RAKU: FORM, EXPRESSION, AND TECHNIQUE

A Thesis

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by

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Approved by

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I would like to thank my husband, George Zaros, for his help with kiln building and for his assistance with the research on kilns and firing. To my adviser, Mr. Friley, go thanks for help and advice with research and the preparation of the manuscript.
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RAKU: FORM, EXPRESSION AND TECHNIQUE

Introduction

The term Raku ware, in the twentieth century, is descriptive of low-fire ware usually glazed with a lead glaze and removed from the kiln while red hot.

The first pottery to bear the name raku was made during the sixteenth century in Japan. This ware has been said to be the "essence of Japanese pottery."\(^1\) The name raku, which is represented by the single Chinese character, 醓, meaning enjoyment was bestowed both upon the ware and the family of potters producing it by Toyotomi Hideyoshi (1536-1598), de facto ruler of Japan at the time.\(^2\) In Japan the term yaki meaning baked wares is the generic term for all types of ceramics; thus, raku-yaki would refer to pottery made by the raku family of potters.\(^3\)

The line of raku potters is said to have begun with Chojiro (1516-1592), the son of an immigrant Korean potter named Ameiya who married a Japanese woman and settled in Kyoto. Chojiro's original occupation was more that of a sculptor than a potter for

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\(^1\)Fujio Koyama and John Figgess, Two Thousand Years of Oriental Ceramics, pp. 180-181.

\(^2\)Roy Andrew Miller, Japanese Ceramics, p. 64.
it involved the production of ornamental roof tiles.\textsuperscript{4} Around 1572, he began to produce the utensils for the tea ceremony which attracted the attention of Sen-no-Rikyu who was the tea-master of Japan. The attention bestowed upon Chojiro and his wares marked the emergence of Japanese ceramics from the almost total anonymity of its earlier periods.

Although the original line of raku potters has continued through fourteen generations down to the present, there have also been a number of other potters trained in the raku tradition. Many of these have been people for whom pottery-making was a diversion or hobby. Hon'ami Koetsu was one of these "gentlemen potters" who produced many treasured pieces in the raku tradition.\textsuperscript{5}

When Bernard Leach first visited Japan in 1911, he became very interested in the production of raku ware, and studied with the sixth Kenzan, a potter in the raku tradition. It is largely through his teaching and writing that the western world initially became aware of raku. He has done considerable research on the history and technique of raku, and although some of his glaze formulas call for ingredients quite unknown to the western potter, they may nevertheless provide a starting point for some raku glaze experimentation. He describes in detail the construction of a raku kiln:

\textsuperscript{4}Miller, \textit{op. cit.} Plate 54.

\textsuperscript{5}\textit{Ibid.}, p. 64.
The site of a raku kiln should be well drained as otherwise the heat draws up damp into the kiln which has an ill effect. The foundation ought to be dug out at least a foot deep and the cavity lined with either iron or copper sheeting. This should be covered with sand and tiles upon which the kiln proper can be constructed. The space between the inner chamber, or muffle, and the outer wall, ought to be two fingers in breadth. In order to find out if the pots are finished or not, a window, or spy hole, should be left in the outer wall. The flames should look bright at the end (750°C.) Test pieces with pigment and glaze on them should be placed opposite the hole so that they can be withdrawn easily. If the wares are still underfired the surface will be mat and it will not be easy to distinguish between pigment and glaze. If the pigments, mixed with seaweed syrup are not quite dry when the glazing is done, they will smudge.

He also stresses the importance of the glazed ware being completely dry and even heated if the kiln has reached maximum firing temperature when the ware is placed in the kiln.

In Japan today, there are a number of small factories where raku ware is produced. Other colors have been added to the original black, red and white raku teabowls although most bowls for the tea ceremony continue to be glazed either red or black. As with potters throughout the world, the Japanese raku potters have learned to control many of the effects which were initially random occurrences. Other problems have been incurred, however; for instance, one of the primary ingredients used for the black raku glaze is now quite scarce, but the potters have discovered that many tombstones were made from the same material mined long ago and there are reports of night expeditions to burial grounds to

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6 Bernard Leach, *Kenzan and His Tradition*, pp. 154, 155.
chip away a supply of the necessary material.\(^7\)

Potters of the twentieth century became interested in raku because of the expressive possibilities inherent in the spontaneity of the technique. Because of the ease of setting up raku kilns, many non-potters have seen demonstrations of raku firing and the ware has come to enjoy considerable popularity in recent years. No longer are those pieces limited to simple teabowl shapes, but the raku technique has been used to fire many different types of pottery, both functional and non-functional, as well as sculpture.

The firing of raku ware is quite dramatic. Although, when a certain type of clay body is used, bisque firing is not necessary, the more usual practice is to apply the glaze to bisque ware.

