

A PRIVVIE IN PERFECTION Sir John Harrington's Water Closet

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Though it is used throughout the world the humble water closet, one of Britain's great contributions to modern civilisation, is today taken completely for granted. The familiar 'w.c.' was perfected here a century ago and has essentially been improved very little since then. It was not a single invention, but the sum of a whole series of developments aimed initially at making sanitary arrangements more tolerable, and latterly more healthy. Water had been a feature of the better sanitary installations before classical times. Once Roman power had dwindled sanitary engineering was not developed until the middle ages. With their belief in cleanliness, monks became particularly ingenious in their exploitation of natural supplies of water to serve their 'reredorters'. These were generally built over streams so that the waste would be carried away and the use of cisterns to collect rainwater with which occasionally to flush out these elaborate latrines was not unknown. In towns too 'places of ease' were built over running water whenever possible for the same reasons. In London the River Fleet became so offensive as a result that it had to be closed over and became one of the capital's first modern sewers. Most sanitary arrangements however, even in the finest houses and palaces, were appallingly primitive.

One exception, hundreds of years ahead of its time, was built at Kelston near Bath by Sir John Harrington between 1594 and 1596. The modern water closet uses water for three purposes: to clean the bowl, to carry away its contents and to provide a seal to keep the stench of the pipes beyond at bay. The deluge of the flush serves the first two functions and an S bend trap permits the third. Sir John Harrington's device can be described as the very first modern water closet for it uses water (albeit in a different



1 A Privvie in Perfection

Sir John Harrington's closet in use! This woodcut illustrates a poem relating a dispute between 'a Godly father' and the devil about the fitness of the place for holy contemplations.

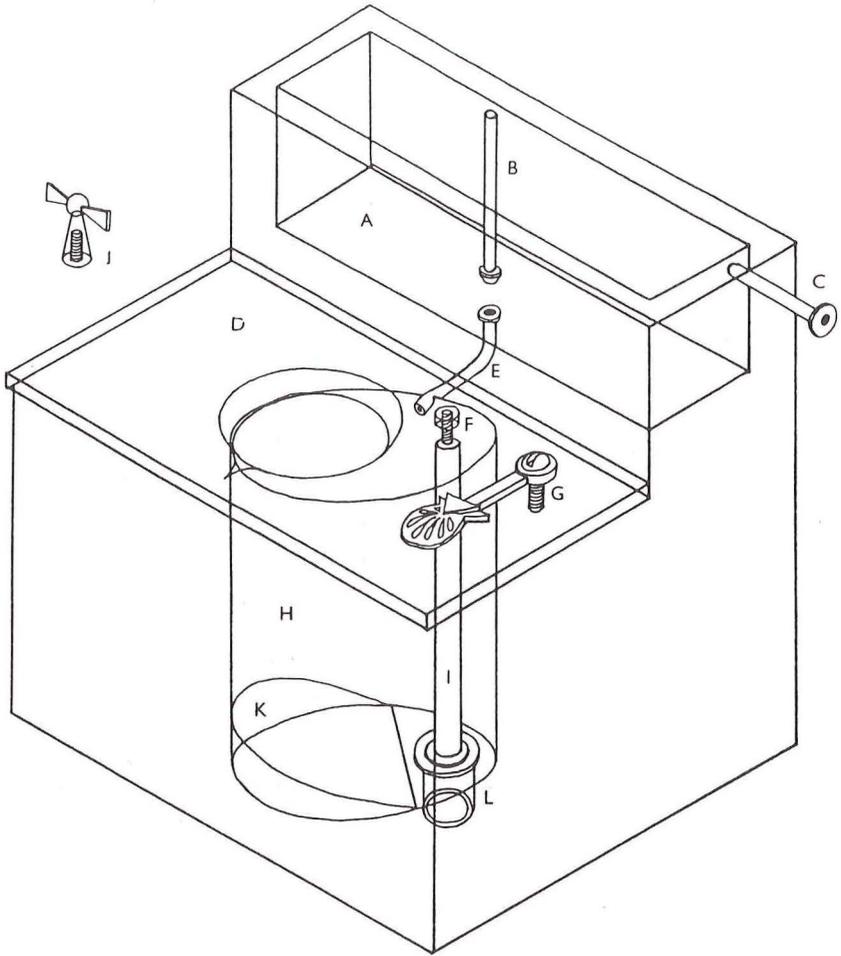
way) to the same three essential ends. Fortunately Harrington was persuaded to publish full details of his invention 'for publike benefite' and although the idea was apparently not taken up, this did enable a working reconstruction to be built recently.

