Medieval Distilling-Apparatus of Glass and Pottery

By STEPHEN MOORHOUSE

with an introduction by

FRANK GREENAWAY

Keeper, Department of Chemistry, The Science Museum, London

and contributions by

C. C. MOORE, C. V. BELLAMY and W. E. NICOLSON, and L. BIEK

THIS paper brings together for the first time a selection of medieval glass and pottery distilling-vessels from British sites. A discussion on the technical aspects of distilling by F. Greenaway (Part I) is followed by a report on two important groups of glass and pottery distilling-apparatus from Selborne and Pontefract priories of the middle and late 15th century respectively (Part II). Part III discusses pottery distilling-vessels from other finds in Britain. Two types of pottery alembic are distinguished and their use in association with bases of either furnace or bowl type is suggested; industrial bottles connected with distilling are also briefly considered. The survey has brought much information to light but has also left many problems unanswered. Coordination of documentary research into techniques, archaeological recognition of vessels, and the chemical analysis of residues is necessary before firm decisions can be made about the uses of the vessels and the types of unit required for specific operations. It is hoped that this paper will stimulate further work in this field.

I. INTRODUCTION

By FRANK GREENAWAY

GLASS fragments submitted by the Inspectorate of Ancient Monuments, Department of the Environment, have been recognized by the Science Museum as parts of distillation-apparatus of a type known to have reached a high state of development by the 15th century but not hitherto identified in a domestic or monastic context in Britain. Indeed, these glass fragments may well

be the earliest European distillation-apparatus that has so far been discovered.

In D. B. Harden's brief summary of medieval glass in the west[1] the types he refers to include, for instance, cups, decanters, lamp-glasses, urinals, and 'ampullae' (a type of long-necked bottle), as well as window-glass, but he makes no mention of glass being used to make technical apparatus. Yet is it quite clear that there existed from late antiquity onwards a technique for which glass vessels not only were suitable but were used. This was the art of distillation, the history of which, while well established in outline by historians of technology, has been overlooked by historians at large and archaeologists in particular.

Distillation originated in the eastern Mediterranean at about the time that alchemy became a distinct discipline. It is important not to equate alchemy and early chemistry. Alchemists studied for their own philosophical purposes technical processes familiar to the practitioners of commercial arts, and we must remember that the transformation of one substance into another, into which the alchemists read hidden meanings, was, for the most part, already familiar to humbler persons engaged in the day-to-day manufacture of articles of trade. As so often the literary tradition survives with some continuity: the practical tradition transmitted by precept and practice needs to be reconstructed.[2]

We can picture the state of the practice of distillation in the 16th century in considerable detail, since it is fully and clearly described in a number of works. For example, in 1574 Lazarus Ercker[3] described and illustrated the methods of making mineral acids which were used in assaying precious metals. The earliest undisputed description of making a mineral acid is given by Geber in the 14th century.[4] It is there regarded as accepted knowledge, not as an innovation, but, even if it were recent, we may be sure that the technique of distillation developed bit by bit until it reached the astonishing high level of Ercker's account. This again is offered as accepted good practice, not in any way novel. We may infer, therefore, that distillation, in sizable pieces of apparatus made in some quantity, was widely used wherever metallurgy and, in particular, the art of assaying were practised; and since assaying was an essential feature of the use of a regulated coinage and of the payment of taxes in coin or precious metal, it follows that distillation was likely to be known and understood in many technical centres.

[1] D. B. Harden, 'Medieval glass in the west', *VIIIth International Congress on Glass, 1968* (Soc. Glass Technology, Sheffield, 1969), 97–111. See also F. Rademacher, *Die deutschen Gläser des Mittelalters* (Berlin, 1933), 41–50, and A. Gasparetto, 'Zwei wenig bekannte Gebiete der alter venezianischen Glashestellung', *Glastechnische Berichte*, 32 K, 1959, Heft 8, 39–49. Rademacher's summary of the history of distillation is now superseded by Forbes, *op. cit.* in note 2. Among the illustrations cited neither author has anything earlier than 1400. Rademacher's earliest reference to glass used for distillation is ascribed to Raymond Lull, but the work is now believed to be by John of Rupescissa *c.* 1340 (Multhauf, *op. cit.* in note 4, 180, 210 ff.).

[2] R. J. Forbes, *Short History of Distillation* (Leyden, 1948).

[3] Lazarus Ercker, *Treatise on Ores and Assaying* (1574), trans. with commentary by A. G. Sisco and C. S. Smith (1952).

[4] 'Geber' here means the Latin Geber, the reputed author of a corpus of alchemical writings containing much information about medieval chemical techniques. Some authors persist in equating him with the Islamic Jabir-ibn Hayan (8th century), but this controversy is irrelevant to the present paper. For an excellent short appraisal of 'Geber' and of his contribution to technical chemistry see R. P. Multhauf, *The Origins of Chemistry* (London, 1966), 171–5.

Another 16th-century description of distillation is that of Brunschwig.[5] Distillation of alcoholic liquors seems to have been introduced about the same time as that of acids, and the level of technical complexity described in Brunschwig is comparable with that in Ercker. While we know less about the dissemination of alcohol distillation than we know about that of acid distillation, it is likely that the former was practised in many places by the 16th century and probably much earlier.

The importance of the present study is that it supports this view with physical evidence, some of which is much earlier than any hitherto available. The familiar shapes of distillation-apparatus in use from early times up to the late 18th century figure prominently in works of art as well as of science and technique over a long period.[6] This apparatus consisted of two main parts. A liquid was boiled in a lower vessel which, being shaped like a gourd, was known as a cucurbit. The vapour from this liquid was condensed in an upper vessel called an alembic, which had a domed head and a spout.[6a] The liquid ran from the domed head into a collecting-channel and so down the spout into a receiver. In the early stages of this kind of device cooling of the vapours was carried out in a very elementary fashion by exposing the top part of the vessel to the air, aided sometimes by placing wet cloths over the dome.

Our museums contain some examples of distillation-apparatus dating from the 16th century[7] and from then onwards we have all the necessary pictorial and documentary evidence to support the accepted narrative of the development of this important process. Until recently, however, physical evidence for the earlier, formative period has been exceedingly meagre. Apart from a green glass alembic in the Victoria and Albert Museum which may be medieval Egyptian,[7a] there were barely half-a-dozen specimens described as alembics by their discoverers which could confidently be dated earlier than 1600. The position has changed radically, however, in the past few years with the examination of some new discoveries.

RECENT FINDS OF DISTILLATION-APPARATUS

In 1958 in an excavation on the site of the manor of the More, Rickmansworth,[8] some glass fragments with strongly adherent deposits were found in an early

[5] Hieronymus Brunschwig, *Liber de Arte Distillandi* (Strassburg, 1500); for editions and copies see J. R. Partington, *History of Chemistry*, II (London, 1961), 83. See also Lu Gwei-Djen, J. Needham and D. Needham, 'The coming of ardent water', *Ambix*, XIX (July 1972), 69–112, for a summary of the history of alcoholic distillation, and Multhauf, *op. cit.* in note 4, ch. 4, for that of acids. Neither alcohol nor the mineral acids were brought to light suddenly by one person or in one place. Both were slowly developed and characterized over a long period, being recognized as distinct entities by the end of the 14th century.

[6] C. A. Burland, *The Arts of the Alchemist* (London, 1967). This shows the range of later alchemical illustrations. Teniers' many paintings of alchemical subjects add to the practical details, but show no notable variant from the common type of still.

[6a] The retort, familiar to school-children, is a later development from the earlier, more complex shape, the alembic.

[7] Available, for example, in the Science Museum, London; the Deutsches Museum, Munich; the Pharmaceutical Museum, Heidelberg; and the Wellcome Institute of the History of Medicine, London.

[7a] See note 33.

[8] M. Biddle, L. Barfield and A. Millard, 'The excavation of the manor of the More, Rickmansworth, Hertfordshire', *Archaeol. J.*, CXVI (1959), 180, fig. 18, no. 17 (= PL. XI, C, below).

16th-century midden. When they were examined at the Science Museum it seemed likely that they were fragments of alembics, a form of vessel then unfamiliar to archaeological investigators, though well known to historians of chemistry. This led to some interesting discussions, but, at the time, no firm conclusions. The fragments are described briefly in the excavation-report, with only a conjectural footnote on their possible nature.

The investigation took on a more serious form in 1965, when excavations at Selborne Priory (pp. 98 ff.) brought to light a number of fragments of glass dating from the middle of the 15th century, which Leo Biek of the Ancient Monuments Laboratory thought should be examined, and to these were added the late 15th-century material from St John's Priory, Pontefract (pp. 89 ff.).

Some hundreds of small pieces of glass and pottery were examined from these two groups. Among them were a number of crucibles and other familiar vessels, but there were also fragments, mostly no more than a few centimetres long, whose origin was not at all clear. All those of glass were devitrified and decayed and in only a few was the transparency of the original glass still visible. In spite of their irregular shapes it is possible, by considering the curvature of their profiles, to relate them to one very distinctive shape, the alembic. The various parts of the apparatus exhibited three main curvatures, positive, negative, and what we may refer to as double curvature. The fragments with positive curvature could have belonged to any globular vessel. The parts with negative curvature can be pieced together to make tubes of decreasing diameter, rather like the tube of a long trumpet (PL. XI, A), or (and this is what is important) the elongated spout of an alembic (cf. FIG. 27, nos. 5–6). The key feature of the whole collection, however, was the appearance of a double curvature in some of the fragments. The individual fragments from the manor of the More could come from different vessels (although the reconstruction makes this very unlikely), but among the Pontefract glass one complete ring was found (PL. XI, B; FIG. 27, no. 1). Such a ring could be assigned to no medieval vessel other than the alembic, on which the wall turns outwards and downwards above the lip, to produce a collecting-channel, and then upwards again in a convex curve to form a dome. The origin and significance of this double-curved channel is clear from Sherwood Taylor's diagram showing the origin of the alembic (FIG. 23). Although his theory about the origin of the alembic has been much questioned, the general principles are acceptable for our purposes.[9] The only known shape that has this channel and the trumpet-shaped tube is the alembic. In all probability, therefore, the fragments we are discussing were parts of distillation-apparatus older than any that has so far been recognized in England, or even possibly in Europe.

If this view is accepted, the other fragments can also be identified as parts of distillation-equipment. The profiles (FIGS. 27, 30) show that many fragments could belong to the dome of an alembic or to the lower parts of the cucurbit. In practice any vessel might have been used as a receiver, but in fact the many extant 16th- and 17th-century illustrations show only a limited range of shapes which match those of the fragments found. It may be concluded therefore that

[9] F. Sherwood Taylor, 'The evolution of the still', *Annals of Science*, v (1941-7), 185–202.

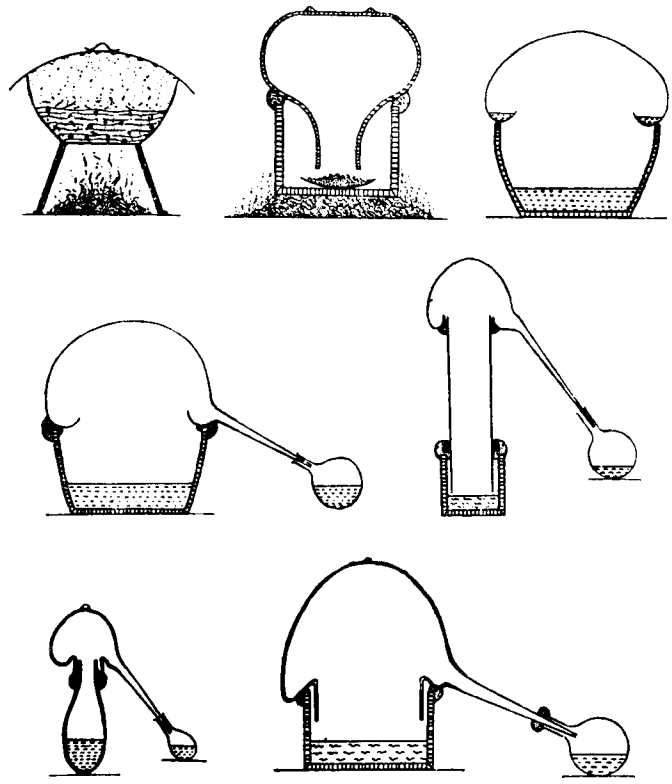

FIG. 23

CONJECTURAL EVOLUTION OF THE STILL (p. 82)

After F. Sherwood Taylor, Annals of Science, *v* (*1941–7*), *185–202, fig. 14*
Compare lowest left-hand sketch with still in centre of FIG. 24 and profiles of fragments from Pontefract and Selborne (FIGS. 27 and 30).

the material excavated at Selborne and Pontefract contains glass distillation-apparatus.

COMMENTARY

Why should this kind of material occur on this kind of site? What other sorts of material might be found in association with it? What other kinds of material might be sought on similar sites elsewhere? During the middle ages there was a considerable variety of chemical technology. The working of metals was known, ceramics were made, there was a considerable art and craft of pigments and colouring matters, glass is known to have been made in some quantities, and there were important technical advances associated with the development of medicine and pharmacy. In several of these connexions distillation became important. The art of distillation has never been entirely confined to students of alchemy, although at first they were its principal exponents.

There are, for example, 10th-century records of distillation of roses to produce one variety of the celebrated Persian rose perfume. Not until after this, however, does distillation move away from its esoteric associations to become a socially important technique, but the change, once it does take place, is substantial and influential.

DISTILLATION OF ALCOHOL

Two types of substance were discovered whose role in subsequent technical and social history is hardly matched by any other. Alcohol has been consumed as wine and ale since time immemorial, but, although there are legendary accounts of drinks of high potency, no positive evidence exists to show precisely where and when alcohol was first concentrated by distillation. Italy about the year 1100 seems the most likely, but the subject is still open.[9a]

Medieval Europe gradually developed a taste for distilled alcohol, at first generally in the form of liqueurs sweetened and flavoured by infusing leaves, etc., or by distillation of a mixture. More efficient distillation gave stronger distillates and eventually produced the aquavits and the brandy-wines, which are very strong indeed if drunk exactly as distilled. The abuse of these drinks is a part of social history. There was no dividing line between regimen and pharmacy in early times. The new strong drinks gave a feeling of warmth and well-being which led to their being prescribed from the 14th century onwards for conditions producing feelings of chill and debility, notably enteric diseases. It is to be expected, therefore, that, where the sick were cared for, aquavits or liqueurs were used and made, and so it is no accident that liqueurs and monasteries are commonly linked, as happened with Benedictine and Chartreuse. But there had already been more than 200 years of liqueur-making before these celebrated drinks came to the fore.

DISTILLATION OF ACIDS

The mineral acids, another product of distillation, also developed rapidly in the 14th century. The history of these substances is confused, but seems to be linked with the developing study of certain mineral substances, particularly the vitriols, which were a popular subject of study among the Arabs and therefore also among medieval commentators on them. Although sulphuric acid was possibly the first known, it was nitric acid which was made in the greatest quantity. Sulphuric acid was made by heating vitriol (hydrated sulphates of iron or copper) but, although its powerful solvent properties were remarked, no use was found for it. However, when vitriol was distilled with saltpetre (familiar from the 12th century in connexion with military combustibles), an acid was produced which had one very distinctive property, that of dissolving silver while not dissolving gold. This was of great significance in two interacting fields, assaying and alchemy. The history of alchemy is complex and fascinating. It is enough to say here that it was at first a serious and dignified study of the human spirit and of the analogies to perfecting it that might be found in studying natural phenomena, but it later

[9a] For the most recent assessment of the problem see Lu Gwei-Djen *et al.*, *op. cit.* in note 5.

decayed into occultism and charlatanry. It made progress both in nonsense and in high craftsmanship. The search for the means of turning base metals into gold was allied to that for the means of perfecting the human spirit. In the course of his search the alchemist developed an intense interest in the nature of the precious metals and the means of handling them. This study was allied in some ways with the important economic process of assaying (FIG. 24).

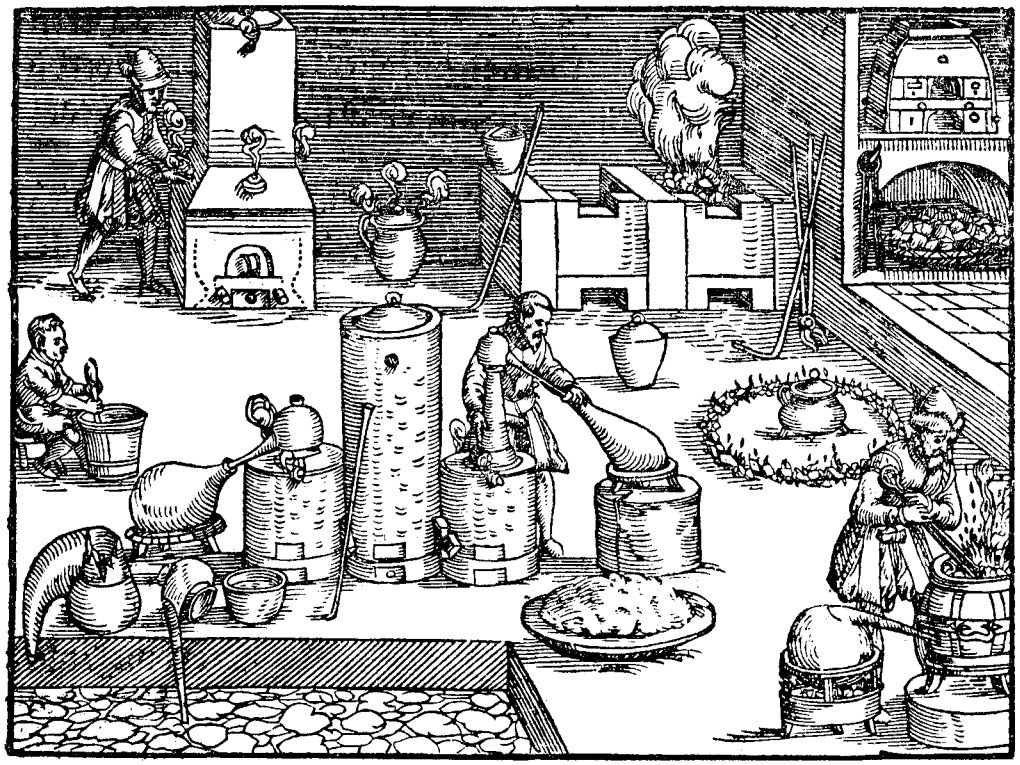

FIG. 24

DISTILLING IN THE 16TH CENTURY (p. 85)

After L. Ercker, Treatise on Ores and Assaying (*1574*), *title-page*. Much of the apparatus shown is repeated in greater detail elsewhere in Ercker's book.

