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THE NATIONAL COLLEGE OF ART AND DESIGN

SALTGLAZING IN GERMANY

A THESIS SUBMITTED TO:

THE FACULTY OF HISTORY OF ART AND DESIGN & C. S.

IN CANDIDACY FOR THE DIPLOMA

FACULTY OF DESIGN

DEPARTMENT OF HANDCRAFT DESIGN

BY

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APRIL 1979

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ILLUSTRATIONS

PREFACE

This thesis is a study into one of the branches of Ceramic activity called saltglazing. In itself the subject is quite broad, though for a lot of reasons its use today has become obsolete. The use of such objects such as churns has passed on, the cheap glasswares have replaced the old saltglazed jugs, the fountain pen eliminated the need for inkwells; all this and more have incredibly disappeared, apart from the use the studio potter makes of this craft, and for glazing of pipes and fittings for water borne drainage, but this is also declining rapidly.

What makes saltglazing a source of interest is that it originated in Europe and continued to be used right up to the 20th century, where its decline took place. This decline for some reason could possibly have been caused by the great industrial methods, but this would mean that the art itself was a sort of industrial method. The real virtue of saltglaze however, is not in its industrial usage in may opinion, but rather the scope it offers to the potter in extending the technique in a very personal way.

What is expected from this thesis, is to show the history and development of saltglazing right up to today in its country of origin - Germany.

Introduction

EARLY STAGES OF SALTGLAZE IN GERMANY

The exact origins of the saltglazing technique have remained a mystery, but is seems probable that the technique was hit on fortuitously by the potters of Germany in the 14th century. However, it is reasonable to believe that the discovery was made in the Rhineland of Germany, where several factors necessary to the process were easy to hand, i.e., rich natural resources, most importantly vast beds of excellent easily prepared clays; an abundance of wood for fuel; and knowledge of high-firing kilns. The Rhineland had been an active pottery centre since around the 7th century, so the awareness of wuitable clays was known well in advance of the high-firing methods developed between 1000 and 1200 a.d. when stoneware, or 'steinzeug' was first made in Europe. Quite likely, salt glazed ware was being produced as early as the 1300s - it was most commonly applied to the making of wine jars and bottles. By the mid 1500s, potters in Siegburg had formed a strong trade union. Careful regulation of their activities was practiced. They permitted strangers to work only at the coarsest tasks, and their hard-earned knowledge was guarded jealously. This secrecy seems to have been the traditional way of the potter, probably explaining why there are no records of a new discovery such as salt-glaze. In the absense of such records, much speculation has arisen as to why potters began to throw salt into their kilns to produce glaze on their wares.

One theory suggests that salt was used to keep red clays in suspension and that the sodium was sufficient to produce a faint glaze during the firing. This is a possibility, but red clays in particular do not take vapour glaze especially well, and it seems it would require more sodium than would be present in such a slip. This theory cannot therefore be considered airtight.

Another possibility is that wood from old salt-impregnated fish storage or sauerkraut barrels, was used to fire the kilns; it seems feasible that if such fuel were employed during the late stages of firing, potters might well have concluded from the results that salt had played a part in whatever differences were apparant in the fired objects. It is possible to introduce sodium into the atmosphere of a firing kiln in this manner, and assuming the receptivity of the clay, glaze might well have formed under such conditions.

Perhaps also, someone in a moment of spite, mischief or madness, threw salt - a commodity in wide use - into a kiln at a high temperature, with unprecedented results. However, one would imagine that such a dramatic occurance would have been recorded, but it seems not.

Each of these possibilities are unsatisfactory, as they are only suggestions; the reality of the discovery has

not yet been found. This subject, though very broad, leaves plenty of work for contemporary chemists working with art historians, to figure out as to why potters began this rather unnatural practice of throwing salt into their kilns to produce a glaze on their ware.

Chapter 1.

DEVELOPMENT OF SALTGLAZED WARE IN GERMANY

The Middle Ages was by no means an outstanding era in the field of ceramics - in fact, ceramics seems to be one of the few branches of Art left relatively unaffected. The Rhineland proved to be the only region where any thchnical advances were made, these advances being of course in the development of stonewares. Some of these cities whose traditions date back to the Middle Ages and which are credited with developments in stoneware, are Siegburg, Cologne (or Köln) Frechen, Raeren, and Grenzhausen.

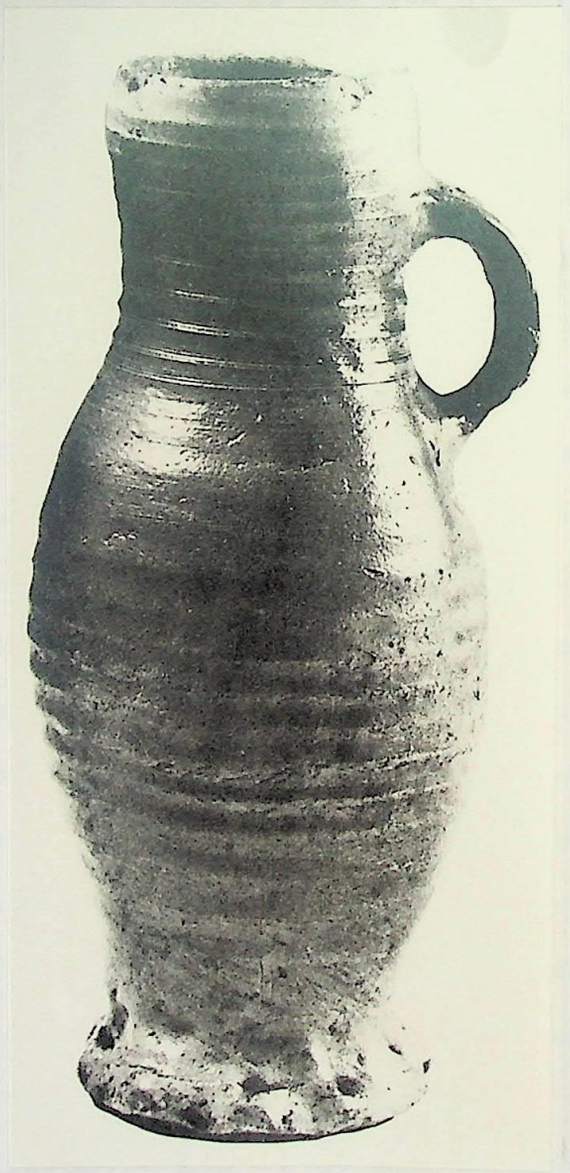

Fig 1 Drinking vessel 'Raeren'. about 1500.

There are no samples of salt glazed ware produced in these areas prior to the mid 1500s, though it is possible that "Salt glazed ware was being produced as early as the 1300s". Actually the earliest dated piece glazed with salt is a fragment of Raeren ware dated 1539. This fragment was from a hand thrown piece, thrown on a footwheel. It is believed to have been part of

a drinking vessel similar to figure 1. The actual salt used was, as stated without doubt "acquired through the Low Countries", and it is said that "the red salt in which New Foundland fish had been preserved was thought the best".[1] It is clear however, that the brewing industry contributed greatly to the development of stoneware in Germany.

Around 1500, as the use of hops in malt liquors gained popularity, inns and taverns developed, thus creating a large demand for drinking vessels. As the public's taste leaned in favour of stoneware rather than earthenware or metal tankards, the stoneware pottery industry grew, though in some cities such as Siegburg, careful regulation of their activities was practised. The rules allowed the potters to work only certain months of the year and to make only a specified number of pieces at a given time. Since the potters were Catholic, tithes were levied by the Catholic abbots on all the pots made. As the Reformation spread through Germany, the Siegburg potters, though remaining Catholic, had no objection to making pots for the Protestants, but would occasionally be fined by their ecclesiastical rulers for an especially flagrant offense. This trade came to an end early in the 17th century, when the Thirty Years War (1618-1648) between Catholics and Protestants disrupted all of Germany.[2]

1. John C. L. Sparkes and Walter Gandy - Potters, Their Arts and Crafts (London. S. W. Partridge & Co 1896)

2. Harold R. Holmes - Religion in Europe L.Martin & Co, London 1893.

Siegburg Ware

As already stated, the production of stoneware in this region dates back to the Middle Ages. The previous decades saw the decline of the use of earthenware. The large stoneware producers had a competitive advantage, and either forced the earthenware potters out of business or made it necessary for them to learn stoneware methods, or else move out of the area. The stoneware clay was dug in the surrounding locality. Kickwheels with fly-wheels were used. The pottery forms were straight-forward, simple and direct.

The main characteristics of Siegburg ware are the presence of throwing marks which are the spirals around the pot caused by the action of the hands in throwing the pot; the pinched "pie crust" type of foot, which was simply done while the pots were still soft on the wheel; and lastly the tall vigorous shapes. Similar pots appear in many paintings of Peter Brueghel, such as that shown in figure 3, ~~and another example being the~~ "Peasant Dance". Such paintings depict wares which have been flashed in firing and show signs of small stones or bits of organic matter which caused surface blemishes, common in the country pottery of the day. (These foreign bodies found in the clay, i.e. stones, organic matter, give a good idea to the modern historian of how close to the nature of the clay the early potter was. The contemporary potter would clean this clay so as to compare to the modern trend of today's mass produced wares) This type of pottery is known now as "early Siegburg" which was produced prior to 1400.

