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A CERAMIC MURAL
ITS DESIGN AND CONSTRUCTION

BY

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Presented in partial fulfillment of the requirements for the degree

Master of Arts

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1959

Approved by:


Chairman, Board of Examiners


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INTRODUCTION

Mural decoration has been enjoying a healthy renaissance during recent years. With the development of structural concrete about the turn of the century, architects turned their backs on the over-decorated forms that had come into universal use. They concentrated their efforts on the investigation of new forms and new materials. Architecture moved into a period of beautifully engineered buildings without ornamentation of any kind. This unadorned style or architecture is an end in itself, however, and during the past decade architects have begun to welcome, even seek, the services of painters and sculptors.

Due to current trends in architectural decoration, it seemed logical that experience in this field would be valuable. Therefore, attention was given to the possibility of doing a ceramic mural. The project was discussed with the thesis chairman, Mr. Rudy Autio, and it was decided that a project of this nature would be a rewarding experience. Subsequent efforts were, therefore, directed toward the production of a ceramic wall mural.

CHAPTER I

DESCRIPTION OF THE PROJECT

The mural is rectangular in shape and measures 70 inches by 92 inches. It consists of 148 pieces, one inch thick. The design is nonrepresentational, being composed of rectangles of varying size; the element of realism was avoided because of the symbolic meaning so often attached to works of art by those who view them. The mural was meant only to act as a decorative device and not to be a story-telling or symbolic object.

There are strong movements, both horizontally and vertically, in the design. The color pattern is in contrast to the grout lines between the individual tiles which aid the eye in moving over the surface of the mural. The colors used were a neutral tan, black and white with slight touches of yellow as the transitional shade between the stark white and the warm tan.

A. THE SITE

The project included all aspects of designing, executing, and installing a ceramic mural. Consideration was first given to the selection of a suitable location for its installation. Sites considered for possible mural decoration were:

1. Elevated wall over the main entrance to the Lodge.
2. West entrance wall of the Fieldhouse.

3. Lobby entrance to the Little Theater in the Fine Arts Building.
4. Stair landing between the second and third floors of the Fine Arts Building.

Through a process of elimination, a site was selected for the installation. The site is number 4 above.

B. THE DESIGN

A number of design ideas, all of which were suitable for any of the proposed locations, were considered for this site. Three painted models were executed and presented to the art faculty for their criticism and approval.

The first design (see plate 1) was an arrangement of black abstract forms over a white field. In the upper left center of the white field was a red sun shape which was overlapped by the black forms previously mentioned. No attempt was made in this design to integrate the motif with the architectural plan of the location where it was to be placed. Instead, the design idea was similar to that of a framed painting, a self-contained unit without external dependence.

The second design (see plate 2) consisted of five colored, vertical panels of almost equal size, each of which contained a bold abstract form differing in shape to add an element of variety. The panels were black, white and reddish brown. The abstract forms with these same colors, were placed each on a panel of a contrasting color. This design was slightly more architectural in both organization and intent than the first

design, in that the large vertical shapes repeat basic forms found in the building.

The third design (see plate 3) was more architectural in nature than the others by virtue of its strong horizontal and vertical movements. This design was selected by the art faculty as the one they preferred to see executed.

C. PURPOSE

The project was developed to offer experience in the investigation and mastery of the technical problems involved in the production of a ceramic mural from the initial design to the installation; in criticism and evaluation; and to add an object of art to the campus of Montana State University.

It was felt advisable to select a problem within my field of study that would utilize my technical ability and at the same time introduce new and more complex problems with which I have had no advanced experience. After having considered a number of ceramic projects, the execution of a non-structural ceramic wall mural seemed a very desirable problem.

The development of a ceramic mural presented problems which would require all of my skill, as well as my knowledge of the science of clays, glazes, and firing techniques. The size of the project offered a strong challenge. A project of this scale presents many problems that are not present in works of smaller size. The design assumes a different

character when enlarged. Design elements which might work well together on a small scale are not always compatible when increased in size. Also, the clay is a material which is difficult to work with on a large scale. True, a mural is made up of many pieces. Nevertheless, constructing a large number of thick tiles and controlling the warping and cracking tendency through the drying and firing process requires a good knowledge of the use of clays and an extra measure of care and attention. It was hoped that meeting and solving these problems would prepare me for further productions of large ceramic objects.