I have described elsewhere the long tradition of the process of assaying[10] and need here only recall that excellent descriptions of the process of determining the purity of silver by melting it with lead are to be found in the 12th century in the *Dialogus de Scaccario* of about 1182.[11] An assessment of the importance of this to society is to be found in the *De Moneta* of Nicolas Oresme. Many documents,

[10] F. Greenaway, 'Historical continuity of the tradition of assaying', *Proc. International Congress Hist. Science* (1962), 819–23.

[11] This is the important *Dialogus de Scaccario* or *Dialogue of the Exchequer*. See *De Necessariis Observantiis Scaccario Dialogus qui vulgo dicitur Dialogus de Scaccario: The Course of the Exchequer by Richard, Son of Nigel*, trans. with introduction and notes by C. Johnson (Nelson Medieval Text Series, London, 1950).

some of which have been collected by Johnson,[12] show how thoroughly assaying techniques were being taught, studied and criticized between the 12th and the 14th centuries. The most important process was that of cupellation, in which a specimen of impure silver was melted with some lead in an absorbent crucible. The lead melted and oxidized, absorbed the oxides of the impurities and was itself absorbed by the wall of the crucible, leaving pure silver. Some idea of the importance of this process is obtained from the edict of Philip de Valois of 1343, which explained in substantial detail how it was to be carried out in accordance with law. By the late middle ages the estimation of silver and gold, for which methods were known in antiquity, had already been practised for over three centuries by methods we can recognize and reproduce, and had become very important in the western Europe economy. The difficult problem had always been that of separating gold from gold-silver alloys. Cementation (prolonged heating with salt) was known, but was unsatisfactory. The discovery of a low-temperature solvent, that it to say nitric acid, for silver was a great step forward. By the middle of the 16th century nitric acid was being made on a considerable, even industrial, scale and new types of furnace were invented to help with large-scale manufacture. The distillation-vessels themselves, however, retained their traditional shape throughout. Trade in apparatus developed, but the practitioner of assaying and other metallurgical processes continued to be able to use his own equipment, and in fact was recommended to know how to make his own material by those who wanted to raise standards.[13]

IMPORTANCE OF NEW EVIDENCE OF MANUFACTURE AND USE OF ALEMBICS

The occurrence of fragments of glass alembics on a site suggests several possibilities:

1. The site could be a glass-factory making distillation-apparatus. If so, the site would be expected to yield other evidence of glass-working, such as furnaces or fragments of partly-worked glass.
2. The apparatus could have been used in the kitchen for making potable liquor, for distilling wine to make an aqua-vitae, or for distilling wine with herbs to make a liqueur. Examination of deposits should then show some sort of carbon or carbonaceous or organic matter. So far no such examinations have been carried out.
3. The apparatus could have been used for alchemical experiments connected with religious studies in the institution where the material was found. It is well known that careful and searching criticism of alchemical practice was made by a number of distinguished writers such as Albertus Magnus, and it is not unlikely that similar critiques were made by other studious members of religious orders. If this were so, almost anything might have been distilled in the wide-ranging search for alchemical wisdom. Examination of deposits

[12] C. Johnson, *The* De Moneta *of Nicholas Oresme and English Mint Documents* (London, 1956).
[13] Ercker, *op. cit.* in note 3, 137–41.

in the glass vessels used by alchemical students would not be distinctive in any way.

4. The apparatus could have been used to make nitric acid for use in assaying. One would then expect to find other evidence of metallurgical work, for example, furnaces, and small, porous crucibles containing lead or lead oxide or traces of silver or even of gold. Deposits on the vessels would be inorganic with high proportions of iron and copper (from green or blue vitriol) and they might possibly contain lead or tin. Larger crucibles containing quantities of lead or other metals would not be evidence of assaying, since they might have been used for manufacturing purposes. It is likely that assaying apparatus would be found on sites connected with mints, and therefore an investigation of any coinage struck in the area should be made. One other element that might be found in an adherent deposit is phosphorus. If alone, it might come from distilled urine; if in association with calcium, it could come from distilled bones or (quite likely) from bone-ash, a substance from which assaying crucibles were made, at least from the latest medieval period onwards.

X-ray fluorescent or spectrographic analyses of some deposits found in distillation-apparatus have been made in the Morganite Research and Development laboratories and in the laboratory of the Government Chemist, and other deposits have undergone visual comparative analysis in the Ancient Monuments laboratory of the Department of the Environment (TABLE I, p. 120).

The analyses so far carried out show virtually no organic matter but, in several, calcium was associated with phosphorus and, in one, tin with lead, together with calcium and phosphorus, was present. These findings would be consistent with the addition of crucible fragments to a distillation. It is well known that such fragments added to a boiling liquid prevent local over-heating or bumping. This would explain the presence of bone-ash in distilling-vessels used in conjunction with metallurgy. This suggestion can as yet be only conjectural, but it shows the possibilities inherent in the study of this material. It is important, however, for the evidence of metal-working on the site at Pontefract to be investigated further, particular attention being paid to any crucibles which are discovered.

FUTURE WORK

Whatever the eventual interpretation of the examples of glass and pottery discussed in this paper, it is clear that the repertoire of vessels hitherto accepted as a regular feature of day-to-day life on medieval monastic or domestic sites must now be extended to include distillation-equipment. There was a great intensification during the later middle ages of two activities with which distillation was very closely related: metallurgy and the consumption of distilled alcohol. The former was the subject of legislation and was also very fully described in some of the first printed books devoted to technical subjects. Much attention has been paid to the development of mining and metallurgical work in Great Britain,

particularly during the Elizabethan period, but it has to be remembered that small-scale metallurgy was practised earlier than that and was not dependent, as was the later Elizabethan metallurgy, on a stimulus from central Europe. Although our knowledge of the coinage and of its economic importance is considerable, we still know far less than we should about the important processes of assaying by which the composition, and therefore the true value, of precious metal alloys (and, in particular, the metals of which coins were made) was effectively determined. The main features of this story can be established from official records, but there is much still to be discovered about the accompanying techniques, such as the distillation of acids.

TERMINOLOGY USED FOR PARTS OF THE GLASS STILL

By C. C. MOORE
Research Assistant, Science Museum

A variety of names are found in medieval documents referring to the still and its various components. For simplicity, however, a standard terminology has been adopted in the present paper and is illustrated in FIG. 25, showing the relation to each other of the parts of a typical glass unit. The following table correlates these, the terms in capitals being those used throughout this paper, while those in italics are the ones most commonly met in the documents.

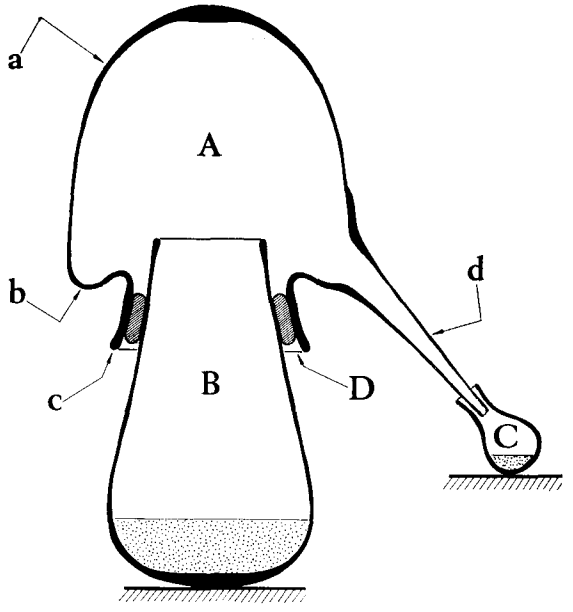

FIG. 25
DIAGRAMMATIC REPRESENTATION OF A TYPICAL GLASS STILL (not to scale)
The letters refer to the component parts, as listed on p. 89.

COMPLETE UNIT

The complete apparatus is known as either a *still*, *alembic* or *limbeck*, with variations in the spelling.

A. ALEMBIC: *alembic*, *still-head*, *head* and *helm*
B. CUCURBIT *cucurbit*, *body*, *matrass*, *flask* and *gourd*
C. RECEIVER: *receiver* and *bolt-head*
D. LUTE: *lute*

DETAILS OF THE ALEMBIC

a. DOME
b. COLLECTING-CHANNEL
c. RIM
d. SPOUT: *pipe*

LIQUIDS

The residue left in the cucurbit is termed *caput mortuum*. The distillate is termed *phlegm* when distilling off excess water in acids.

II. DISTILLING-GROUPS FROM PONTEFRACT AND SELBORNE PRIORIES

A. GLASS AND POTTERY FROM ST JOHN'S PRIORY, PONTEFRACT, W.R. YORKSHIRE

By C. V. BELLAMY
Department of Adult Education and Extra-Mural Studies, University of Leeds
and
W. E. NICHOLSON
Hon. Keeper of Ethnography, City Museum, Leeds

During excavations in 1966 on the site of St John's Priory, Pontefract, a quantity of glass and pottery was found in a small area of about 30 sq. yd. at the S. end of the dorter range (FIG. 26). It lay in filling used to raise the ground level south of the reredorter drain when the drain was reconstructed towards the end of the 15th century.

The glass was mainly vessel-glass, but included a few fragments of window-glass, with which was some lead channelling. Some pieces with trailed or moulded decoration presumably came from domestic glassware; other pieces have been identified as fragments of alembics and vessels used in distillation, and of urinals. Similarly the pottery comprised vessels intended for chemical and medicinal

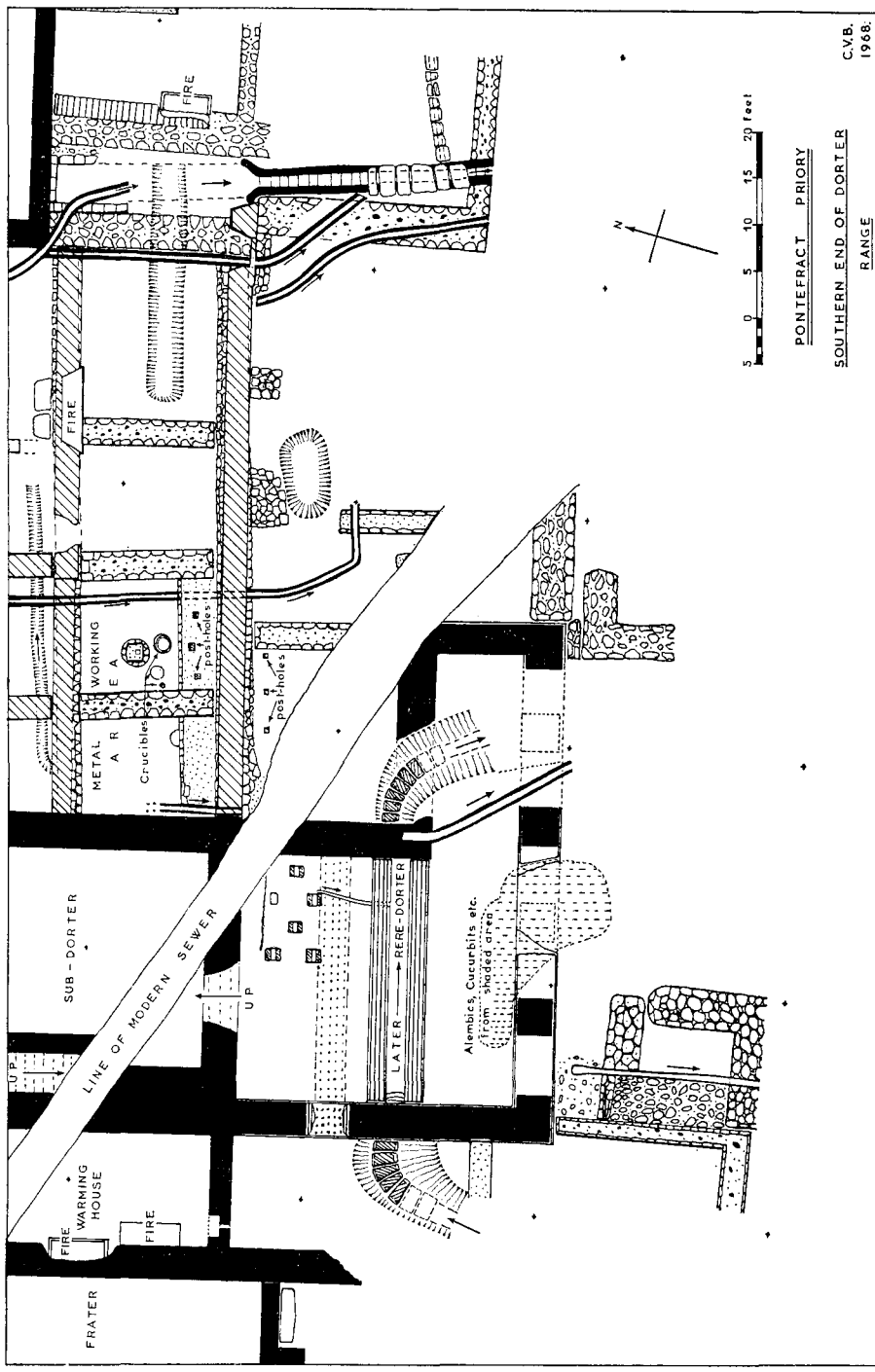

FIG. 26
PONTEFRACT PRIORY, W.R. YORKS.
Plan showing location of late 15th-century deposit of glass and pottery distilling-apparatus at S. end of dorter range (p. 89)

purposes as well as the usual domestic types. A few small crucibles were also found.[14]

GLASS (FIG. 27, nos. 1–32)

Pieces of glass recovered number about 640, varying in size from 13 cm. by 8 cm. to very small fragments. Originally green glass, it has been much affected by weathering of the kinds described by Harden,[15] with the result that most of it is now opaque and milky-white or grey, with some almost black; a little is still semi-transparent. Although in some instances the vessels from which the pieces came can be identified as parts of distillation-apparatus, in most it is only possible to conclude that they could have been so used. Many vessels would have been suitable for either domestic or scientific use and small fragments are often indeterminable.

ALEMBICS (FIG. 27, nos. 1–8)

1. (PL. XI, B). Nearly half of rim showing regressive fold and beginning of collecting-channel; 4 mm. thick; internal diam. mouth 11 cm.

2. Two-thirds of rim showing regressive fold, return fold forming collecting-channel, and part of attached spout; 2 mm. thick, increasing to 5 mm. at mouth; internal diam. mouth *c.* 5·4 cm.

3. Complete rim (five joining fragments) with regressive fold; 2 mm. thick, increasing to 2·5 mm. at mouth; internal diam. mouth 7·4 cm.

4. Two fragments of rim, apparently from one vessel, showing regressive fold and indication of collecting-channel; 2 mm. to 3 mm. thick; internal diam. mouth *c.* 6·7 cm.

The group includes another complete rim (internal diam. mouth 7 cm.), pieces of rims from three other vessels and twenty-two fragments of collecting-channels.

5. Two joined fragments, 6 cm. long and 1 mm. to 2 mm. thick, forming part of spout, showing attachment to channel and body; at lower end, which is broken, spout is *c.* 9 mm. diam. widening to *c.* 30 mm. where attached to collecting-channel. A third piece, tubular, 3·3 cm. long and 1·5 mm. thick, with internal diam. tapering from 7 mm. to 5 mm., apparently belongs to lower part of same spout.

6. Two joined fragments, 10·5 cm. long, forming part of spout (lower end missing) with fragment of body attached. At point of attachment to body spout is oval in section (*c.* 3·2 cm. by 3·6 cm.), the spout being *c.* 2 mm. thick and the wall of the alembic *c.* 4 mm.; at lower end spout is 6 mm. diam. internally and of irregular thickness.

There are two other fragments of spouts and a third fragment which might be from point of attachment of spout and body.

7. One of nine fragments with regular convex curvature and no traces of bosses or puntee-marks. Perhaps from domes, but equally likely to be from bottoms of vessels (e.g. flasks).

8. Convex piece with small round external boss, but no trace of puntee-mark.

Domes with bosses appear in illustrations of chemical apparatus and alchemists'

[14] By courtesy of the Director most of the relevant pottery and glass is at present stored in the City Museum, Leeds, until proper museum facilities for all the material from Pontefract are available. We are indebted to Mr. J. G. Hurst for initial recognition of the pieces of chemical apparatus; to Dr. D. B. Harden, who saw samples of the glass and was good enough to give us advice about it; and to Mrs. H. E. J. Le Patourel for help in identifying and describing the pottery.

[15] D. B. Harden, 'Glass and glazes' in C. Singer *et al.* (ed.), *A History of Technology*, II (Oxford, 1956), 333–4.