Harrington's father, also named John, was a well educated and cultivated gentleman, a poet and translator and an accomplished musician – a student of Tallis. He married Isabella Markham

whose father had been Lieutenant of the Tower of London. Isabella became a maid of honour to the Princess Elizabeth at Hatfield; Harrington was also loyal to the Princess and he and Isabella were independently sent to the Tower as a result of their service. Elizabeth approved the marriage of the couple and became Godmother to their son John who was born in 1560.

The boy studied at Eton and then at King's College, Cambridge, where he received his degree in 1577/8 and remained until 1581. In that year he began a career in the legal profession at Lincoln's Inn, but this was short lived for in 1582 his father died and Harrington returned to the family estate at Kelston. A fine manorhouse was nearing completion, and its gardens contained walks, ponds and a 'fountain standing on pillars under which one may dyne and suppe'. In 1583 Harrington married Mary, the daughter of Sir George Rogers, and spent the rest of his life either at court unsuccessfully seeking an appointment, or at Kelston attending to his duties, his books and his growing family. Though a great scholar and something of a wit Harrington directed his work towards a close circle at court rather than publication, but some of his pieces did appear in print. The first of these was a translation of *Orlando Furioso* published in 1591 and the second is the subject of this paper. From 1594 or slightly earlier Harrington designed and built his water closet, and in 1596 published a full description of it. Three years later he was hurriedly appointed a captain of horse and sent on the ill-fated expedition to Ireland. In recognition of his service there he was knighted on 30 July by Essex – at this date a commander in the field could still confer knighthoods.

Harrington's life and career had long been closely attached to the court of Elizabeth, and though latterly a supporter of the Scottish claim to the throne, he quickly became disillusioned on the accession of King James. In 1603 he confided in his brother that he wished to 'go to Bathe and drinke sacke, and wash awaie remembrances of paste times in the streams of Lethe'. He had already been in trouble under Elizabeth because of some of his writings but now his difficulties began to multiply. Rashly he had stood as security for another's borrowing; in 1603 the borrower defaulted and Harrington had to find the large sum involved. Unable to do so he was imprisoned for debt, but after escaping he was able to arrange payment. Somewhat impoverished Har-

