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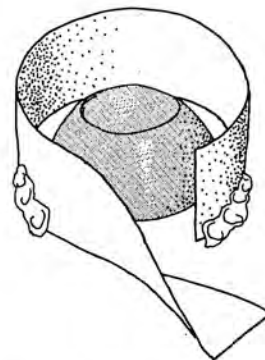
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Crack. (1) To make the first opening of a kiln after firing. As the kiln cools it is clammed up at red heat to give uniform cooling over the dunting period. It is cracked when dunting and other thermal shock hazards are passed.

Crack. (2) An unwanted break in a piece of pottery. It should always be remembered that cracks are caused by physical stress and that some stress is always present in a pot resulting from the expansion, contraction and shrinkage the pot has experienced. Cracks occur when the stress is greater than the pot can withstand.

General points in the analysis of any crack are as follows:

1. The position of the crack on the pot is related to the form of the pot. The design of the pot controls the form and therefore the stresses. A badly designed pot, with awkward angles etc of unequal section, is likely to crack although it may be made from ideal materials. A well-designed pot made from infamously awkward materials may survive. Two pots which are similar but not identical may be on each side of an unknown safety line. One may crack; the other remain sound.

2. If one takes liberties in pottery-making, one must expect differing results. Potters talk about good-natured clays and well-disposed glazes but this only emphasises that they can be otherwise. A variation in body, form, method of making, method and speed of drying, firing temperature, firing cycles, slip or glaze will result in a variation of product. The variety may include a crack.

3. Cracks in raw ware arise from faults in the making of the pots, and these can be overcome however difficult the clay may be to deal with. The design, that is, the form, is all important and achieving the design means working with the clay and not against its nature. Uniform consistency of clay, before and after making, uniform thicknesses and uniform drying are the ideal principles.

4. In finished ware one should look where the crack started to understand when it happened. The wider end of the crack was the starting point. If the crack started at the rim, the fault is likely to have been somewhere at the raw stage. If in the base, the crack usually occurred in the firing and could be caused by the materials, the type of firing and the type of setting used.

5. The edges and faces of the crack are another indication of when the crack occurred. Frayed edges and rough faces on the two sides show that the crack occurred relatively slowly and probably at the making and drying stages even though it may be that the crack did not show until after firing. A glaze on such a crack will be seen to have rolled back from the edge and rounded itself. On the other hand, if the edge of the crack is sharp and the faces of the crack are smooth, the crack is a kiln crack. If glaze around the crack has smoothed itself and is rounded at the edge, the crack must have occurred early in the firing and the glaze during fusion crawled back from the edge. If the glaze is sharp-edged, the crack must have occurred after the glaze had set during the later stages of cooling.

6. Whether a crack is hairline or wide is a matter of amount of stress. A differentiation should not be so much in width as in whether there is sideways displacement as well as parting. Fine dunts may be undiscernible but are discovered by touch when the finger catches upon an edge. In this case there is a displacement. Displacements are usually firing cracks. Cracks which are partings without displacement, even if apparently happening in the glaze firing, are usually from an earlier process, e.g. a biscuit dunt or a drying crack.

The illustrations show typical cracks and a brief comment is made on the causes. The reader is often referred to other items in the book for details.

CRACK A. The crack is at right angles to the rim and is wider at the rim and peters out below.

Crack A in raw ware:

1. The design is poor giving a structurally weak pot. Probably the rim is too thin to contain the stresses in the remainder of the pot.

2. Method of working was incorrect for the clay used. Probably the drying was too rapid and unequal.

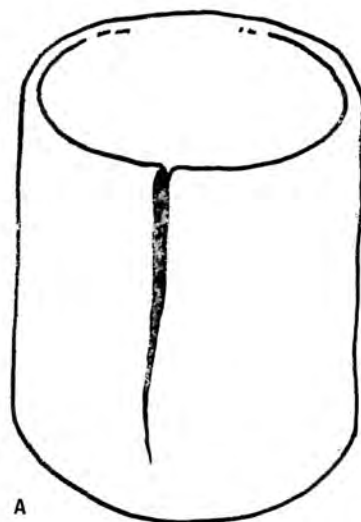
3. If the crack is in newly-thrown clay and shows whilst still on the wheel or soon after removing, it is likely to be insufficiently prepared clay or possibly tired clay or over-short clay. If the clay has had extra sand or grog added this may have made the clay too short for the type of throwing used. This crack has the appearance of a fibrous tear. Illustration A iii.