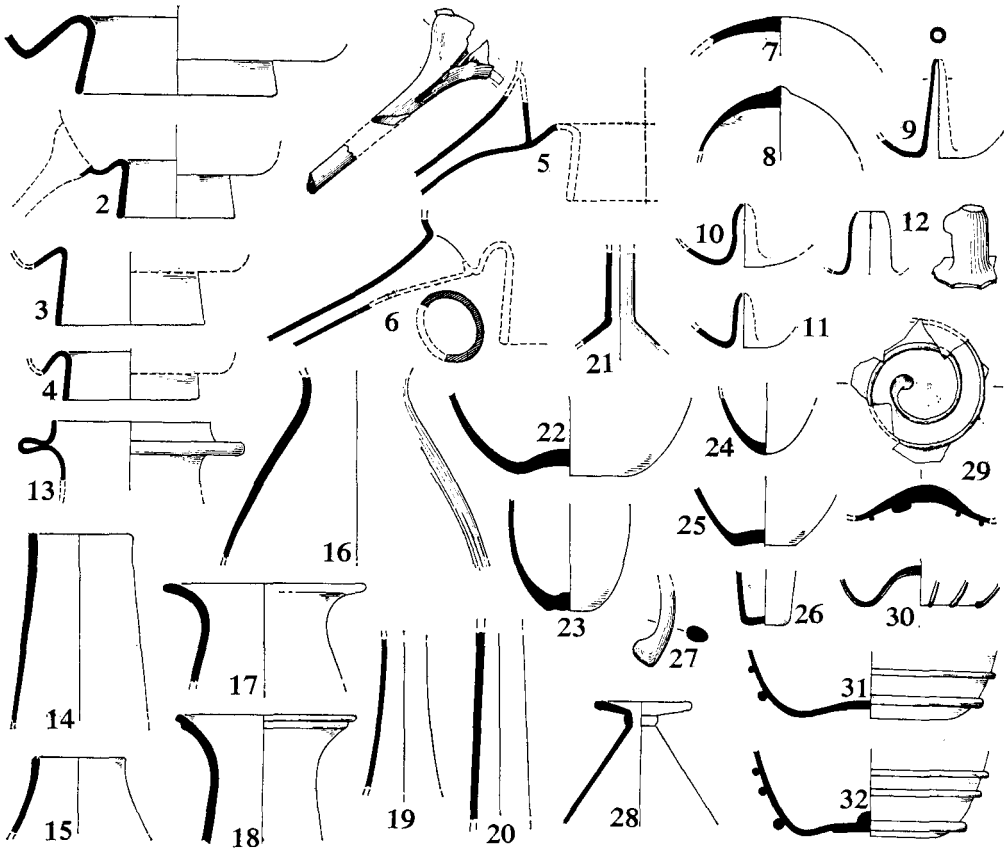

FIG. 27

PONTEFRACT PRIORY, W.R. YORKS.

Late 15th-century glass distilling-apparatus (nos. 1–28) and domestic glass (nos. 29–32) (pp. 91 ff.). Sc. $\frac{1}{4}$

workshops; this piece seems to come from such a dome. On another, similar piece (not illustrated) the boss does show traces of a puntee-mark.

Nine other pieces (not illustrated) may be from the bodies of alembics or vessels of similar shape.

VENTS (FIG. 27, nos. 9–12)

The four pieces illustrated are of unusual shape and uncertain purpose. Each consists of a short length, 3 cm. to 5 cm., of narrow-gauge tubing tapering to a rounded end with a small aperture; at the other end the tube is expanded outward in a regressive curve. The pieces are not large enough to indicate the full shape of the vessels to which they belonged, but the impression given is that of small inward-facing vents in the centres of their bottoms. Possibly their purpose could have been to conduct vapour into alembics of an alternative pattern, in which the channel was formed by the single fold between vent and body; to this fold the spout would have been attached.

Illustrations of Alexandrian alchemical apparatus may give support to this

suggestion. Two of them, in particular,[16] show alembics in which the mouth turns inwards, not outwards, and is large enough to admit the neck of the cucurbit, on the widening shoulder of which, presumably, it rested. If the aperture were as small as that in the Pontefract vents, it would be necessary for the alembic rim to be supported on the neck instead of admitting it. Alternatively the alembic could have rested on a wide-mouthed cucurbit.[17]

9. 5·2 cm. high and 2 mm. thick; diam. tube at broad end *c.* 1·3 cm., diam. aperture at tip 2 mm.

10. 3·2 cm. high but apex damaged and incomplete; diam. tube at broad end *c.* 1·1 cm., diam. aperture 4 mm. Another example occurred (not illustrated) of similar dimensions.

11. 3 cm. high and *c.* 3 mm. thick; diam. tube at broad end *c.* 9 mm., diam. aperture 2 mm.

12. Tubular piece, *c.* 2·8 cm. long and 1 mm. thick, internal diam. *c.* 1·8 cm. At one end edge of tube turns inwards to reduced diam. of 1.3 cm. and near its mouth side of tube is blown out into round protuberance or bubble; at other end tube widens in sharp asymmetrical curve, in parts regressive. The fracture is so close to the bottom that the shape of the complete vessel cannot be deciphered, but it seems just possible that this piece may have been similar in purpose to nos. 9–11.

One fragment (not illustrated) appears to be from a vent for a considerably larger vessel.

CUCURBITS (FIG. 27, NOS. 13–15)

13. Half circumference of rim in three fragments, 2 mm. thick. About 1·3 cm. below mouth neck is folded to form projecting ledge, outside diam. 12 cm., which could support a superimposed alembic-rim of 9 cm. diameter. A pot from Pontefract (FIG. 28, no. 4) has a similar ledge. A similar fragment (not illustrated) is almost certainly from a cucurbit.

There are also fragments from vessels with uneverted or slightly everted rims, many having a widening below the neck, so that they may have come from gourd-shaped vessels possibly used as cucurbits or receivers.

14. Nearly complete rim in three pieces; 4 mm. thick at mouth, 3 mm. at neck; external diam. *c.* 5·6 cm.

15. Complete rim 4 mm. thick at mouth; external diam. 5 cm.

Three complete or nearly complete rims and twelve smaller pieces (none illustrated) come from vessels of similar types.

OTHER SHAPES (FIG. 27, NOS. 16–28)

Rims, necks and bodies

16. Two large pieces forming part of neck or body, possibly of flask or urinal, with walls 3 mm. thick, increasing to 4·5 mm. at neck.

17. Nearly complete rim and part of neck in eight fragments; rim seems slightly oval, external diam. *c.* 10 cm. by 9 cm.; walls 2 mm. thick, increasing to 4 mm. at the rim. Considered by Harden to be probably from a urinal.

Twenty-one similar rim-fragments (not illustrated) occurred, belonging probably to eleven vessels.

18. Nearly complete everted rim with moulding at lip; external diam. rim *c.* 9·6 cm., internal diam. neck *c.* 5 cm.; walls 4 mm. thick.

Three other pieces of similar rims (not illustrated) were found.

[16] *Op. cit.* in note 2, fig. 7; E. J. Holmyard, 'Alchemical equipment' in *op. cit.* in note 15, 733, fig. 660.
[17] *Op. cit.* in note 2, fig. 25.

19. Two joined fragments from neck of flask; diam. at top 2 cm. increasing to *c.* 3·6 cm. towards bottom, walls 2 mm. thick.

20. Neck of bottle, 10 cm. long, broken away at both ends; internal diam. at top 1·4 cm., at bottom 2·6 cm.; thickness of walls at top 5 mm., at bottom 3 mm.

Seven pieces of tubing (not illustrated), of various dimensions, are probably from necks of bottles.

21. Tubular fragment, with end expanding sharply outwards, perhaps neck and shoulder of bottle, or part of funnel, *c.* 5 cm. long, walls *c.* 2·5 mm. thick; internal diam. at top *c.* 1 cm.

Bottoms

Many bottoms of vessels have survived, a few from small phials but most from larger vessels. Some are rounded, and unstable; others are flattened and, in some instances, concave or kicked on under side, so that they would stand unsupported. Receivers and flasks could have been of either type and some of the larger examples may well belong to such shapes, while some of the rounded pieces may be alembic-domes rather than bottoms of vessels.

22. One example from twenty-seven bottoms, all similar, with internal diam. varying from *c.* 2·5 to 9 cm.

Six other bottoms (not illustrated) with pronounced external concavities and puntee-marks are possibly from bottles.

23. Lower part of vessel, sharply curved, with flattened bottom and puntee-mark; walls 2·5 mm. to 4 mm. thick and reaching 10 mm. at centre. Harden suggests that this may be the bottom of a lamp.

24. Convex bottom rounded and smooth on outside, no visible puntee-mark; probably from a phial or small lamp; walls 1·5 mm. thick increasing to 6 mm. at centre.

The bottoms of two phials (not illustrated), diam. 2 cm. and 3 cm., with puntee-marks, were also found.

25. Bottom of flask, walls 2 mm. thick increasing to *c.* 7 mm. at centre, internal diam. at bottom *c.* 3·5 cm.

Two fragments of bottom of flask (not illustrated), 3 mm. thick increasing to 8 mm. at centre, internal diam. at bottom *c.* 3·5 cm., containing residue, were found.

26. Bottom of lamp, with puntee-mark; walls 2 mm. thick increasing to 4 mm., internal diam. at top *c.* 2·7 cm.

Portions of three similar bottoms (not illustrated) were found.

Handles

27. Portion of solid glass handle, 5 cm. long with oval section 10 mm. by 6 mm.; splayed at one end where it joined the vessel, broken at the other.

Fragment of vessel (not illustrated) with traces of fused attachment, possibly a handle.

Flask (?)

28. Part of vessel shaped like an inverted goblet, with short, slightly bulged, hollow 'stem' (internal diam. *c.* 9 mm.) and about half the 'foot' (diam. *c.* 5 cm.). It was thought at first to be part of an unfinished goblet; there is, however, no evidence of the manufacture of glass in the vicinity at this date, although in the 17th century there was a glasshouse at Glasshoughton, two miles from the priory site. We are indebted to Mr. S. Moorhouse for identifying the piece. He writes: 'The fragments appear to be the neck of a flask.[18] We may compare a complete glass of the 15th century in the

[18] Alternatively, the piece could be one of a pair of such glasses inverted and joined at the mouth by binding and used as hour glasses. I am grateful to Mr. R. J. Charleston for this suggestion.

Stadtmuseum, Cologne, illustrated by Rademacher.[19] A piece in blue glass, and similar in size to the Pontefract example, was found on the late 16th- to early 17th-century glasshouse site at Buckholt, Hants,[20] while the top of a vessel of similar size with a wider aperture in the rim came from a pit of the 2nd half of the 17th century at Southampton.[21] These, with the Pontefract example, show that on present evidence this form was current in this country from the late 15th to the late 17th century, but future finds could well extend the range at both ends.'

DOMESTIC GLASSWARE (FIG. 27, nos. 29–32)

Recognizable domestic glass is also included, although its very existence in the deposit raises the question whether other unrecognizable pieces are domestic and not industrial. As the illustrated domestic glass was found in the same deposit as the other material it forms one of the few late 15th-century groups of finer glassware in this country.

29. Bottom of bowl or jug, concave on under side, with puntee-mark, walls *c.* 4 mm. thick; thin, spirally-trailed band of irregular gauge dropped on at centre, underneath, which evidently continued over basal angle on to the body.

30. Bottom of mould-blown bowl; kick, 2 cm. deep, on under side; narrow, vertical ribs fan out at intervals from bottom; internally there are hollows between the ribs, giving a scalloped effect; walls 3 mm. thick at ribs, 2 mm. in hollows.

31. One-third of bottom and part of body of bowl, internal diam. at bottom 10 cm.; walls 2 mm. thick, increasing to 5 mm. at bottom. Spirally-trailed band, circular in section, dropped on at basal angle; diam. of trail at lowest circuit 4 mm. and at second circuit 2 mm.

32. Bottom and three pieces of body of bowl showing parts of three circuits of a spirally-trailed band dropped on at bottom; diam. of trail at lowest circuit 4 mm., and thinning thence to 2 mm. at highest circuit. On inside of bottom a central boss, on under side a puntee-mark. Internal diam. bottom 8·4 cm.; walls thicken from 2 mm. on body to 4 mm. at bottom excluding puntee-mark and boss.

Three other small fragments (not illustrated) bear trailed decoration.

MISCELLANEOUS

In addition to the pieces described there are about 350 unidentified fragments, mostly very small. Also associated with the group are:

1. Thirty-four pieces of badly-weathered window-glass. Many are shaped to form quarries of various forms and sizes; some have painted designs, e.g. of 'trellising' and curved lines. Colours now appear as red, white and black.

2. Broken stone, 6 cm. by 5 cm., on one face of which molten vitreous material which seems to be glass, not glaze, has run.

3. Fragment of glass, 4 mm. thick, triangular; at one angle it divides into two layers enclosing a very small limestone pebble.

4. Fragment of bottom of vessel, with puntee-mark, on which another piece of glass appears to have fused. Interior covered with hard-set material.

5. Concave fragment of glass containing a lump of greenish material. Analysis shows that it contains tin, lead, copper and calcium. TABLE I, p. 120, no. 7, A.M. 680578(x).

[19] F. Rademacher, *Die deutschen Gläser des Mittelalters* (Berlin, 1933), pl. 7c. This glass, along with others which were in the Rheinisches Museum when R. wrote, is now in the Kölnisches Stadtmuseum.

[20] Material in God's House Tower Museum, Southampton; for the site see G. H. Kenyon, *The Glass Industry of the Weald* (Leicester, 1967), 214–17. A full report on the glass from this site is in preparation by S. Moorhouse and R. G. Thomson.

[21] From excavations carried out by Dr. Colin Platt, to whom gratitude is due for access to the material in advance of his own publication. Found in pit 42, reg. no. 2604 (4).

POTTERY (FIG. 28, nos. 1–8)

Associated with the glass fragments was a quantity of pottery, including a few almost complete vessels and many capable of reconstruction. The greater part is Humber ware and is consistent with a late 15th-century date. Most of the vessels are of usual domestic types but a few, of which four are illustrated, appear from their shapes to have been designed for chemical or medicinal purposes; seven others contain residues from their original contents or show traces or stains of coloured powders, e.g. red, reddish-brown and green. Analyses of some of these residues are given in TABLE I, p. 120, nos. 3–6.

It is of interest to note that, although the group contained some sherds of Cistercian ware, none of these was decorated. This may be significant, for it is now becoming apparent that decorated Cistercian ware belongs to a short-lived period in the 1st half of the 16th century.[22] A date in the late 15th century could therefore be suggested for the group, in keeping with that suggested for the domestic wares.

1. Reconstructed jug, complete with handle but no lip, 21 cm. high, of oxidized Humber ware with dark red burnish on surface of shoulder. Flat bottom added and luted on. Scored horizontal lines; patch of green glaze on outside opposite handle. On inside extensive staining with adhesions of red and green powder; some staining on outside presumably occurred while jug lay in fragments. Analysis of residues shows iron, copper and calcium. TABLE I, p. 120, no. 6, A.M. 680577(x) and (w).

2. Reconstructed jug with lip, handle missing, 21 cm. high, of oxidized Humber ware; bottom added. Two scored horizontal grooves round body between handle-attachments; traces of brown glaze on upper part of body; vessel apparently was subjected to intense heat. Interior extensively stained with red powder coated in some places with green.

3. Small jug, handle, rim and part of neck missing, ht. as extant 10 cm.; oxidized Humber ware, unglazed, with light red ochre staining on outside. Nearly full of light-brown hardened matter, solidified at angle to plane of bottom; analysis shows this to be largely iron oxide and calcium. TABLE I, p. 120, no. 4, A.M. 680575.

4. Cucurbit, *c.* 17 cm. high; oxidized Humber ware, brown-glazed and now very dark with use. At 3·8 cm. below rim a projecting ledge, 1·6 cm. wide, to support rim of alembic.

5. Upper part, ht. as extant *c.* 23 cm., of pear-shaped vessel, presumably a cucurbit with rounded bottom, in reduced Humber ware; greenish-brown glaze; internal diam. rim 4·5 cm. Vessels of similar shape are illustrated by De Givry[23] and Forbes.[24]

6. Small shallow bowl, diam. 12·5 cm., with short projecting handle and added flat circular bottom; oxidized Humber ware brown-glazed on inside. Somewhat similar dippers appear in paintings of chemists' workshops by David Teniers[25] and are also illustrated by Forbes.[26]

7. Upper part of wide-mouthed vessel, ht. as extant *c.* 16·5 cm.; oxidized Humber ware with dark red burnish outside and medium-brown glaze inside, which extends (since vessel was dipped) on outside of rim to a more or less even depth of *c.* 7 mm.

8. Complete clay crucible, apparently unused and unfired; some black stains near lip; ht. 4·1 cm., max. internal diam. rim 6·6 cm. Twelve similar pieces occurred, three complete or nearly so, the rest fragmentary.

8A [Not illustrated, but shape as FIG. 28, no. 3]. Jug, handle and rim missing,

[22] Cistercian ware was initially defined in *Publns. Thoresby Soc.*, XLIX, no. 110 (1965), 116–19, pl. 38; a type series and bibliography and a full discussion of decorated Cistercian ware will be found in P. C. D. Brears, *English Country Potting* (Newton Abbot, 1971).

[23] G. de Givry, *Witchcraft, Magic and Alchemy* (trans. J. C. Locke, London, 1931), 379, taken from the corpus in Mylius, *Chemica: Basilica philosophica* (Frankfurt, 1620).

[24] Forbes, *op. cit.* in note 2, figs. 24, 44 and 55.

[25] De Givry, *op. cit.* in note 23, 376 and 378.

[26] Forbes, *op. cit.* in note 2, 113.