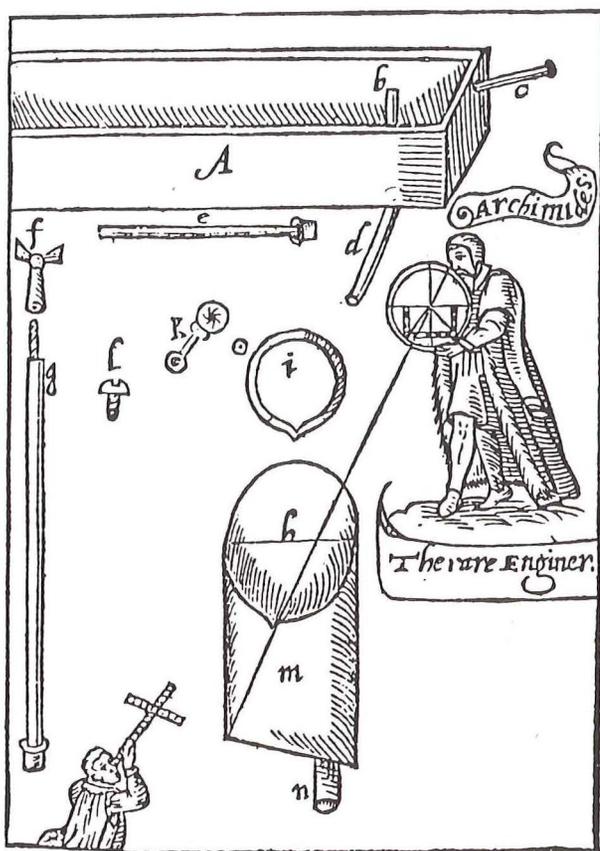


2 An isometric projection of the reconstructed closet. The prices are those quoted by Coombe.

A	Cistern	6s 8d		G	Scallop and its screw	
B	Little stopple and stem	} 4s 6d		H	Stool Pot	8/-
C	Waste pipe			I	Great stopple and stem	} 1s 6d
D	Seat		J	Key		
E	Pipe from cistern		K	Sloped bottom of pot		
F	Hole for great stem		L	Great sluice		

rington desperately began to seek an appointment from the court. He tried for the post of Colonel of the County of Somerset and even applied to become Chancellor of Ireland and Archbishop of Dublin, but all to no avail. Harrington's last years were devoted to his writing and his family. He died in 1612 survived by his wife and seven of their eleven children.

According to Harrington's own account, the water closet was invented as a result of a stay with Sir Mathew Arundell at his splendid house, Wardour Castle. Amongst the select group of guests were the Earl of Southampton and Sir Henry Danvers,

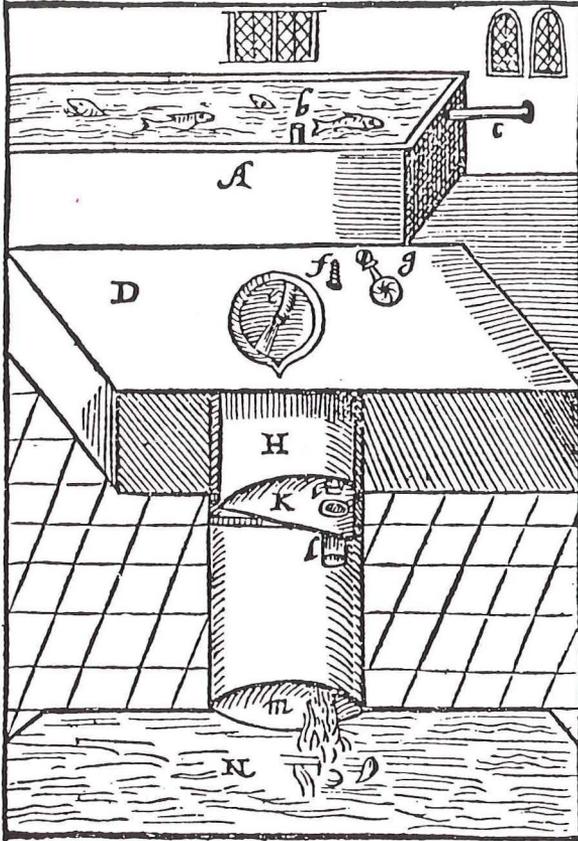


3 Components for the closet shown 'all in sunder' and to a scale of 'halfe an inch to a foote'.

whose presence places the date before October 1594 when he fled the country after committing a murder as a result of a feud. During his stay conversation seems to have turned to domestic sanitary arrangements and how they might be improved. The basic principle of the closet seems to have been discussed and developed at this time, but it was Harrington who put the idea to practical use at Kelston.

The result was evidently so successful that Harrington was persuaded to publish a full description of it. He produced a work in three parts known collectively by the title of the first as *A New Discourse of a Stale Subject Called the Metamorphosis of Ajax* – a pun on the common name for a privy, a 'Jakes'. This first part is in essence a literary work of a type described by Elizabeth Story Donno as 'intellectual gymnastics', an encomium on a trivial or unworthy subject. It opens with a letter from 'Philaretus' (evidently Harrington's cousin) urging the author to make his invention known to the world. By so doing he 'may not only please many great persons, but do her Majestie good service in her pallace of Greenwich' and become 'a great benefactor to the City of London, and all other populous townes'. The text continues as a reply to this letter written under the name 'Misacmos' (hater of filth). Harrington begins by joking that if his contraption did indeed prove to be so popular he might be rewarded by being created 'one of the Privie Chamber'! Although this first part of the text does prepare the way for a description of the closet its true purpose is to serve as a vehicle for a satire of contemporary persons and practices. Introducing her study of the subject Elizabeth Story Donno described it as 'a tissue of learned and topical references' touching upon 'courtly scandals, literary extravagances, current social ills, religious intolerance and controversies'. Though he did not put his name to the work Harrington's authorship is not disputed, and it is illustrated with his rebus, a hare with a ring in its mouth upon a barrel or tun.