With respect to the current popularity of mural decorations, it was hoped that this work would be of a quality acceptable to the art faculty and worthy of becoming part of the artistic decoration of the Montana State University campus. This popularity is evidenced by the many fine things being done in schools and universities throughout the country by established artists, student artists, and Public School classes as group projects. For example, the artist and teacher, Josef Albers, has recently completed a modular brick wall partition for the Harvard University Graduate Center. Grade school students in Bellevue, Washington, have also recently executed a large mural on one of their school buildings. There are many other excellent examples of similar works which can be seen in Art in Modern Architecture and Modern Architecture in Europe. (See bibliography.)

CHAPTER II

SELECTING THE MATERIAL

A. THE CLAY

In selecting a clay body for the mural, a number of types were considered. These types were: a clay body made up of commercially prepared materials; one using local raw materials; and one which combines both commercial and local clay. It was decided that a good quality clay body could be economically developed by combining local and commercial materials. Fortunately, the Missoula area has abundant natural deposits of good quality clay.

Two locations were selected as possible sources for the local material. Clay was mined from a site five miles west of Missoula adjacent to highway 10. This sample was labeled "Local 1". Clay was also mined in an abandoned brick yard in East Missoula and labeled "Local 2". It was known from previous experience with both of these clays that they were very plastic, had a high rate of shrinkage, and matured at a temperature of 1950° Fahrenheit.

It was felt advisable to alter both of these clays in a manner which would reduce their plasticity and shrinkage, and raise their maturing point. To accomplish this, samples of clay bodies were composed that contained commercial materials which would alter the undesirable qualities of the local clays and produce a body suitable for mural work. The local

clays constituted a range of from 25% to 80% of the total in six sample bodies. To reduce the plasticity and to "open" the clay for more even drying, a number 40 grogite and a small amount of feldspar were added. The same series of tests was used for each of the local clays. (See plate 4.)

From these sample batches, bricks of approximately 12 inches by 3 inches by $1\frac{1}{2}$ inches were formed. Each brick was marked for identification and a line, 10 inches in length, was inscribed into the brick while still in the wet stage. The temperature at which the bricks were to be fired was also noted on the clay by scratching the proper cone number on the face of the brick. (See plate 5.) After these sample bricks were thoroughly dry, they were fired to cone 04, or 1950° Fahrenheit. Each of the bricks was remeasured upon removal from the kiln to ascertain the amount of shrinkage that could be expected from the various samples. (See plate 6.) Each brick was also inspected for signs of warping and cracking.

Body number 4 in both samples of local clay produced the most satisfactory results. Test tile number 4 of "Local 2" was of slightly better quality and was selected as the clay body to be used in the project.

B. TESTING THE CLAY

Determination of the shrinkage factor. Because of the shrinkage of clay from the green state to the fired state, it was necessary to establish the percentage of shrinkage in the sample selected, and to project this

shrinkage percent in terms of the measurement of the "green" size of the mural. This was done to insure accuracy in the ultimate size of the fired piece. The shrinkage factor was called X. Thus, the formula was:

X = shrinkage factor

10 inches = green length

9 $\frac{1}{4}$ inches = fired length

Therefore: 9.25X = 10 inches

X = 1.08

With X equal to 1.08, the size of the mural in the green state was:

1.08 x 72 = 77.76

1.08 x 120 = 129.60

The size of the mural in the green state was then:

77.76 x 129.60 x 1

Determination of volume. To find the amount, in weight, of each of the ingredients needed to complete the mural with the clay body selected, the following procedure was used:

A sample batch of clay was made up, using:

Denver Fire Clay - 6 lbs.

Local 2 - 10 lbs.

#40 grogite - 4 lbs.

Feldspar - 1/2 lb.

This sample batch of clay was then formed into a brick with dimensions of 10.5 inches by 6 inches by 5 inches. This was called Volume 1, or V₁.