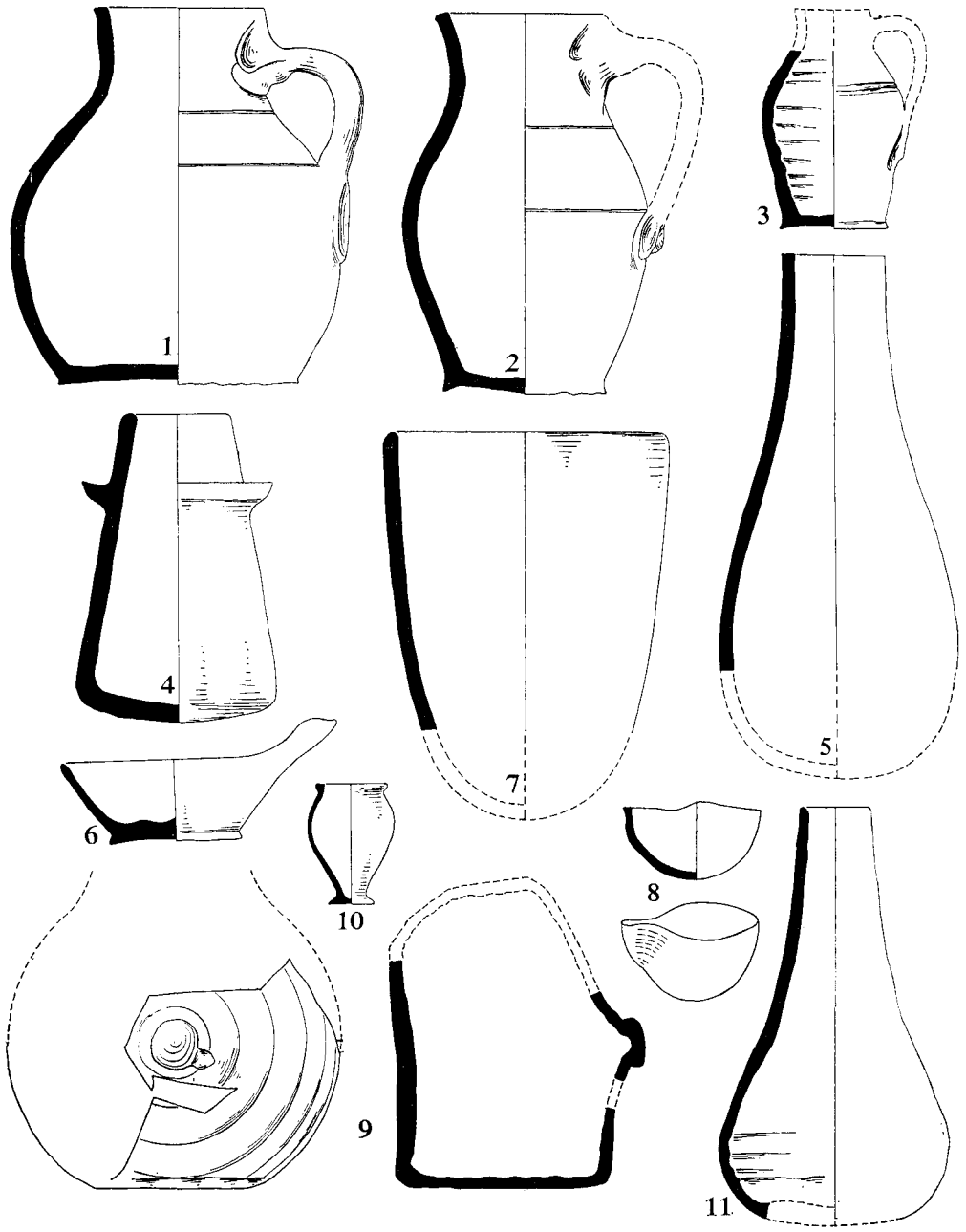

FIG. 28

PONTEFRACT PRIORY, W.R.YORKS., AND SELBORNE PRIORY, HANTS

Pottery vessels associated with distilling (nos. 1–8 from Pontefract, late 15th-century, p. 96; nos. 9–11 from Selborne, mid 15th-century, p. 101). Sc. $\frac{1}{4}$

otherwise unbroken; possibly Humber ware, much discoloured by secondary firing; added flat bottom. Very slight traces of yellowish-green glaze; on shoulder two horizontal grooves. Inside, residue of red powder, with some green, which, on analysis, yielded appreciable amounts of copper, iron and calcium with some zinc, as well as silicon. TABLE I, p. 120, no. 3, A.M. 680574(Y).

8B [Not illustrated]. One-handled jug, rim and part of neck missing; oxidized Humber ware, probably from kiln at Cowick, Yorks. Yellowish-green glaze on upper body and neck, and two pronounced horizontal grooves above base of handle. Internal adhesions which, on analysis, consisted mainly of calcium and phosphorus. TABLE I, p. 120, no. 5, A.M. 680576A(X).

During excavations at Kirkstall Abbey in 1954 the lower part of a small pot, of similar size and shape to no. 3, was found in the kitchen area.[27] It contained a red residue, darker in colour than those from the Pontefract vessels, on which the Department of Colour Chemistry, Leeds University, reported that the pigment consists essentially of oxide of iron and is contaminated with sand and earthy matter. A note by Dr. David Owen, who was in charge of the excavation, points out that the red oxide of iron, haematite, has been used as a mineral colouring agent for thousands of years.

B. GLASS AND POTTERY FROM SELBORNE PRIORY, HANTS

By STEPHEN MOORHOUSE

The priory of Selborne lies one mile north-east of the present village of Selborne and four miles south-east of Alton. It is important archaeologically because of its comparatively short life. It was founded in 1233 and appropriated to Magdalen College, Oxford, in 1484–6, a date which thus becomes the terminal one for the material here discussed. The associated glass and pottery distilling-vessels were found towards the S. end of the reredorter in the main drain, which flows past the E. end of the church down the E. wall of the reredorter range into Oakhanger Stream on the north (FIG. 29). That the group is of one date is evident by its concentration in the drain, since it occupied the full 3-ft. width for a length of *c.* 2 ft. and a depth of 2 ft. Although the pottery was not directly associated with the glass, the form of no. 11 (FIG. 28) suggests a distilling function, whilst nos. 9 and 10 (FIG. 28) have been included for their similarity to the glass. Although the priory was not finally dissolved until 1486, the house was in financial difficulty from the middle of the 14th century; by 1462 there were only four canons with their respective servants in residence, and in 1463–4 the prior was twice sued for debt in the sheriff's court. By 1484 the only resident was the prior, Thomas Ashford, and the buildings were ruinous.[28] The filling of the main drain may therefore be earlier than the final dissolution of the priory in 1486 by some twenty to thirty years, and a date around the middle of the 15th century can be assigned to the glass and pottery.

[27] D. E. Owen, 'Kirkstall Abbey excavations, fifth report, 1954', *Publns. Thoresby Soc.*, 1955, 77, 82, fig. 24, no. 7.

[28] D. Knowles and N. Hadcock, *Medieval Religious Houses of England and Wales* (London, 1953), 153, and *V. C. H., Hampshire*, II (1903), 175–180. The main source of information on this house is *The Charters of Selborne Priory*, ed. W. D. Macray (Hants Record Soc., 1891–4).

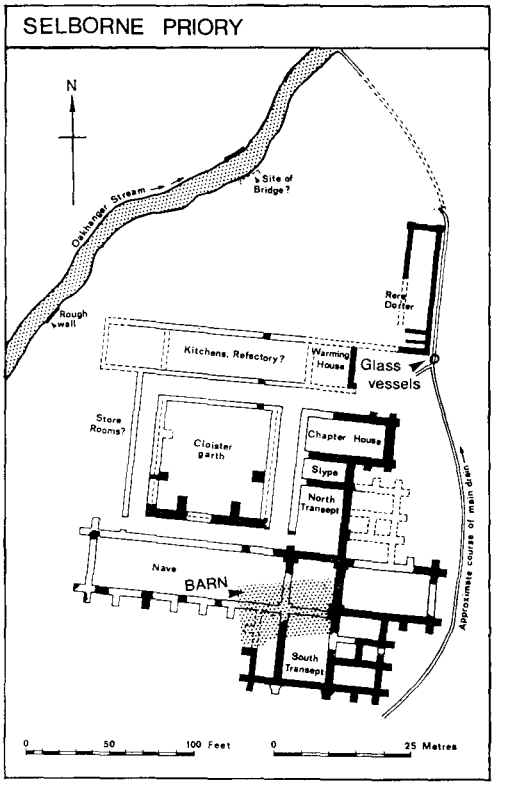

FIG. 29

SELBORNE PRIORY, HANTS

Plan showing location of mid 15th-century deposit of glass and pottery distilling-apparatus at S. end of reredorter (p. 98)

GLASS (FIG. 30, nos. 1–15)

All the glass is of the 'common green' type, the majority of it being badly laminated. All the pieces are listed, except for some two dozen small, unidentifiable fragments.

1. Reconstructed alembic: ten fragments, including dome, fragment of the vertical rim, fragment of collecting-channel and small pieces of body. A.M. 620592F.[29]

2. Reconstructed alembic: large fragment of dome and many small pieces which disintegrated during drawing. A.M. 620595.

3. Reconstructed alembic: eleven fragments, including complete rim. A.M. 620593B.

4. Reconstructed alembic: ten fragments, including complete dome, fragments of rim and collecting-channel, piece of top of spout where it joins body, two unconnected pieces of spout and various small pieces of body. A.M. 620592E.

5. Large piece of dome of alembic and many small pieces of body. A.M. 620596B.

6. Complete rim. A.M. 620594.

[29] Numbers following the description of the Selborne vessels refer to the laboratory number given to each piece when the group was conserved in the laboratory of the Inspectorate of Ancient Monuments.

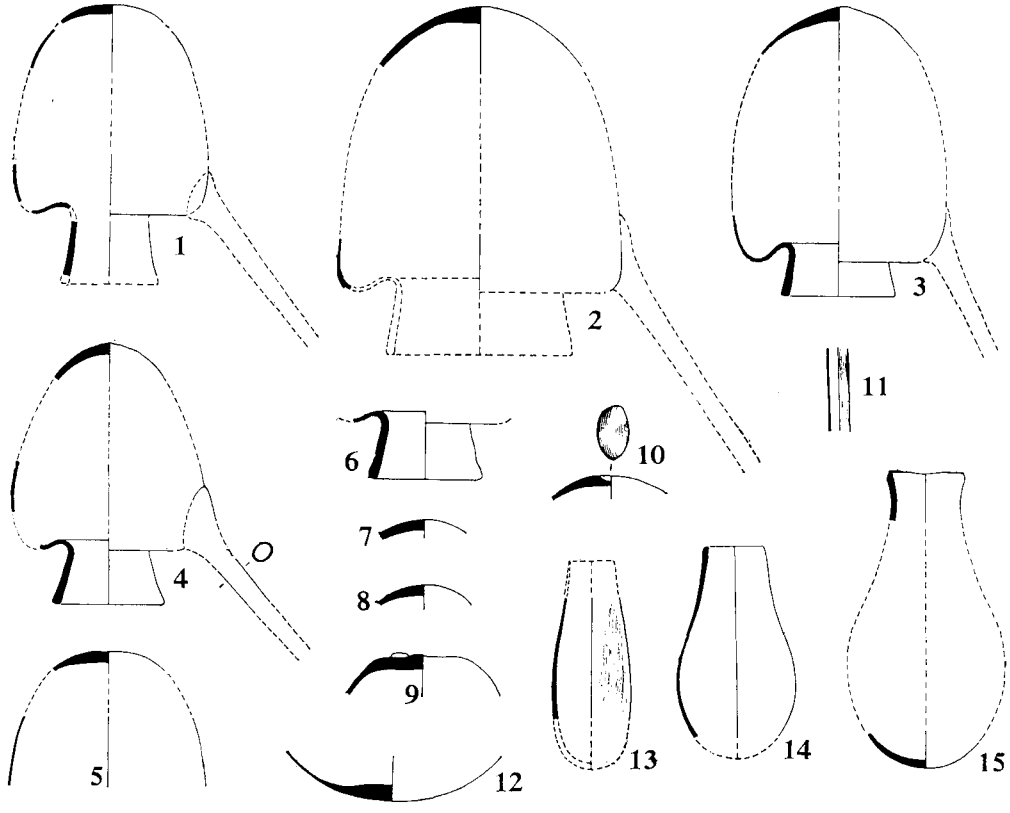

FIG. 30
SELBORNE PRIORY, HANTS
Mid 15th-century glass distilling-apparatus (pp. 99 ff.). Sc. $\frac{1}{4}$

7. Fragment of dome of alembic, or possibly bottom of flask, cucurbit, receiver or urinal.[30] A.M. 620596D.

8. Piece similar to no. 7, slightly flattened on top. A.M. 620596H.

9. Large fragment of dome of alembic, slightly flattened on top with scar of circular piece of applied glass, possibly a knob-handle, of a kind more frequently seen on later alembics, but more likely part of a puntee-wad. A.M. 620592A.

10. Large piece of dome of alembic (or of bottom of vessel, cf. no. 7), with oval depression in centre externally, which is possibly accidental, but could serve as a rudimentary foot of a vessel. A.M. 620596Z.

11. Fragment, 4·2 cm. long, from spout of alembic. A.M. 620596A.

12. Fragment of bottom of flask or large cucurbit (?), or of dome of large alembic similar to no. 2. A.M. 620596X.

13. Three fragments of receiver, one large enough to provide the drawn section. A.M. 620596C.

[30] It is obvious that hemispherical bottoms of this kind could belong to any one of these four varieties of vessel, as well as to alembics. In the Selborne deposit the presence of more than one of these types makes positive identification virtually impossible.

14. Thirteen fragments in silvery laminated glass, most small, but one large enough to provide the drawn section. A.M. 620597.

15. Two fragments, possibly from the same vessel, reconstructed as receiver or small cucurbit; the bottom piece seems too small to be the dome of an alembic. A.M. 620592D.

Complete rim of alembic (not illustrated), similar in size and form to no. 3. A.M. 620592H.

POTTERY (FIG. 28, nos. 9–11)

9. Lower half of costrel or flask in hard-fired, smooth sandy fabric with light grey core and pinkish inner surface; outside surface slightly duller, with patches of dull olive-green on shoulder. Neck missing and remaining pieces do not suggest its shape or position, so that reconstruction is not possible, for the type has many variations, mainly regional.

10. Small complete vessel in creamy sandy fabric with unevenly applied glaze on outside, varying from light green with brown speckles to dark green.

11. Nearly complete cucurbit in hard-fired smooth sandy light pinkish fabric, slightly darker on outside; bib of dull brownish-green glaze round lower shoulder. Inside, near bottom, residue of bright red powdery substance (see analysis, TABLE I, p. 120, no. 9), A.M. 640002.

All the material from the excavations is housed in the Wakes Museum, Selborne, Hampshire.

C. TYPES OF GLASS VESSELS FROM PONTEFRACT AND SELBORNE PRIORIES

By STEPHEN MOORHOUSE

ALEMBICS

A wide range of alembic forms is to be seen in late medieval illustrations[31] and it is perhaps curious that more forms are not represented in museums and from excavations. A possible explanation is that a great many appear to have been made of pewter, so that, when they had outlived their usefulness, they were melted down again. Glass examples are, however, known.[32] The commonest form is that represented by those reconstructed from Selborne (FIG. 30, nos. 1–4). This form is known, with little change, from Islamic[33] times to the 18th century, but despite this long history the earliest glass alembics from this country are those from Selborne (FIG. 30) of the middle of the 15th century and Pontefract (FIG. 27)

[31] Holmyard, *op. cit.* in note 16, 749, fig. 680, from Chapter Library, Canterbury, MS. Lt. B.8, fols. 60v, 61r, 61v, and Rademacher, *op. cit.* in note 19, pl. B opp. p. 48, after Brunschwig, *op. cit.* in note 5.

[32] Rademacher, *op. cit.* in note 19, pl. 5.

[33] A well-known example (see also p. 81) in the Victoria and Albert Museum, London (acc. no. 337–1900) is said by C. J. Lamm, *Mittelalterliche Gläser und Steinschnittarbeiten aus dem nahen Östen* (Berlin, 1930), 28, pl. i, no. 17, to be Egyptian and probably of the 6th to the 8th century, and he cites also E. von Czihak, *Schlesische Gläser* (Breslau, 1891), 183, fig. 46, for another example found in Silesia and now in Wroclaw (formerly Breslau). F. Rademacher, however (*op. cit.* in note 19, 46, note 6), thinks that the V. and A. piece belongs to the 16th century and can hardly be of Syrian (by which he seems to mean eastern) origin, and that the Wroclaw glass is not antique. R. J. Charleston believes it is unsafe to attempt to date the V. and A. alembic closely, although its good-quality green glass suggests that it is Egyptian and probably medieval. I am grateful to Dr. D. B. Harden for drawing my attention to the doubts about the date of the V. and A. piece and for providing these references, and to Mr. Charleston for his comments.

of the late 15th century. It is likely that future work on glass deposits may produce an earlier dated example. Other glass alembics of this form are known from the manor of the More at Rickmansworth, Herts., of *c.* 1520 (PL. XI, C);[34] the mid 16th-century glasshouse site at Knightons, Surrey;[35] a deposit at Bramber Castle, Sussex, of the 16th century;[36] and a late 16th- to early 17th-century deposit from the site of no. 8 Castlegate, Nottingham (a large piece incorporating the spout and collecting-channel).[37]

CUCURBITS

It is extremely rare for glass cucurbits to survive in archaeological contexts. They suffer the same fate as any thin glass vessel in that, when smashed, they are virtually beyond repair, and only the more durable pieces like the rim and bottom survive. As few are known from dated deposits, it is extremely difficult to see any development in form, and indeed those which survive appear normally to be of the same shape. This is implied by the rather singular design of the alembic rim in manuscript illustrations throughout the period. Apart from the nearly complete example from Chester,[38] others are known from the early 16th-century glasshouse at Bagots Park, Staffs.;[39] the late 16th- to early 17th-century glasshouse site at Buckholt, Hants;[40] and a pit on the site of Angel Court, Trinity College, Cambridge, of the 2nd quarter of the 17th century.[41] The evidence of the Selborne example (FIG. 30, no. 14) carries glass cucurbits of this form back into the middle of the 15th century,[42] the argument that it is a cucurbit and not a receiver (see below, p. 103) being strengthened by the presence in the same group of a small rim of an alembic (FIG. 30, no. 1) capable of being used with a cucurbit of this size.