The second part of the work is the one which concerns us particularly for it is *An Anatomie of the Metamorphosed Ajax published for the common benefite of builders, housekeepers and houseowners*. It is quite a short piece illustrated with the woodcuts reproduced here. Harrington did not write this section himself, but left it to his assistant Thomas Coombe, who signed himself 'Traveller, Apprentice in Poetrie, Practiser in Musike, professor of



- 4 A sectioned view of Harrington's closet. The fish in the cistern serve to identify its contents as water.

painting, the mother, daughter and handmayed of all Muses, artes and sciences'. The *Anatomie*, as its title suggests, describes the closet in considerable detail, and uses direct and (by contemporary standards) plain language. It describes the various parts of the closet, their dimensions and construction; one of the woodcuts shows the components separately and to scale whilst another shows them assembled. Clearly it was intended to give all the practical information necessary for the reader to construct a similar closet

The third section of the work was written by Harrington and is

called simply *An Apologie*. In it the author puts forward arguments against the work (and its lowly subject) and tries to counter them.

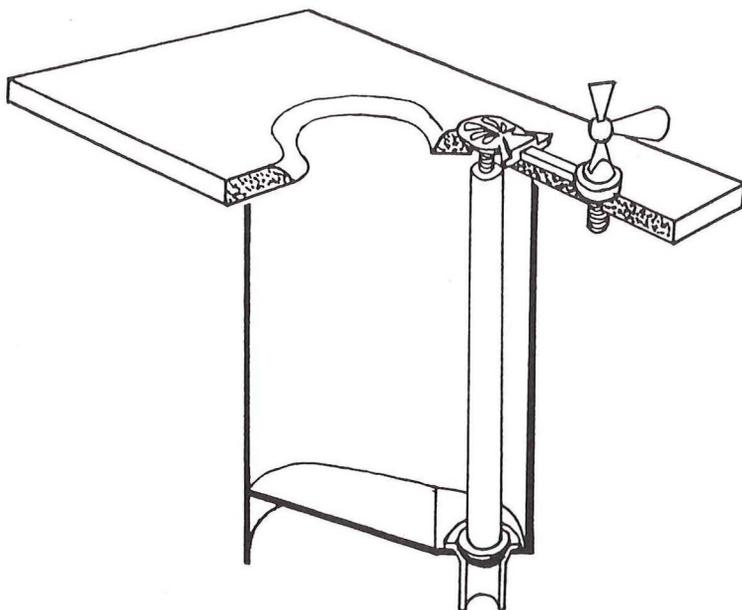
The original manuscript Harrington sent to the printers has survived in an incomplete form and was amongst the Harrington papers purchased by the British Museum in 1947. The work was first published in its complete form in 1596 and there were soon several further editions including only two of the sections – the choice varies. Because of its unusual subject matter it has never really been forgotten. A modernised edition of 100 copies was published in 1814 and another version appeared in an edition of 450 in 1927 but it is only in recent years that the work has been taken seriously. By far the best source is the study by Elizabeth Story Donno under Harrington's original title (Routledge and Kegan Paul, London, 1962). This contains a complete version of the original text with an inordinate number of footnotes highlighting the differences between the various early editions and an introduction containing a long and scholarly appraisal of Harrington, discussing his life, his work and the *Discourse* in particular. This modern version has made Harrington's text available and intelligible to the modern reader.

