minerals and rocks) and his 'extraneous fossils' (fossils in the modern sense). He divided his foreign fossils in a

Table 1 Present composition of Woodward's collection, in terms of numbers of specimens and numbers of records for each part of Woodward's catalogue (see pp. 93–4)

	Number of explicit catalogue records	Minimum number of specimens	Specimens known to be missing	Unrepresented catalogue records
Catalogue A	1,477	1,650	39 (2.4%)	32 (2.2%)
Catalogue B	2,329	2,965	57 (1.9%)	44 (1.9%)
Catalogue C	705	750	14 (2.0%)	12 (1.5%)
Catalogue D	357	500	10 (2.0%)	7 (2.0%)
Catalogue E	393	400	3 (0.75%)	3 (0.76%)
Catalogue F	104	295	3 (1.0%)	3 (2.9%)
Catalogue G	188	231	6 (2.6%)	5 (2.7%)
Catalogue H	24	36	1 (2.7%)	0
English Totals	5,577	6,827	133 (2.0%)	106 (2.0%)
Catalogue I	765	900	12 (1.3%)	12 (1.6%)
Catalogue K	371	590	14 (2.4%)	4 (1.1%)
Catalogue L	367	440	2 (0.4%)	2 (0.5%)
Catalogue M	284	620	6 (1.0%)	5 (1.8%)
Foreign Totals	1,787	2,550	34 (1.3%)	23 (1.3%)
Whole Collection	7,364	9,377	167 (1.8%)	129 (1.8%)

similar way, but kept these quite separate from his English material, and probably did not begin to catalogue them as early. At some stage, however, there were four separate catalogues relating to the four main parts of the collection: English Native, English Extraneous, Foreign Native, and Foreign Extraneous.

Having begun in this way, Woodward then had to deal with the problem of cataloguing a continually growing collection. Since both the physical arrangement of his collection and the arrangement of his catalogue reflected a complicated scheme of classification (a great advance on those of previous authors) this was not an easy matter. His initial strategy was to leave gaps in his numbering sequence so that future acquisitions could be accommodated at appropriate places in his classification. Where there were no such gaps he created extra numbers by adding prefixes or suffixes to numbers already used. Clearly, this method could only cope with a limited amount of growth before becoming unwieldy, and as his collection continued to expand Woodward found it easier to start again from scratch with each of the four main sections of his collection, and to begin for each a new, separate catalogue. His original collection of 'English Native Fossils' was, therefore, followed by 'Additional English Native Fossils', this by a 'Second Addition of English Native Fossils', and this ultimately by a 'Third Addition of English Native Fossils'. There were, similarly, three additional collections and catalogues of 'English Extraneous Fossils', and one addition each to the original collections of 'Foreign Native' and 'Foreign Extraneous' fossils. As a result, there were ultimately twelve separate sections and twelve separate catalogues to Woodward's entire geological collections. Specimen numbers were thus duplicated several times over. Because of this and because of the complicated pagination of the final published version of the complete catalogue, I have found it expedient to refer to each section of the catalogue separately as Catalogue A, Catalogue B, etc. (see Appendix 1).

The published catalogue is the printed version of the manuscript catalogues still kept with the collection at the Sedgwick Museum, Cambridge. A note in the manuscript version of Catalogue B dated 20 June 1724 states that it was 'copy'd by Mr. Stevenson' and that it had been 'compared with ye Original and corrected throughout by Mr. Taylor and Mr. Chace'. A similar note indicates that Catalogue C was checked and corrected by Taylor and Mr Dukeson on 14 April 1725. Catalogue G was checked and corrected on 29 August 1725, Catalogues D, E, and F on 30 August 1725, and Catalogue A on 11 October 1725, all by Taylor. Since Catalogue K contains a prefatory note dated 10 July 1725, and Catalogue L a preface dated 25 August 1725, it would seem likely that all Woodward's catalogues were ready for the printer by late 1725, and that the collection was not added to beyond that date.

There seem to be no contemporary references giving details of Woodward's cabinets prior to their mention in his will dated 1 October 1727.[29] In that will Woodward stated that his original collection of English fossils (i.e. both English Native and English Extraneous fossils as detailed in his Catalogues A and B) were contained in the two of his cabinets marked A and B. His foreign fossils (Catalogues I, K, L, and M) were said to be in his cabinet marked D, and his additional English fossils (Catalogues C, D, E, F, G, and H) in Cabinet C. At what date the collections were so arranged in the cabinets is not clear. The four cabinets differ in dimensions and details of construction in such a way as to indicate that they were made piecemeal and not at one time as a set. Cabinet A is undoubtedly the prototype with many points of difference from the other three, while Cabinets B, C, and D are sufficiently similar to suggest that they came from the same workshop and were probably commissioned at different times as the collection expanded.

All four cabinets are in the style of secretaire writing cabinets (Figs. 2, 3) with two small drawers at the top, a fall front, and a pair of cupboard doors below with sets of fourteen oak-lined drawers behind the fall, and doors. They are veneered in walnut on a pine carcass; the fall is quarter veneered with herring-bone decoration and cross banding, the cupboard doors are half veneered with similar decoration, and the carcass fitted with wide, cross-grained mouldings. It is clear from threaded holes still present in the bases that the cabinets originally stood on turned feet.

The Collection after Woodward's Death

In his will Woodward bequeathed the two cabinets of his original English fossils to the University of Cambridge where they were 'to be preserved with great care and faithfulness'. The University subsequently purchased the other two cabinets from his executors for £500 before they came to auction. That it was prepared to spend up to £1,000 in doing so (Grace of Senate, 20 February 1729) is an indication of just how highly the collection was then valued. The

FIGS. 2–3. The earliest of Woodward's original cabinets, probably commissioned in the 1690s or very early 1700s.

will also instructed the executors to convert Woodward's estate to money and to purchase land whose income was to pay a lecturer. Apart from lecturing, he was to be responsible for the care of the Woodwardian collections and their catalogues, for showing them during prescribed hours (9.00–11.00 and 2.00–4.00 three days a week, except in long vacation) to 'all curious and intelligent persons as shall desire a view of them for their information and instruction' and 'to be always present when they are shown, and to take care that none be mutilated or lost'. In addition, the University was to appoint annually two inspectors to examine the specimens and check them against Woodward's catalogues. He also made provision for the lecturer to procure additional specimens. Clearly Woodward intended his collection to survive!