4. If the crack is in the rim of a plate or dish, especially a press-moulded dish, the clay was probably over-wet unequally in some way. Also the drying which followed was too rapid for the clay to equalize its moisture content. Illustration A iv.

5. If a slip coating has been poured or brushed inside the dish it was done when the dish was too dry. Illustration A v.

6. If a slip coating was used and the dish was too damp then some distortion will have taken place. Illustration A vi.

7. If the crack is hairline, it could be that the pot has been waiting for firing over a period which involved dry



A



Aiii



Aiv & Av



Avi

weather followed by wet weather. The resulting crack is a result of readsorption and the phenomenon is described under **Readsorption** in this book.

Crack A in biscuit and glazed ware:

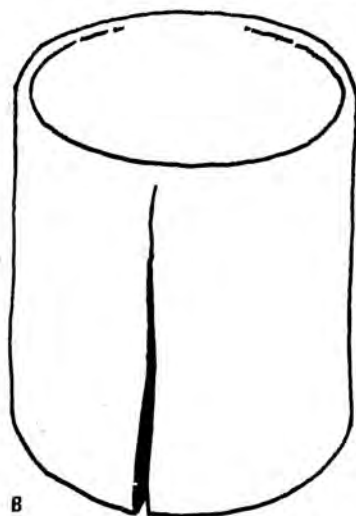
8. The crack is probably the development of one that was latent at the raw stage. The stress at the raw stage may have ruptured the clay without visible signs at the surface. Such cracks are called latent or dormant cracks and no matter how careful the firing they are forced to develop. Mishandling of raw ware when packing a biscuit kiln may have induced cracks, but the cause should first be sought as poor design, rapid drying, unequal drying, incorrect method and readsorption.

9. Stress in the raw ware which could be successfully

Crack

contained by careful drying and firing may have been over-emphasised by too rapid a firing in the early stages of biscuit.

CRACK B. The crack is at right angles to the rim but is wider below the rim and almost undiscernible at the rim. It starts at the base or some other feature.



Crack B in raw ware:

1. Very rare but could result from a thin base and unequal drying.

Crack B in biscuit ware and glazed ware:

2. The crack is a cooling dunt caused by the crystalline silica in the body. The crystalline silica undergoes an inversion or change of crystal structure. This is accompanied by a change in size which proportionately affects the body of the pot but not the glaze. Stress within the body, or between body and glaze, may be sufficient to rupture the pot. See **Dunting, cooling dunts**.

CRACK C. The crack is at right angles to the rim and the sides are almost parallel. The crack originates at a star-shattering in the base. See crack F.

Crack C in raw ware:

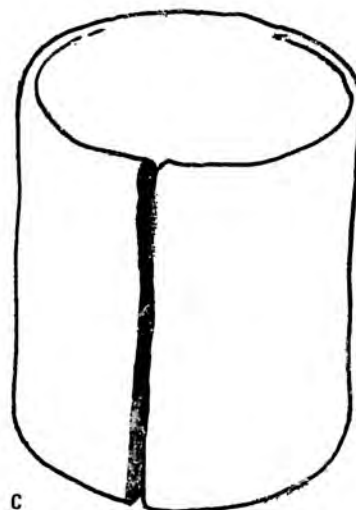
1. The wall and the base are unequal in thickness, with the base probably too thin for the pot. It is also likely that the base was left too wet after throwing and that drying followed immediately and was too rapid. This could occur where a wet pot was left on a very absorbent surface.

Crack C in biscuit ware:

2. The crack is a development of one that already existed at the raw stage.

Crack C in glazed ware:

3. This type of crack is most common on glazed ware



and is a cooling dunt caused by a thick glaze layer inside the pot. It does not matter that the glaze is crazed and therefore one would expect it not to force the pot body apart. There existed a point during cooling when the glaze was too large for the pot surrounding it. It is most likely to occur where the pot is glazed inside only and the base is thinner than the walls.