Harrington's closet was a very simple device consisting of a brick, stone or lead receptacle which could be placed over an existing privy shaft. Like a close stool this receptacle was described as a 'stoole pot'. It was two feet deep and oval in plan, measuring sixteen by twelve inches. Its bottom was raised three inches at one end to provide a slope down to the outlet placed at the other. The stool pot had 'sides all smooth', dressed with pitch resin and wax to 'keep it from taynting with the urine'. A 'great brasse sluice' was soldered or cemented into place to form an outlet 2½ inches in diameter opening directly into the privy shaft below. This sluice or 'washer' was sealed with a 'stopple', or plug, probably of leather. An iron stem as 'bigge as a curten rod' was attached to the stopple so that it could be operated from above the wooden seat which it penetrated. To accommodate the user the seating plank had a circular hole with a chamfered rim and a V-shaped notch at the front 'for elbow roome'. This was likened in shape by Coombe to a 'peke devant', the short beard then in fashion.

Water from the closet was stored in a cistern 'containing a

barrell or upward', placed either behind the seat or at some convenient spot elsewhere in the room or above it. A lead pipe one inch in diameter brought water to the stool pot, and entered the closet from behind immediately beneath the seat so it would remain hidden. A 'cocke' or tap could be fitted to the pipe to 'yeeld water with some pretie strength, when you would let it in'. Coombe's illustrations show a simpler system for an open cistern placed behind the closet; in this the flow was controlled from within the cistern by a stopple plug attached to a little stem handle. The text speaks of water running to the cistern which is probably a reference to rain water channelled from a nearby roof. If this were not possible Harrington pointed out that with a 'force' costing 20/- and pipe at 18d per yard, water could be pumped from the lowest to the highest part of any house. Whatever system was adopted his design prudently included an overflow pipe for the cistern.

The stool pot was fitted just below the seat with the raised end of its base directly below the hole. It was angled so that the stopple stem would penetrate the seat behind the hole three or four inches to the right of its central axis. A T-shaped key was screwed onto the end of the stopple stem through a small hole cut for it in the seat to provide a handle with which to lift the stem and empty the closet. The top of the stem was accordingly given a strong thread and the hollow shank of the key was cut with a corresponding 'worme'. The removable key was used to stop unauthorised emptying of the closet in order to conserve the limited water supply. Harrington provided a further device to prevent children and 'busie folk' disordering the closet. Presumably he feared that even without the handle they might contrive to lift the stopple stem and empty the stool pot; since they would not then replace the water the whole point of the contraption would be lost. He therefore added a clamp which could be fixed over the stopple stem to prevent its being raised. The clamp comprised a 'little button', or 'scallop shell' attached by a short bar to a ring, through which it was secured to the seat by a large 'vice pinne' or screw. When free the clamp could revolve around the screw, which was placed to the right of the stopple stem. By placing the 'scallop shell' over the stem (which projected through the seat 'not above a strawsbreadth') and tightening the screw the closet was securely clamped. Easing the screw released



6 The key is used to release the clamp screw.

the clamp which could then be swung clear of the stem enabling the key to be attached.

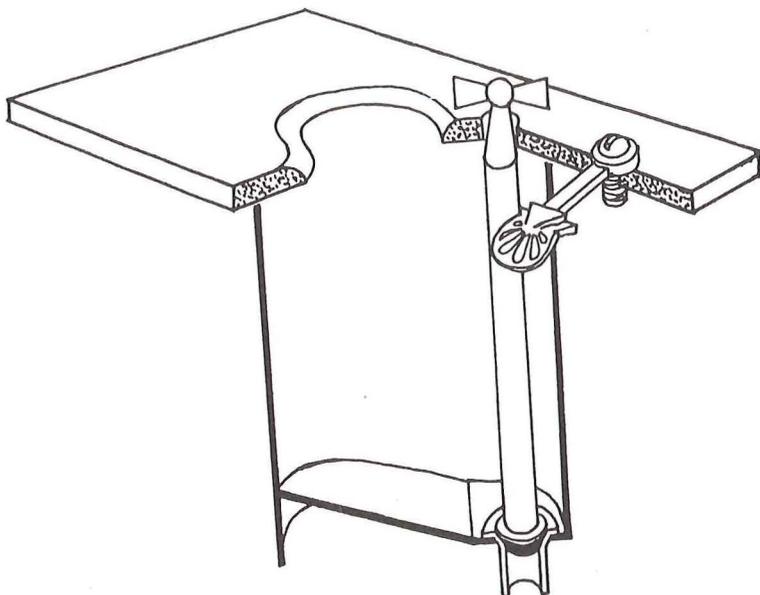
Harrington clearly thought this clamp to be an essential part of his design. Unfortunately it is not very well explained in his text and its function has been misunderstood – some works refer to it vaguely as an operating handle! The appearance of the clamp is unclear for it differs in each of the illustrations, though the end was clearly intended to resemble a scallop shell. We are not told what material it was to be made of but in view of the cost of brass at the time iron seems more likely. Coombe said when describing it that ‘such are in the backside of watches’. This may be a reference to the screwed clamp which retains the roller bearing on the ‘stackfreed’ mechanism on some old fashioned watches at the time, or more probably to the elaborately pierced and decorated clamp generally used to retain the bearing for the balance wheel. The greatest mystery is that Coombe did not explain how the clamp screw was to be tightened and released and remarked simply that ‘without the key it will not be opened’. It seems

