

THE UNIVERSITY OF CALGARY

BRONZE CASTING: CHANCE AND ORDER

by

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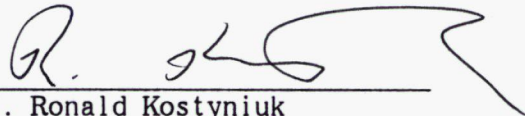
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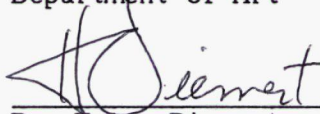
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ABSTRACT

This support paper is a partial fulfillment of the requirements of the degree of Master of Fine Arts. Providing information which relates to my thesis exhibition, it begins with an articulation of the theoretical framework which underlies my artistic activity. Topics include: cultural influences; intellectual climate; reality as a cognitive structure; the psychological processes of individuation and integration; and an argument for the perception of reality as process. Also included is a discussion of historical stylistic and artistic precedents to my work and a description of the practical application of this theoretical structure to the process of bronze casting.

TABLE OF CONTENTS

	Page
INTRODUCTION	1
ART AND THEORY - A COGNITIVE FRAMEWORK	2
Contemporary Culture	
Intellectual Foundations of Western Thought	
Reality as a Cognitive Structure	
Psychological Processes	
Thought and Reality as a Process	
HISTORICAL PRECEDENTS	14
PRACTICAL APPLICATION	17
Process Orientation and Chance in Casting	
Organizational Systems	
CONCLUSION	24
REFERENCES	26

INTRODUCTION

This paper, in support of my Thesis Exhibition, will present the theoretical framework of my view of reality and my consequent artistic activity pertaining to this view. The first section will deal with theoretical concepts that form the basis of my art work. Since contemporary art and culture are aspects of the environment that I interact with, this section will outline my attitude towards these aspects. It will also review historical developments in science and intellectual thought which, in my opinion, form the foundation of the contemporary western intellectual climate. The psychological processes of individuation and integration will be discussed, as will our concept and our perception of reality. These concepts and influences make up the theoretical basis of my creative activity. The second section of this paper will review the historical precedents to my art form, as well as the artists and styles that have influenced my attitude towards art. These influences range from Abstract Expressionism to Dadaism and Constructivism. The third section of this paper will describe the practical application of the conceptual structure to the materials and processes with which I work. This will include the methodology of bronze casting, process orientation, and the use of chance as well as organizational systems used in casting and in the organization of the final installation.

The artistic process is a reflection of the life process and deals both consciously and unconsciously with selected aspects of this reality. It is a

forum for dealing with the processes of individuation, self-realization, and integration with greater social or physical wholes. For myself, art is the preferred means by which to achieve integration with my social and physical environment. An aspect of this environment is contemporary art and culture.

ART AND THEORY - A COGNITIVE FRAMEWORK

Ours is an age of personal synthesis. We face the most pluralistic, complex, and contradictory era the world has ever known: individuals must now determine for themselves their own set of values and beliefs. No one system, mode of thought, or methodology seems to provide all of the answers to the intricacies of present day life. (Smagula, 1983)

Contemporary Culture

Contemporary art is an expression of cultural values and it reflects societal trends. Throughout history, art has always served some social purpose outside itself, whether it was spiritual, communicative, or simply decorative. Only in recent history has art divorced itself from these traditional functions in an attempt to serve its own autonomous ends. It has become perfectly acceptable for today's artist to concern himself exclusively with satisfying his own expressive needs and addressing his own personal sense of aesthetics. With the focus on satisfying his own needs, the artist has redefined his commitment to tradition, function, and role in society.

Art functions as an act of self-expression. It provides a medium which embodies the artist's beliefs and ideals. It reflects his sphere of interest, his position before the world, and his endeavours to establish a bond with his environment (Pellegrini, 1966).

The artist is sensitive to the contingencies of the age in which he lives; the intellectual, political, and socio-economic climates. The artist

expresses what it means to be human, who he is as an individual, and his definition of the milieu in which he lives (Pellegrini, 1966).