RECEIVERS

Glass receivers appear to have altered little in shape during the medieval and later periods[43] and generally take the form of the Selborne example (FIG. 30, no. 15), although later paintings suggest that domestic vessels were also being used to catch the distilled liquid.[44] This may have been so during medieval times

[34] *Loc. cit.* in note 8.

[35] Among material displayed by E. S. Wood at the glass conference of the Society for Post-Medieval Archaeology at St. Helens (Lancs.), April 1970; for interim reports on this site see *Post-Med. Archaeol.*, II (1968) 191, *id.*, III (1969), 204–5, and Kenyon, *op. cit.* in note 20, 208.

[36] Material in Barbican House Museum, Lewes, no. 57:18. The deposit contains rims from flat-topped flasks with cylindrical necks, a rim of a urinal and two nearly complete cups of Tudor green ware, type 4, in addition to the fragments of alembic. Publication forthcoming.

[37] Material in the Castle Museum, Nottingham, no. 66–170.

[38] *J. Chester and N. Wales Archit., Archaeol. and Hist. Soc.*, n.s. XXXIII (1939), 22, pl. v, no. 4.

[39] *Post-Med. Archaeol.*, I (1967), 71–2.

[40] See note 20.

[41] *Proc. Camb. Antiq. Soc.*, LVIII (1965), 117, fig. 17, A2/4.

[42] R. J. Charleston, *op. cit.* in note 39, 72.

[43] Rademacher, *op. cit.* in note 19, 46, fig. 2, from a German manuscript at Nuremberg dated 1416–1419; Holmyard, *op. cit.* in note 16, 741, fig. 668, and 745, fig. 677, both from Thomas Norton's laboratory of *c.* 1470–1480 and *Le Livre de la très Sainte Trinité* of the mid 17th century; D. Duveen in *Ambix*, III, nos. 1 and 2 (1948), pls. 7–8.

[44] 'The Alchemist's Laboratory' by David Teniers of *c.* 1650, conveniently illustrated in A. Barclay, *Pure Chemistry*, pt. I (Science Museum Publn., H.M.S.O., 1937), pl. iv.

also, but the few contemporary illustrations depicting chemical apparatus show gourd-shaped receivers of the Selborne type. The evidence from Pontefract suggests that domestic jugs were used in the chemical process, but their precise function is not clear; certainly there is no reason why domestic vessels should not be used as receivers. The difficulty of differentiating between bottoms of receivers and cucurbits has already been mentioned. This is equally true of the complete forms of these vessels, particularly among smaller examples, where both kinds are identical. The only feature differentiating them appears to be the rim. Cucurbits tend to have a straight-sided body tapering up to the rim, whereas receivers have a slight contraction of the body towards the rim, forming a neck and giving the rim a tendency to flare outwards (cf. FIG. 30, no. 15). In some the difference is barely discernible, but that some difference existed seems to be confirmed by manuscript illustrations.

MISCELLANEOUS

Identification of glass shapes from fragments is difficult unless a piece forms a distinctive part of a vessel, i.e. rims from urinals, alembics, etc. Complete vessels of a finer kind—decorative or ornamental rather than for common use—have found their way into museums. Until recently, however, little attention was paid to fragmentary domestic glass, so that the complete profiles known for domestic glass fall far short of the range suggested by incomplete pieces. The ambiguity of small dome-shaped 'bottoms' has already been noticed (p. 100, note 30). The forms to which most of the Pontefract green glass belong can only be conjectured, although basic types, i.e. flasks, etc., can be recognized. FIG. 27, no. 26, is likely to be the bottom of a lamp of a type known from the 11th century onwards in Europe. A complete 13th-century example is known from Winchester;[45] a bottom was found at the 13th- to 14th-century glasshouse site at Wephurst, Kirdford, Surrey;[46] and examples also came from Tynemouth Priory.[47] This type was also copied in pottery during the 12th and 13th centuries.[48] Neck-fragments (FIG. 27, nos. 19 and 20) possibly come from long-necked flasks similar to the one from Bagots Park;[49] indeed, tubular glass of this general type is common on glasshouse sites. The 'vents' from Pontefract (FIG. 27, nos. 9–12) are hard to assess, for they are among the first of their kind to be identified and do not appear to belong to any recognized form of glass vessel found in this country. They may be parts of vessels resembling the more recent glass inkwell, the 'funnel' being the device to prevent spilling. If so the drawings are the wrong way up. Similar pieces in the National Museum, Stockholm,[50] are described as candlesticks.

[45] Harden, *op. cit.* in note 1, fig. 4; *id.* in *Archaeol. J.*, CXXVII (1971), 105, pl. xiii, D; and Kenyon, *op. cit.* in note 20, pl. xv.

[46] Kenyon, *op. cit.* in note 20, pl. xiii, no. 3, and (for the site) pp. 180–2.

[47] *Archaeol. Aeliana*, 4 ser., XLV (1967), 85, fig. 12, nos. 2–3, and p. 84; see also Rademacher, *op. cit.* in note 19, pls. 18–20.

[48] For the type in pottery see *London Museum, Medieval Catalogue*, new ed. (H.M.S.O., London, 1967), 174–6, fig. 54, no. 8; for its development, *Oxoniensia*, XV (1950), 57–9.

[49] *Op. cit.* in note 39, 69, fig. 20, no. 6.

[50] See C. J. Lamm, *Glass from Iran in the National Museum, Stockholm* (Stockholm 1935), pl. 14, F and G (fragments similar to those from Pontefract), and pl. 14, K (complete form). I am grateful to Mr. R. J. Charleston for discussing these pieces and providing this reference.

However, the aperture in some of the Pontefract pieces makes it impossible for them to be either inkwells or candlesticks. Whatever their function, it is of interest that they are associated with a group belonging to the later 15th century, most of the vessels in which would be used in distilling or some ancillary process.

III. POTTERY DISTILLING-EQUIPMENT

By STEPHEN MOORHOUSE

TERMINOLOGY USED FOR PARTS OF THE POTTERY STILL

To avoid confusion a standard terminology is used throughout this paper to describe the vessels forming the distilling-unit. The terms listed by Moore for the parts of the glass unit (p. 88 f.; FIG. 25) have been retained for its pottery counterpart where basic form and function are the same. However, as certain variations from the glass still occur in the lower part of the pottery unit, the terms used for the vessels making up the latter are defined below. As the precise functions of some of these vessels are uncertain, and as it appears that vessels of the same form were not always used for the same purpose, these definitions are based on form alone and should be regarded as tentative. Further research may require a new terminology for the pottery still, its combinations and variety of uses.

A. BASE (FIG. 32)

This took the form of a bowl with an internal or, more commonly, an external flange. An alembic of type 2 (p. 110 f.) would rest on the flange, so that the base took the place that the cucurbit occupied in the glass still (FIG. 31, nos. 7 and 8). The flat bottoms of some bases possibly allowed them to be placed on a retort. The combinations and different uses are discussed on p. 113f.

B. PEDESTAL-BASE (FIG. 33, NO. 13)

This was similar in form to A, but of stouter construction and with vertical lug-handles on the wall of the bowl. It differed in function from A in that it was apparently self-supporting on a pedestal and was made to hold a cucurbit seated within it and held in place by a deposit or filling inside the vessel which formed a cushion for it. The method of use and function are discussed on p. 114 f.

C. 'BOTTLE'-LIKE VESSEL

This is defined and discussed on p. 115f.

The identification[50a] of the complete 'bowl' (FIG. 32, no. 5) from Toynton All Saints, Lincs., as a distilling-base prompted me to look in more detail at thick-

[50a] I recognized it as such amongst a collection of material from the kiln at Toynton All Saints which was displayed at the Lincoln conference of the Society for Post-Medieval Archaeology in March 1969.

bodied bowls with either internal or external flanges and at pottery chemical apparatus in general. My survey is not intended to be exhaustive, but rather to point out the problems in the interpretation and use of these vessels. I at first proposed to deal only with medieval types; but it has seemed worth while to include the 17th-century group from Lambeth Hill because of the light it throws on medieval counterparts.

DOCUMENTARY EVIDENCE

We do not know when pottery distilling-equipment began to be used. Archaeological evidence suggests that bowl-type bases had been introduced by the late 13th century (FIG. 32, nos. 4 and 7), but there is little or no evidence for pottery alembics at such an early date, although on the evidence of later examples a complete unit comprising alembic and base is to be suspected. Chaucer, wiriting in the late 1380s or the 1390s, describes the equipment and atmosphere in a contemporary laboratory,[51] mentioning 'sondry vessels maad of erthe and glas, oure urynales and oure descensories [vessels for making extracts], violes, crosletz [crucibles] and sublymatories, cucurbites and alambikes eek'. He also describes the grinding of the various powders, which were placed in 'an erthen pot' and 'ycovered with a lampe of glas', which was then sealed by 'enlutyng' and placed on an 'esy [slow burning] fir'.[52] The reference to the 'vessels maad of erthe' is of interest in confirming the early introduction of those of pottery. Although their precise forms are not described, the reference to a 'lampe of glas'[53] implies that they were either bases or cucurbits. The use of urine as a medieval medicinal prescription is well known and its distillation is seen in medieval and later illustrations.[54] This explains Chaucer's reference to urinals and also their presence in quantity in the Pontefract deposit, although there is as yet no evidence for urine in the analyses (TABLE I, p. 120). Crucibles were also found at Pontefract (FIG. 28, nos. 8 and possibly 7) and Gresham Street (FIG. 33, no. 4), but the crucible-like vessels from Lambeth Hill (FIG. 33, nos. 11 and 12) are more likely to be mixing mortars of the type seen in Brueghel's paintings.[55]

Pottery vessels in general are rather infrequently referred to in medieval documents, but in household accounts of the 16th and 17th centuries references

[51] F. N. Robinson, *The Works of Geoffrey Chaucer* (2 ed., London, 1957), 'The Canon's Yeoman's tale', 216, ll. 791–4.

[52] *Ibid.*, ll. 761, 764, 766, 768. The techniques and vessels cited in this extract are fully dealt with in Holmyard, *op. cit.* in note 16, 731–52.

[53] 'Lampe of glas' could lead to confusion. From Tyrwhitt's reading, 'lamp of glass' (T. Tyrwhitt, *The Canterbury Tales of Chaucer*, III (Edinburgh, 1855), 151), it could be interpreted as 'glass alembic'. But modern commentators take the phrase to mean 'plate or sheet of glass' (lampe=*lambe*, OF 'lame', Lat. 'lamina'): see Robinson, *op. cit.* in note 51, 761, note to l. 764, and W. W. Skeat, *The Complete Works of Geoffrey Chaucer* (2 ed., Oxford, 1961), vol. entitled 'Notes on the Canterbury Tales', 422, note to l. 764.

[54] On this point see the 17th-century *Cabala Mineralis Rabbi Simeon ben Cantuar*, B.M. Add. MS. 5245, illustrated in Burland, *op. cit.* in note 6, 134. A reduced grey-ware jug of Hertfordshire type contained on analysis incrustations of urine pigment; it must have been used to store urine (G. C. Dunning, 'A medieval jug and its contents', *Lancet*, 11 July 1942, 56).

[55] E.g. in 'The Alchemist', engraved in 1558; see Barclay, *op. cit.* in note 44, 25, pl. iii.

to 'stills'[56] or 'lymbecks'[57] are fairly common; mention of pewter stills[58] is frequent, since vessels of this material are invariably dealt with separately in inventories. One useful reference is found in Sir William Petrie's accounts for 1550,[59] where payment is made to 'Prentice, the potter at Stock' for various domestic vessels (the names of which in themselves are of interest), and 'also a still with cups for it, and two watering-pans'. The same accounts record that Lady Petrie bought '6 stilling glasses' at Chelmsford for distilling herbs.[60] Presumably these were really of glass, but the other reference is valuable, since it not only mentions 'the potter at Stock' (Essex),[61] but also 'a still with cups for it', that is, a complete still, i.e. alembic and base with receiver or alembic with receivers. This, though ambiguous, at least shows that pottery vesesls were competing commercially with those of pewter and glass in the middle of the 16th century. The inventory of John Twine,[62] a grocer of Winchester, taken on 16 November 1583, lists various items from his shop, including counter, chests, weights, balances, brass mortars, gallepotes and 'one lymbike and a stillorage'—another puzzling reference, for the two terms are synonymous. Possibly future documentary research will provide an explanation. This record at least shows that other tradespeople besides alchemists and herbalists used distilling-equipment.

An illustration of Thomas Norton's laboratory of *c.* 1470–1480[63] shows a multiple pottery still. It is worth describing the vessels in detail for the light they shed on medieval distilling techniques and forms. The basic unit is made up of three type-2 pottery alembics (see below, p. 110 f.) set one upon another in decreasing sizes, with the smallest at the top. The lowest one is resting on a pottery cucurbit of the glass type (FIG. 28, nos. 5 and 11), which in turn rests on a bowl, but this is obscured by a brick furnace which surrounds it, making it difficult to see any detail. A surrounding furnace of this kind appears to be a common feature of later medieval distilling-units, judging from contemporary illuminated manu-

[56] 'An olde stille . . . vs.' and 'an other litell still . . . iiijs. vjd.' are mentioned in Archbishop Parker's inventory of 1575 (*Archaeologia*, XXX (1844), 22) and in an inventory of a gardener, George Bradford, in 1671, a 'still head' is mentioned (*Farm and Cottage Inventories of Mid-Essex 1635–1749*, Essex Record Office publn. no. 8, p. 209, no. 166). Another interesting reference occurs in Sir Thomas Fairfax's inventory of Walton Hall taken in 1624: 'Fower stills, a sellar for glasses, two shelves and three in the wall all full of glasses with distilled water' (*Archaeologia*, XLVIII (1885), 139).

[57] 'A Lymbeck' is referred to in the Walton Hall inventory of 1624 (*op. cit.* in note 56, 148).

[58] Sir Thomas Ramsey's inventory of 1590 refers to 'Item . . . iij pewter stills . . . 20s.' (*Archaeologia*, XL (1881), 332); nearly contemporary pewter stills can be seen in paintings by Pieter Brueghel the Elder, e.g. in 'The Alchemist' (cf. note 55) and in 'The Extraction of the Stone of Madness or The Dean of Renaix', engraved in 1556–7 (Jacques Lavalleye, *Brueghel and Lucas van Leyden* (London, 1967), pl. 39). Indeed alembics which by their symmetry appear to be of metal are frequently seen in late medieval illustrations. These are most likely of pewter, since so many in this metal are mentioned in inventories. That more have not survived in museums is probably because they could readily be melted down and the metal reused. The Scottish Lord Treasurer's accounts for 1501–1508 show that silver alembics also existed at this period (Holmyard, *op. cit.* in note 16, 746).

[59] F. G. Emmison, *Tudor Secretary* (London, 1961), 158.

[60] *Ibid.*

[61] See *V.C.H., Essex*, II (1907), 414, and Brears, *op. cit.* in note 22, for the later industry at this site.

[62] Hampshire Record Office; Administration, 1583. I owe this reference to Mr. Derek Keene of the Winchester Research Unit.

[63] Thomas Norton, 'Ordinall of Alchimy' in Elias Ashmole, *Theatrum chemicum Britannicum* (1652), B.M. Add. MS. 10303, which is illustrated in Holmyard, *op. cit.* in note 16, 745, fig. 677. For a different version of the same scene see J. R. Green, *Short History of the English People* (London, 1893), 573, adapted from the same B.M. manuscript.

scripts and illustrations. Suspended on the ends of the alembic-spouts are receivers similar in shape to those from Selborne (FIG. 30, nos. 13–15). This in itself suggests that the alembics must have been of pottery, for the spouts of glass alembics would hardly withstand the weight of a receiver and its contents. The multiple still implies a free passage of air throughout the unit and indicates that the tops of at least some pottery alembics may have been open. A unit on the right of that just described displays the same arrangement of furnace and cucurbit, but a conical alembic is suspended above the cucurbit by three long inward-sloping legs; no spout is visible and the purpose of the unit is not clear. The illustration suggests that pottery alembics and cucurbits of glass type were used in the same manner as their glass counterparts, instead of the alembic being seated on the base and the cucurbit being supported independently by the deposit within the base.

TYPES OF DISTILLING-VESSELS

ALEMBICS

All pottery alembics known can be divided into two groups, depending on the type of base with which they were used.

Type 1 (FIG. 31, nos. 3–6)

This is basically a copy of the typical glass form with a domed or semi-domed top, an inner collecting-channel, and a hollow, splayed-out pedestal-type rim. This last feature limits the range of cucurbits with which the alembic can be used, for the inner face of the rim must rest on the tapering outside surface of the form of cucurbit found at Pontefract and Selborne (FIG. 28, nos. 5 and 11). It is unlikely that this type of alembic was ever purposely made for use with the type of base represented by that from Nuneaton, Warws. (FIG. 31, no. 8), although it could be argued that the internally-flanged bases (FIG. 32, nos. 10 and 11) could accommodate the external curve of the collecting-channel found on the example from Fenchurch Street, London (FIG. 31, no. 4). This would, however, require a substantial cut-out in its rim to clear the spout of the alembic, and no vessel of this type has so far been identified.

Alembics of type 1 are known from Oxford (FIG. 31, no. 3), Fenchurch Street, London (FIG. 31, no. 4) and Surrey Street, London, an example in Raeren stoneware (FIG. 31, no. 5). This last piece is the only stoneware example from this country as far as I know, but they exist on the continent. The rim-fragment from Selborne (FIG. 31, no. 6) is probably of this type and was intended to fit a cucurbit similar to that from Jedburgh Abbey, Roxburghshire,[64] although it could fit either of the forms of bowl-shaped base.