CRACK D. The crack is clean and sharp-edged. It divides the pot into two almost equal pieces. It is common on stoneware and porcelain bowls, especially refires, where it is discovered on opening the kiln. The parts are unlikely to fit together perfectly because distorted.



Crack D in raw ware:

1. A crack of this sort is virtually impossible because cracks in raw ware tend to avoid the foot rim.

Crack D in biscuit ware:

2. A rare possibility of a cooling dunt caused by a cold draught on an inverted bowl.

Crack D in glazed ware:

3. The clean break through body and glaze shows that the crack took place after the glaze had set. It is classified as a cooling dunt caused by the crystalline silica in the body. The crystalline silica undergoes a change in size and proportionately changes the size of the body. The glaze, which is not crystalline, does not change and stress results. Also, the difference in thermal contraction between body and glaze without considera-

tion of crystalline silica inversions causes stress. See **Dunting: cooling dunts and Silica inversions.**

4. In consideration of the above stress between body and glaze there is a factor which exaggerates the danger of a crack occurring. It is the over densification of the body. Overfiring the pot brings the body nearer to its total vitrification point, makes it more brittle and hence, less able to absorb the stress. Refiring pots, even to the same temperature, continues the vitrification process beyond its original point. Already dense ware is forced to be adversely affected and become over-glassy and brittle. During the firing, a bowl is likely to distort and go oval which concentrates the stresses upon cooling.

5. An over-dense body tends to fuse itself to the kiln shelf unless a very efficient bat wash is used. The foot rim becomes fastened to the shelf upon cooling and, since the shelf is likely to contract less than the pot body, the pot is torn apart starting at the foot.

CRACK E. The crack is a hairline crack which runs across the base in a straight line. It almost invariably continues up the side of the pot at least as far as the thickness of the base. It may continue up both sides of the pot. It is closely related to cracks D and F and occurs on glazed ware only. It is not to be confused with cracks H and G which are more commonly confined to the base.

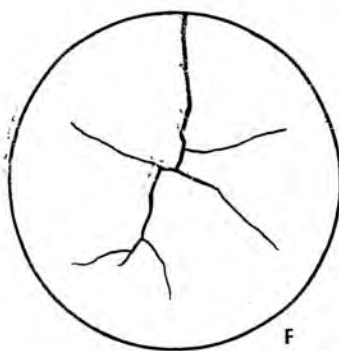


Crack E in glazed ware:

1. The glaze is obviously too big for the body so that the base of the pot is trying to squeeze the glaze. If the stress is great enough the body ruptures itself. The crack would be classified as a cooling dunt resulting from the different contraction rates of the body and glaze. See **Dunting: cooling dunts, Glaze fit and Silica inversions.**

2. If the crack occurs months or even years after the pot has been made, it is likely to be called the result of thermal shock. The cause of the stress is still the difference in contraction rates between body and glaze but not directly attributable to crystalline silica. See **Thermal shock and Glaze fit.**

CRACK F. The drawing shows star shattering of the base seen from underneath. The actual pattern of the star varies considerably but there is usually a main crack with subsidiary ones at approximately right angles. There is often a fifth crack making the star as in the example shown.



Crack F in raw ware:

1. If the base of a thrown pot is too thin in relation to the walls, it could crack in this way.

2. If the base of a thrown pot was left over-wet and then possibly dried quickly the stress of (1) would be exaggerated.

Crack F in biscuit ware:

3. Cracks in biscuit would be developed from cracks in the raw ware and in this case should have been discernible at raw stage.

Crack F in glazed ware:

4. The star is closely related to cracks D and E. In this case the glaze layer inside is usually thick, even thicker than the base of the pot. The fluxing action of the glaze on the thin base makes the base almost vitrified and hence brittle. In cooling, if the body contracts more than the glaze, even by a small amount, it is too brittle and weak to compress the glaze. The body ruptures and the crack probably continues up the side to the rim as at crack C.

CRACK G. The crack is straight or nearly so. In most cases it is related to crack H. In raw ware and biscuit, it is only a hair crack but in glazed ware there is likely to be some slight sideways displacement as if one side of the crack had curled up and the other side down.