The artist has at all times been the instrument and spokesman of the spirit of his age. His work can only be partially understood in terms of his personal psychology. Consciously or unconsciously, the artist gives form to the nature and values of his time, which in turn, form him. (Jaffe, 1982)

Art delves deeply into the reality of man on the premise that all reality exists only in relation to man. Conversely, man who is not a function of the reality about him is not truly authentic (Pellegrini, 1966). Whether he is in agreement with the values of his culture or critical of them, he is nonetheless constantly surrounded by their influence and must remain conscious of this fact.

The world into which artists today are born displays features radically new to history. . . . It is a world complicated by changes without parallel. Models and standards of the past seem of little use to us. Everything is in continuous flux; there are no fixed goals or ideals that people can believe in, no tradition sufficiently enduring to avoid confusion. (Gablik, 1984)

Art critic Suzi Gablik expounds on four prevalent developments in modern society and their repercussions are evident in contemporary art. Secularization, pluralism, individualism, and bureaucracy are four social trends which are shaping contemporary culture.

Secularization, supported by science, is the movement responsible for the demystification of the factual world. In previous times, art had a religious, moral, and social mission and an integral role in spiritual and social orders (Gablik, 1984). Presently, art has divorced itself from any spiritual function and adopted the scientific approach in exchange for its "visionary

style of knowledge" that is "able to 'see' the divine in the human, the infinite in the finite, the spiritual in the material" (Gablik, 1984).

The second characteristic is pluralism. It suggests that any number of alternative views may be equally valid and equally true. A problem arises, however, when there is a lack of consensus on what is valid and true. When the grounds for determining validity and truth no longer exist, then validity and truth, in themselves, are no longer of any consequence either.

The extreme degree of freedom offered by our present-day pluralism has placed everyone under increased pressure to choose for themselves among unlimited alternatives. But with the breakdown of social consensus, it has become harder and harder to know how or what to choose, or how to defend or validate one's choice. The freedom from all determinants leads to an indeterminacy so total that, finally, one has no reason for choosing at all. Pluralism is the norm which cancels all norms. It means we no longer know where truth lies. (Gablik, 1984)

Individualism, closely related to pluralism, deals with entities, rather than ideals or concepts. The movement of priority towards individualism corresponds to a movement away from shared goals or collective standards. In order to fully realize individual goals, the conflicting constraints of collective goals must be abrogated.

Individualism destroys that complex equilibrium within a society whose various elements limit one another - since from the standpoint of liberal, individualist modernity, society is simply an arena in which individuals are free to pursue what is useful or agreeable . . . one's own success and satisfaction; there is no struggle to realize spiritual or ethical values. And to the extent that art itself has lapsed into this function - of primarily serving the career interests of artists and their dealers - it has come to lack what used to be its unquestionable moral substance, its link with intrinsic value. (Gablik, 1984).

Bureaucracy, the fourth facet of modern culture is related to secularization. A religion-based system governing standards of behaviour and

codes of ethics has given way to the prominent rise of a management system, with profit factors taking the place of morality.

. . . belief in managerial expertise has all but replaced belief in God in our culture, and we no longer seem to have any justifications for authority which are not bureaucratic and managerial in form. Modern mass culture has tried very hard to avoid the moral and spiritual aspects of human living and affluence has become the major alternative to religious renewal. (Gablik, 1984)

The only genuinely moral ends are collective ones: behaviour, directed toward personal ends does not have moral value. The object of moral goals is society (Gablik, 1984). The achievement of moral goals, necessitates a system of rules or a behavioural code:

The imperative quality of the rule lies precisely in the fact that it is binding - the element of choice is taken out. It requires us to act a certain way simply because it is good to do so. Virtues are necessary instruments which help us to keep a balance between stasis and change, conservation and innovation, morality and self-interest - and which provide us with a sense of limits. It is this balance which our culture seems fatally to have lost. (Gablik, 1984)

By immersing himself in society and adopting its values, the artist puts himself in danger of losing his critical social vision. Without the artist's critical stance, art's function as a social tool will be ineffective in influencing social attitudes.

In the manner that art is a product of its cultural context, it is likewise influenced by its intellectual climate. There have been several developments in scientific and intellectual thought, which in my opinion, form the basis of the western world view.

Intellectual Foundations of Western Thought

One of the roles of science is to make evident the laws and structures which dominate the world and enable us to make sense out of it (Weiss, 1968).