Type 2 (FIG. 31, nos. 1–2, 7)

This form is restricted to pottery. It has all the main features of type-1 alembics except the projecting rim at the bottom. Its dome, however, is invariably

[64] *Proc. Soc. Antiq. Scotland*, LXXXIX (1955–6), 77, fig. 2.

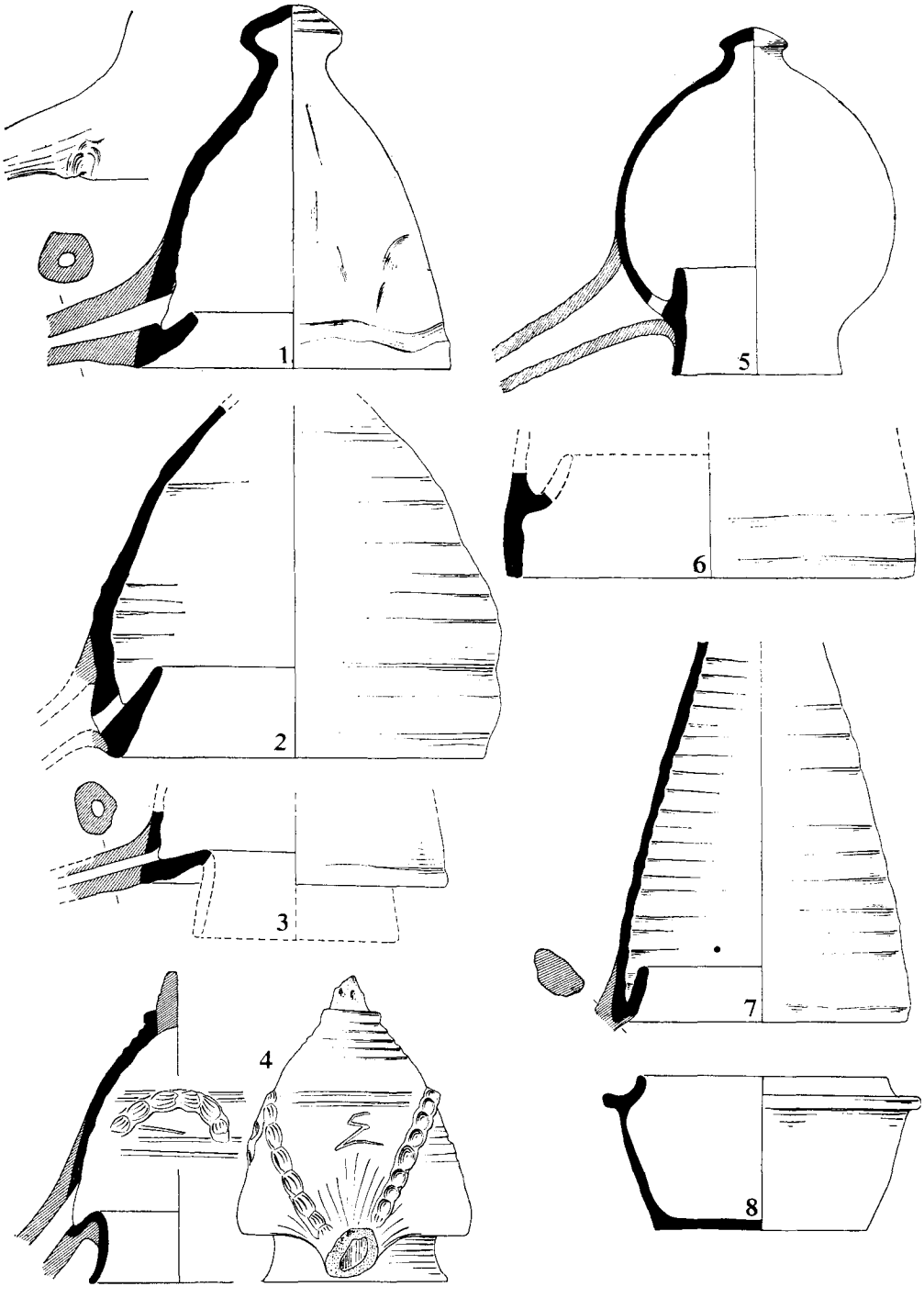

FIG. 31

LATE MEDIEVAL POTTERY ALEMBICS OF TYPE 1 (nos. 3–6, pp. 107, 116) AND TYPE 2 (nos. 1–2, 7, pp. 107, 109, 115 f.) AND POTTERY BASE (no. 8, pp. 107, 116). Sc. ¼

1. Friary Lane, Nottingham; 2. Hailes Abbey, Glos.; 3. Bodleian Library tunnel, Oxford; 4. Fenchurch Street, London; 5. Surrey Street, London; 6. Selborne Priory, Hants; 7 and 8. Nuneaton kiln-site, Warws.

in the shape of a tall cone, unlike that of type 1, which is more rounded, and, indeed closer to the glass prototypes. The cone-shaped dome could reflect the type of distilling-unit. It is evident that type-2 alembics were used with externally flanged bowl-type bases, as implied by the Nuneaton pair found in one kiln-group. The Lambeth Hill, London, base (FIG. 33, no. 13) shows that round-bottomed cucurbits were used in these bases. A possible explanation for the tall dome of type 2 could lie in the necessity to include within it the height of a cucurbit set in the base. The idea of a secondary, isolated internal cucurbit was known in some form at a later date, as the Lambeth Hill pedestal-base shows.

Alembics of type 2 are known from Nottingham (FIG. 31, no. 1), Hailes Abbey, Glos. (FIG. 31, no. 2), and Nuneaton, Warws. (FIG. 31, no. 7). A rim from Bodiam Castle, Sussex,[65] is to be dated after 1386, when the castle was founded. The rim from a vessel of this type, associated with the Lambeth Hill pit-group (FIG. 33, no. 14), shows that this form persisted into the 17th century, although it appears that this particular alembic was not used in the conventional manner, but was supported by three feet on the shoulder of the cucurbit(?).

The application of a spout to a pottery alembic is carried out in two ways. The commoner method appears to be to fashion the spout by rolling, attach it to the alembic body and then pierce a hole through the spout and body just above the angle of the collecting-channel. This method is suggested by the Nuneaton example, where the hole was never pierced; instead, the spout was formed round a spigot projecting through the wall of the alembic from the bottom of the collecting-channel. A less common method is seen in the examples from Hailes Abbey and Surrey Street, London (FIG. 31, nos. 2 and 5), where the spout has been thrown in the form of a long tapering tube, the broad end of which is then attached to the body after the drainage-hole from the bottom of the collecting-channel has been pierced. Large thick spouts(?) with narrow central holes, heavily rilled with throwing grooves on the outside, are known from contexts of the 1st half of the 17th century at Basing House, Hants[66] and the kiln-site at Milney Road, Ash, Surrey.[67] No certain explanation can be given for these pieces; it is possible they are spouts from large alembics.

The drawing of Thomas Norton's laboratory (pp. 108, 110) suggests a possible reconstruction of the alembic dome. That multiple units were built up is evident, but no finished top from a pottery alembic forming such a unit has been identified. Because of the uncertainty no reconstruction has been attempted. The handled top is a feature of some later glass alembics, but is not present at Pontefract or Selborne, and none has been recognized from medieval archaeological contexts

[65] *Sussex Archaeol. Coll.*, LXXVI (1935), 228, fig. 5, pot 42.

[66] Now in the museum at Basing House, near Basingstoke.

[67] Excavated by F. W. Holling and now in Guildford Museum. I am grateful to Mr. Holling for showing me this piece. The spout of an alembic was found in an early 15th-century kiln at Cheam, Surrey (*Surrey Archaeol. Coll.*, XXXV (1924), 84, fig. 5); another was found in excavations at Farnborough Hill, Hants, in 1970 (inf. from J. H. Ashdown).

in this country.[68] It is tempting to suggest that it was mainly a later innovation, the earlier examples having plain domed tops. A large irregular pottery vessel was found at Bodiam Castle, Sussex,[69] which could be interpreted as the top of an alembic.

Present evidence suggests that both types of pottery alembic existed in the later medieval period and well into the 17th century. The pottery distilling-bases from later 13th- and 14th-century contexts might indicate that pottery alembics were introduced earlier, but, as the late 14th-century description by Chaucer shows, 'an erthen pot . . .ycovered with a lampe of glas' was an accepted form of unit.[69a] It may be that pottery alembics were a later innovation, or were only used for specialized forms of distillation. A wide range of alembic forms in glass is known from manuscript and documentary sources and some of these may have been copied in pottery, but so far the only pottery examples that have been recognized are those reflecting the characteristic profile of the glass alembic described in this paper.

Pottery alembics and bases are also known on the continent. A complete stoneware alembic, similar in form to the example from Surrey Street, London (FIG. 31, no. 5), with a slightly more rounded profile, comes from Lilletorvet in Trondheim, Norway.[70] This is undoubtedly an import from the Raeren factories, as is the London example. Type-2 alembics were also current on the continent, for a rim incorporating the collecting-channel was found at the monastic establishment at Mariendael, near Utrecht, Holland.[71] It is in the characteristic Dutch red earthenware belonging generally to the 15th and 16th centuries, and probably before the 1570s, when the Dutch reformation took place. The Stuttgart Museum contains a distilling-base from an unknown site in the Biberach area of SW. Germany.[72] It is complete with thick walls and of crude construction, 25 cm. diam. and 24·6 cm. high. The lower part of the vessel is vertical, but the shoulder is defined by a shallow girth groove above which the neck tapers upwards. Within it was a hoard of 293 coins, the latest of which suggests that it was buried shortly after 1428. This find is of interest for two reasons. First, the vessel resembles in shape distilling-bases seen in paintings by Brueghel and later artists, and since the vessel is a good deal earlier than these paintings, it also shows that the form had a long life. Secondly, its contents, together with the Hartford, Hunts., coin-

[68] Unless the broken scar on an alembic dome from Selborne (FIG. 30, no. 9), which appears to have been hollow when complete, is the remains of a handle of this type. An example of the 1st half of the 17th century was found in St. John's Street, Chester (*op. cit.* in note 38, 22, pl. v, no. 7).

[69] *Op. cit.* in note 65, 220, fig.1, pot 21.

[69a] If 'lampe of glas' means 'plate or sheet of glass' (see note 53), it follows that the' erthen pot' was not covered by a pottery alembic. It could however be interpreted as a reference to a particular or specialized form of distilling-unit, but is not evidence for the introduction of the pottery alembic in the late 14th century or later.

[70] *Foreningen til Norske Fortidsminnesmerkers Bevaring*, CXIX (1964), 193.

[71] J. G. N. Renaud, 'Aarewerkvondsten van het klooster Mariendael', *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek*, IX (1959), 204, 207, fig. 8, no. 7. The true function of the piece was not recognized and it is illustrated upside down.

[72] Uwe Lobbedey, *Untersuchungen Mittelalterlichen Keramik, vornehmlich aus Südwestdeutschland* (Berlin, 1968), 116, fig. 70, no. 7. The identification of this pot as a distilling-base is based on the illustration only and on its similarity in form to English vessels. It bears no resemblance to common contemporary shapes from the Biberach area.

hoard found in a bowl of the type used in a distilling-unit (p. 114), suggest that these two pots may have been used for assaying by fraudulent alchemists. It is therefore apparent that ceramic vessels purposely made for distillation and its various sidelines were used on the continent as well as in Britain. A closer inspection of continental collections will undoubtedly reveal many more examples.

CUCURBITS AND DISTILLING-BASES

It will be shown in the next paragraph that to identify all flanged-rim bowls as distilling-bases is hazardous, but some possess characteristics to show that they were so used. These include thick bodies, internal glaze, external sooting towards and under the base, and an external and, less frequently, an internal rim-flange. These features may not occur together on the same vessel, for it is apparent that the vessels served more than one purpose. Although it was the identification of the 'bowl' from Toynton All Saints, Lincs. (FIG. 32, no. 5) as part of a distilling-unit that led to this survey, this is the only one known which shows any sign of the cut-out in the rim which would be required to accommodate the spout of an alembic. Internal and external rim-flanges are to be expected on this type of vessel, but caution is necessary, since they are also frequent on jars and cooking-pots in certain regions of the country during the 15th century.[73] Among material from the kilns at Hinderclay, Suffolk, in Ipswich Museum there are quantities of flanged rims similar to FIG. 32, no. 8, but flatter; no complete profiles of the vessels, however, are known from that site. Material from various sites in Norwich Castle Museum shows that this type of rim comes from tall storage-vessels and that the rim is a lid-seating. Despite this ambiguity vessels of this general form with rim-flanges (FIG. 32), found in contexts earlier than the 15th century, particularly in areas where lid-seating is not common on later vessels, probably belong to a distilling-unit; but more research on a regional basis is required before this can be verified. The process described by Chaucer as 'enlutyng', i.e. the sealing of the junction between alembic and cucurbit,[74] does not appear to have left its mark on any of the pottery vessels so far examined, nor on any of the better-preserved glass vessels. Despite this, such a sealing should be looked for on pots with a flanged rim, since it may well be decisive in their identification.

I have attempted to illustrate a comprehensive range of distilling-bases and cucurbits (FIGS. 28 and 32). At present it has been thought undesirable to classify the bowl-type bases further, for it is apparent that they served different purposes and on present knowledge it is difficult to separate the types on form alone. However, many variations other than those illustrated here occur in both bases and cucurbits, and it may be possible in the future to define regional variations. Rims differing from the typical pottery version of the glass type (FIG. 28, nos. 5

[73] See E. M. Jope, 'Medieval pottery lids and pots with lid-seating', *Oxoniensia*, XIV (1949), 78–9, fig. 2; *Med. Archaeol.*, V (1961), 274; *id.*, VI–VII (1962–3), 147, fn. 78.

[74] On this point see FIG. 23; see also *Proc. Soc. Antiq. Scot.*, XI (1874–5), 193, where the 17th-century process of 'enlutyng' is described in detail.

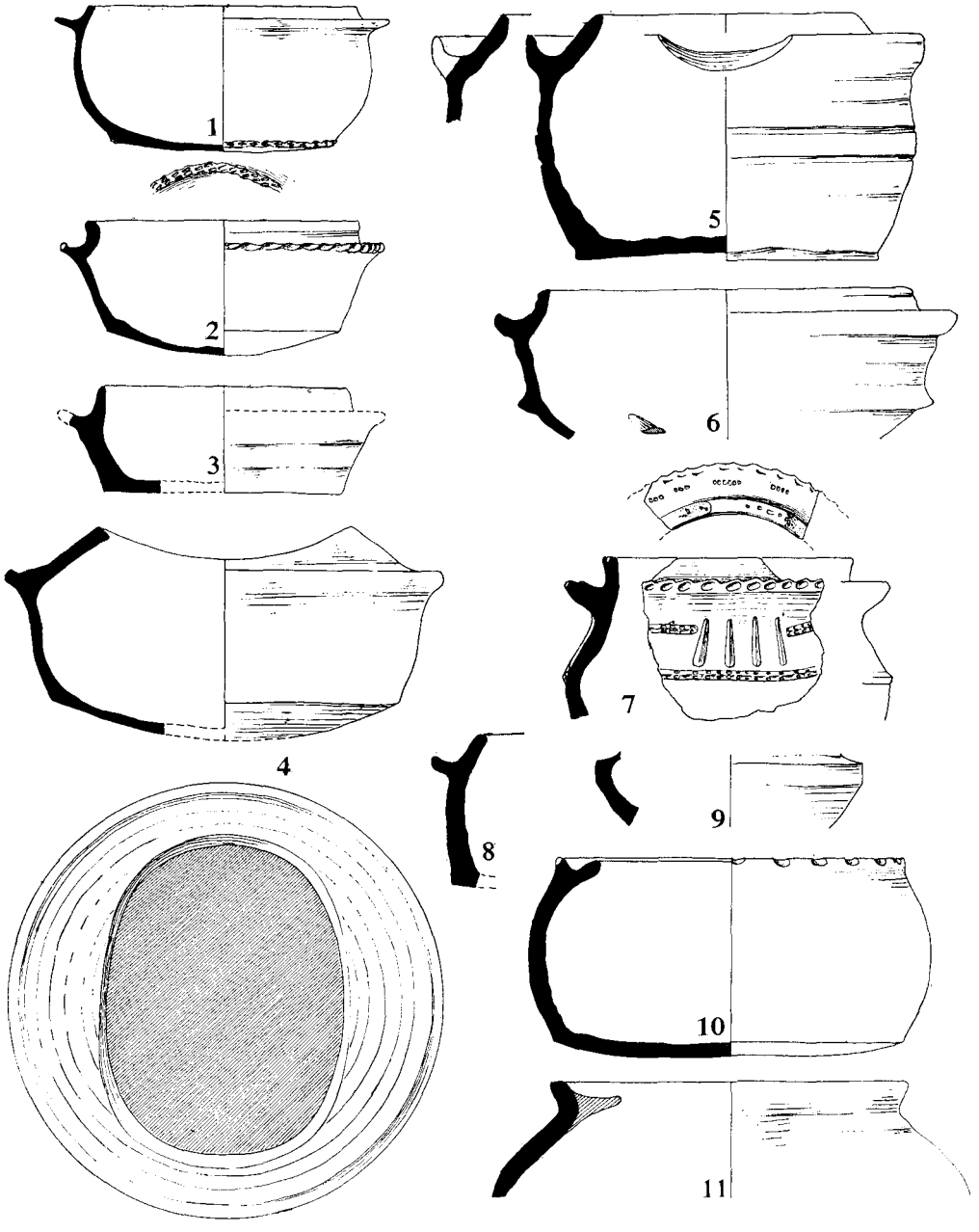

FIG. 32

14TH- TO 16TH-CENTURY POTTERY DISTILLING-BASES
(pp. 111, 113, 116 f., 119). Sc. $\frac{1}{4}$

1. Gracechurch Street, London; 2. Gresham Street, London; 3. Brill kiln-site, Bucks.; 4. The Woolhouse, Southampton, Hants; 5. Toynton All Saints, Lincs.; 6. Guy's Hospital, London; 7. Bentley kiln-site, Hants; 8. Watton Priory, E.R.Yorks.; 9. Biddenden kiln-site, Kent; 10. Brasenose College, Oxford; 11. Lyveden kiln-site, Northants.

and 11) can be seen at Pontefract (FIG. 28, no. 4) and Jedburgh Abbey,[75] where they belong to the 15th or early 16th century. More certain versions of the bowl-type base come from the late 13th- to 14th-century kiln-site at Ashstead, Surrey;[76] Southampton, where they belong to the 2nd half of the 14th century;[77] Hartford, Hunts., where a nearly complete base contained a hoard of coins deposited in or shortly before 1503;[78] Haverholme Priory, Lincs.,[79] and Watton Priory, E.R. Yorks. (FIG. 32, no. 8), both rims; and the kiln-site at Yearsley, N.R. Yorks., where a complete bowl was found.[80] Less certain examples are known from St. Neots Priory, Hunts., of late medieval date,[81] and from the site of the Clarendon Hotel, Oxford, where a flattened right-angled rim came from site Z, of the 15th century.[82] The rim from St. Neots is almost identical with that of a complete vessel from Trinity College, Cambridge,[83] which has two thick suspension-lugs pierced horizontally, and the scar of a tubular spout midway between the lugs. This vessel is a copy in pottery of a thurible or censer more usually made of metal and emphasizes the difficulty of identifying flanged distilling-bases solely on the evidence of the rim. The identification of the piece from Oxford is uncertain because it comes from a region where flanged rims are common in the later medieval period.[84]

DISTILLING-UNITS

A range of distilling-units is suggested by archaeological finds and documentary illustrations and implied by the variety of bowl-type bases. One unit is illustrated in FIG. 31, nos. 7 and 8, found in a kiln-deposit on the extensive pottery-making site at Nuneaton, Warws. As no other flanged rim or, indeed, any fragments of chemical apparatus were found in association with any of the other kilns at Nuneaton it seems clear that, as they are independently associated with the distilling process, they must form part of the same unit—a type-2 alembic fitting on to a bowl with external flange. It has been suggested above (p. 111), from the evidence from Lambeth Hill, that the purpose of the tall conical shape was to accommodate the height of the cucurbit seated inside the bowl. Although, so far, there is no material evidence for this, the lack of any residue in most of these distilling-bases seems to support this theory. Another type of unit is suggested by the Lambeth Hill example (FIG. 33, no. 13) and possibly by the one from

[75] *Op. cit.* in note 64, 75, fig. 2.