From 1734 until 1842 the four cabinets resided in a small room, divided off from what was then the Arts School, in the north-east corner of the Schools Quadrangle (now generally called the East Court of the Old Schools). While they were housed here it was the second of the lecturers—'Woodwardian Professors' as they came to be known—who first appears to have taken his duties seriously in regard to the collection. Charles Mason held the Professorship for twenty-eight years from 1734 to 1762. In a memorandum written in 1756, Mason referred to the complicated arrangement and specimen numbering schemes of Woodward's collection, and to difficulties to which this gave rise in using the collection. He also referred to remarks made by Woodward himself in the prefaces to his later catalogues which show that in the case of the foreign Extraneous Fossils he had wished to 'reduce all into one common method and series and one catalogue'.[30] Woodward would have done the same with the foreign Native Fossils and 'would also dispose all the Native Fossils of England, in my Collections, into another like method'.[31] Mason's memorandum goes on to describe how in 1738 he started to put Woodward's wishes into practice and

began 'to dispose all the Eng. Nat. Foss. into one Series, picking all the samples of a sort from distant places together . . . and after some time completed it and began the same for the Foreign ones'. The Woodwardian Inspectors, however, did not approve, since their work was made more difficult and Mason was for several years prevented from continuing, though he did eventually complete the rearrangement of the foreign Native Fossils and begin on the English Extraneous.

Mason's rearrangement of the collections involved a great deal of specimen renumbering. He thus began a new series of catalogues, the so-called 'consulting catalogues', in which specimens were listed, drawer by drawer, according to their new arrangement and new numbers together with Woodward's original numbers and catalogue entries. It was also during this reorganization of the collection that the construction of a fifth Woodwardian cabinet became necessary in order to give Mason sufficient drawer space for his specimen rearrangements. Cabinet E is similar in general construction to the earlier four but has its fall and doors veneered in plain rather than burred walnut, and its brass drawer-handles have bolted, elongated backplates and D-pulls rather than the drop-pulls and wired circular backplates of Cabinets A–D. It is first mentioned in the Inspectors' report of May 1744, and must have appeared between then and the previous report of April 1743. It was made with bracket feet, and, at the same time, the original bun-shaped feet of the earlier cabinets were replaced, by the same maker, with similar bracket feet. The Inspectors in their 1744 report also refer to Mason's new consulting catalogue for Cabinet E.

The work begun by Mason remained incomplete until 1767 when it was continued under the supervision of the fourth Woodwardian Professor, Samuel Ogden. During 1767 and 1768 the consulting catalogues for Cabinets B, C, and D were drawn up to reflect the completed new arrangement. Ogden also had drawn up, for the whole collection, separate lists correlating the new numbers applied to specimens by Mason and himself with Woodward's original numbers.

There has been very little change to the collection since the Mason-Ogden rearrangement. Thomas Green, the fifth Woodwardian Professor, added 22 specimens to the collection between 1779 and 1785 but these are easily distinguished from Woodward's originals and were catalogued in a small separate volume. It is interesting to note from this catalogue that, by the time of Green's Professorship, it had become customary to refer to individual specimens in the collection not by Woodward's original numbers, nor even the newer Mason-Ogden numbers applied to them, but by their position within a particular drawer of a particular cabinet. The first specimen in drawer 7 of Cabinet B became B-7-1, the tenth specimen B-7-10, and so on.

In 1842 Woodward's collection was moved the short distance from its room in the Old Schools to Adam Sedgwick's new geological museum, still called the 'Woodwardian Museum', and housed in the new Cockerell Building constructed to accommodate both the museum and the University Library. It was while the collection was here during the subsequent professorship of T. McKenny Hughes that five fossils were removed from the Woodwardian cabinets to the main museum collections. When they were found in the main museum, the specimens bore labels in the handwriting of Walter Keeping who had worked in the museum from around 1878 to 1881. All but one have now been located. With the exception of these few specimens the Woodwardian Collection has otherwise been kept strictly separate from all the other Cambridge geological collections since 1842.

In 1904 the cabinets were moved with the rest of the old 'Woodwardian Museum' collections to the present Sedgwick Museum building. They were disposed there between two 'pews' partitioned off from the Palaeozoic end of the displays in the main gallery until 1964. Between then and 1967 the cabinets were cleaned and renovated (the dry atmosphere of the museum having led to extensive cracking and peeling of veneers) and then assembled together in the present Woodwardian 'pew' which was converted into a room sealed off from the rest of the museum and maintained, for the sake of the cabinets, at a cool and rather humid environment, the relative humidity being kept above 50%. (It should be understood that the role of humidity in promoting the decay of pyritic specimens was not at that time fully appreciated.)

Size, Scope, and Present State of the Collection

The following brief description is based on a thorough survey of the Woodwardian Collection which I began in early 1984, and continued intermittently until late 1987. The aim of this survey, carried out in conjunction with a close reading of Woodward's catalogues, was to identify as many of Woodward's original specimens as possible, to check their present numbering and their present position within the Woodwardian cabinets, to gain an idea of their

present state of conservation and generally to gain a better understanding of the scope and organization of the collection.

Although time-consuming, the identification of specimens against Woodward's original catalogues was not difficult. The majority of specimens still bear labels with Woodward's original numbers. Most which do not, have labels with their Mason-Ogden numbers. Many have both, though in some cases the later label obscures the earlier one! Also, the position of specimens within the Woodwardian cabinets has, with a few exceptions, been stable since the Mason-Ogden rearrangement, and specimens can usually be identified from the old 'consulting catalogues' on the basis of their position even when they have lost their labels. Moreover, Woodward's original catalogue descriptions are often sufficiently detailed to be used as a check against identification by any other means.

Size

Because of the frequent use in Woodward's original catalogues of vague terms such as 'several' or 'many', or entries such as 'More from the same locality', it is very difficult to arrive at any accurate figure for the original size of his collection or to deduce accurately how many specimens might now be missing. Where counts are given in the original catalogue or where catalogue records are now completely unrepresented, a number of specimens can be shown to be missing, but that number is clearly a minimal one. Similarly, if the number of specimens thus known to be missing is added to the number of apparently authentic specimens now remaining, a minimum number for the original collection size can be obtained. Such figures are given for each section of the catalogue in Table 1. Here I have counted 'bulk-samples' such as trays