Fig 2 Siegburg ware 3" to 8" high. Vitreous stoneware, vapour glazed.

Fig 3 Detail from Peter Breughel's 'The Peasant Dance'

In the mid-1500s, white burning clays were discovered in the Siegburg area, whereas all previous salting had been done on the darker stonewares. With this development, elaborate moulded relief friezes were used to decorate the vessels.

These reliefs became very common especially on the drinking tankards used in inns and taverns. A favourite shape made by Siegburg potters was the "Schnell", a long tankard for beer, the name meaning "fast-goer" and referring to the manngr¥in which the contents were to be emptied.

Fig 4 *Siegburg Schnelle with gold fittings. 1560.*

The surface decoration, being very elaborate, usually depicted biblical and historical scenes, often copies from engravings. The technique used in making these decorations was borrowed from the example of engravers of the Middle Ages. By cutting the complex textural patterns into wood or by modelling the mould in clay and firing it in the same manner as they would fire the pots, thereafter they would take a series of slabs of clay and press them into the moulds.

Fig 5 *Detail from Siegburg Schnelle, about 1600.*

Another common feature on this Schnell was the added lid made from either pewter, silver, or gold, and sometimes even bronze or iron. These additions were rarely produced in the potteries, but the pots were sent to the local metal workers. (Figures 4 & 5)

Raeren Ware

From Raeren in the Low Countries comes a brown type of salt glazed pottery, sometimes taking on the quality and colour of bronze, probably owing to the presence of iron bearing clay.

This area had much the same type of pots as the Siegburg region: throwing marks were present, a pinched "pie-Crust" type of foot, and vigorous tall shapes. In this area, however, sectional throwing (which means throwing in separate sections) was perfected. (figure 1) Many of the jugs produced there were made from three peperate sections joined and rethrown to complete a form.

Fig 6 Jug by Engel Kroin 17¼"
Raeren 1584

Fig 7 Spouted pitcher with hinged lid. 13"
Raeren. Dated 1539.

Many of the jugs produced there were made from three separate sections joined and rethrown to complete a form.

Another important aspect which made this area somewhat unique was their moulded relief friezes, which were moulded using a thrown pot rather than as in the Siegburg method of pressing slabs of clay into the mould. (Figures 6 & 7)

Cologne (Koln) ware

Cologne ware was of a dull brown colour similar to the Raeren ware, although some light burning clays were also produced. (Figure 8). A favourite decorative motif emulated precious stones in metal settings,(as in figure 9). These pieces were generally very expensive, and used only by the potters' Church Leaders.

Cologne ware was artistically important by 1520, but owing to fueds between town authorities and potters during the second half of the 16th century, the industry moved to nearby Frechen. Some authors attribute the ill feelings to the kiln vapours, others to "conflagrations" caused by the kilns. By 1650 the industry at Frechen rivaled that at Raeren, and to this day some of Germany's largest ceramics manufacturers are located there.

One particular type of ware which was produced in this area and which was exported widely was the Bellarmine jug, made for the purpose of holding wine. This first emerged in

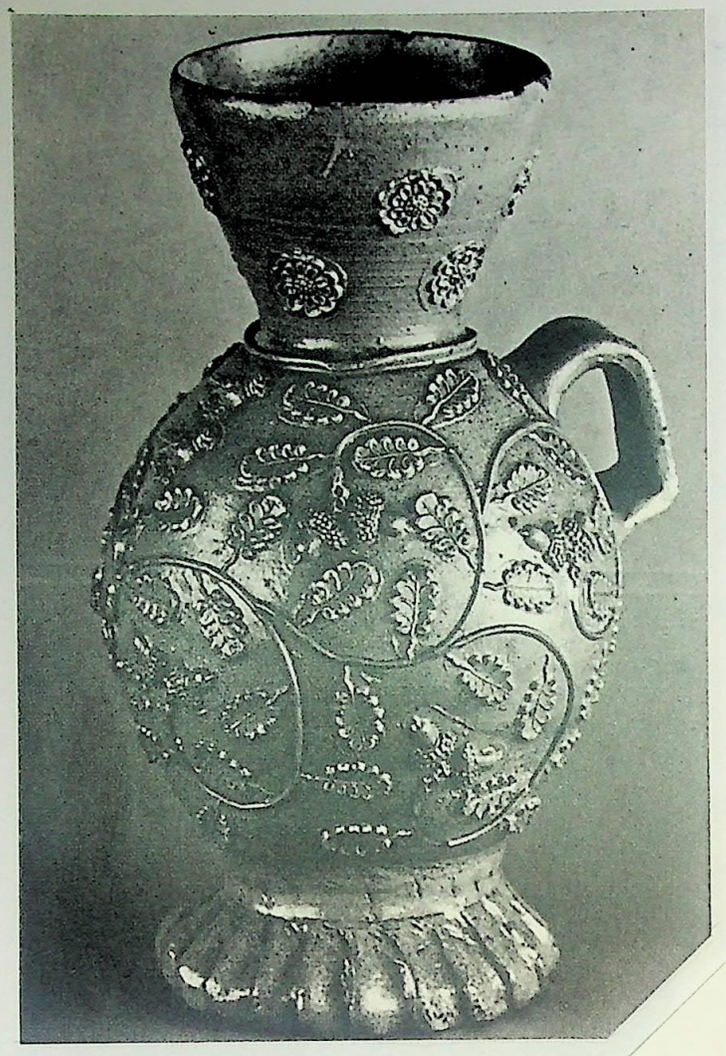

Fig 8 Drinking vessel 9½". Cologne. about 1520.

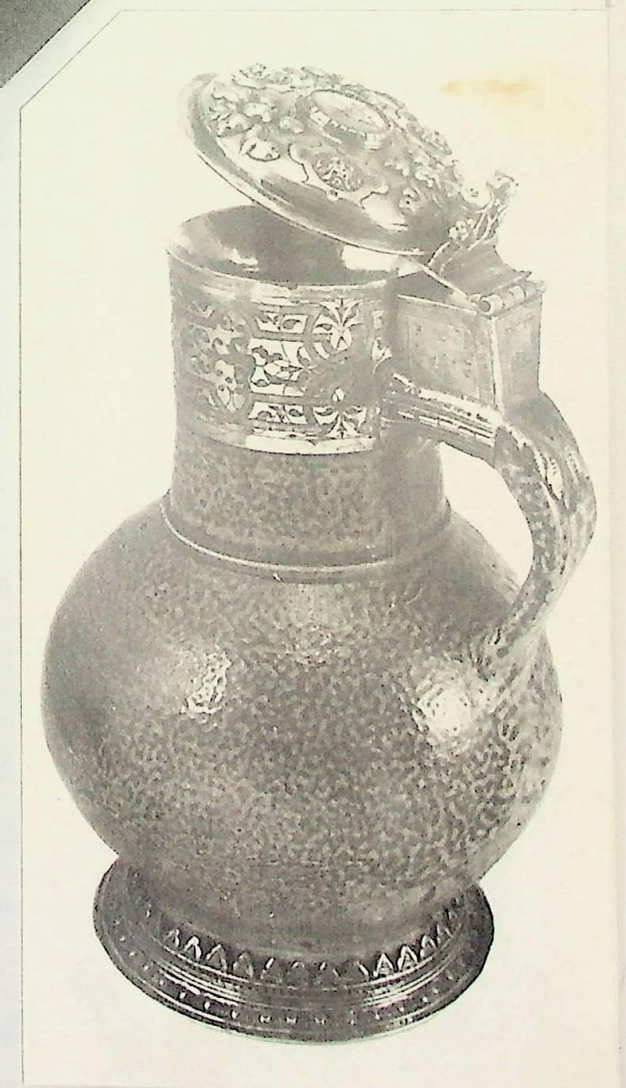

Fig 9 Pitcher 8½". Cologne (1562)

Cologne in the mid-16th century.[3] The jugs were characterised by the bearded face on the shoulder of the jug. This face however, as well as other aspects of decoration, seems to change by degrees over the decades during which the jugs were continuously produced.

Fig 10 *Bellarmine Jug, salt glazed Cologne (Frechen) late 16th century.*

Looking at the face of specimens of the Bellarmine, dated around 1560, one can see, in the treatment of the hair and beard especially, a strong affinity with sculpture in wood and stone of the latter half of the 15th century. The speciman shown in Fig.11 has a mask like the "Trinity" face found now and then in ecclesiastical woodwork or stonework, with side views of noses where the ears should be, and the eyes and beard doung duty for full face and profiles as required.

In the late 16th century, the mask takes at least one step towards naturalism. The beard is no longer cut in a formal square, but is pointed or rounded in the characteristic German fashion. The body decoration of the central band,

[3] L. Holmes, The Antiquaries Journal Volume 31, Page 173 1951.