[76] *Surrey Archaeol. Coll.*, XLVII (1941), 63, fig. 5, no. 16 (in Guildford Museum).

[77] From the High Street site, pit 260, reg. no. 15326. I am grateful to Dr. Colin Platt for permission to inspect this material before its publication.

[78] *Proc. Camb. Antiq. Soc.*, LVIII (1965), 139–40, fig. 1.

[79] Excavated by Mrs. M. U. Jones.

[80] *Yorks. Archaeol. J.*, XXXVII (1951), pl. 2 opp. p. 437, to r. of large dish (Yorkshire Museum, York).

[81] *Proc. Camb. Antiq. Soc.*, LIX (1966), 65, fig. 13, no. 112.

[82] *Oxoniensia*, XXIV (1959), 28, fig. 12, no. 9.

[83] *Proc. Camb. Antiq. Soc.*, XLVI (1953), 23, fig. 7. The top of another, with sgraffito faces on the lobes, is from Trinity Hall, Cambridge (*ibid.*, pl. vii), and a complete jar from Cambridge, found in 1883, has a similar arrangement at the rim, consisting of two small horizontal lug-handles, combed on top (acc. no. A83 Cambridge 489E). All three are in the University Museum of Archaeology and Ethnology, Cambridge.

[84] For a comprehensive range of types in the Oxford area during the 15th century see *op. cit.* in note 82, 28, fig. 12, nos. 4, 7–9 and 11.

Guy's Hospital, London (FIG. 32, no. 6), where the base acts as the holder of the cucurbit. The impression left in the deposit inside the bowl from Lambeth Hill shows that the bottom of the cucurbit was hemispherical, similar to those from Pontefract and Selborne (FIG. 28, nos. 4, 5 and 11). The superstructure of this type of unit is not known, but if the interpretation of the Guy's Hospital piece is correct, the pedestal-bowl probably had a flanged rim to take a type-2 alembic, as in the Nuneaton pair. This is partly verified by the discovery at Lambeth Hill of a rim of a type-2 alembic (FIG. 33, no. 14) with the base (FIG. 33, no. 13); although not meant to fit this type of base, the existence of a type-2 rim in the same group at this late date supports the suggestion.

At least two groups of industrial pottery have associated hollow open-ended tapering pots. Excavations at Weoley Castle, Warws., produced a bowl-type base similar in size and shape to the Toynton example (FIG. 32, no. 5), together with a truncated hollow-ended conical pot interpreted as a lid,[85] both from period VIII of the 2nd half of the 15th century and both of the same fabric. The base contained a 'metal deposit—mainly mercury'. The form of the base and the mercury content[86] strongly suggest that the vessels were used in some distilling process. A group of material from the moat of Wisbech Castle, Cambs.,[87] dating from the late 15th to early 16th century, contained the lower part of a similar hollow cone with two perforations near the bottom as well as the rim of a distilling-base, both in identical fabric and presumably made as a pair. The rim of the distilling-base is similar to that of the Gresham Street vessel (FIG. 33, no. 3), but with a more horizontal shoulder, and is heavily encrusted with industrial waste. A pot, shaped like an inverted funnel, found during clearance work at Byland Abbey, Yorks., and now in the site museum, is similar to the Weoley Castle example but more constricted at the neck with an aperture in the enclosed top. The function of these pots is far from clear. The complete profile of the Weoley Castle example suggests a form of adapter for alembics of varying sizes, the rim of the alembic resting on the tapered surface of the cone. This would increase the number of sizes of alembic with which the base could be used instead of restricting it to that purposely made for it, as seems likely for these units and is, indeed, implied by the Nuneaton pair.

INDUSTRIAL 'BOTTLE'-LIKE VESSELS

Associated with the Lambeth Hill pit-group were a number of bottle-like

[85] *Trans. Birmingham Archaeol. Soc.*, LXXVIII (1962), 81–2, fig. 13, no. 59 (in the City Museum and Art Gallery, Birmingham).

[86] A glass chemical deposit found by Miss C. Mahany in 1970 at St. Leonard's Priory, Stamford, is associated with a quantity of mercury, Cistercian ware, Raeren mugs and a group of pottery bottles of uniform size and form. Unfortunately this deposit is not yet completely excavated and the glass vessels are too fragmentary for conclusions to be drawn from them. The mercury found at Weoley Castle and Stamford is the only mercury from medieval contexts and its purpose in a distilling operation is not clear. This problem is being studied jointly by F. Greenaway and C. C. Moore of the Science Museum and L. Biek of the Ancient Monuments Laboratory. I am grateful to Miss Mahany for telling me of this important deposit and for permitting me to examine it *in situ*. For a brief note on it see *Med. Archaeol.*, XV (1971), 139.

[87] For analysis and discussion of these pieces see S. Moorhouse, 'A late medieval domestic rubbish-deposit from Wisbech Castle moat, Cambs.', *Proc. Camb. Antiq. Soc.*, LXV (1973), forthcoming.

vessels of pottery, the small ones being thrown in one piece (FIG. 33, nos. 7 and 9), while the larger ones have necks luted on (FIG. 33, no. 6). Such vessels are frequent in post-medieval deposits in the city of London[88] and have also been recognized among finds at Oxford,[89] where they were initially interpreted as acoustic jars or bottles. On present evidence the type appears to be post-medieval, the earliest examples coming from the pit-group at Gresham Street, London, of the 1st half of the 16th century. A kiln-dump from Salamanca Place, Lambeth, London,[90] included a nearly complete bottle, ht. 36 cm., similar to FIG. 33, no. 9, which was shown by associated pottery to belong to the 2nd half of the 16th century. The small difference in form and size between the Gresham Street and Lambeth Hill examples suggests a common function, although the evidence of industrial use which is visible on the outside surfaces implies more than one purpose. The necks of some of those from Oxford are heavily burnt at the top, while others from London have burnt bottoms (FIG. 33, no. 6), suggesting direct contact with a flame or furnace, possibly from use as a cucurbit. The Lambeth Hill group, where the 'bottles' are associated with the rim of a type-2 alembic which has been adapted, by the addition of feet, to sit on the shoulder of a cucurbit, possibly of this type, provides evidence in support of this suggestion. Whatever their function the crude workmanship must class them as industrial vessels.

CONCLUSION

Two types of pottery alembics have been defined, various forms of distilling-bases discussed and two, possibly three, unit combinations have been described. The problem of distinguishing between glass cucurbits and receivers is reflected in their pottery counterparts and this may only be solved if the vessels occur in a large enough group to enable the two types to be separated according to the size of the appropriate alembic. Ample evidence has been cited to suggest that chemical apparatus was produced in more than one centre. With the recognition of more vessels of this type it may well be possible to distinguish regional groups possessing characteristic features. Future work, not only on the recognition of distilling-vessels but on the analysis of residues, is most urgently needed. Greenaway has described (p. 86 f.) the various chemical combinations left as residues after the distillation of certain materials. The archaeologist must now supply the material evidence for these various operations.

[88] There is material in the Guildhall Museum from various sites apart from that referred to here. An example from the Mansion House, London, is in the City Museum, St. Albans, Herts., and a nearly complete example (rim and top of neck missing) from Park Street, Southwark, in the London Museum (no. 33/304) is similar in shape to FIG. 33, no. 6, but with a taller body, in a fine sandy powdery brick-red fabric with dull surface. This Southwark piece contains a mauve powdery substance of which there are also traces on the outside of the neck.

[89] *Oxoniensia*, IV (1939), 110, fig. 26, B, and pp. 138–9, and unpublished vessels from Nuffield College and St. John's College (all in the Ashmolean Museum, Oxford).

[90] Collected on the site by J. H. Ashdown in 1963 and now in his possession.

DESCRIPTION OF POTTERY DISTILLING-EQUIPMENT

ALEMBICS (FIG. 31, nos. 1–7)

1. Complete type-2 alembic with broken spout. Sandy dull reddish-brown fabric, smooth on outside, which has various incised grooves formed during the smoothing process. Extremely crudely thrown with coarse internal throwing grooves. Handled top very smooth after long use. Found in 1930 in well on site of friary, Friary Lane, Nottingham.[91] Castle Museum, Nottingham.

2. Nearly complete type-2 alembic, spout missing and incomplete top. Hard sandy buff fabric with purplish surface, dull pink in places. Covered on outside with thick dark brown glaze getting darker towards the top; inside unglazed. From clearance work many years ago at Hailes Abbey, Glos. The abbey was dissolved in 1539, but occupation persisted until *c.* 1730. Date of pot *c.* 1550–1650. Preserved on the site.

3. Angle of collecting-channel from type-1 alembic with adjoining incomplete spout. Bright pink sandy fabric, typical of later medieval Oxfordshire wares, with dull green glaze round inside of spout-aperture and bright clear yellow-orange glaze outside. Found during excavations for the Bodleian Library tunnel, Oxford, 1938. Ashmolean Museum, Oxford.

4. Complete type-1 alembic with broken spout and remains of knobbed handle(?) on dome. Hard sandy dull lightish brown fabric showing off-white in fracture; unglazed. Letter E scratched on after firing, possibly the owner's initial or mark. Found during building-operations at Plantation House, 31–4 Fenchurch Street, London. Guildhall Museum, London, no. 17,419.

5. Complete type-1 alembic. Fine grey stoneware, with light grey glaze on outside, mottled light brown in patches and with whitish horizontal streaks. Fabric and glaze suggest that it was made at Raeren and belongs to the 16th century. From Surrey Street, London. London Museum, no. A4784.

6. Lower part of type-1 alembic with bottom of inner collecting-channel. Dark grey reduced sandy fabric with dull pinkish-red surface; unglazed except for sporadic clear lead splashes on outside. From Selborne Priory. Wakes Museum, Selborne.

7. Nearly complete type-2 alembic, top missing and spout broken. Hard-fired orange-red sandy fabric; unglazed. Discarded as waster, perhaps because spout is not pierced, or because the missing top was faulty. Found *in situ* as part of a drain(?) made of complete waster jugs and cooking-pots with bottoms knocked out, which may have been laid down to provide some form of forced draught, since it led to one of five baffles of a multi-flue kiln. The associated pottery was of the midland purple type containing no Cistercian ware, thus indicating a date around the middle of the 15th century. From kiln-site at Nuneaton, Warws.,[92] associated with material from kiln in front garden of no. 10 Bermuda Road, Chilvers Coton, Nuneaton. To be deposited in Nuneaton Museum. For matching distilling-base from same deposit see FIG. 31, no. 8, below.

DISTILLING-BASES (FIG. 31, no. 8; 32, nos. 1–11)

FIG. 31

8. Nearly complete base. Hard sandy totally-reduced dark grey fabric with over-fired reduced glaze on inside. From same deposit on kiln-site at Nuneaton as FIG. 31, no. 7 above.

[91] A. Parker, 'Nottingham pottery', *Trans. Thoroton Soc.*, XXXVI (1932), 86, pl. iii.

[92] For interim note on this extensive kiln-site see *Med. Archaeol.*, XII (1968), 208–10; for the kiln referred to here see *ibid.*, 209, fig. 58, F. A full excavation report is in preparation.

FIG. 32

1. Complete base with rouletted band round basal angle. Fine sandy bright pinkish-red fabric; deep reddish-brown glaze on inside, blistered in places, extending on to top of rim, with splashes outside. From Gracechurch Street, London. London Museum, no. A24391.

2. Base, complete except for small part of rim. Hard-fired dull pinkish sandy fabric covered with deep rich mottled green glaze on inside, and with dark streak on under side of bottom. Inner surface covered with thick reddish powder, and with slag-like substance all round below the rim. Heavily burnt all over the outside, but not blackened. From Gresham Street, London. London Museum, no. A24616, bought in 1922, along with three crucibles, found with it, containing copper oxide. London Museum, nos. A24617–9. The accession books of the London and Guildhall Museums do not suggest any connexion between this group and that illustrated in FIG. 33. For description of residue in bowl see TABLE I, p. 120, no. 10, A.M. 700256.

3. Fragment showing complete profile. Very sandy dull brown fabric with grey reduced core; unglazed. From kiln-site at Brill, Bucks., amongst material from kiln D; possibly waster.[93] Ashmolean Museum, Oxford.

4. Nearly complete flanged base with domed top pierced by large circular cut-out. Hard-fired brown sandy fabric with grey core. Slightly knife-trimmed on outside, leaving surface faceted in places. Patchy dull greenish-yellow glaze inside on bottom and extending half way up walls and on to domed top. Outside burnt in places; inside slightly stained grey. Found in pit on site of Woolhouse, Southampton.[94] Late 13th- to 14th-century. To be deposited in God's House Tower Museum, Southampton.

5. Complete base with cut-out in sharply-everted flange. Sandy pinkish-brown slightly lumpy fabric with thick treacly light reddish-brown glaze extending over the rim on the inside; outside glazed sporadically below lower girth-groove. From Toynton All Saints, Lincs. Mrs. E. H. Rudkin collection, to be deposited in Lincoln City Museum.

6. Two large fragments. Harsh sandy dark salmon fabric with totally reduced light grey core. Olive-green glaze on both surfaces, that on outside uniform above lower cordon, sporadic below. Possible soot-ring below lower cordon as if vessel set on retort. On inside, near lower fracture, broad applied strip of clay covered in glaze, possibly intentional, to be radial with base. From excavations at Guy's Hospital, London; stratified before *c.* 1530. Southwark and Lambeth Archaeological Society. Publication by Graham Dawson forthcoming.

The function of this piece is not immediately clear, but considered in conjunction with the Lambeth Hill example (p. 120 f. below; FIG. 33, no. 13), it may be a pedestal-type of base. The internal seating arrangements for the cucurbit could be explained by the remaining fragment of radially-applied strip, while the alembic is seated on the flanged rim and has no contact with the cucurbit. Not enough of the lower part of the vessel is preserved to provide a reconstruction, but the burning on the outside and the form of the bowl might indicate that it belongs to a base similar to the Lambeth Hill example, i.e. in effect, a large crude chafing-dish.

7. Large fragment of rim and side. Harsh friable fabric with many small white inclusions, totally reduced to dull purple, dark grey in parts. Dull yellow-ochre glaze covers tops of flange and rim, extending over rim for 2 cm. on inside and sporadically on outside. Decoration of small neat continuous thumbing on edge of flange, stabbing on top of rim, and horizontal and vertical applied strips on outside, the horizontal ones bearing rouletted notches. Found in association with kiln at Bentley, near Alton,

[93] *Med. Archaeol.*, VI–VII (1962–3), 347.

[94] Excavated by A. Aberg. Publication forthcoming in C. Platt and R. Coleman-Smith, *Excavations in Medieval Southampton 1953–1969* (Leicester, 1973).