The ware is then placed in a red hot kiln (usually a single piece at a time) and the potter watches through a spy hole or a hole in the damper. When the glaze develops a glossy, smooth appearance, the ware is ready to remove from the kiln. It is then extracted with tongs. The open, porous nature of the clay body permits it to undergo the shock of the rapid temperature change without shattering. The ware could then be permitted to cool naturally in the open air. It is quite likely that the early raku potters followed this procedure. Modern potters, however, like to remove the ware from the kiln and place it in a bucket of sawdust or straw and cover the bucket with a lid. The

red hot ware will ignite the sawdust producing fire and smoke. The ware in the container will receive heavy surface reduction and this can create startling and dramatic effects in many glazes. To further increase the dramatic effect of the entire process, the ware, after smoking, may be placed in a bucket of cold water to speed the cooling process.

The rapidity with which the entire process proceeds coupled with the excitement and drama of the glowing pot, the smoke, and steam rising as the pot is rapidly cooled has an entrancing effect on the student potter as well as the uninitiated observer.

While it is very enjoyable for the student potter to spend an afternoon spattering glazes on pots, firing and smoking them, and then reveling over what may or may not have happened accidentally as a result of the various processes the pots have undergone, one may eventually, however, desire to control some aspects of the total process.

Consequently, the writer has spent several periods of intensive research in attempts to develop clay bodies and glazes suitable for raku ware. In addition, two simple kilns have been constructed, the second a modification and improvement of the first, for the firing of raku ware. Through careful observation of the smoking process, it was learned that by varying the smoking time and even the placement of the material used for smoking, some control could be obtained over what might otherwise be random effects. These experiments will be discussed in detail in the sections following.
Clay Bodies

The first clay body used consisted of 50% Cedar Heights 12-mesh stoneware, 25% Cedar Heights Airfloated stoneware, 25% Tennessee #7 ball clay, plus approximately 30% 20-mesh grog. For most pieces, this was a very satisfactory clay body. It was, however, somewhat lacking in plasticity and not completely acceptable for use on the wheel. Various formulas for raku clay which had been developed by other potters, e.g., Leach and Soldner, were tried and most of them were found to be satisfactory for handbuilding and throwing small pieces on the wheel, but not plastic enough for throwing larger pieces or for bottles where necking in has to be done. These formulas are listed in Appendix A.

Since the first clay body actually had fewer shortcomings, some tests were run varying the proportions of those ingredients. Whereas those formulas containing ball clay in substantial amounts were plastic enough for throwing on the wheel, some drying shrinkage can be eliminated by omitting it. There is also a slight cost savings by using only Cedar Heights Airfloated stoneware. Thus, by this means, it was determined that a satisfactory clay body for raku wares could be made quite simply by combining 100 pounds of Cedar Heights Airfloated stoneware and 20 pounds of 20-mesh grog. This body is plastic enough for throwing and also open and porous enough to withstand the thermal shock incurred in raku firing. By varying the size of grog from small to large
(20-mesh to 9-mesh), quite large pieces can be hand-built.

Although the temperature for glaze firing rarely exceeds cone 03, it is quite possible to achieve a slightly harder body by bisque firing to cone 1. Wares fired beyond approximately this point are not sufficiently porous to withstand the thermal shock incurred during glaze firing.

**Glazes**

Not all glazes that mature in the range of cone 06-03 are satisfactory for raku firing. There are, however, many formulas for raku glazes that have been developed by various potters, and it is possible to combine just a few simple ingredients to make a completely satisfactory raku glaze.

Although a few glazes can be formulated with Colemanite (Gerstley Borate) as a flux, the majority will use lead, either in raw or fritted form, as the major flux. Thus, it becomes the responsibility of the potter to caution potential users that raku ware should not be used for preparation or storage of foods, especially liquids that have a high acid content.

A wide variety of effects can be achieved from a single glaze by the addition of various oxides and by the amount and type of reduction (smoking). Some very interesting effects can be obtained through the use of oxides, both alone and over and under glazes. A combination of approximately 50% iron oxide and 50% copper oxide mixed with water was found to give rich and varied effects depending upon whether it is used alone, over, or under a
glaze. Cobalt alone can be a bit harsh in coloration, but the addition of approximately 2% iron oxide will yield a softer, more subtle blue.

While firing pots made with slip containing iron oxide as the lubricant for throwing, it was noted that the slip showed through some of the glazes. Some experimentation was then done with various slips and commercial underglaze colors which could be painted on and handled like a water color.

Appendix B contains glaze formulas used successfully for raku ware. Several of these formulas list volumetric measurements and these should not be confused with the usual avoirdupois measurements.

Kilns and Firing

It is a simple matter to construct a kiln which is satisfactory for firing raku ware. It could consist simply of bricks piled together with an opening for a single burner and a lid fashioned of bricks held together with angle iron or even a piece of kiln shelf.