Thus, our formula was:

$$\frac{V_1}{V_2} = \frac{10.5 \times 6 \times 5}{77.76 \times 129.6 \times 1}$$

$$V_1 = 315$$

$$V_2 = 10101.0240$$

To find the exact amount of each of the materials needed:

$$\frac{6}{315} \times \frac{D_2}{10101}$$

D_2 = The amount of Denver Fire Clay needed.

$$\frac{10}{315} \times \frac{L_2}{10101}$$

L_2 = The amount of local clay needed.

$$\frac{4}{315} \times \frac{G_2}{10101}$$

G_2 = The amount of grogite needed.

$$\frac{05}{315} \times \frac{S_2}{10101}$$

S_2 = The amount of feldspar needed.

C. THE ENGOBE

An engobe is a liquid clay called slip which is used for decorating or coloring the surface of clay objects. For best results the engobe should be slightly more vitreous than the clay and slightly less so than the glaze. Because it is a clay, there is a problem of "fit" to be considered. If the clay body and the engobe do not have the same shrinkage character, or if their maturing points differ, the engobe is apt to crack and peel away from the body. In this case it was necessary, therefore,

to select an engobe which would be most likely to work well with the clay that was to be used.

An engobe formula was selected from Clay and Glazes for the Artist Potter as the most likely to produce satisfactory results. This engobe was tested for its firing characteristics with respect to the clay body and was found to be excellent in every respect.

The basic engobe formula (see plate 7) produces a white color when fired. To develop colors, oxides are added to this basic formula. For our test, six batches of ten grams each were measured and placed in containers. To each of these ten gram batches a different oxide, or combination of oxides, was added. (See plate 7.) Water was then added to each sample batch and the slip from each was painted on a slab of bisqueware and fired to cone 02 or 2003° Fahrenheit. Out of the six samples tested, four were chosen to be used on the mural. These were black, white, tan and yellow.

D. THE GLAZE

The glaze formula used is one that is a standard in the ceramic department. (See plate 8.) It is a clear, transparent glaze with a glossy surface quality when applied thickly. Being transparent, the engobe decoration and the color are not altered. This glaze was tested on the clay and engobe to make sure that the results would be satisfactory. As in the case of the engobe, the results of this test were excellent.

CHAPTER III

PRELIMINARY PROCEDURE

A. THE DESIGN

To enlarge the original design to full scale, it was marked off as a grid with one inch squares. Squares of one foot were then marked out on a very large piece of paper the size the mural would appear in the green state. The detail of each of the one inch squares was then transferred to the corresponding square on the large paper. This process was continued until the complete design was transferred and enlarged to the proper size.

The full scale drawing (called a cartoon) is, in addition to being a detailed drawing of the surface decoration, a detailed plan of the tile pattern. The tile pattern is the plan on which the tiles are cut. Each tile section was numbered for identification in order to facilitate the assembly of the mural after firing.

B. SPACE REQUIREMENTS

The execution of such a large project requires a good deal of space. The large back room of the Fine Arts Department's ceramic laboratory was made available for the work. This room has adequate space for a large easel and sufficient storage room necessary for a project of this nature.

A flat easel, eight feet by eight feet, was constructed using two sheets of transite, or cement board, eight feet by four feet. These were framed on one side with two inch by four inch lumber. The opposite side of the easel, the working side, was smooth and free from any irregularities. The easel was then set up against the wall and anchored securely to the floor. It was slanted backwards at the top at a seventy-five degree angle from the floor to hold the clay as it dried.

CHAPTER IV

EXECUTION OF THE PROJECT

A. MIXING THE CLAY

After determining which local clay was to be used in the mural, a sufficient amount of it was mined and stored in the ceramic laboratory. The commercial materials to be used were purchased and stored also. When all of the materials were assembled, the clay body was mixed. The materials, in the proper proportions, were mixed in the dry state. Water was then added to about two hundred pounds of this dry mix. This was mixed in the clay mixing machine for approximately one-half hour. The wet clay was then stored adjacent to the easel and covered with a plastic sheet to retard drying. The mixing process was continued until the required amount of clay, including a small surplus to take care of replacements, was stored and made ready for the next step.