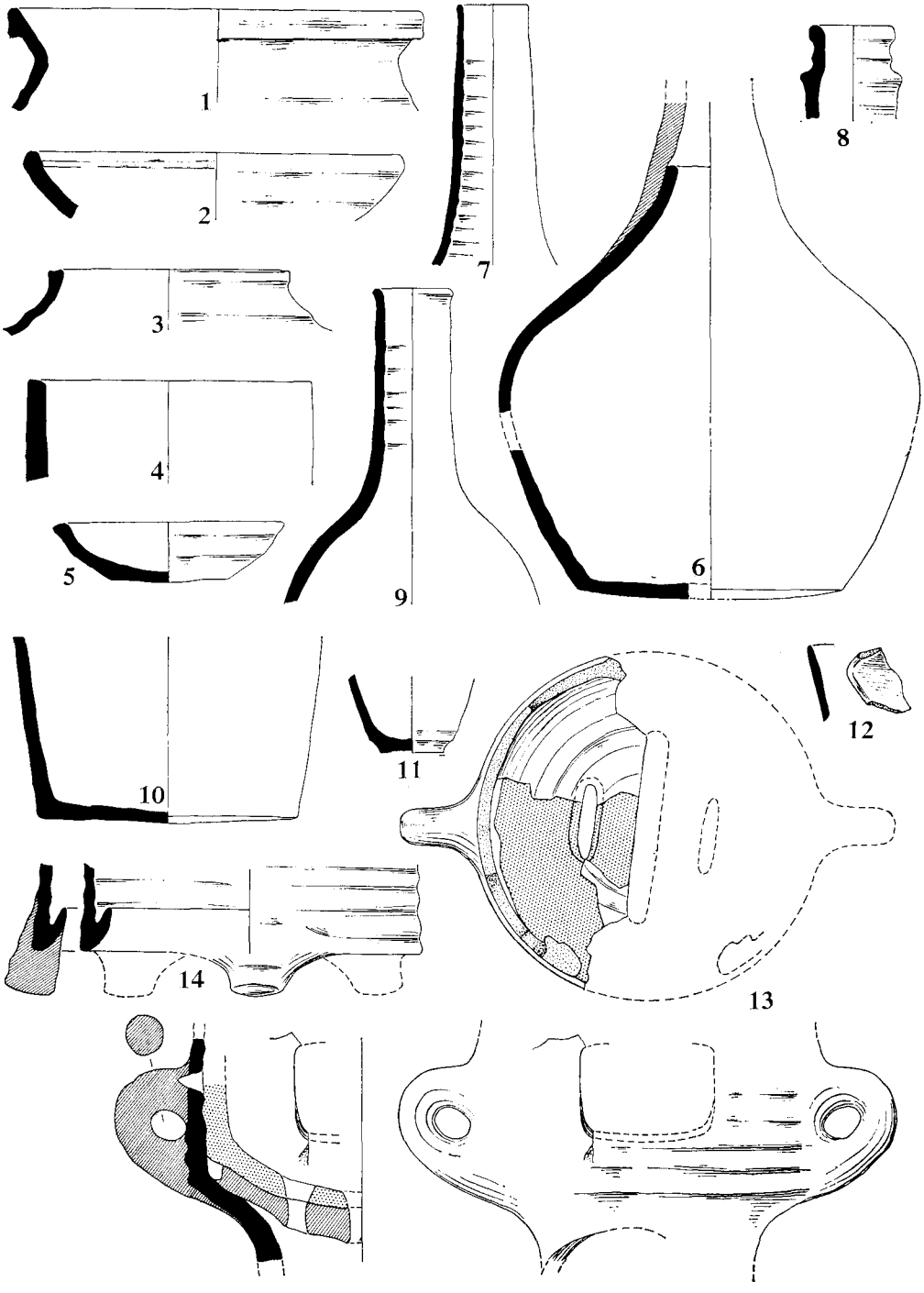

FIG. 33

POTTERY DISTILLING-GROUPS FROM LONDON (pp. 119 ff.). Sc. $\frac{1}{4}$

1–7. Gresham Street, 1st half 16th-century; 8–10. Addle Street, possibly 16th-century; 11–14. Lambeth Hill, mid 17th-century

Hants. Late 13th- to early 14th-century. Wilmer House Museum, Farnham, Surrey.[95]

8. Fragment showing complete profile. Sandy coarse reddish-brown fabric with bright mottled reddish olive-green glaze, iron-flecked, on inside; grey reduced core. Part of outside heavily sooted. From Watton Priory, E.R. Yorks. Yorkshire Museum, York.

9. Fragment of side. Fine sandy orange fabric with speckled orange glaze on inside. From kiln-site at Hairplain, Biddenden, Kent.[96] Probably early 16th-century. Maidstone Museum.

10. Complete base. Very smooth buff fabric with very little sand content; light pink core at bottom and very light grey core at rim. Puddled light yellowish-green watery glaze on bottom, inside; outside covered with slight layer of soot. Shallow, pinched depressions in top of rim. From Brasenose College, Oxford. Probably 16th-century. Ashmolean Museum, Oxford, no. 1959.194.

11. Upper part of base with inner support rim luted on. Light pinky-salmon fine slightly sandy fabric containing small to medium flecks of crushed limestone; unglazed. Associated with tile-kiln of 14th to 15th century at Lyveden, Northants., site E (1969).[97] To be deposited in Westfield Museum, Kettering, Northants.

GROUPS OF DISTILLING-VESSELS FROM LONDON

Gresham Street (FIG. 33, nos. 1–7)

Associated group found in 1956 on site of Goldsmiths' Company property. The coarse wares, all illustrated, suggest a date possibly in 1st half of 16th century, since no Surrey white wares, which appear towards the end of the century, are included. Guildhall Museum, London, no. ER 360. Other industrial pottery from Gresham Street includes the bowl in the London Museum (p. 118; FIG. 32, no. 2) and its associated crucibles, and unassociated crucible fragments from site of nos. 20 to 38 in that street (Guildhall Museum, no. ER 460). All these imply a concentrated industrial area in Gresham Street during the later middle ages.

1. Rim. Hard sandy brick-red fabric with well-defined grey core and reddish-purple surface covered in bright lustrous khaki-green glaze on outside and sporadic spots inside. Fired in inverted position, since glaze thickens towards rim. Evidence at one edge for thumbing for handle.

2. Rim from shallow bowl. Dull orange-red fine sandy fabric with smooth surface and bluish-grey core; unglazed.

3. Rim. Hard fine sandy brick-red fabric, darkened on outside, possibly from industrial use; unglazed.

4. Rim from crucible. Hard fired coarse dull grey fabric, highly vitrified outside from industrial use.

5. Shallow bowl. Hard fired brick-red sandy fabric with dull reddish-purple surface and grey core (on body only). Top of rim heavily sooted and dark grey, which fades on body into surface colour both inside and outside; unglazed.

6. Large pieces from body and neck of bottle-shaped vessel. Fine smooth sandy brick-red fabric with slightly bluish-grey core towards the inner face; outside surface dark orange with dark staining from industrial use towards and under bottom. Long neck luted to body.

7. Complete neck from bottle-shaped vessel similar to no. 6. Hard sandy reddish-orange fabric; unglazed.

[95] For this site see *Country Life*, 7 April 1944, *Hampshire Herald*, 15 August 1957, and letter from Major A. G. Wade accompanying a selection of the pottery in the British Museum; a more extensive collection is at Farnham. Publication forthcoming by P. C. D. Brears and K. J. Barton in *Proc. Hants Field Club.*

[96] Publication forthcoming by D. B. Kelly in *Archaeol. Cantiana*; see *Post-Med. Archaeol.*, IV (1970), 183.

[97] S. Moorhouse, 'The pottery from the Lyveden kiln-site', *J. Northampton Mus. and Art Gallery* (1973), forthcoming.

Addle Street (FIG. 33, nos. 8–10)

A small group of associated finds from this site included nos. 8–10 below and a base of a bottle-like vessel (not illustrated) containing a residue, which has been comparatively analysed: see TABLE I, opposite, no. 11, A.M. 700153. Guildhall Museum, London, no. ER 388.

8. Moulded top from long-necked bottle similar to no. 6. Fine sandy dull reddish-brown fabric with abundant signs of heavy industrial use both inside and outside.

9. Neck and shoulder of bottle-shaped vessel. Fine sandy brick-red fabric with grey core; outside dull purplish, inside sparsely covered in red-ochre powdery substance.

10. Lower part of bottle-shaped vessel. Hard sandy brick-red fabric with ash and industrial slag adhering outside and corky residue inside similar to that from no. 14 below. For description of corky residue see TABLE I, opposite, no. 12, A.M. 700154; for material from similar vessel see *ibid.*, no. 11.

Lambeth Hill (FIG. 33, nos. 11–14)

Found in pit, associated with vessels similar to no. 6 and with domestic coarse wares (not illustrated), suggesting a middle 17th-century date. Guildhall Museum, London, no. ER 778.

11. Lower part, nearly complete, of crucible or more probably mixing mortar. Hard coarse gritty dark grey fabric having uniform even surfaces with creamy yellow inclusions. Possibly from same vessel as no. 12.

12. Rim of mortar or crucible. Same fabric as no. 11 and possibly from same vessel. Yellowish tinge on inside surface and signs of sooting on outside.

13. Fragmentary vessel. Fine sandy dull brick-red fabric with dark bluish-grey core; surfaces dull where exposed. Handle of rod section neatly smoothed over at junctions on outside, and, on inside, stabbed horizontally at upper junction and vertically into vessel at lower one. Thick, slightly sagging bottom on inside giving effect of crude chafing-dish, pierced by three(?) slots, two of which survive, resting on shoulder of pedestal foot, which has remains of large aperture slightly to left of straight-sided opening in vertical wall of bowl. Half of inside covered with thick corky light brown deposit which runs over and down sides of slots in bottom and over lower part of opening in wall of bowl (for description of residue see TABLE I, opposite, no. 13, A.M. 700155). No signs of burning or sooting except where deposit has fallen off on inside.

Although its crude construction and internal bonding agent indicate that this vessel was used in some industrial process, its precise function is not clear. Greenaway suggests that it formed some kind of furnace and that, as it was found in a group containing pottery distilling-vessels, it was connected with the distilling process, the residue inside the bowl acting as a support for the cucurbit seated on it, which appears to have had a hemispheral bottom (cf. FIG. 28, nos. 4, 5 and 11). The three elongated slots obviously formed an integral part of the vessel, for the holes are pierced through the inside deposit and were therefore functional, perhaps being location slots for positioning the cucurbit. The upper part of the vessel is missing, but the aperture in the wall of the bowl could have been for the spout of an alembic to pass through, with the rim of the alembic either resting on a flanged rim as in the Guy's Hospital example (FIG. 32, no. 6) or more probably on the cucurbit. The only objection to this interpretation is that the under side, and indeed all the lower part of the vessel, show no sign of heavy burning, as would be expected if it was used as a furnace.

Sherds from excavations carried out at Tattershall College, Lincs., in 1967 by L. Keen in an early to mid 16th-century context have recently been identified as a considerable part of a vessel of the same form and fabric as no. 13. There were not enough sherds to reconstruct a profile. There is no sign of burning beneath the pedestal and the vessel has the same arrangement of slots in the bowl. It is not possible to be sure whether there

TABLE I. EXAMINATION OF RESIDUES

Compiled by L. Biek, Ancient Monuments Laboratory, Department of the Environment

ITEM	A.M. no.	DESCRIPTION OF CONTENTS	ELEMENTS DETECTED BY SPECTROGRAPHIC ANALYSIS[1] — Major constituents of the order of 10%[3]	Minor constituents of the order of 1%	Traces
I. PONTEFRACT[2]					
1. A. Pot 1a	680572	Similar to 680574	NOT ANALYSED		
2. B. Pot 1b	680573	Similar to 680577(x)	NOT ANALYSED		
3. C. Pot 2 pp. 96/98, no. 8A	680574(y)	Red and green powder from unbroken pot	Cu *4*, Fe *4*, Ca *4*, Si	Zn *0·4*, P, Al, K	Pb, S, Cl, Sr, Ba, Mn, Zr, Rb
4. D. Pot 3 p. 96, no. 3 FIG. 28, no. 3	680575	Similar to 680576A	Fe, Ca	P, Si, Al, K, S	
5. E. Pot 5 p. 98, no. 8B	680576A(x)	Pale brown ferruginous substance	Ca, P	Si, Al, K	Cu, Fe, Zn, S, Sr
	680576A(v)	Dark grey vesicular 'clinker'-like material	Ca, P, Si	Al, K	Cu, Fe, Zn, S, Sr
	680576A(y)	Glossy white, soft, crystalline material	Ca, P, Al	Si, K	Cu, Fe, Zn, S, Sr
6. F/G. Pot 6 p. 96, no. 1 FIG. 28, no. 1	680577(x)	Lumps containing material similar to 680574(y) but entirely green and semi-glost(?).	Cu *20*, Fe *6*, Ca *12*, P	Zn *0·7*, Al, K, Cl	Si, Sr, As
	680577(w)	Lumps of greenish-white powdery substance, attached to the green lumps in 680577(x)	Cu *20*, Fe *8*, Ca *10*	P, Al	Zn, K, S, Cl, Sr
7. N. Glass frag. p. 95, no. 5	680578(x)	Green crystalline deposit showing smooth surface where attached to glass vessel	Cu *8*, Pb *17*, Sn *26*, Ca *6*	P, Al	Fe, K, S, Cl
8. O. Sample assoc. with pottery and glass.	680579	Similar to 680576A	NOT ANALYSED		
II. SELBORNE					
9. Pot from main drain, 1961 p. 101, FIG. 28, no. 11.	640002	Bright red deposit similar to deeply burnt clay, mixed with earthy material	Fe *5–10*, Ca *10–15*, Si *20*, Al *5*	Pb $\frac{1}{4}$, P *1–2*, K $\frac{1}{2}$–*1*	Na, Mg, Ti
III. LONDON					
10. Gresham St., A24616, p. 118 FIG. 32, no. 2	700256	Similar to 640002	NOT ANALYSED		
11. Addle St., ER 388, p. 119	700153	Similar to 640002	NOT ANALYSED		
12. Addle St., ER 388, p. 120 FIG. 33, no. 10	700154	Similar to 680576A with some material similar to 640002	NOT ANALYSED		
13. Lambeth Hill, ER 778, p. 120 FIG. 33, no. 13	700155	Essentially a fine-textured material ('luting clay') containing impressions and residues of vegetable origin ('grass' and charcoal) and occasional coarser-grained particles. Has been heated to a medium-high temperature (less than 500°C) and indurated with iron compounds which show some selective leaching.	NOT ANALYSED		
14. Lambeth Hill, ER 778, p. 121 FIG. 33, no. 14	700156	Most similar to 680576A(v); contains charred insect remains.	NOT ANALYSED		

[1] The Pontefract analyses were carried out by X-ray fluorescence, mainly by the laboratory of the Government Chemist at L. Biek's request, except that of no. 4, an analysis made for C. V. Bellamy at Leeds. The Selborne sample was analysed by optical methods at the Morganite Research and Development, Ltd., through the good offices of Mr. D. W. Brown.

[2] The site references and numbers cited for the pots from Pontefract are those in the original catalogue of analysed pottery, which is in the possession of the excavator, C. V. Bellamy.

[3] The figures in italics under chemical symbols are approximate percentages.

[face page 120

were handles or apertures in the walls, but the fabric, glaze and technique of manufacture suggest that both it and no. 13 come from the same centre of manufacture, probably somewhere in S. Lincolnshire. It is becoming increasingly clear that vessels of 15th- and 16th-century date found in London have parallels in S. and central Lincolnshire, and this suggests strong trading connexions. As there are now two identical examples of the same kind of vessel, neither of which shows any signs of burning, the type is unlikely to have been used as a combined furnace and base. Its function remains uncertain.

14. Three joining fragments from rim of alembic with one complete foot and springing for another; position of spout visible half way between two of three equally-spaced supporting feet. Hard fine sandy reddish-orange fabric with pronounced bluish-grey core; unglazed. Industrial slag adheres to outside. (For description of residue from inside the collecting-channel, see TABLE 1, p. 120, no. 14, A.M. 700156.)

This is the only pottery alembic with feet which I know. The feet were perhaps intended to support the alembic on the shoulder of the cucurbit, an arrangement that would give a firmer support than the simple rim-seating used on the examples from Nottingham, Hailes Abbey and Nuneaton (FIG. 31, nos. 1, 2 and 7), which would tend to rock if, as so often on medieval pottery, the surfaces of both vessels were not perfectly uniform.

ACKNOWLEDGEMENTS

I would like to thank the Rev. G. E. C. Knapp and Mr. C. V. Bellamy for readily granting permission to include in this report the groups from Selborne and Pontefract respectively and for affording every facility to make this possible; Dr. F. Greenaway for contributing the technical introduction; Mr. W. E. Nicholson for his report on the glass and pottery vessels from Pontefract and for supplying a set of drawings; Mr. J. H. Ashdown, Mr. R. J. Charleston and Mr. P. C. D. Brears for various helpful suggestions during the preparation of this paper; Mr. Leo Biek of the Ancient Monuments Laboratory for compiling TABLE 1; and the editors for making valuable comments while seeing the paper through the press. I am also grateful to the following people who have allowed access to pieces either in museums or from excavations and to them and the authorities of the museums mentioned for readily giving consent for the vessels to be published: Mr. A. Aberg; Mr. H. G. A. Booth (Wilmer House Museum, Farnham, Surrey); Mr. G. F. Bryant; Mr. N. C. Cook and Mr. H. Chapman (Guildhall Museum, London); Mr. G. F. Dawson; Mrs. P. J. Glanville (London Museum); Mr. L. R. A. Grove and Mr. D. B. Kelly (Maidstone Museum); Mr. D. A. Hinton (Ashmolean Museum, Oxford); Mr. A. G. MacCormick (Castle Museum, Nottingham); Dr. C. Platt; Mr. A. D. Saunders and Mr. T. Miles (Inspectorate of Ancient Monuments); the National Trust; and Mr. G. F. Willmot and Mr. P. Hall (Yorkshire Museum, York). Mr. C. V. Bellamy drew FIG. 26 and Mr. F. J. H. Gardiner, Mr. J. Thorne and Mr. D. S. Neal (Inspectorate of Ancient Monuments, Illustrators' Office) drew FIGS. 25, 29 and 30 respectively; FIGS. 27, 28 and 31–33 are from my own drawings.