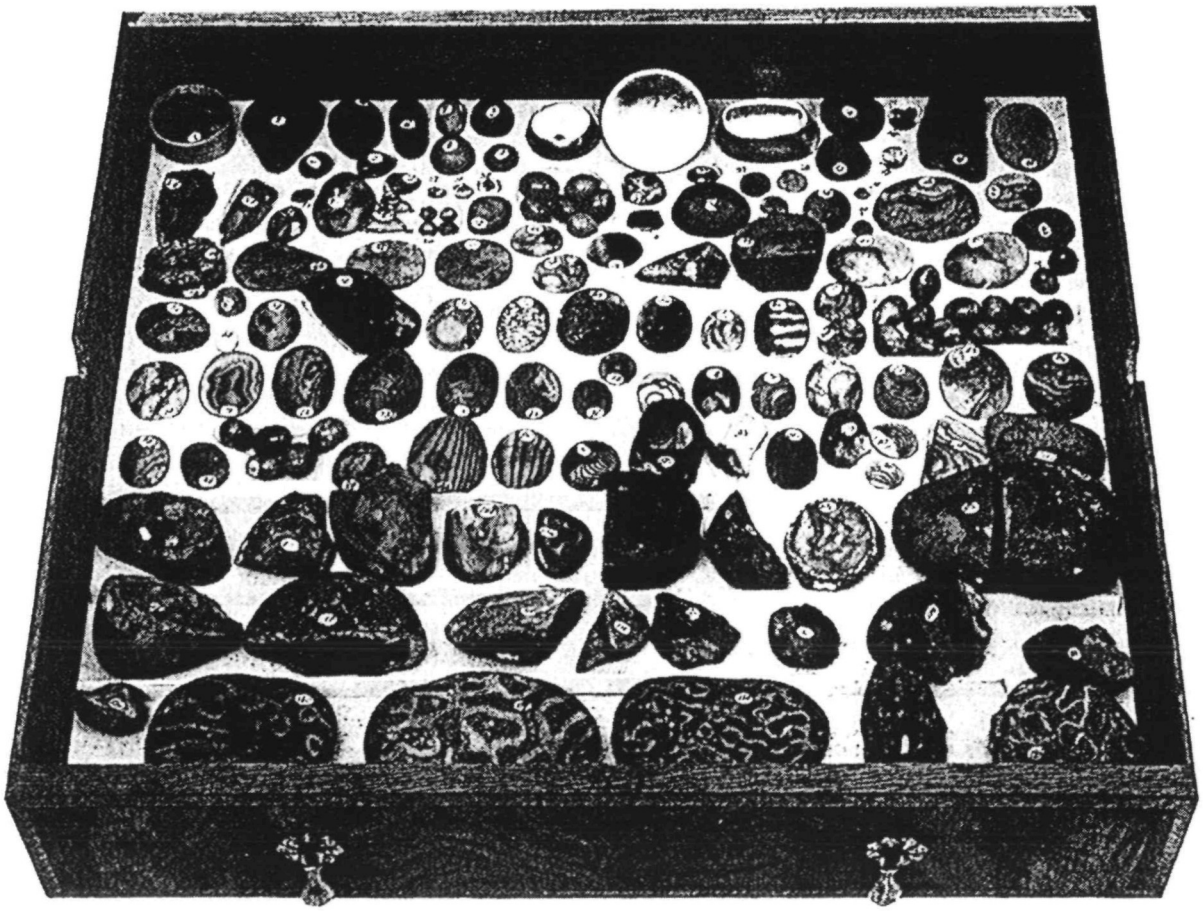

FIG. 4. Drawer 7 from Cabinet A, containing 'pebbles, flints and agates'.

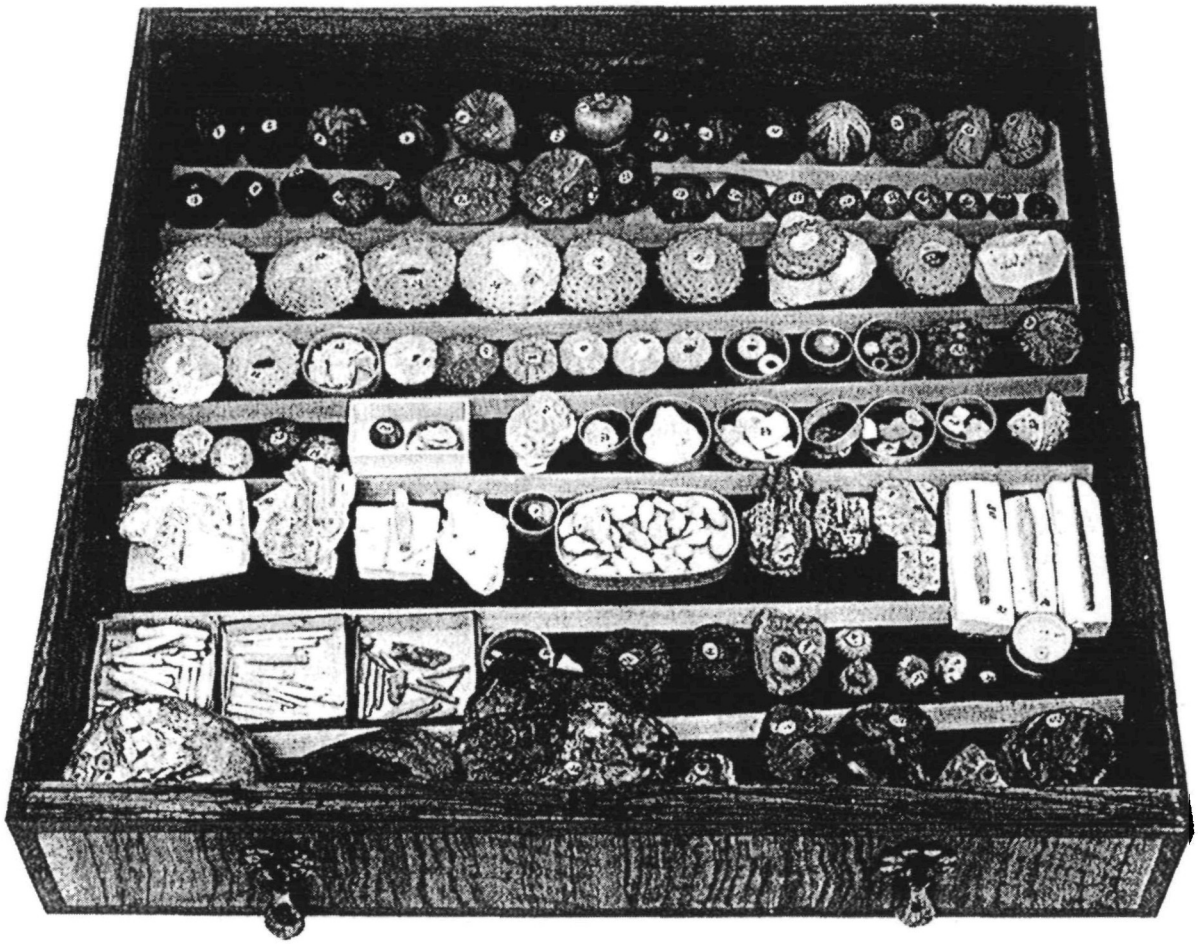

FIG. 5. Drawer 5 from Cabinet D, containing various classes of fossil 'echini' or sea-urchins.

with large numbers of small crinoid columnals or of minute gastropod shells, as single specimens. To count such specimens individually leads to a collection total very close to 10,000 specimens.

In several cases where specimens can be shown to be missing, the absent specimen is only one of a number of identical or closely similar specimens of identical provenance covered by a single catalogue entry. Such losses can not be held to be as serious as those which have resulted in an original entry's complete lack of representation. Thus, a more realistic idea of how intact the original collection now is can probably be given by the proportion of original catalogue entries unrepresented by extant specimens. Such figures for each section of the catalogue are also given in Table 1. It is interesting that the figures for the proportion of unrepresented records are closely comparable with those for the proportion of known missing specimens. In either terms, all sections of the collection appear to be at least 97% to 98% complete. In those figures lies another factor of great importance for the Woodwardian collection—that whereas the geological collections of Woodward's predecessors and those of his contemporaries listed above have been lost or have virtually disappeared, Woodward's remains practically intact.