Crack G in raw ware:

1. The crack is the result of unequal drying in some way. For example, the pot was not cut from the wheel-head after throwing but was allowed to dry on the wheel-head or bat. The pot was cut under but not lifted clear from the wheel-head or bat. The pot was lifted

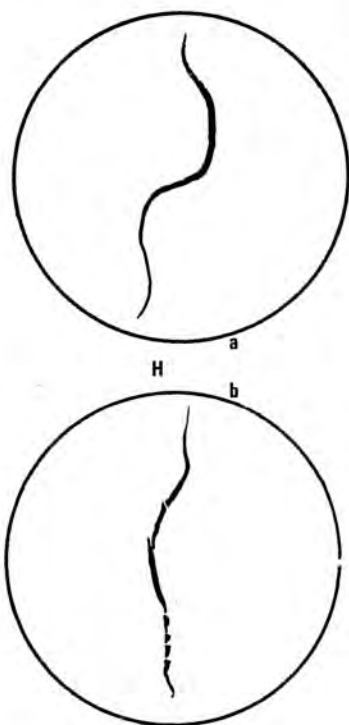
Crack

clear but was placed on a pot board that was not sufficiently porous to allow the base to dry. These cracks can sometimes be patched at the dry stage by using some very soft and sticky body clay.

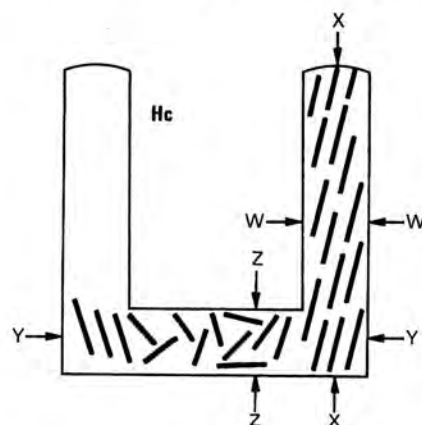
Crack G in biscuit ware and glazed ware:

2. The crack is really a drying crack and occurred much earlier although being only a hair crack it was not discovered at the raw stage. In glazed ware the crack sometimes goes the whole way through the base. In this case the glaze will have rolled back from the crack with rounded edges or, if the glaze is very runny, it may have run through the crack and appeared underneath. The crack, if small, can sometimes be patched at biscuit stage with biscuit stopping or pitchers. This is a ground fired body which is mixed with water to form a paste that can be pushed into the crack. The stopping should be allowed to dry before glazing. Stopping of cracks after biscuit is effective only if the following glaze firing is at a lower temperature than or only slightly more than the biscuit temperature.

CRACK H. This base crack is known as an S crack because it often forms an S across the base. The two illustrations show the crack as seen from (a) inside the pot and (b) underneath. It occurs in thrown ware. The crack, if seen without the glaze covering, looks more like a tear than a sudden crack. Where there is a glaze, it may or may not have flowed into or away from the crack, dependent upon the properties of the glaze and shrinkage cycle of the clay. In these cracks the glaze is no indication. The character of the crack itself is sufficient evidence.



Crack H in raw ware, biscuit ware and glazed ware. The cause is the same throughout. It is the unequal shrinkage of the clay in the base and walls of the pot. Shrinkage starts as the clay dries and continues as the pot fires and is matured or vitrified. The shrinkage is equal in all directions only when the clay particles are haphazardly mixed. This does not happen in a pot. The clay particles are disc-like plates which align themselves across the pressure. There is always some pressure in a pot wall caused by the fingers inside and out. The clay shrinks proportionately to the gaps between the particles and therefore if the particles are all lying in one direction there will be a concentration of the shrinkage. In the diagram H(c) the clay particles are vastly enlarged in a section of a pot to show how there are as many gaps between particles through the wall of a pot as in its height. In this exaggerated case the shrinkage on the pot wall thickness (w) would equal the shrinkage in height (x). The slight angle of the particles is caused by the lifting action of the throwing. See **Clay: physics**.



No harm comes to the pot wall by this shrinkage, in fact, it is strengthened. The base should be similarly subjected to pressure across its thickness resulting in the alignment of particles in a flat way across the base. However in the diagram the base has not been subjected to sufficient pressure. The particles are haphazardly arranged and show only a slight tendency to alignment from the pressure received at the opening up stage of throwing. This pressure has only emphasized an arrangement of the particles vertically because the pressure was outwards from the centre. Shrinkage on this base will be greater at y than at z . The result will be an S crack.