probable that he intended the arms of the T shaped key to be used as screwdriver blades. It was in effect a scaled up version of the gadget used with the newly-invented wheel lock pistol as a key to wind the mechanism and as a screwdriver for replacing flints. Coombe probably thought the dual purposes of the key too obvious to mention.

Once the closet had been installed the stool pot, the privy shaft and their vicinity were to be 'passing close plastered with good lyme and hayre that no ayre come up from the vault'. When this was done and the stool pot sealed with water the stench of the privy shaft would be kept from the room. In a modern water closet the deluge of clean water from the cistern pushes the contents of the bowl out through an air and water seal; though wasteful of water we expect this to be done each time the closet is used. In Harrington's design the emptying and replenishing of the stool pot were quite separate operations. The vessel was first emptied by raising the stopple stem; it emptied rapidly into the shaft below using the force of gravity aided by the gradient of the stool pot's bottom and the generous diameter of its outlet. Only then was the stool pot refilled 'half a foote deepe in fayre water' drawn from the cistern. Harrington recommended that the closet be emptied 'at noone and at night'. He added that if water were plentiful then 'the oftner it is used and opened, the sweeter', but if water was in short supply 'once a day is inough, for a need, though twentie persons should use it'.

Because of its place in the history of sanitation a full scale working reconstruction of Harrington's closet was built at the Gladstone Pottery Museum in Longton, Stoke-on-Trent. This small independent museum housed in a Victorian factory is devoted to the making of pottery and is concerned with the widest possible range of ceramics – from house bricks to electrical insulators. One of its galleries houses a fine collection of sanitary ware, drawn principally from manufacturers' collections, arranged to illustrate the history of the subject. The reconstruction of Sir John Harrington's closet was built to provide a starting point for that display and was installed in the gallery in 1981.

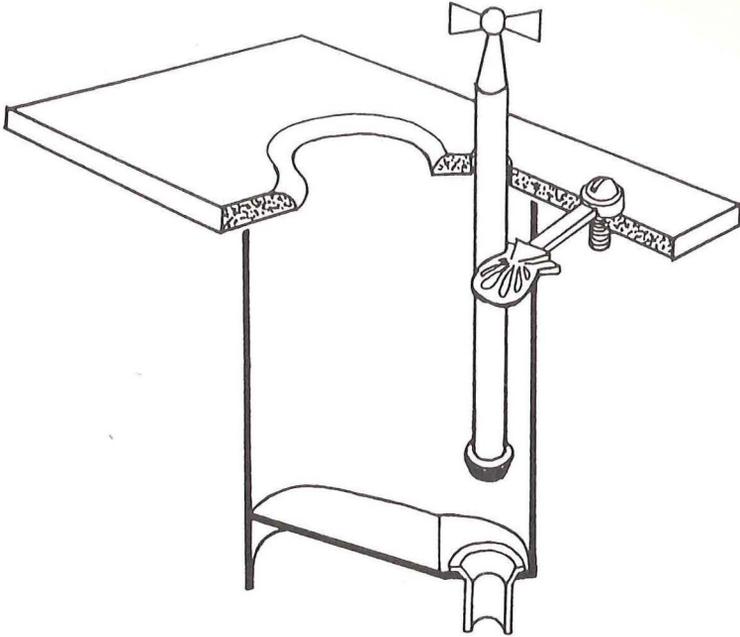
The new closet was built within the museum using the slender resources available in the most appropriate fashion. The project was the responsibility of the author, then Curatorial Assistant at