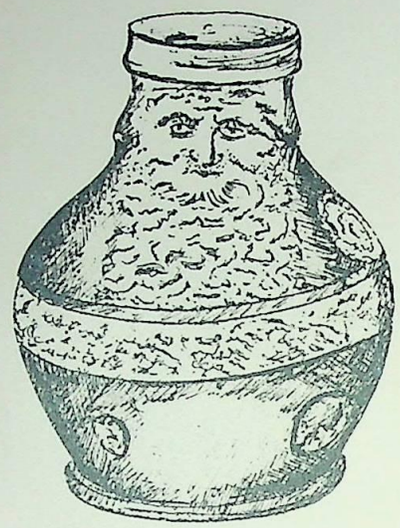

Fig 11 Mug with 'trinity' mask of type I

and the moulded ringfoot on which the vessel rests can still be found in some examples. (Figure 12)

With the succeeding type, the jug develops a more convivial appearance - masks of this type show a mouth curved into a broad grin, and in addition the central band seems to have become obsolete. The body decoration consists of medallions, generally armorial. Dates on such vessels vary around 1602.

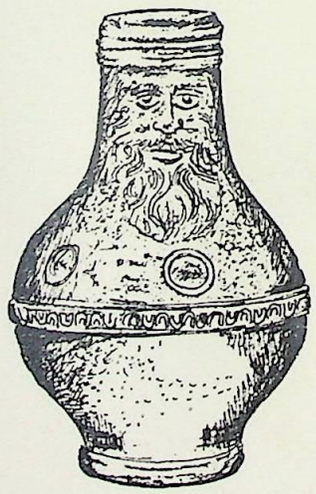

Fig 12 Mug with central band and ring foot type II

Kannenbacherland or "Country of Potmakers" is a fourth German salt-glazing region. Grenzhausen, in the Westerwald area, just northeast of Koblenz, is where many potters fled to escape the horrors of the religiously inspired Thirty Years War. Pottery traditions in this locale, however, were strong, and Siegburg-type ware was made by the emigrant Anno Knutgen and his sons in Hohr (Westerwald) between 1570 and 1590. However, this style overworked itself and with a large influx of new potters, went out of fashion, and a quickening of progress in Westerwald traditions occurred.

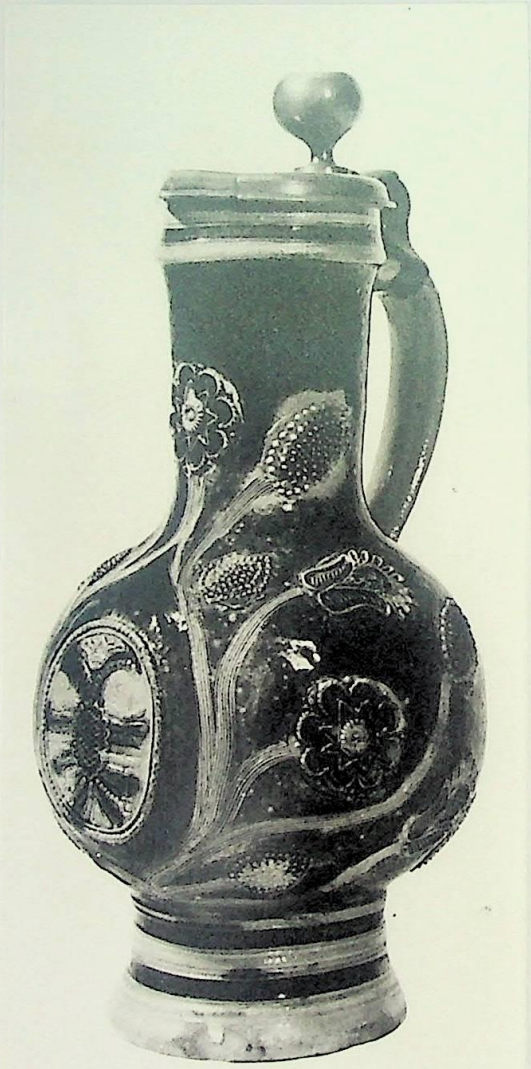

Fig 13 Pitcher with pewter lid
10½"
(1680) Westerwald

The clays found here were burned to a gray or blue gray colour, as well as brown like those of Cologne. However, the lighter gray clays seem to have been favoured, perhaps because they provided greater contrast to the cobalt-blue and manganese purple decorations brought in by the new settlers. (Figures 14,15)

With the development of the Westerwald salt glaze tradition, came a transition away from the friezes and engraving- inspired relief designs of Raerenware toward more colourful surfaces, characterised by brush

Fig 14 Globular drinking vessel
8" Westerwald (1682)

Fig 15 Ringkrug (ring pitcher)
19" Westerwald (1660)

Fig 16 Plate 13" Westerwald 1700s

decoration and bird and floral motifs. (Figure 16)

The vigorous colours combined with the development of techniques such as using a low fired opaque lead glaze known as enamels, made the Westerwald the most costly saltglaze pottery of this period.

Each of these areas, as it is shown here, had their own speciality though each was centred around the same principle of glazing clays; but what is most remarkable about these areas is that the actual Saltglazing process, including the colourants and enamels used for decoration, were unique to this region alone - one of the few techniques developed in the field of ceramics independantly of the Orient.

There is no doubt that saltglazed ware was greatly

appreciated in its day. Queen Elizabeth 1, during her reign in the 17th century, was presented with large quantities of salt glazed ware imported from Germany, and at that time, it was regarded as a high point of Germanic achievement. In fact, its uniqueness and durability were highly prized, and the earthenware potters in England and elsewhere on the continent were eager to learn the secrets of the process.

Saltglazing then was eventually produced in England. It is believed that a German named Wrede [4] first started its manufacture in England. Eventually, potteries throughout the country and the continent also commenced the production of salt glazed stoneware.

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[4] Llewellynn Jewett, The Ceramic Art of Great Britain From Pre-historic Times to the present Day London, Virtue & Company Ltd, 1878

Chapter 2

CONTEMPORARY SALTGLAZING IN GERMANY

Potteries developed in many towns in Germany. The Westerwald region along the banks of the Rhine was the largest combination of potteries in Germany. A number of itinerant potters worked for a season or two in one locale and moved to another. Quite likely these were simply restless, often skilled, individuals who were reluctant to make the material commitment of staying in one place, which ownership of a pottery can entail. Most potteries had access to the River Rhine for transporting their wares. In fact the river provided excellent clays.

Clay Processing, Throwing and Firing

The clays dug were processed by simply sieving the clay through a fine mesh sieve, usually made from cloth. In later years it was processed by a pugmill operated by a horse or mule walking in a circle and turning a central shaft; then it was kept indoors to prevent it from freezing. Wedging the clay was often done by an apprentice or helper, and it was brought to the thrower weighed out in the proper sized balls for the days production.
One of the few written records of pottery processes in the 19th century comes down from Nathan Clark, who operated potteries in Athens, Cologne, New York and Lyons. These were called "Rules for making and burning stoneware.":

1. Let the wheelman be careful to have every piece run exactly true on the wheel. Make them of a kind precisely of the same height and width, have the ware turned light, handsome shape, smooth inside and outside, the bottom a suitable thickness, and a good top.

Fig 17 *Digging and transporting clay*

2. Let it be handsomely handled and smoothly polished in the proper season.

3. Let the ware when dry be carefully set in the loft washed and blued.

44. Let the plats (flat coils for setting)be well made. Kiln cleaned out and mended in complete order for setting.

5. Care must be taken to set the courses plum and one piece exactly over another.

6. Have your wood in good order, raise your fire progressively, neither too fast nor too slow, examine well and understand the management of your kiln so as to heat all parts alike, be careful not to throw your wood inthe arches too soon or do any other act that may have a tendency to retard the heat, when fit to glaze have your salt dry. Scatter it well in every part of your kiln (during this act you must keep a full and clear blaze so as to accelerate the glazing and give the ware a bright gloss) stop it perfectly tight and in six days you may draw a good kiln of ware. "[5]

German salt-glazed stoneware, "saltzglaiser steinzeug", continues to be produced in huge quantities, both industrially and by studio potters.

[5] Janet R MacFarland, Nathan Clark, Potter Antiques LX (1951)

Westerwald ceramic traditions flourish today, and the visitor to the village of Höhr-Grenzhausen, where there were 22 potteries in 1976, will be quick to notice signs of ceramic activity everywhere. Glass showcases displaying contemporary work can be seen on the main streets; a large ceramics education facility exists there and the "Potter's Hotel" and "Potters' Drugstore" are evident. Many studio potters reside here and in the neighbouring villages, and ceramics industries of all kinds seem to flourish side be side. Some of Europe's finest clay-processing equipment is designed and produced in Höhr-Grenzhausen.

Fig 18 Jar 12" Adendorf, about 1840-1900

The formal training period for potters in Germany may last as long as seven years, during which the students receive intensive training in business management, machinery maintenance, clay processing, production methods and technical studies. Rigorous exams are administered, and diplomas are proudly displayed by those who earn them, for they represent a great deal of difficult work and remain a kind of passport for teaching credibility and the sale of one's work.

German salt-glaze production is of the most consistently high quality anywhere in the world. The virtual perfection of methodology and the practice of high work standards in every aspect of shop management are evident to the visitor. Most prosperous potteries in Germany are run with an almost startling air of diligence and efficiency. Ram presses (high speed pressure molding devices) have been in wide use since the 1950s, and the production of 1,000 pieces a day in a pottery employing four persons is not at all uncommon.