To overcome the S cracks requires a change of throwing technique to include a compression of the base. The term compression is used in this sense. Some potters beat the bases of the pots as soon as the pots can be inverted but this is likely to be too late for most clays. Although damaging to modern wheel bearings, the age-old custom of throwing the clay down hard onto the wheel head may help. Holes in wheel-head bats are a

place where pressure can be lost and can be a starting point for an S crack. Most trouble is experienced when throwing many pots from one lump. It is very difficult to compress the base sufficiently. A technique has to be developed whereby pressure downwards inside the pot is met by a pressure upwards from a squeezing action of the other hand. These pots should be turned when fairly soft and the base beaten before turning.

With large flat plates and dishes it may be necessary to beat the inside of the base with a stone, piece of wood or the hand before finishing the throwing. Also running the fingers towards the centre as well as outwards helps. Traditionally the thrown oven dishes were often made oval by cutting a leaf-shaped piece from the base and pushing the joint together. Extra clay was stuck onto the joint and beaten into place. The extra compression thus gained improved the strength of the base and overcame the S cracks. Also by cutting across the base, the centripetal base stress was hindered from development in the thermal shocks of use. An oval dish has the stresses connected with only the lesser width but has the stability of the greater width. See also cracks I and K.

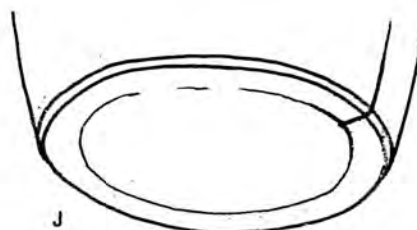
CRACK I. The crack is a hairline around the base seen from the underside but probably invisible inside. At its worst it forms a complete circle and the base falls out. However this is more common with crack J, which is slightly different and more drastic. Crack I appears on ovenware, both glazed and unglazed, and is often noticed because it has stained. It will be seen to extend itself slowly with further use of the piece of pottery.



Crack I in fairly dense ware both glazed and unglazed. The crack is caused by thermal shock. There is probably some difference in thickness between base and wall which results in unequal expansion and contraction. Repeated subjection to the stress in daily oven use extends the weakness. See **Thermal shock**.

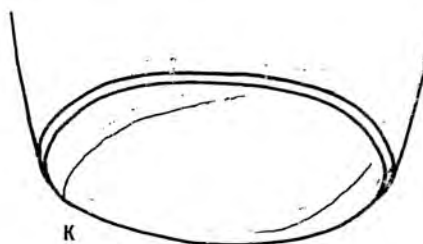
CRACK J. The crack is circular, or almost, and has an extension at right angles which goes outwards to the edge of the foot and part way, or all the way, up the side of the pot. The crack occurs quickly with a loud noise, or is discovered on opening the kiln. The circular base piece drops out of the pot. This is most common on plates and dishes.

Crack J in glazed ware. There is stress between body and glaze. The glaze is too large for the body and



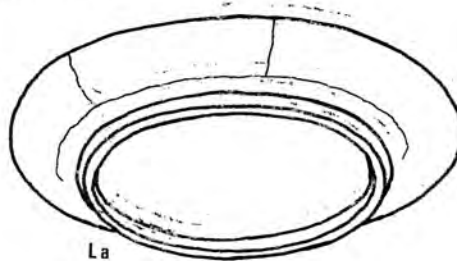
ruptures the body that is compressing it. See **Dunting: cooling dunts**. It occurs where the glaze is too thick and has collected inside around the base because the base is slightly humped.

CRACK K. There are two hairline cracks seen from underneath. They describe an incomplete oval which would overlap the base. The cracks, or just one of them, appear on ovenware after use.



Crack K in fairly dense ware both glazed and unglazed. The crack is caused by thermal shock and is similar to crack I. See crack I and **Thermal shock**.

CRACK L. The first illustration shows the underside view of a plate. Haircracks, at first not noticeable, result in rectangular pieces breaking from the rim. In the second illustration the haircracks do not reach the rim but form a set of cracks like brickwork which give that part of the pot a deadness although the rim may still ring when struck.