B. LOADING THE EASEL

To load the easel, the clay was slapped, a handful at a time, onto the easel surface. Each handful of clay was placed on the easel to overlap a portion of the clay already on the easel. This operation was continued until the easel was completely covered with a rough layer of clay about one inch in thickness. By raking the surface of the clay with the fingertips, the low areas were filled and the high spots leveled.

Following this process, the surface was troweled with a metal scraper to smooth the surface and to make the clay uniform in thickness. At this point the easel was covered with a sheet of plastic to slow the drying process. Slow drying is necessary to prevent warping. The clay was allowed to stand for twenty-four hours.

C. CUTTING THE TILE PATTERN

The mural was to be made on the easel in two sections, or two operations, because its size exceeded that of the easel. Consequently, the cartoon was cut into two pieces, one for each operation.

Half of the tile pattern was placed over the clay surface and the pattern was then traced and impressed into the wet clay. This was done with a dull instrument to avoid cutting the pattern. The cartoon was then removed and the wet clay slab was cut, at a right angle to the surface of the clay, with a fettling knife. When this was done, the clay was again covered with a sheet of plastic and allowed to stand for twenty-four hours. At this time the clay had dried sufficiently to allow safe handling of the tiles. The plastic cover was removed and as drying continued the tiles parted from the easel. They were then removed, numbered, and stored on an open shelf. They were stacked on edge to allow an even circulation of air around each tile and more even drying, minimizing any tendency toward warping.

The same procedure as sketched above was followed on the second easel to complete the other part of the divided cartoon. All of the

tiles were allowed to become as thoroughly dry as possible before loading them into the kiln.

D. THE FIRST FIRING

After ten days of drying, the tiles were carefully moved to the kiln room and loaded into the kiln. They were again stacked on edge to prevent uneven heating and warping. Because of the varying temperatures at different levels in the kiln, the tiles were placed at as near the same level as possible. When all of the tiles had been placed in the kiln the kiln was lighted and the burner set on a low heat. The kiln door was left ajar, and the tiles were allowed to soak in a low heat overnight. This was done to drive off any moisture that might still be present in the clay and to prevent any firing accidents. At this time the kiln doors were closed, the dampers adjusted, and the burners were ignited. When the temperature in the kiln had reached the desired heat, the burners were turned off and the dampers closed to slow the cooling process. The kiln was then allowed to cool for about fifteen hours before the door was opened. The tiles were then removed from the kiln and returned to the work room.

E. APPLYING THE PATTERN

The large cartoon was hung on a wall of the work room for reference to the number sequence of the tiles. In this manner the tiles were assembled on the easel. Then, referring to the color pattern on the

cartoon and using the tile pattern as a guide, the design was penciled onto the tiles. The tiles were removed from the easel in sections large enough to cover a work table and the colors were then painted into the proper sections. The decorated tiles were removed to make room for another section. When the entire surface had received its color, the mural was reassembled on the easel and made ready to receive the glaze. The glaze was applied with a painter's spray gun.

F. THE SECOND FIRING

The methods of the second firing, or glaze firing, were much the same as those applied in the first. The loading of the kiln for the second firing differed only in that the tiles required more space. Due to the possibility of the tiles adhering, they had to be kept from touching one another.

When the second firing had been completed the tiles were removed to the work room where they were reassembled on the easel. Each tile was inspected for excessive warping and cracking. Some replacements were found necessary. Some cracking and warping had been anticipated because of the high percentage of local clay in the body. Overall results of the second firing were satisfactory.

G. MOUNTING THE TILES

It was decided to mount the tiles on two plywood panels of one-half inch thickness. Each would receive half of the mural and, when placed

together, would dovetail snugly and appear as a single unit.

The mastic used was a commercial product called "Tuff-Bond". This material was troweled over an area of about three square feet at a time. When this small area was covered with a thin layer of mastic, the corners of the tiles were covered with the same cement; the tiles were then pressed firmly into place.

The binding of the mastic became firm in twenty-four hours. To add support to the tiles, nails were driven into the panels along the bottom edge of the tiles. The nail heads were then clipped off and the nails were bent into the crevices between the tiles to be covered later with grout.