Fig 19 Vase by Wilhelm Mühlenbyck. 16". 1975. Incised and slip decoration

Clay at the Karl Corzelius Pottery in Adendorf, near Bonn, where there were 14 potters in 1976, is dug locally and staked down in the corner of a room, in a pile about 6½ ft high by 10 ft deep and wide. It is then mixed in a verticle pug mill, which extrudes it in a continuous piece about 10 ft square. From there it is pugged in a horizontal mill to a diameter of about 5" and cut into lengths about 1 yd long, then is cut with a wire device similar to an egg slicer,

which eliminates weighing each piece of clay. Thrown ware is limited to pitchers and globular forms, demanding more skill than straight-sided pieces, which are pressed.

Throwing is done ina standing or semistanding position (arrived at by leaning on a board inclined slightly away from the wheel, to the right side) From two to six wheels may be run from one motor by means of a belt and slip-clutch arrangement, and throwing takes place at a constant, quite rapid, speed.

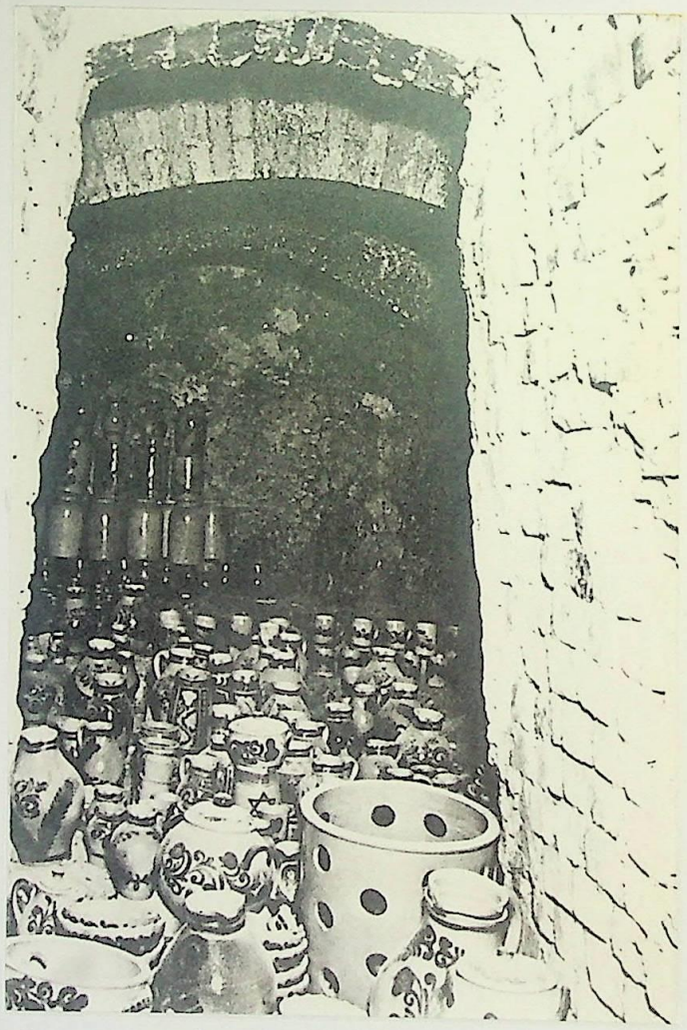


Fig 20 *Interior of old traditional German wood fired kiln ; Höhr-Grenzhausen.*

Decoration is usually done on bone-dry ware and consists of designs painted in a commercially prepared cobalt slip by women or girls related to or employed by the potter. The traditional brush is made of pig bristles and is about as large as a pencil eraser.

Wares are once-fired, and are usually stacked without shelves. Clay wadding about 1 to 1½" thick is rolled out, flattened, and then sprinkled with sand. The kiln is set by stacking larger pieces first and working on up in tiers, or "bungs" which are kept separate periodically by wadding,

preventing the tiers from shifting and tipping. Flattened, doughnut-shaped wadding placed around the rims of some forms helps reduce the diameter of a larger supporting piece so that it is closer to the size of the base of the object it holds up. Fired clay wadding is discarded, often to be crushed and used to repair streets and roads. (The shoulder of the road from Meckenheim to Adendorf is built up in some places of brightly glazed clay fragments.)

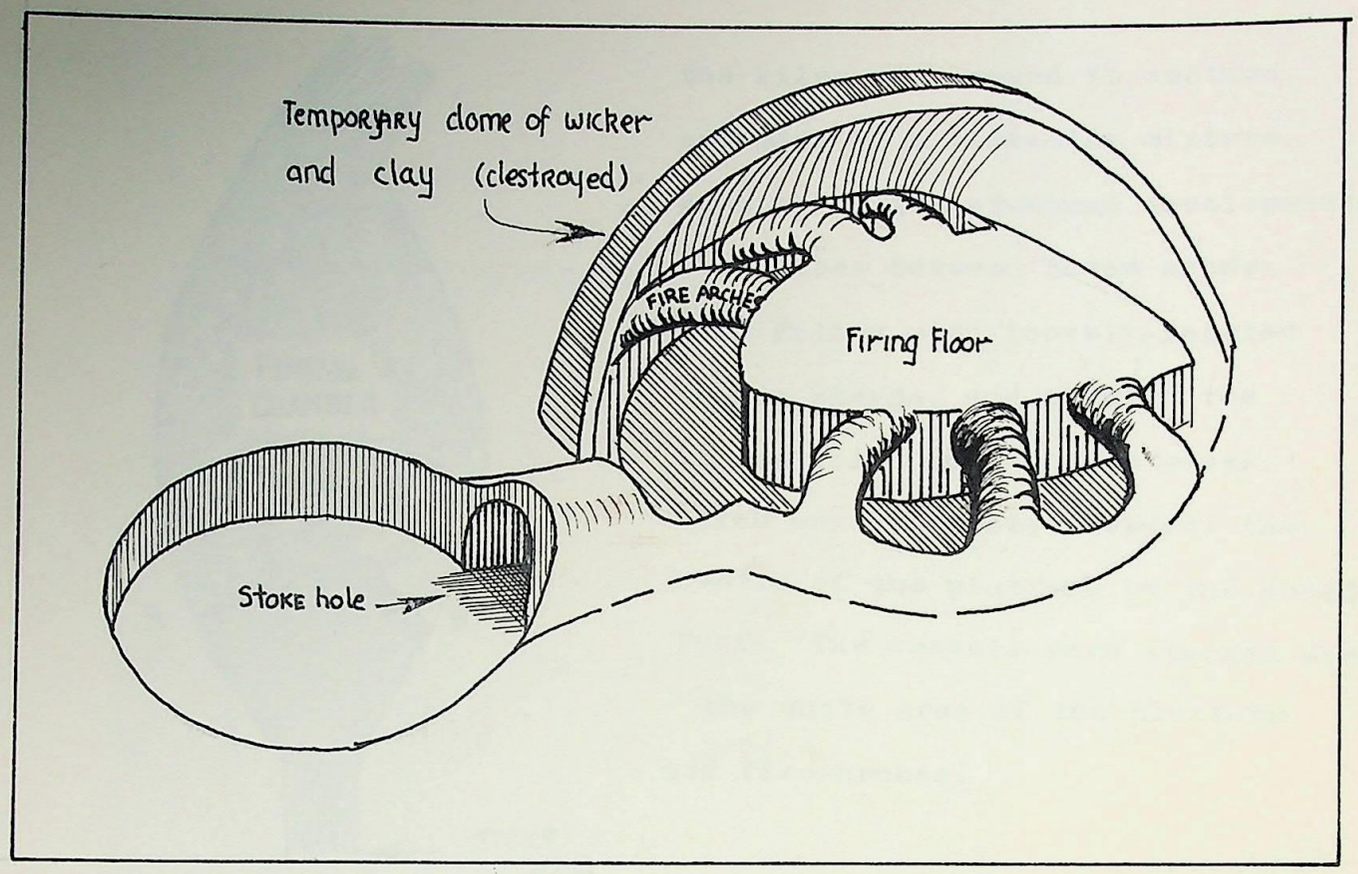
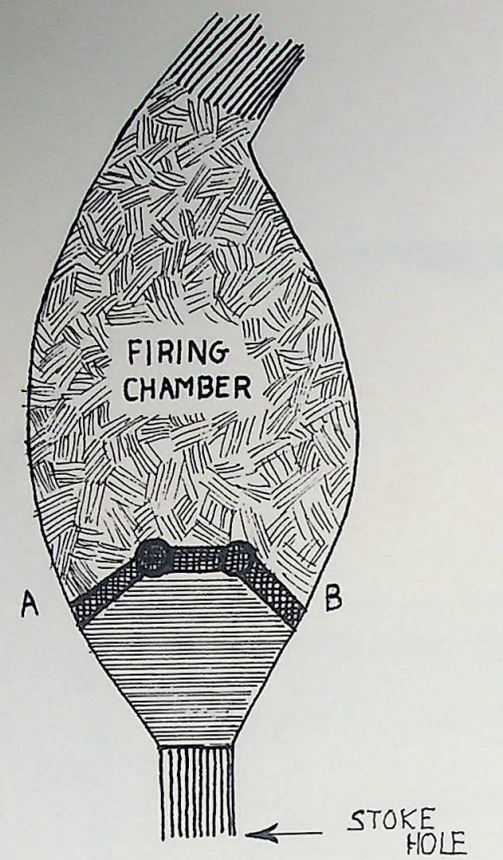