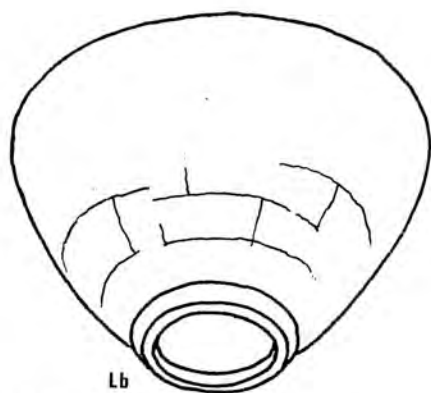
Crack L in biscuit ware:

1. The crack is a dunt caused by cooling the biscuit too quickly or firing it insufficiently to give it strength. See **Dunting: biscuit dunts**. Plates that are piled one inside the other, not rim to rim, will hold their heat around the foot rims when the outer rims cool. A thin plate on a thick kiln shelf is also unable to cool uniformly.

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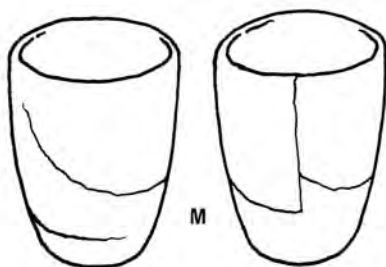
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Crack L in glazed ware:

2. The crack is probably more than a haircrack in a few places and results from a biscuit dunt that was unnoticed at biscuit stage. At biscuit stage some dunts do not penetrate through the pot. A slip coating could dunt separately from the pot body and *vice versa*.

CRACK M. A sharp-edged crack with sideways displacement. This occurs on glazed ware and is discovered on opening the kiln, soon after and on rare occasions up to a year later. The crack is accompanied by a loud noise as it quickly ruptures the pot. It may not reach the rim.

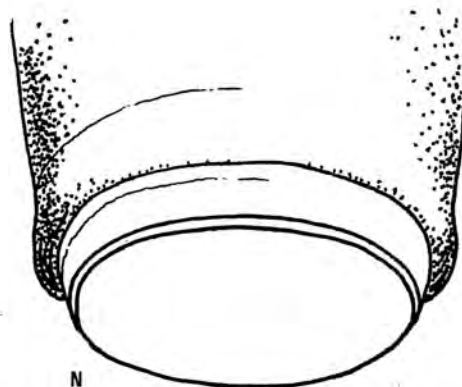


Crack M in glazed ware, especially dense stoneware. There is stress between the body and glaze which cannot be absorbed. The body is compressing the glaze but the glaze is strong and does not flake away as in crack O. The glaze remains as one piece because it is well attached to a dense and finely-grained body. The body therefore ruptures and as it does so there is sideways displacement or strain to accommodate the stress. This displacement ruptures the brittle glaze also. See **Dunting: cooling dunts**. It is likely to happen with stoneware bodies which include cristobalite. See **Silica inversions**.

CRACK N. The cracks are hairlines but, where glazed, are sharp edged and can often be felt before seen because there is a very slight displacement. They appear above, below or along a glaze roll.

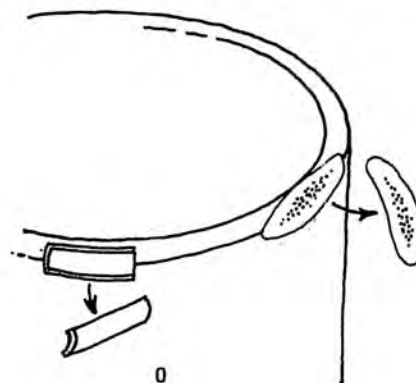
Crack N in glazed ware. The crack is a dunt caused by the difference in expansion/contraction rates of body and glaze. The stress between the body and glaze over most of the pot is satisfactorily absorbed by the body-glaze layer. However at the roll there is an exaggerated

Crack



stress which is sufficient to cause the dunt. Sometimes part of the glaze roll will shiver also. See **Dunting: cooling dunts, Glaze fit and Shivering**.