- 7 The clamp is moved aside and the key screwed down onto the stopple stem through the hole provided.

the Museum, assisted from time to time by various volunteers, by youngsters on a Youth Opportunities Programme and by students at the North Staffordshire Technical College. A previous attempt to reconstruct the closet had been abandoned at a very early stage because the volunteer engineers who were to build it were unable to comprehend the original text. This was therefore studied at length in order to prepare a brief but, since Coombe did not trouble to explain matters he thought obvious to his sixteenth century readers, this was not straightforward. The closet is a very simple device, but the project was only feasible when the nature of the scallop shaped device was understood and the dual purpose function of the key recognized.

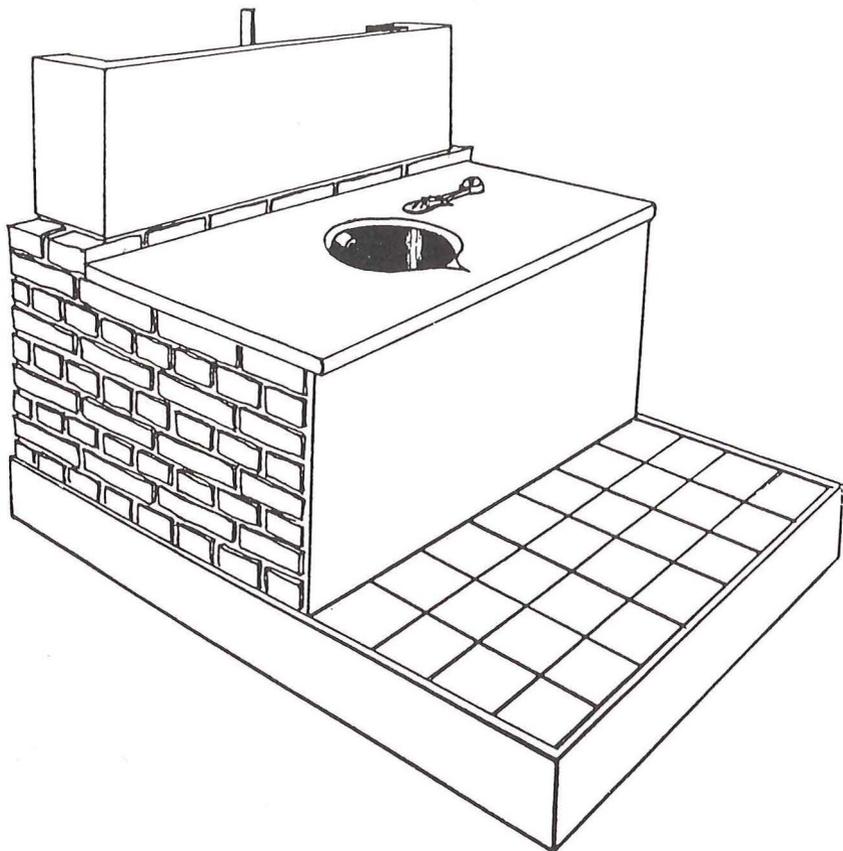
From the outset it was determined to follow Coombe's diections as closely as possible. Dimensions were to be those specified in the text or indicated on the scaled woodcut but where this was not possible the proportions and appearance indicated in the woodcuts were followed and the dimensions dictated by human ergonomics. The reconstruction was to be built in sections



- 8 The stopple is raised using the key as a handle and the closet empties; only when the stopple is replaced is fresh water run in from the cistern.

so that it could be taken into the gallery for assembly and would have to be solid enough to withstand the public and yet not be so heavy that it placed a strain on the joists below. It was to be a working exhibit, supplied with water and connected to the drains below, but not permanently installed so that the gallery could eventually be reorganized. Complete authenticity was limited by these factors, by the need to keep within a £40 budget and by the skills and materials available to the museum.