FIG 21 Fourteenth century potters kiln of a vertical type. Note the solid structure supporting the firing floor

Chapter 3

THE SALT KILN

At the time of salt glaze's emergence, kilns in common use were quite primitive. For example, horizontal kilns were used for some hard-fired stonewares in the Rineland. In these kilns the pots were stacked on the floor of the chamber, over which a temporary vault of turf, clay or wicker was built. Some of the Rhineland stonewares of the 9th to the 12th centuries were fired in vertical kilns (Figure 21) These kilns had a round or oval chamber, and supported above the kiln-floor was a platform on which the pots were stacked. The simplest vertical kilns had a central pillar, with loose fire-bars laid across from the kiln-wall. Fire-arches permanently built in, springing from



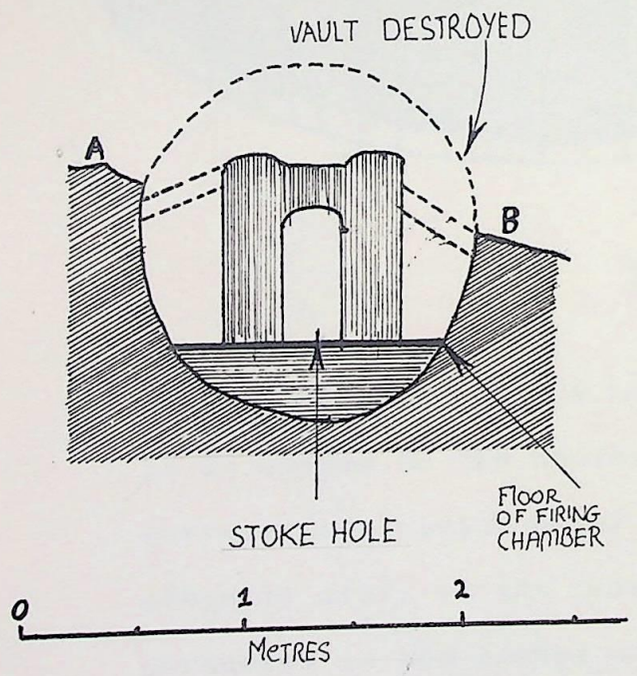


FIG 22 Plan (above) and section below of a medieval Pottery kiln of horizontal type. Gudenberg, near Siegburg, Rhineland. The hard Rhenish stone wares were made in these simple kilns.

the kiln-wall, round in section, and made of a lime-clay mixture, seem to be a post-Roman development. The spaces between these arches were filled with loosely-joggled broken sherds, and through the interstices came the hot gases, which were deflected towards the centre of the platform by the domed roof. The vessels were stacked over the whole area of the platform and fire-arches.

Most of the medieval kilns could capacitate about two hundred normal pots at a firing. The pots were stacked and spaced from one another by clay rings or placed in saggars (fine clay containers) to achieve more even heating, as they still are today.

Little research has been done about later early kilns in Germany. Most were torn down and the material recycled when the potteries were closed, but it is generally agreed that the use of the more traditional European kilns, of the updraft variety, based on the Roman designs, were used

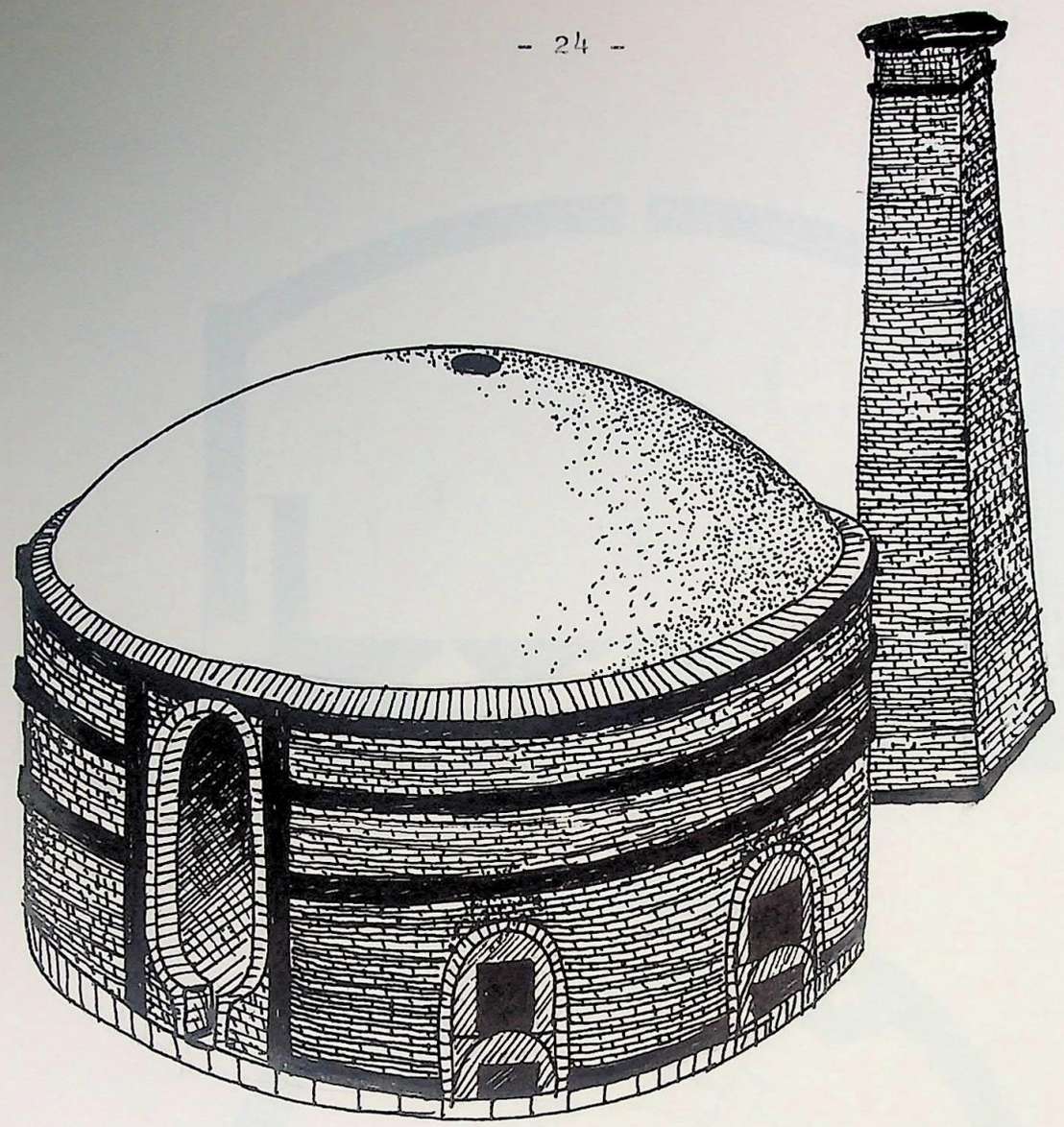


FIG 23 *Round downdraft kiln*

It is not known how the Germans elongated the structure, but it is unique to the history of kiln design (Figure 22), whereas the Chinese built elongated on hillsides to provide adequate draft at the firemouths. The Germans designed lidded portholes in the arches of their structures, retaining the updraft principle, but providing combustion space to the front of, and beneath, the ware chambers.

The introduction of the downdraught kiln was a great boost to saltglazing work in the 19th century, as it avoided most of the disadvantages of other systems, and it may be considered the ultimate development in fuel burning kilns. The German