Reductivism is a form of analytical thinking which entails the focusing of attention on small parts of a whole. Discrete fragments and distinct tendencies are isolated for the purpose of analyzing and understanding the parts which make up the whole (Thorpe, 1974). Reductivism entails: "the attribution of reality to the smallest constituents of the world and the tendency to interpret higher levels of organization in terms of lower levels" (Thorpe, 1974). By understanding the basic constituents and principles, reduction functions as one of the most successful forms of scientific explanation, since it results in the identification of the unknown with the known. Even analytical thinking itself, which underlies reductivism, is an abstraction from the more elaborate, complex reality (Thorpe, 1974).

Since the time of the Ancient Greeks, the universe was thought to possess an order which could be understood in logical, mathematical, and mechanical terms. Physics, for the most part, still supports the notion of mechanistic order:

The world is assumed to be constituted of a set of separately existent, indivisible and unchangeable 'elementary particles' which are the fundamental 'building blocks' of the entire universe

.....
The laws of physics . . . express the reason or ratio in the movements of all of the parts, in the sense that the law relates the movement of each part to the configuration of all the other parts. This law is deterministic in form, in that the only contingent features of a system are the initial positions and velocities of all its parts. It is also causal, in that external disturbances can be treated as a cause, which produces a specific effect that can in principle be propagated to every part of the system. (Bohm, 1980)

The notion of mechanistic order fulfills its role in providing laws and structures which enable us to understand our world, but only to a limited extent.

The work of Albert Einstein questioned the validity of some of the tenets of mechanistic order. In a world where everything moves, any calculation or prediction must be based on the relative position of the observer (Fleming, 1974). No coherent concept of an independently existent 'elementary particle' was possible, whether it was an extended body or a dimensionless point. Thus, one of the basic assumptions underlying the concept of mechanistic order was shown to be untenable (Bohm, 1980). Relativity theory introduced a new order and measure which implied a new notion of structure, not as a rigid body, but expressed in terms of events and processes:

... the classical idea of the separability of the world into distinct but interacting parts is no longer valid or relevant. Rather, we have to regard the universe as an undivided and unbroken whole. (Bohm, 1980)

The Quantum Theory goes a step beyond relativity and presents a much more serious challenge to the mechanistic order. The key features are that: movement is discontinuous; entities show different properties, depending on their environmental context including the act of observation; there is a non-causal correlation between entities; and properties of matter are simply statistically revealed potentialities (Bohm, 1980).

The notion of mechanistic order, however, still clearly satisfies most of our needs to understand the circumstances and events of our everyday environment. Relativity can fill in some of the questions left unanswered, especially in terms of our social environment. Assumptions of Quantum Theory might prove helpful to the behavioural sciences, however, its significance in light of previous theories is that all theories are, to some extent, limited.

The applicability of their truths to other domains or systems cannot be assumed. No single explanation can sufficiently address all of the questions we pose.

Reality as a Cognitive Structure

Our criteria of truth and reality are examples of modal logic and are subject to change with cognitive growth (Gablik, 1976). If our knowledge of the outer world is never direct but always:

... relative to the actualization of schemata which give stimuli their meanings, then the influence of the environment can never be pure. Cognition can never be the mirror-image of an external world radically divorced from the human mind, since the degree of schematization governs which attributes are actually accessible to the perceiver. Every external stimulus presupposes an internal reaction, a schema of assimilation and the intervention of co-ordinating activities peculiar to the subject. (Gablik, 1976)

Reality then, is not something experienced in itself, but rather the result of a cognitive construction. A theory, likewise, is a notion of reality, not a form of direct description, or even a form of knowledge. It is, rather, a form of insight into reality and a tool for ordering our experience of it. (Bohm, 1980)

In a similar fashion, the metaphor is a method of ordering our perceptions:

Metaphors have emotional and valuational overtones. They call forth feelings and attitudes. Metaphors are dynamic; language becomes event. The reader is involved as a personal participant and is encouraged to draw from various dimensions of his own experience. Metaphor is expressive of the poet's experience and evocative of the reader's. But the presence of these non-cognitive functions does not require that cognitive functions be absent. Metaphors influence perception and interpretation as well as attitude. (Barbour, 1974)

Although more cognitive and elaborate than the metaphor, the model is also a tool for ordering perceptions. "A model is a symbolic representation of selected aspects of a complex system for particular purposes" (Barbour, 1974). Models of reality are not pictures or descriptions of the world, but simply imaginative tools for ordering perception and experience.