General Scope

The majority of Woodward's specimens are either minerals (simple minerals, ores, samples of veins, etc.) or invertebrate fossils. Among the latter, all the

major groups of invertebrate macrofossils are represented, with the exception of graptolites and trilobites. The absence of trilobites is perhaps surprising since Woodward must have been familiar with them, after 1699, from Lhwyd's *Lithophylacii*.[32] There are reasonable numbers too of sedimentary specimens, particularly sands, silts and clays, some of their lithified equivalents, and of fossil plants. There are much smaller numbers of igneous and metamorphic rocks and of vertebrate fossils. A good impression of the general nature of these parts of the collection is conveyed by Figs. 4–7.

Woodward included with these geological specimens (that is, 'fossils') a few which were not naturally occurring geological materials but 'preparations' derived from these which were included because they 'give some Light to Natural History'.[33] Among these are a few that could just as well be regarded as pharmaceutical specimens. These are derived from the clays of various places (Lemnos in the Aegean is the classic example) where the local 'earth' was highly prized for its healing properties. At such localities it was extracted, washed, and usually moulded into troches which were impressed with a seal as a mark of authenticity before being exported. Woodward's collection contains eight examples of such 'sealed earths' or Terrae Sigillatae: they are illustrated in Fig. 8.

Other small parts of the collection are even less geological. These include recent botanical and zoological specimens which were in the collection for comparative purposes, because Woodward considered them to demonstrate the taxonomic affinities of some of his fossil specimens, or to give clues to the processes involved in the formation of such fossils. There are also a small number of specimens which

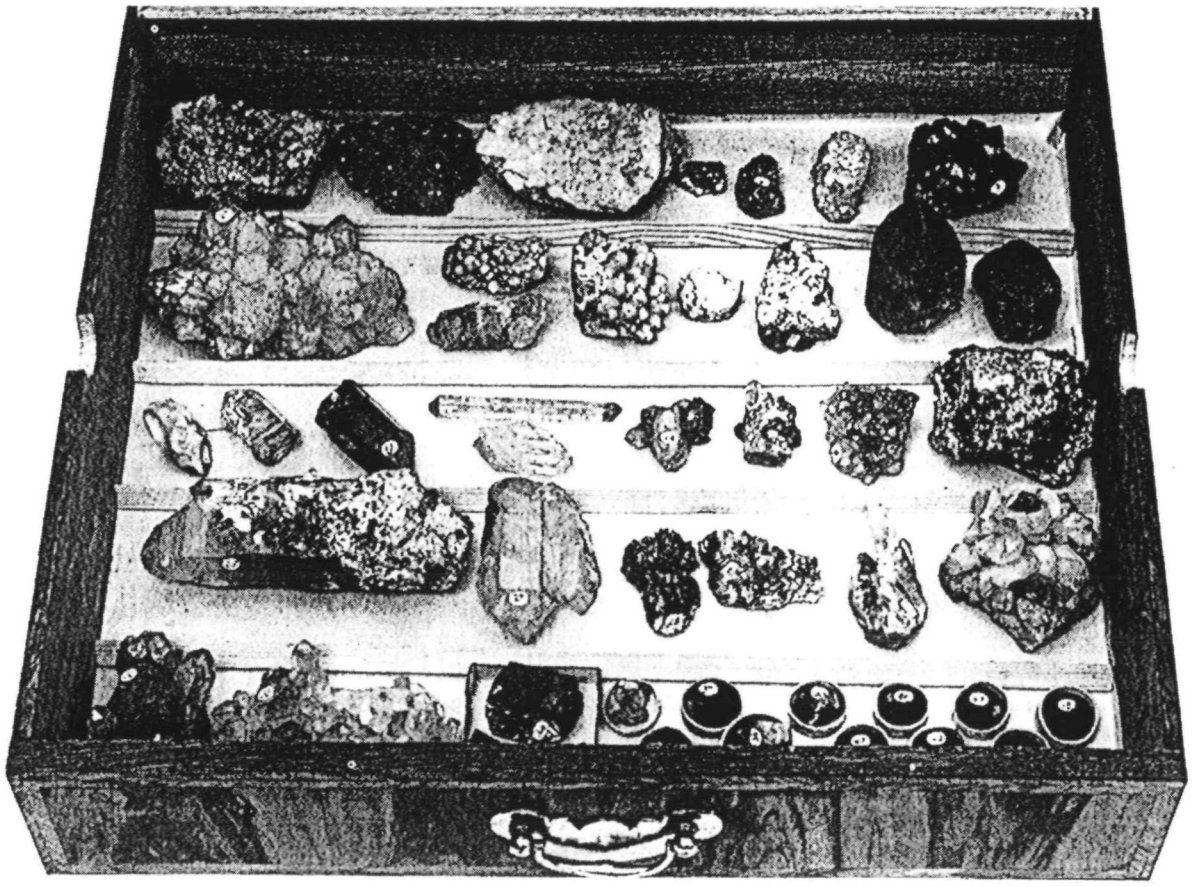

FIG. 6. Drawer 7 from Cabinet E, containing 'crystals, spars and crystalised gems'.