CHAPTER V

PROJECT APPRAISAL

In making an appraisal of this experience, a critical analysis of the methods used was made and the object was then evaluated. This type of project involves many varied activities, such as designing, testing clays and glazes, actually working with the materials, and making critical judgments. The end project is the culmination of all of these activities. In analyzing and/or criticizing the mural, each of these elements must be evaluated with respect to what it contributes to the whole, whether it be good or bad.

The result of this project, on the whole, was satisfactory. Problems which arose were met and solved. However, all of these problems were not resolved as satisfactorily as was hoped for. Even though success was the constant goal in all aspects of the production, failures were experienced. It should be acknowledged that between success and failure, the latter is far the better teacher.

A. THE METHODS

The methods used in the mural's production were, in every respect, successful. The various processes described in this paper have proven successful and will produce satisfactory results for any similar work. It is a valuable learning experience and suggested exciting new possibilities within the field of ceramics.

B. THE OBJECT

The mural is the culmination of all of the planning and work that brought it into being. For the most part the mural is successful. Nevertheless, it fails to measure up to the standards that were set for this project.

The design is basically good. The color, however, does not work as well as was expected. The use of the yellow as a transitional device between the whites and browns is a disappointment. Accurate color reproduction in an engobe or a glaze is difficult and at times impossible. The yellow that was selected seemed to be a desirable color in the sample. However, when fired on the mural, it appears to be too harsh.

C. THE PROJECT

Although fault was found in certain aspects of the final project, the overall experience was most rewarding. It was well planned as a learning device and is to be highly recommended as a problem for anyone doing advanced work in the area of ceramics. Working on such a large scale requires a different approach from that ordinarily employed; consequently, many new problems are encountered. The solving of these new problems provides the advanced ceramic student with knowledge and skill that could be achieved in no other way.

In completing a project of this type, the ceramist must consider influences which lie outside the area of ceramics such as the integrating

of the product into an architectural setting of which the work must become an integral element. The importance of this lies in the self discipline one must employ which is seldom necessary in the production of independent art pieces.

In any work of art, the artist enjoys a feeling of accomplishment when viewing the completed project. It can be said that this feeling is multiplied in proportion to the size of the project. It is with this feeling that I complete this project and look back over an experience of the most pleasant and rewarding kind.