The first raku kiln constructed by the writer consisted of a trash can, which had been lined with insulation bricks cut to fit the curve of the interior. The kiln was loaded and unloaded from the top and the lid was made of insulation brick held together with angle iron and tie rods. While it was not difficult to construct, there were some drawbacks which became apparent in use.
Because heat rises, there was considerable heat loss during loading and unloading. Also, it was rather awkward to reach down with tongs and get pots in and out and quite often eyebrows and arms got singed a bit. Although fairly tall pieces would fit inside a kiln of this type, it was virtually impossible to load and unload them while the kiln was hot. Thus, if one wanted to fire a large piece, it would have to be loaded into the kiln before the kiln was heated up and smoking would have to be done in the kiln, then the kiln would be allowed to cool and the piece unloaded. Although results were the same, the piece was not actually raku ware.

The second kiln was constructed to overcome some of these shortcomings. This kiln also consists of a trash can, but instead of being lined with insulating bricks, it has a lining of castable refractory material. The insulating firebricks had been completely satisfactory in operation, but had required considerable time and effort to shape and fit into the curved interior of the trash can. Thus, for the second kiln, it was decided to try a lining of A.P. Green Cast-O-Lite which is a refractory castable material. The bottom of the trash can was removed by cutting it out. Holes were then cut in the sides for a single burner port and a single spy hole. A smaller trash can of similar shape was placed inside the kiln can and paper cups fitted and secured with clay were used to shape the spy hole and burner port. The castable material was then poured and tamped into place in the opening.
between the two cans. The side walls were allowed to set up before the top was cast over a dome-shaped form made of bent and shaped sheet metal. The inside of the top is dome shaped while the outside is flat; thus, allowing a kiln shelf damper to be easily slid back and forth and also providing a flat place to set pots to dry glazes while firing. Therefore, instead of being equipped with a removable lid, the kiln itself is raised and lowered on a counterweight system. This consists of eight-foot lengths of 2" x 4" lumber joined together in sawhorse fashion. The kiln is connected to the counterweight with chain and cable utilizing two ball-bearing pulleys. Initially, non-ball-bearing pulleys were used, but the friction was too great and the counterweight did not function properly. Although the lumber framework has been adequate, a much stronger, longer-lasting structure could be made by welding together a framework of angle iron.

Thus, both large and small pieces can be loaded and unloaded with ease and with less heat loss than in the first kiln. A diagram and photograph of this kiln are shown in Appendix C.

Both kilns were fired with a single homemade pipe-fitting gas burner. Since the burner port is near the bottom of the kiln and some glazes become blistered if flashed by the burner, it is advisable to place ware on a shelf above the burner port opening or to deflect the direct flame of the burner with a brick. The burner is connected to the gas line with a flexible connector to enable easy raising and lowering. The burner and connection can be seen in the photograph in Appendix C.
Records were kept on the amount of gas used per hour of firing. A single gas burner, open full used two cubic feet per hour. At the lowest rate for nature gas, $.08 per cu. ft., the cost of firing a small kiln of this type would be approximately $.16 per hour. Of course, if during the billing period not enough gas were used to obtain the lowest rate, the cost of a single firing would increase.

Reduction and Smoking of Wares

Various effects can be achieved from a single glaze by the length of time and way it is smoked. Most copper reds and metallic lustres are achieved by quite heavy smoking. It was noted, however, that putting sawdust inside a bowl to smoke it tended to roughen and blister the surface of the glaze. A smoother surface and better color was achieved when the base of the bowl was buried in the sawdust or straw and it was packed up to the rim, but none was placed inside. On the other hand, it was noted that sawdust placed inside a bowl glazed with a glaze containing no oxides tended to produce a silvery lustre in that area.

Intentional crazing (crackle) alone can provide a very interesting decorative effect, but it was discovered that even glazes which are supposed to crackle do not always do so, or they do not do it at the proper time so that the smoking of the body reveals the crackle pattern. It was discovered that placing a bowl in the sawdust as first described when it is red hot, leaving it for approximately a minute, then exposing it to the cool air
for a few seconds and returning it to the sawdust upside down tends to produce rich crackle effects.

While no problems have been incurred with dunking bowls and open forms in water immediately after smoking to cool them more rapidly, it has been found advisable to cool closed forms for a few minutes in the open air before dunking them.

A dark and light pattern has been obtained by placing the ware in green grass when it is red hot, and the pattern of the grass will appear on that part of the pot which came in contact with it.

Some metallic lustres and iridescent effects may appear cloudy after smoking. Careful cleaning with a little cleansing powder will make them more dramatic.