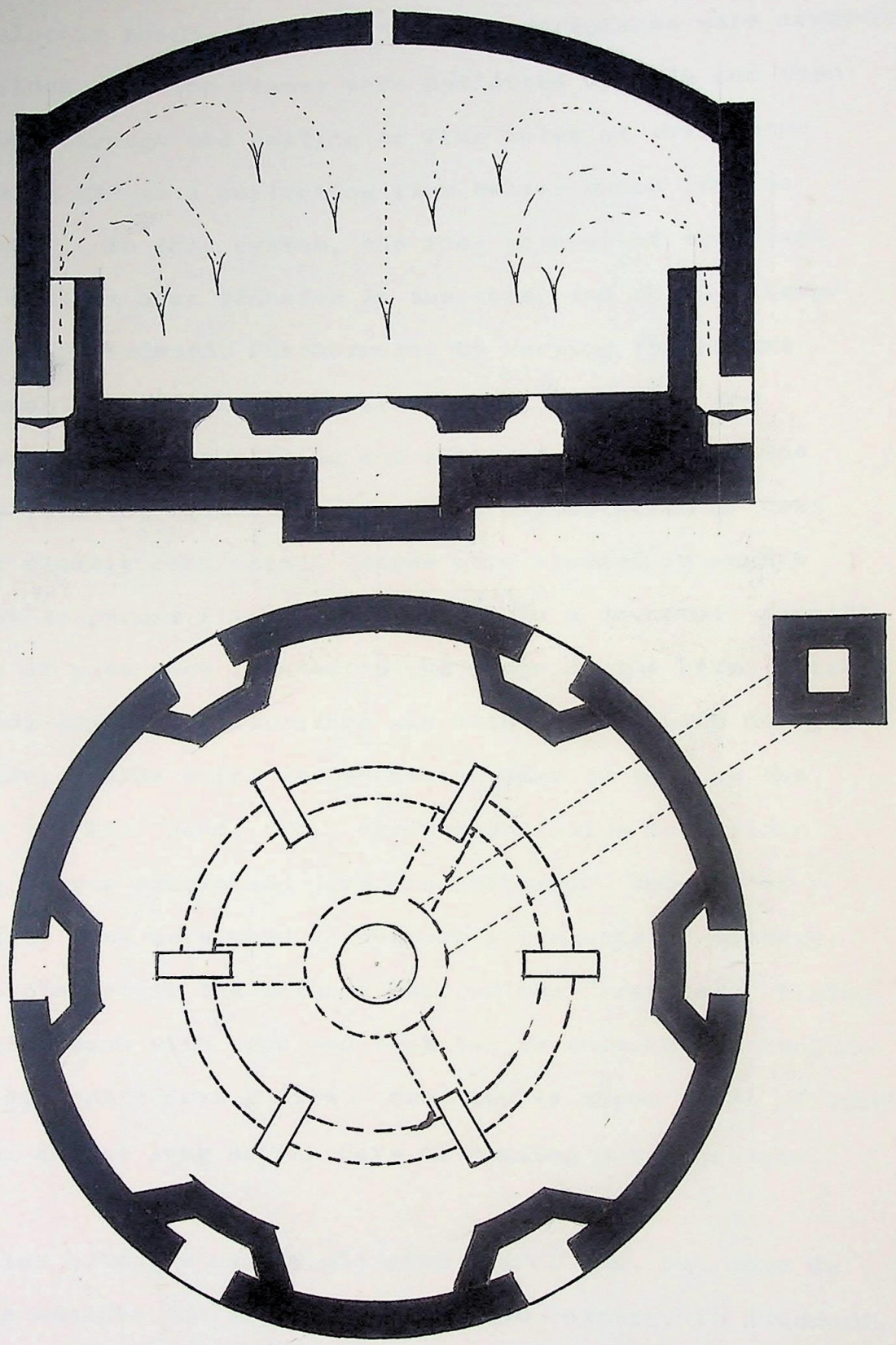


FIG 24 Round downdraft kiln

downdraught kiln was either round (Figures 23 & 24) or rectangular in shape. (Figure 25). The fireplaces were arranged at the sides, and the flames were deflected upwards and then drawn down through the setting to flue holes at the bottom of the kiln and to a collecting flue below, which lead to the chimney. In this system, the long pathway of the flame insured maximum heat transfer to the ware, and chimney temperatures were reduced. Furthermore, by varying the height and permeability of the bag walls, and by adjusting the flameways through the setting and size and position of the openings into the collecting flue, the distribution of heat could be closely controlled. Wares were stacked in such a manner as to permit flames to circulate in a downdraft fashion. A series of pots were located in the crown of the kiln, which was domed, the centre structure was held compact with heavy iron bands, boards being wedged behind them to take up the slack as the kiln aged. This arrangement helps to explain why many larger crocks and jars are deformed - because of their size, they were used to support the stacks of pottery, and were closest to the intense heat of the fireboxes. Firing was usually done with wood and took two or three days, including a long gentle drying fire. From two to three cords of wood were used and as long as six days of cooling was necessary.

These kilns have now nearly all gone out of use, but some do exist for example the kiln at Eugen Brawn Pottery, in Adendorf, contains 13 cubic metres of wood to fire, the stacking space holds 10,000 production items. However, nowadays, the Ministerium, (a Government watchdog agency) encourages the use of newer kilns, which cause less air pollution than wood fueled furnaces.

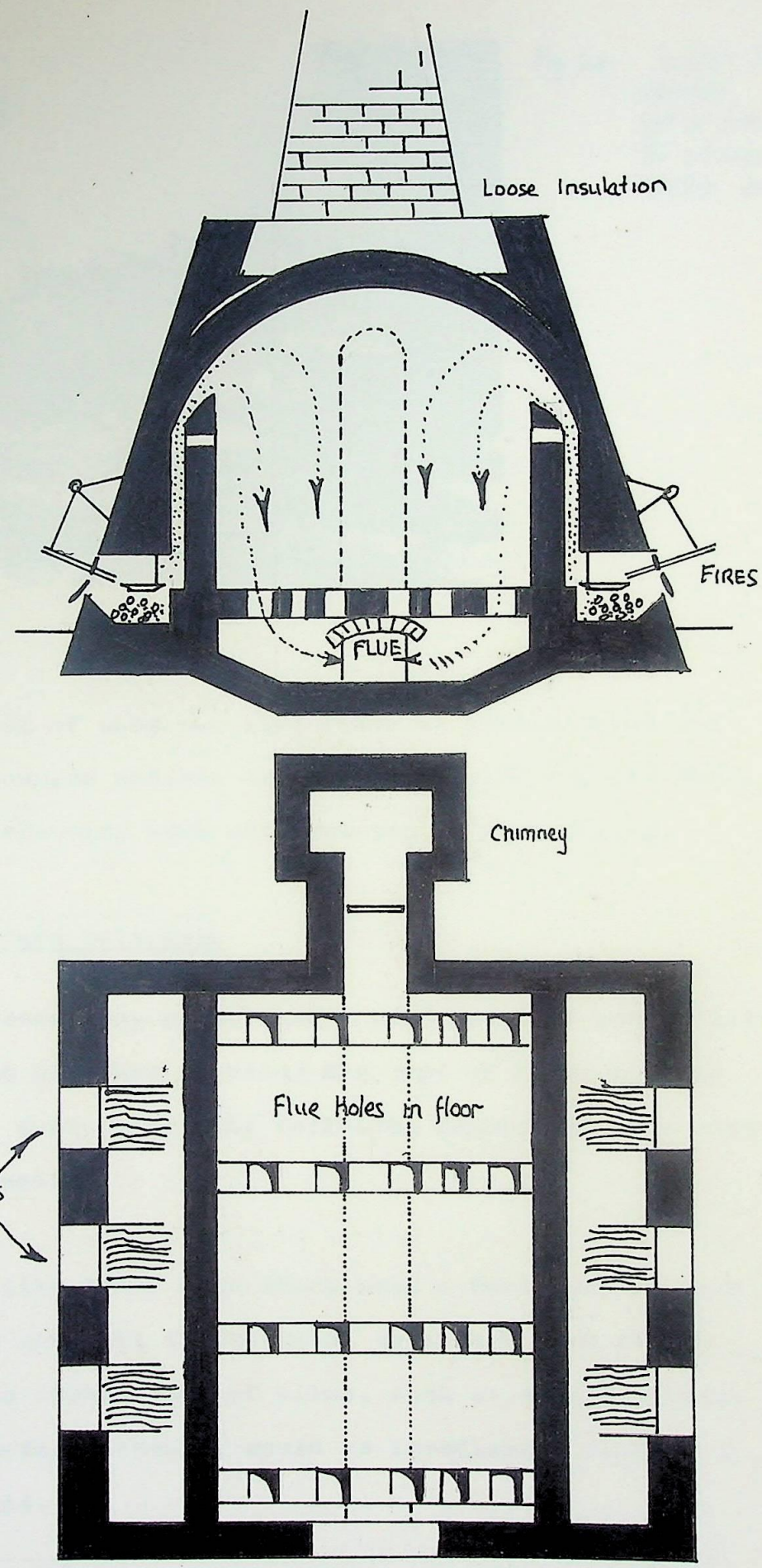


FIG 25 Old German downdraft kiln

Fig 26 Salting the kiln adendorf 1960
Salt is introduced through the archport on a long handled ladle.

The cost of wood has also risen in recent years and many younger potters simply do not care for the hard, time-consuming work necessitated by wood firing.

The Modern Salt Kiln

The present day potter has a wide range of possibilities open to him when choosing his type of kiln, but his choice must fulfil the following requirements to suit saltglazing:

1. A live flame kiln which used a fuel such as wood oil or gas. It is essential to have a live flame, because other types of kilns, such as electric kilns with metal elements, would be immediately damaged by the salt.

2. Donwdraught kilns work best for salting, as they give a better distribution of salt vapour and heat throughout the ware.

3. The salt kiln must be sited out of doors, because of the need for plenty of draught, and also because the effluent gases are dangerous to inhale. In any concentration, the gas is a respiratory irritant, and the displacement of the normal draught of air may, in coal or oil fired kilns, set off an emission of carbon black and reduced sulphur compounds. In damp conditions, films of hydrochloric and sulphuric acid develop, shortening the life of paint and metal work on buildings. As a result of this saltglazing is not acceptable in urban areas.

4. Heavy fire brick must be used for the main structure of the kiln, because the salt attacks not only the pots but the kilns structure itself. The denser the bricks, the less they will wear from the attacks of the salt. The kiln will last longer if the materials used in building are aluminous so that it can resist attack from salting.