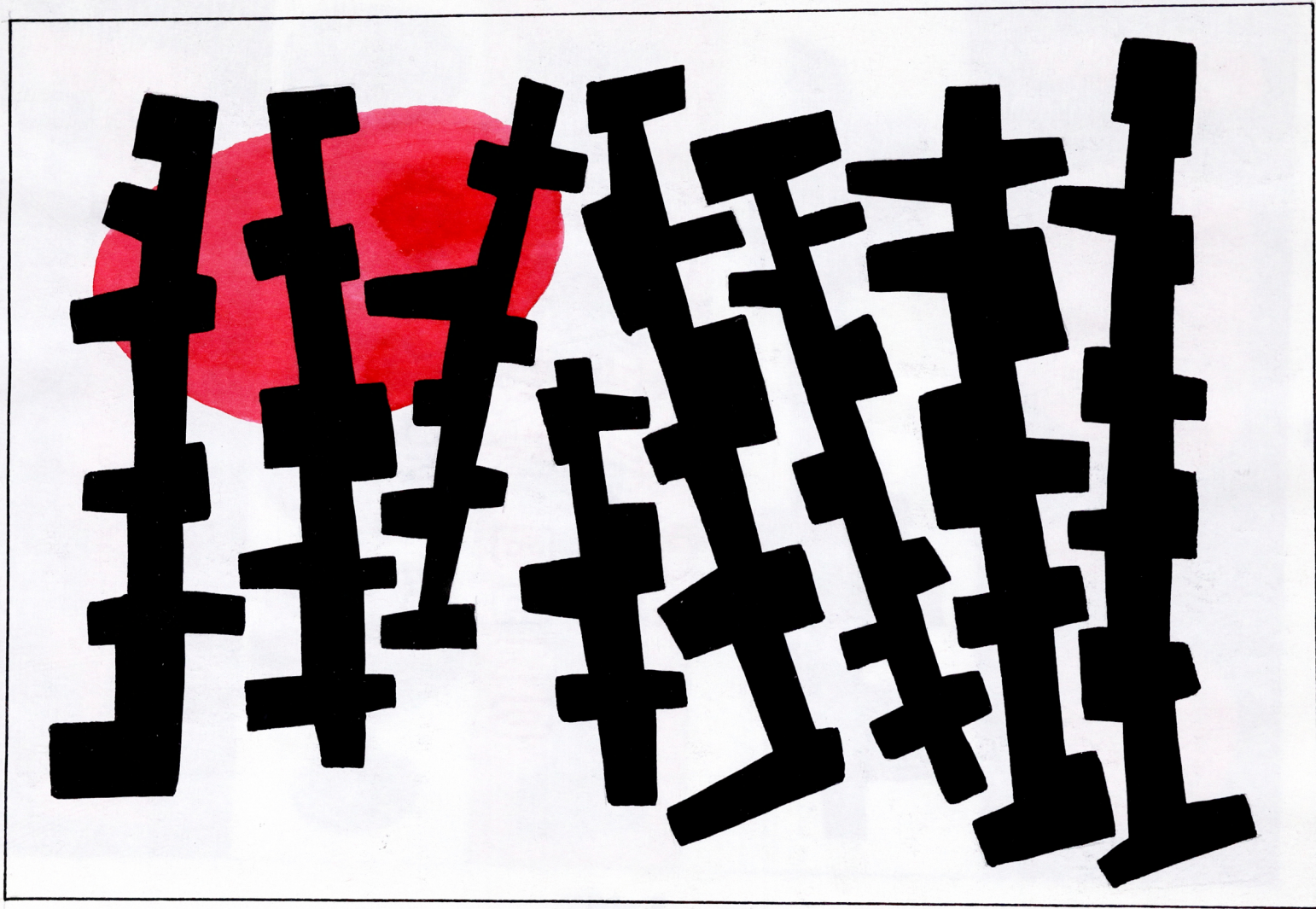


Plate 1

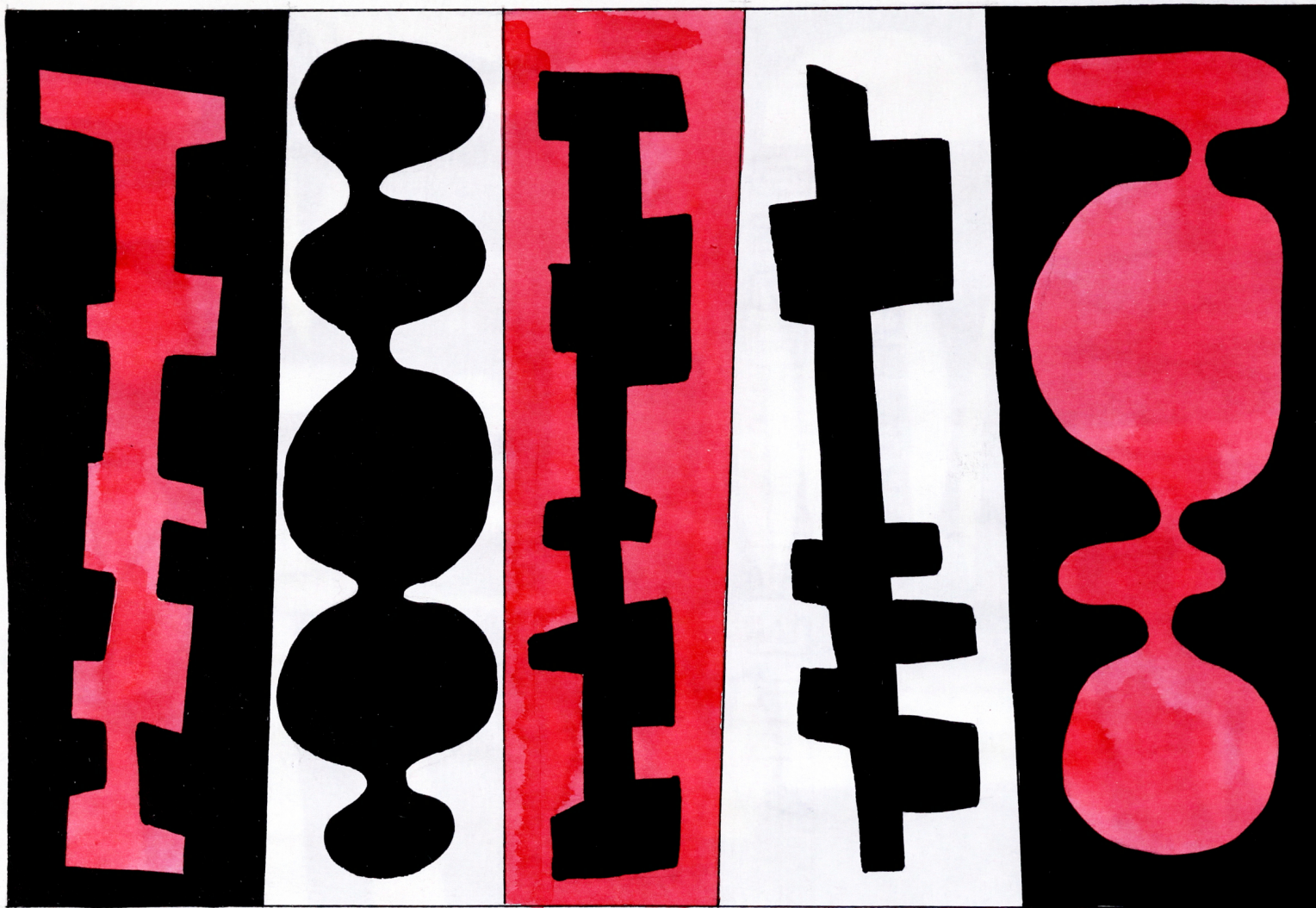


Plate 2

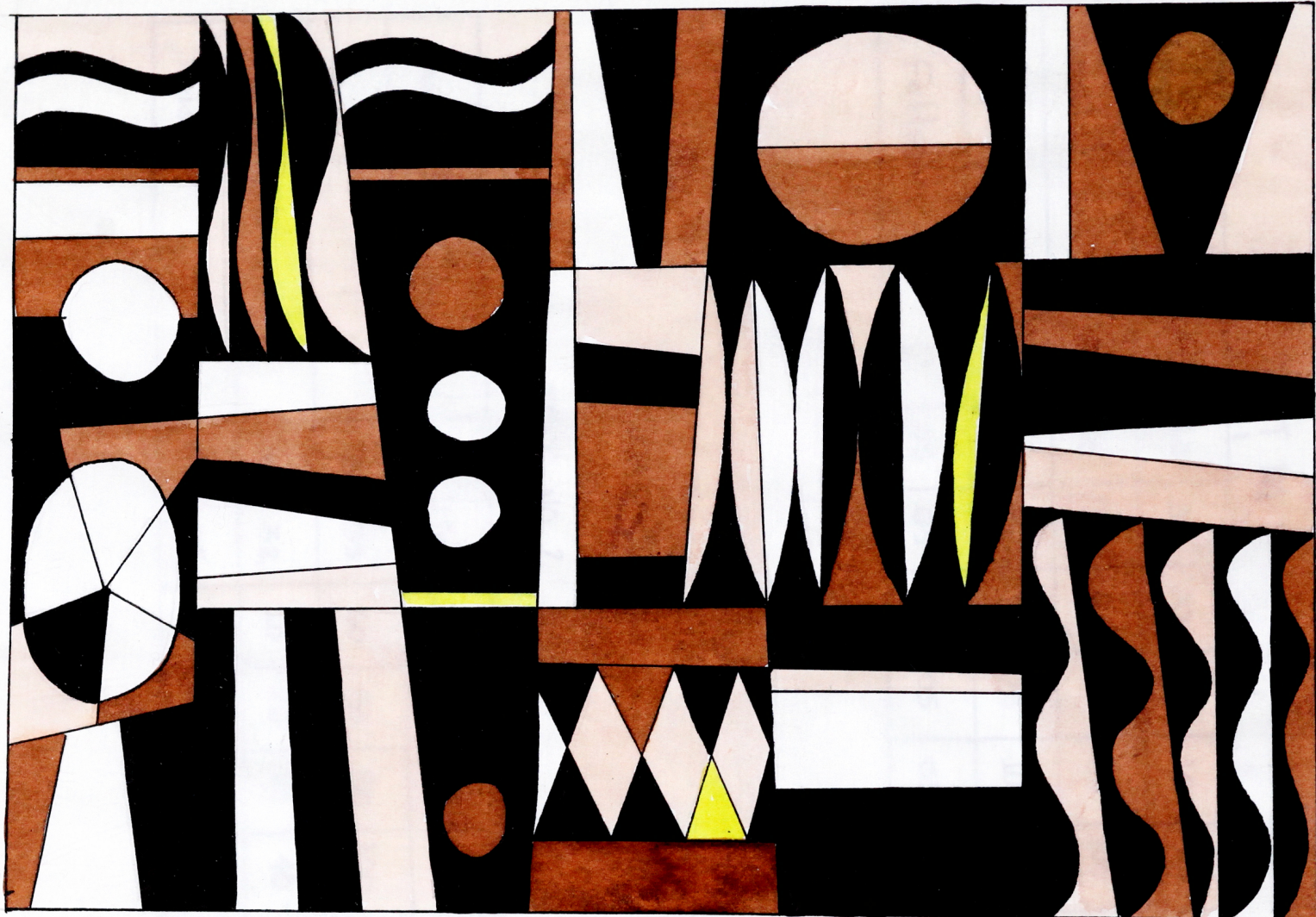


Plate 3

TEST NO. 1

	1	2	3	4	5	6
Denver Fire Clay	40	30	30	30	10	60
Local 1	25	35	60	50	80	100
#40 Grogite	30	32	10	20	10	40
Feldspar	05	05	05	05	05	20

TEST NO. 2

	1	2	3	4	5	6
Denver Fire Clay	40	30	30	30	10	60
Local 2	25	35	60	50	80	100
#40 Grogite	30	32	10	20	10	40
Feldspar	05	05	05	05	05	20

	1	2	3	4	5	6
Green Length Local 1 } Local 2 }	10"	10"	10"	10"	10"	10"
Fired Length Local 1	9 $\frac{1}{4}$ "	9 $\frac{1}{16}$ "	9"	9 $\frac{1}{8}$ "	8 $\frac{3}{4}$ "	9 $\frac{3}{16}$ "
Fired Length Local 2	9 $\frac{3}{4}$ "	9 $\frac{1}{4}$ "	9 $\frac{3}{16}$ "	9 $\frac{1}{4}$ "	9"	9 $\frac{5}{16}$ "