The closet was built in four parts designed for easy assembly. The stool pot was made of roofing lead shaped around a wooden former. It could not be dressed 'all smooth with pitch, resin and waxe' for these were either too expensive or too scarce and a bitumastic sealant was used instead. The 'great brasse sluice' was cast by students at the North Staffordshire Technical College. Because this projected beneath the stool pot the whole assembly had to be supported on a wooden stand which was contrived to serve a second function. The closet casing was designed to



9 A sketch of the reconstructed closet at the Gladstone Pottery Museum.

accommodate the stand in a precise location, placing it in correct alignment beneath the seat, and was built of timber in the interests of lightness and rendered to represent brickwork. A suitable piece of oak for the seat could not be found but part of a scrap Victorian shop counter fitted the bill once stained. Behind the closet casing stands the third component of the reconstruction, the cistern. Because of the weight factor this was given a substantial wooden stand rendered to blend with the closet case. Both stone and lead cisterns proved impractical and a mild steel cistern was placed within a wooden case painted to

represent stone. A length of salvaged one inch lead water pipe was found to convey water to the stool pot. The fourth section of the reconstruction is a low plinth placed in front of the closet to provide an area of floor at the correct height for the seat. Two dozen quarry tiles were used to suggest the flagged floor shown in Coombe's woodcuts.

Working components for the reconstruction were all made by students at the North Staffordshire College of Technology. These comprise the brass sluice, the large and small stopples, the scallop clamp, the clamp screw and the key. Most of these would originally have been made of wrought iron with screw threads cut and filed by hand; machined mild steel had to suffice. The 'washers' or plugs were made of thick leather scraps bolted into place and turned to shape on a lathe. The scallop clamp was at first cast in iron but the design had been misinterpreted and a second pattern was prepared and cast in brass. Because of the inferior timber in the seat the fine modern thread of the clamp screw could not be expected to bite properly and a captive bolt was provided for it beneath the seat.

Construction of this closet took about a year, and the exhibit was placed on display in 1981. A cold water supply controlled by a concealed tap was provided and a hopper and six inch pipe were fixed below the stool pot. The intention was not to have the closet permanently supplied with water, but rather to permit guides to demonstrate its working to groups.

The reconstruction has shown that Harrington's design was, contrary to the belief of some, a very efficient and practical one. When the great stopple is raised, the water in the stool pot truly gushes 'at a gallop into the jakes'. The speed and force with which this occurs were quite unexpected, and better plumbing had to be provided to protect the rooms below from the torrent. There is a story that when testing the flushing power of a new syphonic closet design in the workshop Thomas Twyford flushed away increasing amounts of paper and eventually grabbed the cap of a nearby workman and gleefully flushed that away too! Similarly unscientific tests with the Harrington closet show that it empties itself with impressive efficiency. Water from the cistern enters with considerable force too. The scallop clamp device works extremely well, slight pressure from the screw sufficing to prevent its being moved aside. There are however flaws in the

design. The scallop clamp device is extremely awkward and the leather plugs do not always form a watertight seal. This may be a fault of the materials or design used in the replica, but seems to have been a problem elsewhere.

The influence of Harrington's design remains very much a matter of conjecture. No other closets of the type are known to have been built, though he is supposed to have installed one for the Queen. Evidence for early sanitary arrangements however rarely survives although plug closets of the type are referred to in mid-eighteenth century sources; these lacked the inconvenient, and by then unnecessary, clamp mechanism. According to the nineteenth century sanitary expert Stevens Hellyer they had basins of marble or lead and retained the stopple stem. More complex water closets with mechanical valves were developed in England from the early eighteenth century. Alexander Cumming patented one with a sliding valve in 1775 and Joseph Bramah patented an improved version in 1778 – valve closets of this type were still available in the 1930s. The pedestal closet with which we are familiar evolved from the hopper closets of the 1840's and the wash-down type used today was introduced by Frederick Humpherson in 1885. Sir John Harrington's water closet was a significant development but it needed permanent water supplies and an efficient sewage disposal system to be truly practical. It might keep your chamber 'sweet' but the old privy shaft would still discharge into the moat, garden or cellar. Harrington's achievement does not seem to have been taken seriously by his contemporaries and is only now being appreciated.