CRACK O. This is a crack through the glaze whereby a thin flake of glaze leaves the pot. The flake is sharp edged and if there is a strong body-glaze layer it will have carried with it some of the body. It occurs on rims, edges of handles, relief decoration and throwing marks.



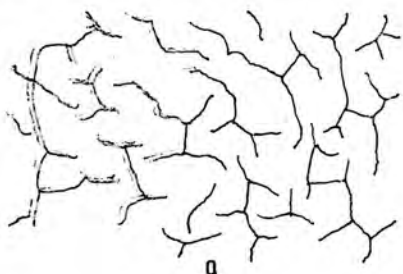
Crack O in glazed ware. There is stress between body and glaze that cannot be absorbed by the body-glaze layer. The flaking is called shivering and shelling and in the case of shelling may have started before the glaze was fired. The lack of bond between body and glaze, or the lack of sufficient body-glaze layer is often caused by over-sponging of rims and edges. Over-sponging takes away the fine clay and leaves behind the sand. If this sand is not fused in the body-glaze layer it presents a weak structure with no elasticity to absorb the stress. See **Shivering and Shelling**.

CRACK P. A network of cracks forms a lace-like pattern in the glaze. This is called crazing. It usually develops after the pot is taken from the kiln but in extreme cases occurs during cooling. On opaque glazes it is often difficult to see and only shows if the glaze is misted by condensation or becomes stained.

Crazing results when the glaze is under tension and cracks to relieve the stress. See **Crazing and Glaze fit**.



CRACK Q. A series of short cracks which divide at the ends to reach into spaces surrounded by other cracks. They occur in slip coatings and are seen at raw stage, biscuit stage and very occasionally through a transparent glaze. They can be one cause of the crawling of the covering glaze. Also glazes which contain a high proportion of clay, e.g. slip glazes and some dolomite glazes, may crack in this way and later crawl during the firing. See **Crawling**. In extreme cases, the slip may peel and lift from the body.



Crack Q in raw ware and biscuit ware. The crack is caused by the drying shrinkage of the clay slip. The slip shrinks more than the clay body which it covers because it is too rich (over-plastic and too fine), applied too thickly, applied when the body was too dry, or dried too quickly. Small cracks rarely show through a glaze. The cracks can be overcome by the addition of some non-plastic material to the slip, e.g. sand, flint, feldspar, pitches, or by the use of a thinner layer and more controlled drying.

Cracks Q should not be confused with the separate crawling of a slip and with the separate dunting of a slip. The three types of cracks can be identified by their different patterns.

CRACK R. These defects are included for completeness. Defect 1 occurs on both biscuit and glazed ware. Defects 2 and 3 occur on glazes.

i. This is a spit-out caused by foreign matter in the body. The object is usually a small stone which decomposes in the firing leaving an unfused spot which



is porous. The porous spot absorbs moisture from the air, expands and pushes off a flake of glaze and probably part of the body. This occurs after the pot is taken from the kiln. The foreign matter can sometimes be seen at the biscuit stage and if small can be dug out and the hole stopped with ground biscuit body. Such foreign matter exists in most clays as dug or might be accidentally introduced as broken bits from drying slabs made from plaster. A sea shore sand used as grog introduces specks of shells which are calcium carbonate. This decomposes at 825°C (1517°F) to little pockets of calcium oxide. If the firing continues beyond 1150°C (2102°F) these will become integrated. But if the firing is finished below this, as for a biscuit at 1000°C (1832°F), then the ware is likely to be covered by a host of little flakey spit-outs within a few days, especially in damp weather. This defect is also called chalking. See **Lime blows**.

ii. The spots are called pin holes. They are small craters left by escaping gases. The glaze is probably stiff and contains a high proportion of aluminium oxide. It therefore requires a slightly longer firing to give sufficient time for the glaze to heal over. Alternatively a slightly higher firing may be used but this could result in more pin holes if the higher temperature boils or decomposes one of the glaze constituents. Alteration of the glaze recipe to reduce the aluminium oxide content slightly should be considered as a long-term policy.

iii. The radiating lines on the glaze surface may be quite tiny or may cover an area 6 mm across. The defect is called crow's feet and occurs on fairly stiff glazes which have difficulty in wetting the body which they cover. Stiff glazes with a strong surface tension do not easily soak into the body or flow into hollows or bridge over large particles. Crow's feet often form around specks of grog and sand on the body surface. Over-sponging, which takes away the fine clay and leaves the coarse clay, sand and grog, is one cause of crow's feet. Under-firing of the glaze is also a cause, because it does not allow the glaze to fuse fully and cover the coarse spot. The use of too much binder in the form of a glue or other organic material on the biscuit or in the glaze can also cause crow's feet. Loss of fine surface by sponging or bad fettling is the usual cause. A reduction in grain size of sand or grog, or the introduction of a ball clay into the body, or a slight extra fusion of the glaze may also be required.