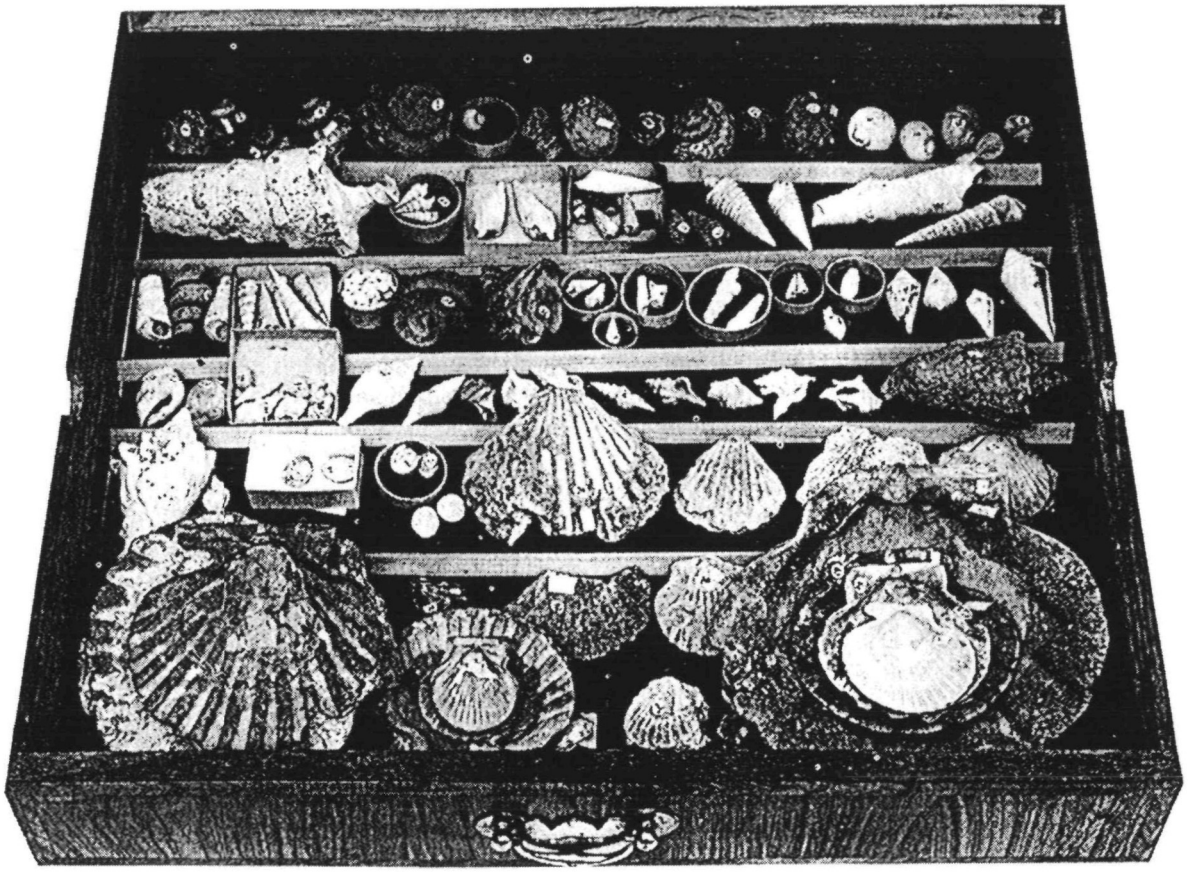

FIG. 7. Drawer 20 of Cabinet E, containing various classes of univalve and bivalve molluscs, recent and fossil.

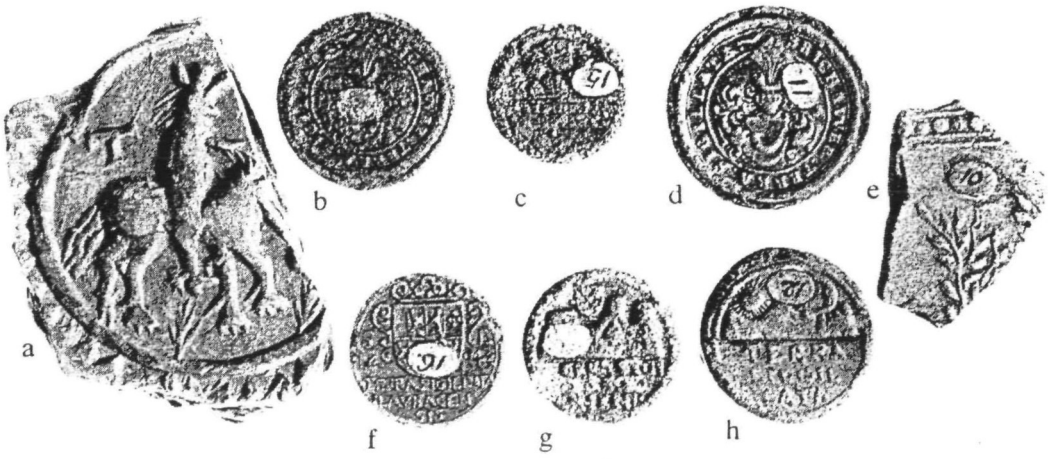

FIG. 8. Terrae sigillatae from Woodward's collection (Catalogue I, p. 49). *A* is Venetian Bole; *B* and *D* are from Seichawer, Hamburg; *C* and *H* are from Laubach in Hessen; *E* is from Crete; *G* is from Striegau in Silesia and *F* is also Silesian.

would, in modern terms, be archaeological, such as flint and stone arrowheads and axes: these are illustrated in Fig. 9. Woodward fully realised that they were human artefacts[34] but thought it important to illustrate their true nature in his collection since many earlier workers had considered them to be natural productions of the earth and described and published them as such under names like 'cerauniae' or 'ombria'.

Also interesting among Woodward's specimens are various more modern artefacts and 'artificialia'. These include lead and wax casts (Figs. 10 and 11) which Woodward had prepared from recent and fossil shells to illustrate modes of preservation, and several precipitates from kettles, boilers, calcareous springs, and even the steam, smoke, and breath-laden atmosphere of a London coffee-house,[35] which he considered might illuminate the formation of corals and other marine 'precipitates'. The later Huttonian 'acutalistic' approach was not entirely unknown to Woodward!

Geographical Scope

Woodward's 'English' collection covers virtually the whole of England and considerable areas of south and mid Wales. There appears to be not a single English county from which he did not collect. He ranged from the Lizard to Newcastle-upon-Tyne, from Whitehaven to the Isle of Wight. Within this broad coverage the strongest representation is within areas around London (which presumably Woodward found easy to visit), the area around Sherborne where he began his fossil collecting, and areas of active mineral exploitation such as the Lake District, Cornwall, the Derbyshire Peak, the Forest of Dean, and