The permanence of the effect of smoking seems to be determined by the duration and intensity of the smoking period. It was noted that on some pieces repeated washings in detergent tended to remove the effect of reduction from the clay body; i.e., it became less black and more gray in color. Some changes were also seen to occur in glaze effects under the same conditions. Lustres and iridescent effects became more bland in appearance. These changes were most pronounced in those wares which had not received a long or heavy smoking treatment. For various reasons, some wares were refired and in some instances, the smoking period was omitted after the second firing. The refiring tended to remove the effects of smoking leaving the clay body white in those pieces which had not received a heavy initial smoking.
Conclusion

The raku method of firing provides a very expressive way of working. In spite of the fact that all raku ware generally bears a certain similarity, the work produced by a certain potter can be very personal in nature. The spontaneity of the process and the rapidity with which results are known and the potter receives feedback encourages a variety of experimentations which may result in even more diversity than is known at present.
Appendix A

Clay Bodies

1. **Raku Clay Body - Rhodes**
   
   1/3 Fire Clay  
   1/3 Sand  
   1/3 Ball clay

2. **Raku Clay Body - Soldner**
   
   Fire Clay 33  
   Silica Sand 30  
   Ball Clay 20  
   Talc 17

3. **Raku Clay Body**
   
   Cedar Hts. 14 Mesh Stoneware 50  
   Cedar Hts. Airfloated Stoneware 25  
   Tennessee #7 Ball Clay 25  
   20-Mesh Grog 30

4. **Raku Clay Body**
   
   Cedar Heights Airfloated Stoneware 100  
   20-mesh Grog 20

5. **Raku Clay Body**
   
   Cedar Heights Airfloated Stoneware 100  
   20-Mesh Grog 20  
   9-Mesh Grog 10
APPENDIX B
### Glaze Formulas

**1. Raku Glaze - Green**

<table>
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<tr>
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<tr>
<td>Ferro Frit 5301</td>
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<tr>
<td>Soda Ash</td>
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</tr>
<tr>
<td>Colemanite</td>
<td>15</td>
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<tr>
<td>Kaolin</td>
<td>15</td>
</tr>
<tr>
<td>Flint</td>
<td>30</td>
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<tr>
<td>Copper Carbonate</td>
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**2. Raku Glaze - Colemanite Crackle**

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<td>Kingman Feldspar</td>
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<td>Colemanite</td>
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<td>Barium Carbonate</td>
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**3. Raku Glaze**

<table>
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<td>Nepheline Syenite</td>
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**4. Raku Glaze**

<table>
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<tr>
<td>White Lead</td>
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<td>Gerstley Borate</td>
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</tr>
<tr>
<td>Florida Kaolin</td>
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<td>Flint</td>
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**5. Raku Glaze**

<table>
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<tbody>
<tr>
<td>Gerstley Borate</td>
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<td>Kingman Feldspar</td>
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<td>Flint</td>
<td>1 part</td>
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**6. Raku Glaze**

<table>
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<tbody>
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<tr>
<td>Florida Kaolin</td>
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<tr>
<td>Flint</td>
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**7. #8 Slip**

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<tr>
<td>Iron Oxide</td>
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<tr>
<td>Flint</td>
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APPENDIX C
Appendix C

Kilns

Diagram of Kiln showing pulleys and counterweight system.
Photograph of kiln showing flexible connection and burner.
Plates

Plate I  Slab-built Raku Bowl. 10" diameter. Clay Body #5. Glaze #4. Iron and Copper Oxide Wash over and under glaze.

Plate II  Raku Bottle. 5" high. 5" diameter. Wheel thrown with slab additions. Clay Body #2. Glaze #5. Copper and Iron oxide wash.


Plate IV  Raku Bottle. 5" high. 5" diameter. Wheel thrown with slab additions. Clay Body #2. Glaze #4. Lightly smoked.

Plate V  Raku Bowl. 5" diameter. Wheel thrown. Clay Body #4. Glaze #5 with 10% Copper Oxide. Heavily smoked.

Plate VI  Raku Bottle. 5" high. 5" diameter. Wheel thrown with slab additions. Clay Body #2. Glaze #6.


Plate IX  Slab-built Raku Bowl. 10" diameter. Clay Body #5. Glaze #4. Iron and Copper Oxide Wash over and under glaze.


Plate XI  Raku Bowl. 6" diameter. Wheel thrown. Clay Body #5. Glaze #4 with Copper Oxide.

Plate XII  Raku Bowl. 4" diameter. Slab built. #8 Slip under Glaze #4.


Plate XX  Raku Platter. 11" diam. Slab Built. Clay Body #5. Glaze #1 and #2. Copper and Iron Oxide Wash over and under glaze.
PLATE III
PLATE V
PLATE VI
PLATE XV
PLATE XVIII
PLATE XIX
PLATE XX
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