CRACK S. The crack is where a handle joins a pot, either at the top or the bottom. It is called 'springing'. All handles, lugs etc are subject to springing. It originates in the making but may not be seen until after the glaze firing.

Crackle-Crank



Crack S in raw ware, biscuit ware and glazed ware.
The handle was incorrectly joined for one or more of the following reasons:

- The join was made too wet.
- The join was not made wet enough. (Less common than above.)
- The join was dried too quickly.
- The pot was too dry when the handle was attached.
- The handle became too wet during attachment.
- The handle clay was too stiff and was subjected to stress during attachment.
- The handle was distorted during drying, causing stress.
- The handle clay was different from the body clay and was therefore subject to a different shrinkage. A handle which shrinks less than the body of a pot can usually survive better than one which shrinks more.

CRACK T. The crack is a break through the handle other than at the joint. It often occurs in the lower half of a pulled handle as in the illustration. The latent crack occurs during the making but can remain undetected until it shows as two parted ends after the glaze firing.

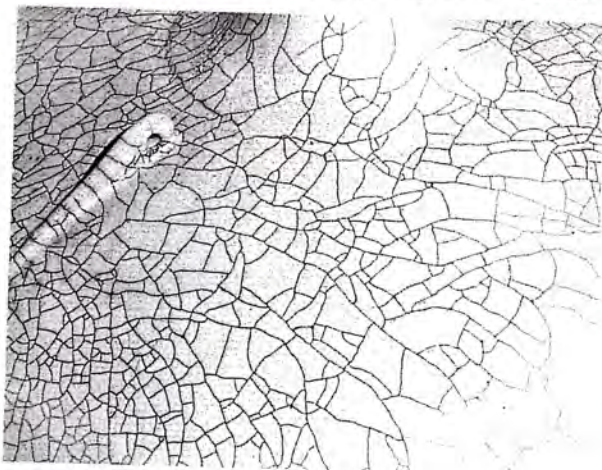
Crack T in raw ware, biscuit ware and glazed ware.
There are two possible and related causes. The clay



used for the handle was too weak, possibly because it had become tired by being overworked in making the handle. The handle was too thin for the type of clay used.

Crackle. Crackelle. Craquelle. A craze in the glaze used as a decorative feature. On some Chinese porcelains the first long craze lines were filled with a stain before the minor craze lines in between were established. The first cracks are inevitably wide but close as the stress is eased by further minor cracks. It is thus possible to choose the best time to stain the craze to show the network of lines to its best decorative effect as a crackle.

Crackle is often a feature of raku ware. A white glaze shows this to advantage after smoking in sawdust. A detail of this is shown on a large pot by Dave Roberts.



There is a method known as melt-crackle in which the glaze is first underfired and allowed to craze. Colouring oxides are rubbed into the craze when it achieves a desired pattern, then the pot is refired to fire the glaze to its correct temperature. The craze shows finally as lines which are inlaid stains.

It is possible to produce one crackle network over another by the use of two separate glazes. The two glazes may have completely different patterns of crackle and the effect can be an interesting lacework.

When considered as a technical fault, crackle is called crazing. See **Crazing**.

Crank. A refractory support for plates, tiles etc in glost and enamel firings. By the use of a crank rather than separate shelves, it is possible to more than double the weight of ware in a given kiln space.

With one type of crank, the plates and tiles rest upon projections (pins) which support the ware close to its edge. Thus this type is not suitable for maturing bodies which would sag. In the other type of crank, the crank is built from a series of separate chairs, tables or thin shelves which support each plate by its base. Pins are usually a refractory body but metal is also used.