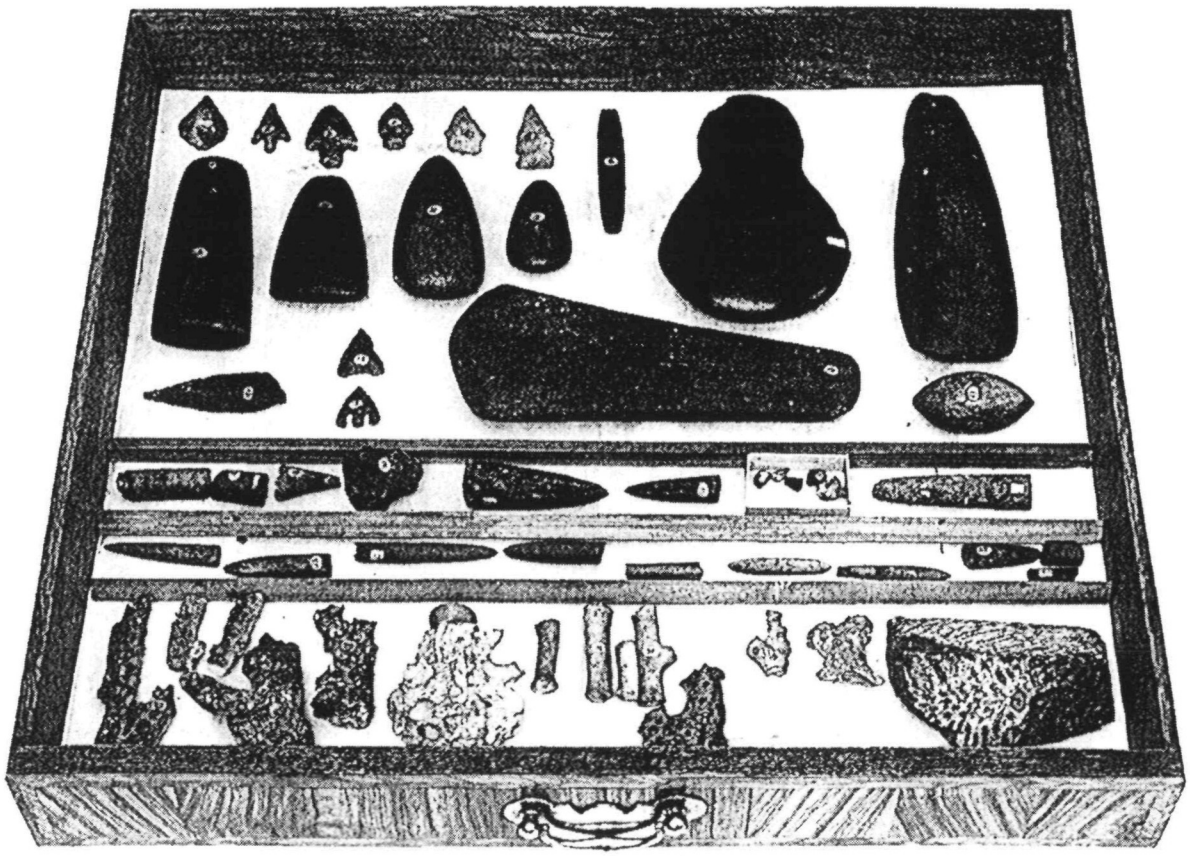

FIG. 9. The 'Arma & Instrumenta lapidea' of Woodward's collection (Catalogue I, p. 51). The drawer (17 of Cabinet E) also contains belemnites and fossil 'coralloides', including three specimens figured by Agostino Scilla in 1670 (*La vana speculazione*, Tav. XX, XXI; see Appendix 2).

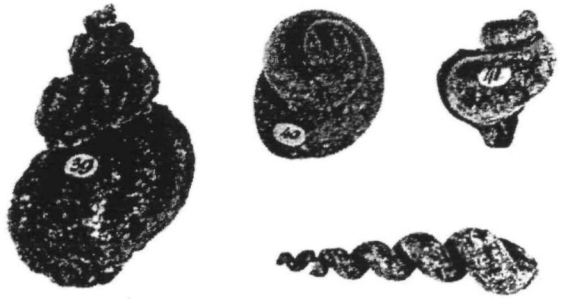

FIG. 10. Lead casts formed by Woodward in recent gastropod shells 'to shew the Manner of the Formation of the Cochlitae, Conchitae, &c. in the Shells at the Deluge' (Catalogue B, p. 115).

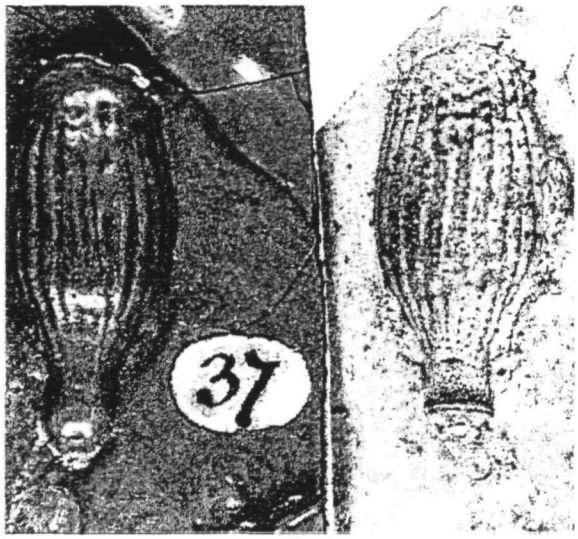

FIG. 11. An impression in red sealing wax (left) taken by Woodward from the flint external mould (right) of the spine (radiole) of the echinoid *Tylocidaris clavigera*.

the Mendips. Welsh material comes mainly from that part of the south coast stretching from Barry through Swansea and Llanelli to Tenby and Caldy Island, and from the old metal mines of Cardiganshire and west Montgomeryshire which were then very active under Sir Humphrey Mackworth's Company of Mine Adventurers.[36]

The geographical range of Woodward's 'foreign' material is one of the most remarkable features of his collection. The bulk of his material came from the mining areas of Germany, Poland, Hungary, and Czechoslovakia. His contact with Scheuchzer ensured that Switzerland was well represented, and specimens purchased from Scilla covered Malta, Sicily, and Calabria. He also had material from France, Spain, Scandinavia, Iceland, and Russia. Crete, Cyprus, Turkey, Persia, and Arabia were represented as were Egypt, the Canary Islands, Guinea, Ascension Island, and the Cape of Good Hope. From the Americas he had material from Barbados and Jamaica, from Newfoundland, Carolina, Virginia, and Maryland, from Guatemala, Brazil, and Peru. From the east he had material from India, Tibet, Burma, China, Japan, Borneo, and even from Guam.

Woodward's Donors

Woodward's catalogues give the names of 151 people from whom, at various times, he obtained specimens. Some of these were celebrated contemporaries whose names are, in many cases, better known today than Woodward's own. They include Sir Thomas Browne, William Byrd of Virginia, William Cole, Captain Dampier ('bucaneer, pirate, and circumnavigator'), John Flamsteed, Sir Edmund Halley, Edward Lhwyd, Martin Lister, John Locke, John Morton, Sir Isaac Newton, William Nicholson (Bishop of Carlisle), Johann Jacob Scheuchzer, Agostino Scilla, and Sir Christopher Wren. Many other lesser-known figures were also among his benefactors.

In terms of specimen numbers, Woodward's most important donors were, for English material, William Nicholson (76 specimens), John Morton (66 specimens), Mr Jackson (43 specimens), and Mr Clarke (24 specimens), and for foreign specimens: Scheuchzer (278 specimens), Scilla (210 specimens), the Baron de Schonberg of Saxony (183 specimens), Valkenier (128 specimens), Mich. Rheinoldus Rosinus (125 specimens), Louis Bourguet of Zurich (121 specimens), Edward Bulkley (96 specimens), Dr A. D. Leopold of Lubeck (91 specimens), and William Vernon (58 specimens).

Early Figured Specimens

It has no doubt been unfortunate for Woodward's reputation that, unlike Lhwyd, he did not illustrate the specimens in his geological collection. He did, in fact, illustrate a few of the artefacts—a quartz sphere, two quartz lenses, some arrow-heads and stone axes—in his *Fossils of all kinds* of 1728. In the same work he also figured three belemnites, but they are rather diagrammatic and not recognizable as particular specimens.[37] Woodward did, however, lend some

of his specimens to Martin Lister, who figured them in his *Historia Conchyliorum* (1685–92), and he received into his collection specimens which had previously been figured by John Morton in his *Natural History of Northamptonshire* (1712) and by Agostino Scilla.

Among the collection purchased by Woodward from Scilla in 1717 are many of the specimens figured in the latter's *La vana speculazione* (1670). It is not always easy to recognize these specimens. In the first place many have obviously been broken or abraded since they were drawn, and secondly Scilla's drawings, although superb aesthetically, are not always accurate in terms of proportion or even of detail. These difficulties were noted by Woodward,[38] who, interestingly, added an explanation of his own for them:

> This he sent me for the Mass exhibited Tab.XIX. Fig.2. But if so, he took a little too much liberty in his Icon, there being several things in the Figure which are not in the Body. But indeed their Ill Usage and Exasperations of him, and his Zeal for maintaining his Argument, disposed him to take that Liberty in several other Particulars.[39]

Such difficulties not withstanding, the originals of many of Scilla's figures can be recognized in Woodward's collection. Two of them are shown in Fig. 13, together with a reproduction of Scilla's original illustrations in Fig. 12 for comparison. A full list of such specimens, together with those figured by Lister and Morton is given in Appendix 2.