Myth is also a symbolic representation. As a pattern for human action, myth manifests an aspect of a shared model of reality. Rooted in an archetypal event it is re-enacted in ritual. Myth integrates the community around a common memory and common goal. Assumed to be neither true nor false, myth is seen as a useful fiction which communicates a truth and fulfills an important social function (Barbour, 1974). Every culture has its own norms which contribute to its perception of reality. Within every tradition, common views of reality are developed and ensconced. As a method of perpetuating a tradition, myth informs the participant about his self-identity and the significance in which he participates by providing a framework for structuring his experience (Barbour, 1974).

The structuring of experience is the function of both religious and scientific models. A parallel exists between the interpretation of observations in the scientific model and the interpretation of experience in the religious one. Theoretical scientific models are provisional ways of imagining what is beyond the scope of observation. They are mental constructs whose function is an attempt to account for phenomena in the natural world. They are symbolic representations of selected aspects of the world which are not directly accessible to us (Barbour, 1974). Religious models focus attention on particular patterns in events and restructure the way one sees the world.

They are analogical organizing images used to order and interpret patterns of experience in human life (Barbour, 1974). Religion is a sophisticated symbol system which serves to evoke "the totality which includes subject and object and provides the context in which life and action finally have meaning" (Barbour, 1974).

Reality lies, not in subject or object, but in the relation between the two. Symbolic representations express attitudes and feelings of subjects. More importantly, they regulate the flow of interaction between subject and object.

Psychological Processes

The previous discussion demonstrated how reality is created through mental constructs and how the conceptual tools of myth, metaphor, and model provide keys to the understanding and assimilation of experience. The next discussion will show how the self strives for the integration of the various aspects of personality. Once the self has realized a satisfactory measure of wholeness, it strives for identification with others and integration with a greater community. Ultimately, the self endeavours to achieve integration with the totality of existence.

The search for self-realization begins in the introverted world of the psyche. The self must resolve the diverse and often contradictory aspects of its own personality and establish its own identity. Psychological symbols function as a useful tool in this process:

The symbol is an object of the known world hinting at something unknown; it is the known expressing the life and sense of the inexpressible. (Jaffe, 1984)

The powerful forces of the unconscious most certainly appear . . . in the mythological, religious, artistic, and all other cultural activities by which man expresses himself. Obviously if all men have common inherited patterns of emotional and mental behaviour (which Jung called the archetypes), it is only to be expected that we shall find their products (symbolic fantasies, thoughts and actions) in practically every field of human activity. (von Franz, 1982)

The symbols of the stone, the animal, and the circle have had enduring psychological significance from the beginning of time (Jaffe, 1982). The stone represents the enduring processes of nature, relative permanence and the earthly or 'chthonic spirit' (Jaffe, 1982).

The animal motif is usually symbolic of man's primitive and instinctual nature. Even civilized man must realize the violence of their instinctual drives and their powerlessness in the face of the autonomous emotions erupting from the unconscious. (Jaffe, 1982)

The circle or sphere expresses wholeness of the self in all its aspects and includes the relationship of man and his environment (Jaffe, 1982).

Psychological symbolism is an attempt to call the attention of the conscious mind to bear upon the need to resolve internal conflicts between instinctual drives and the rational mind's attempt to suppress or control them. The instinctual or unconscious aspect of the psyche manifests itself when rational knowledge has reached its limits. Man tends to fill the mysterious and inexplicable with the contents of his unconscious (Jaffe, 1982). Mystical experience, if carried to extremes, casts aside everything that binds man to the earth, time, space, matter, and the natural living of life. Unless the instinctual is balanced by the experience of consciousness, it will implacably reveal its negative aspect. Inner distress and metaphysical anxiety are the products of such imbalance (Jaffe, 1982).