A kiln must be broden-in to get the best results. Before a kiln really salts well it must absorb a covering of salt, and in doing so begins an inevitable deterioration. The irony of the situation is that just as the pots are firing really well, the kiln is fast on its way to falling down. The older the kiln, the more salt it will have in it and the richer the results will be - even if the amounts of salt thrown into a firing are reduced. If one tries to preserve the kiln by building it of very high alumina bricks, then it seldom saturates with salt, but the result is that it is never broken-in and the pots will never be as rich as they could be.

Summary

Saltglaze was used extensively in Europe, from about 1500 to 1800, primarily by German utilitarian potters, who are also credited with its discovery. The earliest saltglaze pieces had little decoration but gradually elaborate impressed clay motif decoration and a light whitish grey to a thick brown clay glaze finish became typical. A fine example of a simple modelled decoration which is typical of the early German saltglaze is the Bellarmine or "Greybeard" jar produced throughout the 17th century. Made for holding wine these large full bodied jars lampooned Cardinal Bellarmine and were exported throughout Europe.

Once saltglaze production was securely established in the Rhineland, the technique gradually spread to other parts of the Continent. For factory use however, salt-glazing was reserved only for utilitarian purposes - laboratory chemical containers, sewer pipes and tiles, and it became an almost forgotten technique amongst studio potters except for one or two exceptions until a short time ago. Now its fine sensitive qualities, which high-lights modelling and form, are once again proving to be the attraction it was 200 years ago.

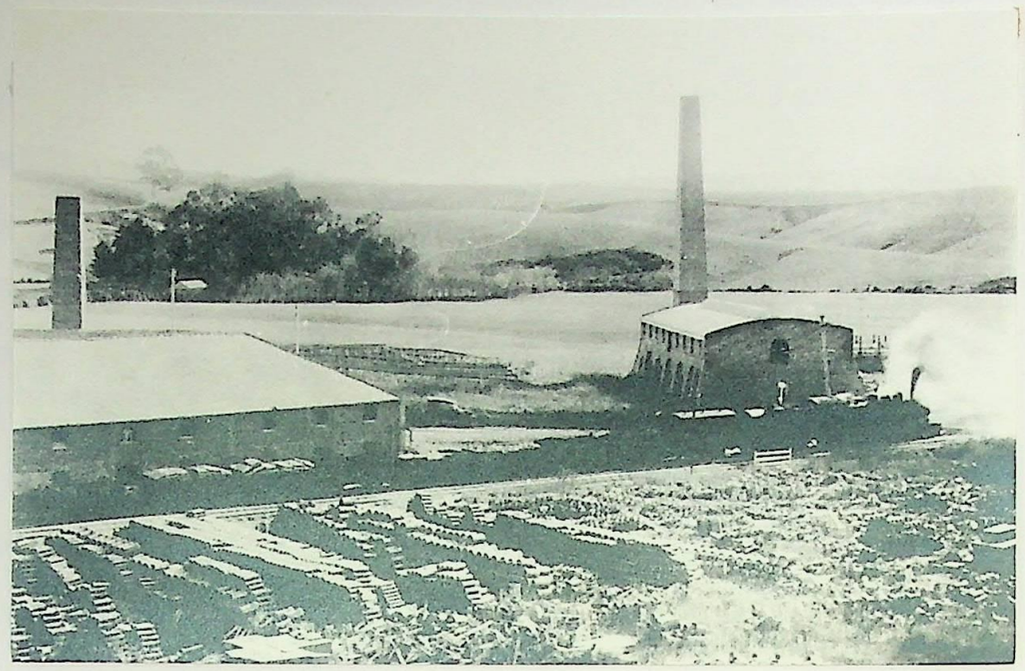


FIG 27 Brick and pipeworks factory at Benhar, Otago, as it looked in 1920.

FIG 28 Drain pipes stacked cheek to jowel in factory yard

Appendix

BASIC PRINCIPLES OF SALTGLAZE

Saltglazing is a very direct and economical way of making pots, as it eliminates one whole firing process. The process effects a very hard, well-fitting glaze. Pots do not need to be biscuit-fired prior to glaze being applied to them, but rather the glazing takes place during the actual firing. Rock salt is thrown into the kiln at around 1260°C and the silica in the clay is fluxed by the sodium in the salt. The sodium vapour attacks the surface of the pots causing the silica to melt and form a glaze on the outside of the clay.

The Chemical Reaction is as follows:

Salt glazing is achieved by throwing common salt into the kiln where it volatilizes and reacts with the surface of the ware to form a sodium alumina silicate glaze. The chemical reactions involved are as follows:-

1) $2NaCl + 2H_2O \rightarrow 2NaOH + 2HCl\uparrow$

The salt reacts with the water vapour present in the kiln atmosphere to form sodium hydroxide and hydrochloric acid fumes which are given off in the surrounding atmosphere.

2) $4NaOH + Heat \rightarrow 2Na_2O + 2H_2O\uparrow$

The sodium hydroxide formed in reaction (1) at the kiln temperature decomposes to form sodium oxide, Na_2O and water vapour which is evolved.

3) $2Na_2O + Al_2O_3.xSiO_2 \rightarrow 2Na_2O.xAl_2O_3.xSiO_2$

The sodium oxide reacts with the surfact of the clay ware to form a sodium alumina silicate glaze.

As noted already, the main active components of saltglazing are sodium and silica. All clay contains some amount of silica, and it is from this glass former that the glaze derives. Alumina is the refractory element of the clay which

does not react with the sodium at all. Clays vary in the ratios of alumina and silica; the higher the proportion of silica to alumina, the brighter the glaze. Besides the silica content, the iron content of the clay must also be considered. All clays contain iron, whether in minute amounts or in quite high percentages. Since iron does not attract the salt, in fact it almost resists it, the iron content of the clay is very important. The suitability of a particular clay also depends on the kiln atmosphere, i.e.whether or not the kiln is reduced or oxidized. Reducing the kiln aggravates the problem of a dull or dark surface in a clay containing too much iron. Strict oxidation, on the other hand, can make an otherwise dark clay more acceptable.[6]

Clays

Clays used for saltglazing must be plastic enough for throwing, dense and witreous enough at the desired temperature, and free from excessive shrinking and warping. Because of these requirements, many clays are unsuitable for salting - except in the case of some of the clays of the Rhineland. Here, the natural clays are ideal for working; they are finegrained and exceptionally plastic, and remarkably responsive without additives. They can be hand-built or thrown with ease, and fire to a rock hard consistency. However, Potters have traditionally tended to come to terms with the clay as they found it, whereas today, as a result of modern technology, an almost ideal clay body should be obtainable by blending various clays together.

[6] Ceramic Science for the Potter W. G. Lawrence: Chilton Press, Philadelphia, 1973.

Appendix

Most clay bodies will have to formulated by the potter to suit his own forming and firing techniques.

The chemical formula of the clay body will give the potter a good idea of the results he is likely to expect from a salt kiln. The ratio of the silica to alumina, the iron content and the temperature of the firing are the most important things to note. Tests have shown that alumina-silica ratios of approximately 1:4 to 1:12.5 are best.[7]

Over 3% of iron causes the glaze to become progressively duller. When high-iron clays are used they should be fired in as much of an oxidizing atmosphere as possible, otherwise many of the more subtle surface characterictics will be eliminated.

When the exact formula of the clay body is known to the potter, he can roughly determine the likely results of his firing. Below is a table, indicating the colours brought about by varying strengths of the substances silica, alumina and iron in the clay:-

8.

Silica	Alumina	
3	1	- Distinct orange peel surface
4	1	- Bright, smooth surface.
5	1	- Glassy surface, probably with minute crazing.

Iron Content

1% FeO	- Pale Gold
1.5%	- Pale Tan
1.8 - 2%	- Medium brown to dark brown
2 - 3%	- Medium brown to black

[7] Ceramic Science for the Potter W. G. Lawrence

[8] Saltglaze by Peter Sharkey: Pitman Publishing 1977

Appendix

Glazes

Glazes in the conventional sense are prinsipally somposed of silica, which is a glass former. This is melted by adding fluxes to it, such as sodium, lead, potash, etc., which reduce the termerature at which silica will melt, commensurate with the clay which is being used. In a salt kiln, the fluxing is done by the sodium, therefore compounding a glaze for a salt kiln is really duplication the action of the salt. The purpose of putting another clay surface on to the pot is to give variety and a further range of colours and textures.

Most of the glazes used on a salt pot are in the form of slips, so they have a high proportion of clay in the recipe. This is particularly so in raw firing, for the more clay there is in the glaze or slip, the better it will adhere to the pot. The more siliceous the clay, the shinier the surface will be. Clays with a high alumina or high iron content give a very different surface to the pot. Dipping, spraying or painting these various slips on to the surface of the pot opens up a whole further range of decorative techniques. Slips can be used to vary the surface textury and colour of a pot without altering the basic body. Generally speaking, any clay can used as a slip, providingit can adhere to the pot. If a very heavy iron glaze (which is usually dark brown or black) is used on a salt pot in a salt kiln, much of the iron is leached away. This results in a pale green glaze, which is far more fluid than it would be in an ordinary kiln.