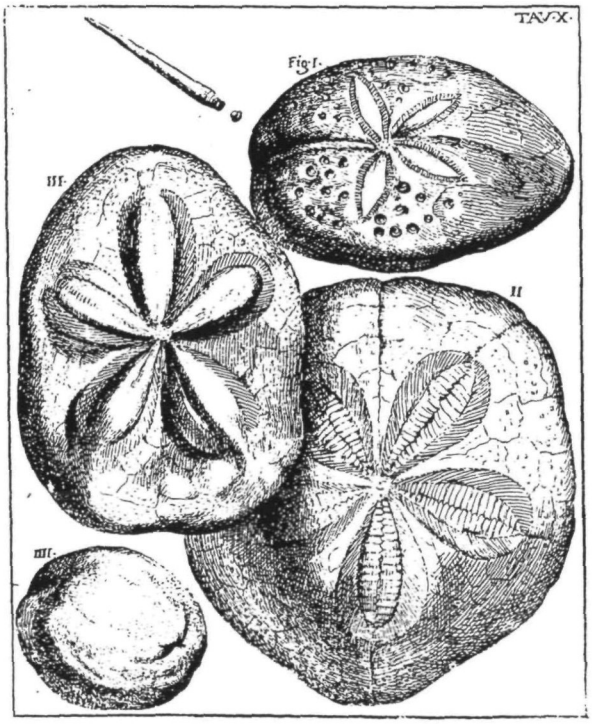

FIG. 12. Reproduction of Tav. X from Agostono Scilla's *La vana speculazione*.

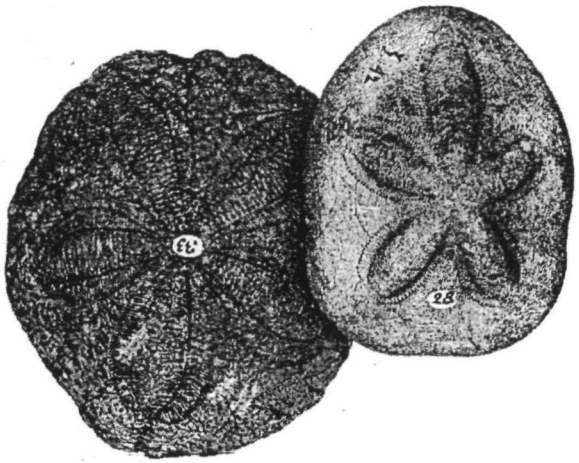

FIG. 13. Two of the fossil echinoids figured in Scilla's Tav. X. (Scilla's figures are mirror-images of the original specimens).

Historical and Scientific Value of the Woodwardian Collection

As noted in the introduction above, Woodward's catalogues are an unrivalled source of information on the late seventeenth- and early eighteenth-century distribution of quarries, pits, wells, and spas, and on the industrial, commercial, agricultural, and medicinal use of their products. Through Woodward's classification of his specimens, his notes on their significance, and his occasional inclusion of relevant field-observations, the catalogues also give a deep insight into the true state of knowledge, and the practical approaches to its acquisition, which constituted the 'earth-science' of the period. Of the greatest importance, however, is the survival of the collection itself along with the catalogues. Woodward's specimens are almost all available to be analysed and identified in modern terms. Where their sources are no longer accessible they can thus give information available in no other way to the topographic mineralogist or even to the bio-stratigrapher interested in the dating and correlation of rocks no longer exposed.[40]

Because of the author's firm belief in the great historical and scientific value of the collection he has

already prepared for it a complete donor index as well as an index of Woodward's British localities. It is intended to index also the 'Foreign' localities and possibly to prepare these indexes (currently card-indexes) for publication.

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Notes and references

1. See V. A. Eyles, 'John Woodward, F.R.S. (1665–1728) physician and geologist', *Nature* 206 (1965), pp. 868–70; idem, 'John Woodward, F.R.S., F.R.C.P., M.D. (1665–1728), a biobibliographical account of his life and work', *Journal of the Society for the Bibliography of Natural History* 5 (1972), pp. 399–427; R. S. Porter, 'John Woodward: "A Droll Sort of Philosopher"', *Geological Magazine* 116 (1979), pp. 335–417; and, particularly, J. M. Levine, *Dr. Woodward's Shield. History, Science and Satire in Augustan England* (Berkeley, Los Angeles, and London, 1977).
2. J. Woodward, *An Essay towards a Natural History of The Earth and Terrestrial Bodies, Especially Minerals*... (London, 1695).
3. An early version of Woodward's rock and mineral classification apeared in the first edition of John Harris's *Lexicon Technicum: or an universal English dictionary of arts and sciences* (London, 1704). Woodward reproduced the system, little changed, in Latin, in his *Naturalis historia telluris illustrata & aucta* (London, 1714) and, more elaborately, in his *Fossils of all kinds digested into a method*... (London, 1728). His most elaborate version, however, much modified from these earlier attempts, is that used in the first part of his catalogue—Catalogue A of Appendix 1.
4. Catalogue B.
5. D. Sturdy and M. Henig, *The Gentle Traveller. John Bargrave, Canon of Canterbury, and His Collection* (n.p., [1983]).
6. Levine, op. cit. (note 1), p. 128.
7. Catalogue A, p. 242. See too Woodward's similar first directive to collectors in his *Brief instructions for making observations in all parts of the world*... (London, 1969), p. 10.
8. Woodward, op. cit. (note 2), p. 3.
9. Woodward, op. cit. (note 2), p. 3.
10. Catalogue A, pp. xiii–xiv.
11. Woodward, op. cit. (note 2), p. 24.
12. Catalogue I, p. 47.
13. F. J. North, 'From Giraldus Cambrensis to the geological map', *Transactions of the Cardiff Naturalists Society* 64 (1933), p. 62.
14. e.g. Catalogue A, pp. 195–6, Catalogue C, p. 29, Catalogue E, p. 85.
15. Catalogue A, p. 45.
16. Catalogue B, p. 46.
17. Woodward, op. cit. (note 2), p. 1.
18. Levine, op. cit. (note 1), p. 81.
19. Catalogue A, pp. 201–5.
20. Catalogue B, pp. 99–101.
21. In a letter to Edward Lhwyd subsequently published in the latter's *Lithophylacii Britanici Ichnographia*... (London, 1699), pp. 106–11.
22. Catalogue B, p. 25, Catalogue D, p. 47, Catalogue E, p. 81. See also Hutchinson's *Observations made by J.H. mostly in the year 1705*, re-printed in Hutchinson's *Philosophical and Theological Works* (London, 1748–9), XII, pp. 259–359.
23. C. Jones and G. Holmes (eds.), *The London Diaries of William Nicholson, Bishop of Carlisle 1702–1718* (Oxford, 1985), p. 344, 31 December 1705.
24. Catalogue E, p. 71.
25. Catalogue G, p. 100.
26. See M. E. Jahn, 'A bibliographic history of John Woodward's *An essay towards a natural history of the earth*', *Journal of the Society for the Bibliography of Natural History* 6 (1972), pp. 181–213.
27. Levine, op. cit. (note 1), pp. 101–2.
28. Catalogue L, p. 14. See also Catalogue B appendices, p. 98.
29. Most accessible as *Part of the late Dr. Woodward's will, dated Oct. 1st, 1727* (Cambridge, 1778).
30. Catalogue K, p. ii.
31. Catalogue L, p. iv.
32. Lhwyd, op. cit. (note 21).
33. Catalogue I, p. 49.
34. Catalogue I, p. 51. Woodward, op. cit. (note 3 [1728]), Letter III, pp. 24–45.
35. Catalogue E, pp. 89–90.
36. D. E. Blick, *The old metal mines of mid-Wales* (Newent, 1978), Part 3, pp. 62–8.
37. Woodward, op. cit. (note 3 [1728]), Fig. 7, opposite p. 58.
38. Catalogue K, p. 17, bottom.
39. Op. cit., p. 31.
40. See J. C. W. Cope, 'A correlation of Jurassic rocks in the British Isles. Part 1', *Geological Society of London Special Report* No. 14 (1980), p. 36 and Fig. 5A for an example of the use of localized fossil ammonites in Woodward's collection to date and correlate rocks no longer exposed in the Vale of Ilchester.