25

Plate 6

ENGOBE FORMULA

KAOLIN.....	5
BALL CLAY.....	15
CALCINED KAOLIN.....	20
LEADLESS FRIT.....	15
TALC.....	15
FLINT.....	20
ZIRCOPAX.....	5
BORAX.....	<u>5</u>
	100%

COLOR

TAN.....	IRON OXIDE	2%
MEDIUM BROWN.....	IRON OXIDE	4%
DARK BROWN.....	IRON OXIDE	6%
TAN.....	RUTILE	5%
YELLOW.....	YELLOW STAIN	10%
BLACK.....	COBALT	1%
	IRON	8%
	MANGANESE	3%

Plate 8

CORNFALL STONE.....75
FLINT.....60
WHITE LEAD.....195

GLAZED FORMICA

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An important source for technical information and basic chemistry of clays and glazes.

GLOSSARY

Bisque - Unglazed, fired ware.

Cartoon - A full size drawing of the mural which also shows the tile pattern.

Clay Body - A mixture of clays and nonplastics that is workable and has suitable firing properties.

Engobe - White or colored slip applied to a fired or unfired body. It may or may not be covered with glaze.

Fettling knife - A knife used by potters to cut or trim ceramic ware.

Fire clay - High refractory clay.

Grogite or Grog - Crushed hard-fired clay, used in terracotta and refractory bodies to reduce shrinkage.

Mastic - A Strong cement used for adhering tiles to a surface.

Plasticity - Property of yielding under pressure without cracking and then retaining the new shape after the pressure is released.

Vitreous - Glassy.