Firing a Salt Kiln

The proceedure for firing a salt glazed kiln today is much the same as it was in the early years of salt glazing. The following is an outline of how a firing usually goes:

Firstly, the termerature of the kiln rises fairly slowly in the preliminary period in order to drive off the chemical water in the clay, and also to warm up the kiln. The temperature of the kiln thereafter rises rapidly until it reaches a temperature of about 1060°C, and at this temperature the kiln is reduced. Reducing the kiln is simply a matter of cutting off the supply of excess oxygen to the kiln itself, and therefore to the flame which passes into the kiln. Anything that burns requires oxygen to do so - starving the flame of oxygen by sealing ports in which air can travel into the kiln, causes the flame to take oxygen from whatever it can, in this case from the clay and the glazes in the pots. Oxygen is drawn from the oxides in the pots and reduces them back to their original state, radically altering the final appearance of the ware.

Reducing is done by closing off the secondary air ports. (Secondary air is any other air which is allowed to pass into the kiln other than through the vent at the fire box or stoke hole, or in the case of modern kilns, from the air blowers.) Secondary air ports consist of loose bricks above the firebox or burner ports which can be removed to allow air to enter. The atmosphere inside a kiln very much

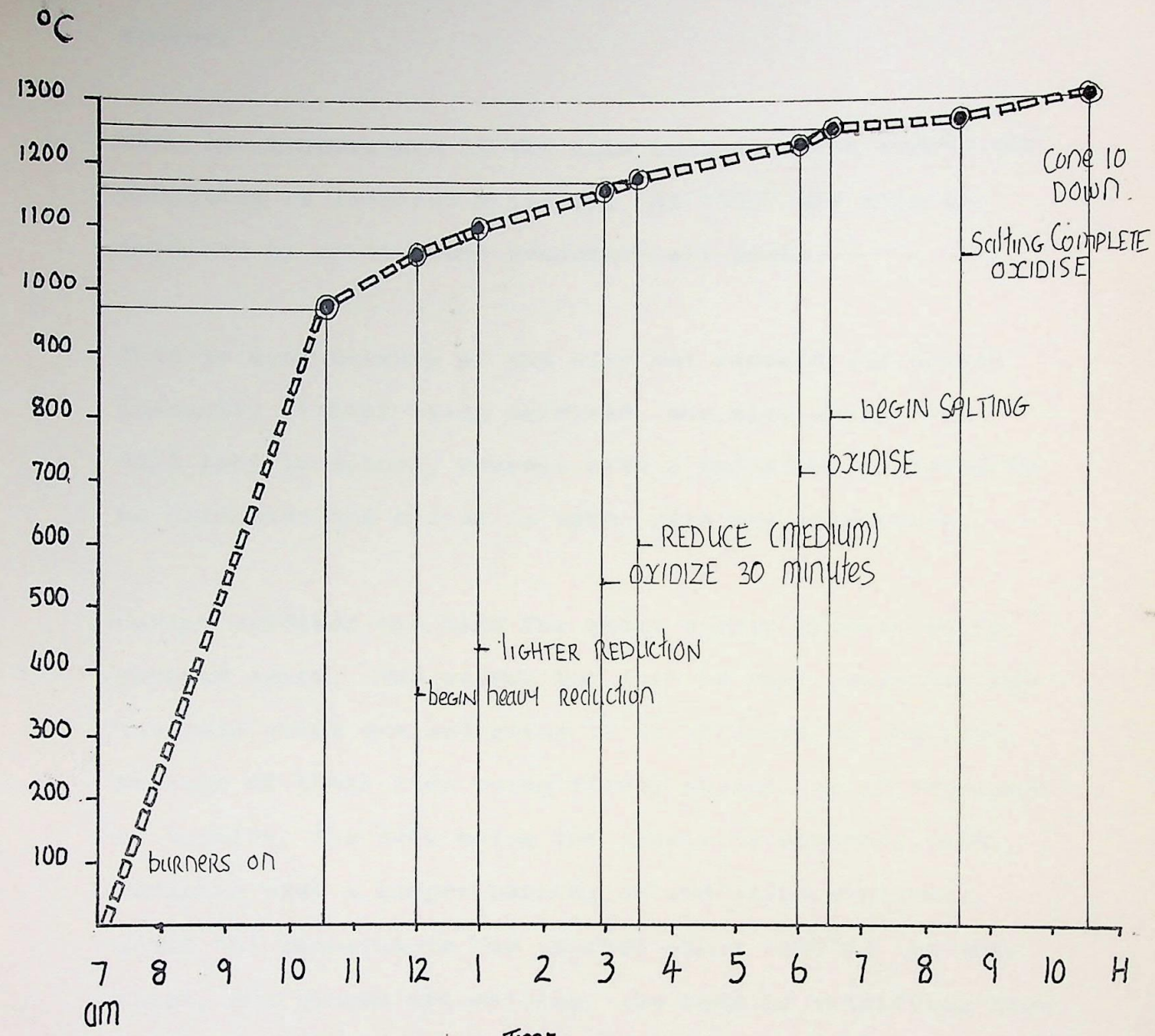


FIG 29 A salt kiln shedule
This graph shows the rise in
tempeture against the time. This
is by no means what should
happen, but the behaviour
of tempeture and the approximate
times for salting are ~~e~~ used in

affects the colour of the glazes, slips, and clay in the kiln; doing this causes the atmosphere to become hazy and smokey.

When the temperature of the kiln reaches about 1100°C the reduction is lessened a little. At 1160° the kiln is oxidised by opening the secondary air ports.

This is done because if the clay was reduced and cooled instantly without being oxidised, the clay would turn a dull grey in colour, whereas with a reduction followed by an oxidation the colour is warm, rich and attractive.

Having oxidized the kiln for about thirty minutes it is reduced again. The reason for this is that glazes inside the pots which are not going to be affected by the salt, because of their lids being firmly sealed, or in the case of bottles, the neck being too narrow or covered, need reducing over a longer period; so reduction continues until the temperature has reached about 1240°C. At this stage, the glazes are melting, the body is vitrifying hard, the silica is becoming active, and salting time is imminent.

The kiln is oxidised once again, because by now the body is sealing over, and by the time the temperature gets to 1260°C - 1270°C the body will be vitrified and any further oxidation is then less likely to be beneficial.

At 1260°C the clay is vitrifying and at its best for the reaction with the salt. The timing of the salting is governed by the size of the kiln and also whether it has

been used for salting before. A new kiln has to be salted as well as the pots, so as to achieve a good appearance on the pots. Coarse industrial salt is used, dampened and served through the salt port in trowel lots. The salting should be completed at 1260°C - 1270°C. Then the atmosphere in the kiln is cleared by opening the secondary air ports and is fired until about 1300°C. The firing is then completed and fuel supply is turned off.

BIBLIOGRAPHY

M. Cardew - Pioneer Pottery
Longmans, Harlow, Essex, 1969

Roy Cowan - "Salt Glazing" - New Zealand Potter
Volume 15, Pages 14, 15, 16.

Peter Gibbs - " Experience with Saltglazing" - New Zealand Potter Volume 20, Page 28.

Harold R. Holmes - Religion in Europe
L. Martin & Co, London 1893

L. Holmes - The Antiquaries Journal
Volume 31, Page 173, 1951

Llewellynn Jewett, The Ceramic Art of Great Britain From Pre Historic Times to the Present Day
London, Virtue & Company Ltd, 1878

W. G. Lawrence - Ceramic Science for the Potter
Chilton Press, Philadelphia 1973

Janet R. MacFarland - Nathan Clark, Potter Antiques LX (1951)

Daniel Rhodes - Kilns
Pitman Publishing Ltd

John C. L. Sparkes and Walter Gandy - Potters, Their Arts and Crafts (London, S. W. Partridge & Co 1896)

Peter Starkey - Saltglaze : Pitman Publishing 1977

GLOSSARY

BISCUIT, Bisque - unglazed ware usually porous. The biscuit firing is for convenience to render the pots less fragile and glazing easier.

BODY - Any clay, mixture of clays, or admixture with other ceramic materials.

DAMPER - A sliding plate which can close or decrease the chimney opening and thus the draft through the kiln.

ENAMEL - On-glaze pigments with a firing range of 690-850°C. They are applied to already fired glazed ware.

FIRING - The heat treatment of ceramic materials at least to the sintering stage, in practice to a minimum of red heat(600°C).

FLUX - The term indicates an oxide, generally a base, which lowers the melting point of an acidic oxide, especially silica.

FRIT - A ground glass of glaze.

GLAZE - A special sort of glass, differing from window-glass and glassware in its lower thermal expansion and higher alumina content, which increase its viscosity and help it to adhere to the clay body.

KICKWHEEL - A foot operated potter's wheel

KILN - Essentially a box where heat can be introduced either by combustion or by radiant heat. A kiln must be capable of reaching at least 600°C.

OXIDATION- The combination of a metal or other element with oxygen to form an oxide.

PLASTIC - Capable of being easily moulded.

PUG MILL - A machine through which clay is forced out in order to consolidate it into a firm state.

REDUCTION - The extraction of oxygen atoms from oxides.

SLIP - Any clay or body mixed with water to a smooth consistency.

VITRIFY, vitrification - To assume the nature of a glass.

For supplementary definitions, refer to:
Robert Fournier - Illustrated Dictionary of Practical Pottery
(Van Nostrand Reinhold Company Ltd, 1973)