Appendix 1: The Structure of Woodward's Published Catalogues

WOODWARD, John

[Catalogue A] *An attempt towards a natural history of the fossils of England; in a catalogue of the English fossils in the collection of J. Woodward, M.D. containing a description and historical account of each; with observations and experiments, made in order to discover, as well the origin and nature of them, as their medicinal, mechanical, and other uses.*

Part I: Of the fossils that are real and natural: earth, stone, marble, talcs, coralloids, spars, crystals, gemms, bitumens, salts, marcasites, minerals, and metals. Tome I.

London, printed for F. Fayram [*et al.*], 1729.

8°

xvi, 243, [1] pp.

TITLE 2

[Catalogue B] *A catalogue of the English fossils in the collection of John Woodward M.D.*
Part II: exhibiting the fossils that are extraneous; the parts of vegetables, and of animals, digg'd up out of the bowels of the earth; in particular the shells of sea-fishes: as also the stoney, mineral, and metallick bodies form'd in them. Ranged and disposed in a classical method, according to their several kinds and alliances; with an historical account of each: as likewise various observations, and reflections.
[n.p., n.p., n.d.]
8°
viii, 115, [1] pp.

TITLE 3

[Catalogue C] *A catalogue of the additional English native fossils in the collection of John Woodward M.D.* Tome II.
[London], [n.p.], 1728.
8°
iv, 110, [2]

Contains within:

[Catalogue D] A catalogue of the additional extraneous English fossils; viz. shells, teeth, bones, and other parts of animals, chiefly marine. As also vegetables digged up in England [39–61].
[Catalogue E] A catalogue of the second addition of English native fossils [62–91].
[Catalogue F] A catalogue of the second addition of English extraneous fossils; viz. parts of vegetables, and of animals, digg'd up out of the earth [92–7].
[Catalogue G] A catalogue of the third addition of English native fossils [98–108].
[Catalogue H] A third addition of English extraneous fossils [108–10].

TITLE 4

[Catalogue I] *A catalogue of the foreign fossils in the collection of J. Woodward brought as well from several parts of Asia, Africa, and America; as from Sweden, Germany, Hungary, and the parts of Europe. With a characteristick description, and historical account of each; as also various experiments, observations, and reflections, in order to the setting forth the natural history, and the medicinal, mechanical, and other uses of them.*
Part I: exhibiting the fossils that are real and natural, earths, stones, marbles, talcs, coralloids, spars, crystals, gems, bitumens, salts, marcasites, minerals, and metals.
[n.p., n.p., n.d.]
8°
iv, 52 pp.

TITLE 5

[Catalogue K] *A catalogue of the foreign fossils in the collection of J. Woodward brought as well from several parts of Asia, Africa, and America; as from Sweden, Germany, Hungary, and other parts of Europe.*
Part II: exhibiting the fossils that are extraneous; the parts of vegetables, and of animals digged up out of the bowels of the earth; in particular the shells of sea-fishes; as also the stoney, mineral, and metallick bodies form'd in them . . .
[n.p., n.p., n.d.]
8°
iv, 33, [1] pp.

TITLE 6

[Catalogue L] *An addition to the catalogue of the foreign native fossils in the collection of J. Woodward.*
[n.p., n.p., n.d.]
8°
vi, 21, [1] pp.

TITLE 7

[Catalogue M] *An addition to the catalogue of the foreign extraneous fossils in the collection of J. Woodward.*
[n.p., n.p., n.d.]
[2], 15, [1] pp.

Appendix 2: Early Figured Specimens in Woodward's Collection

1. From Agostino Scilla, *La vana speculazione disingannata dal senso* . . . (Naples, 1670)

   Originals of: TAV. I, figs. 1–8. TAV. II, figs. I–III; fig. IIII, left ramus only; probably fig. V, in part. TAV. III, fig. I. TAV. III, fig. III. TAV. V, fig. II. TAV. VI, figs. I and III; probably fig. IIII. TAV. VII, fig. I (holotype of *Spatangus scillae* Des Moulins); possibly figs. II and III. TAV. VIII, fig. I. TAV. IX, figs. I and II. TAV. X, figs. II and III (see Fig. 12). TAV. XI, N. II, lower figure. TAV. XII, fig. I (holotype of *Phocodon scillae* Agassiz). TAV. XIII, fig. I. TAV. XIIII, fig. 8; possibly figs. 1–5. TAV. XV, fig. I. TAV. XVII, figs. AA and B. TAV. XVIII, figs. II and IIII. TAV. XIX, figs. I and II. TAV. XX, fig. II. TAV. XXI, figs. I and II. TAV. XXIII, figs. II and III. TAV. XXIIII, figs. I and II. TAV. XXV, fig. I. TAV. XXVI, centre and two lower figures.

2. From Martin Lister, *Historiae sive Synopsis methodicae Conchyliorum* . . . (London, 1685–92).

   Of the specimens attributed by figure captions to Woodward, only the following can now be recognized:

   Appendix to Lib. III (1688): Tab. 450, fig. 8. Tab. 464, fig. 25. Tab. 465, fig. 25b. Tab. 480, fig. 37.

   Appendix to Lib. IV (1692): Tab. 1049, fig. 24. Tab. 1050, fig. 25.

3. From John Morton, *The Natural History of Northamptonshire* (London, 1712).

   Originals of: Tab. 3, fig. 12; p. 197. Tab. 9, fig. 3; p. 225. Tab. 9, fig. 10; p. 227. Tab. 10, fig. 19; p. 239.