The proper balance of the instinctual and rational aspects of the psyche results in a fully integrated self which ultimately transcends this level of being, thereby seeking higher levels of integration:

The single individual constitutes the apex of the organismic hierarchy, and at the same time the lowest unit of the social hierarchy. Looking inward he sees himself as a self-contained, unique, whole; looking outward as a dependent part His self-assertive tendency is the dynamic manifestation of his unique wholeness as an individual; his integrative tendency expresses his dependence on the larger whole to which he belongs. (Needham, 1974)

In this interaction with the greater whole, the individual must put some aspect of the self aside in order to achieve self-transcendence. The act of putting aside self-seeking motives and actions is the beginning of moral consciousness. The function of moral behaviour is to serve the needs, not only of significant others, community, society, but also the greater whole of all of humanity.

"To recognize the existence of a plurality of perspectives . . . is to be in some sense beyond all of them" (Gablik, 1976). The capacity to conceive other points of view leads to the acquisition of insights which defy cultural conditioning. Direct experience "is the only thing that can break the cultural trance: deliberately and soberly changing one's mind about the nature of truth and reality, and about what is really important (Gablik, 1984).

Thought and Reality as Process

Importance lies in the realization that our own perspective is one of many equally valid possibilities. Our own perspective undoubtedly receives our highest priority as the best alternative in light of our personal and cultural backgrounds. However, looking at the overall picture, there is only

one objective reality which we are incapable of reaching and a countless number of subjective realities attempting to approach it.

Scientist and philosopher David Bohm has developed a model of reality which synthesizes aspects of quantum and relativity theories and harmonizes subject and objective realities. He comments on the multiple scientific models (mechanical order, relativity, etc.):

. . . each such way of looking is limited, in the sense that it can lead to overall order and harmony only up to some point, beyond which it must cease to be relevant and fitting. Ultimately, the actual movement of thought embodying any particular notion of totality has to be seen as a process, with ever-changing form and content. If this is carried out properly, with attention to and awareness of thought in its actual flux of becoming, then one will not fall into the habit of treating the content tacitly as a final and essentially static reality that would be independent of thought. (Bohm, 1980)

The fact that thought is inseparable from chemical and electrical functions in the brain and nervous system is evidence that thought in itself is a material process (Bohm, 1980). Mind and matter are both abstractions from the universal whole, and both can be regarded as different and autonomous orders within one universal movement (Bohm, 1980).

Bohm thus unites mental processes, the products of man's imagination, and all of existence into a single whole, which is more than just a conglomeration of matter and energy. This single universal whole is a process or movement in which energy and matter are simply aspects which can be abstracted from the totality and observed in themselves. Matter and energy are only relatively temporary states, and are subject to disintegration or change by the passing of time. The perspective of reality as a single all-encompassing process allows a plurality of individual perspectives and models of reality which are applicable to their own domains.

The foregoing discussion has been the theoretical basis of my present intellectual state of being and forms the framework of my view of art, culture, knowledge, and all of reality. If all thought and existence is seen as part of a greater process, then reality is simply a personal, but also, in many respects, a shared, mental construct of consciousness. In this manner, divergent questions and the plurality of different perspectives and models of reality can co-exist without conflict.

HISTORICAL PRECEDENTS

Divergent questions, a plurality of perspectives, and several models of reality have influenced my approach to life and art. My readings in science, religion, philosophy, and psychology continue to temper my vision of reality. Several artists and artistic styles have influenced by attitudes and approach to art.

Abstract Expressionism directed its attention towards the unconscious, intuitive, and automatic responses of the artist's psyche. Jackson Pollock's untraditional painting technique appealed to my affinity for physical involvement with matter. His imagery was a balance between chaos and control, and dealt with the unconscious as a means of self-discovery and a direct route to the collective unconscious (Rubin, 1979). I choose to interpret Pollock's drip technique as a deliberate attempt to collaborate with Nature's physical forces (gravity, viscosity, surface tension, etc.). The attempt to achieve integration with one's physical environment represents a progressive step in the process of transcending the self. A European style which was similar in many respects to Abstract Expressionism, was matter-

painting. Michel Tapié, one of the proponents of 'arte autre' contended that:

It was necessary to break with the theories and prejudices of the plastic problems; the only thing of importance is purely and simply to 'do', creation in its primary state without control, and what is important is the result: a work that, instead of saying and expressing, just lives (Pellegrini, 1977).

The work of Antoni Tapies, the Spanish painter, is characteristic of matter-painting. He incorporates powdered marble, latex, and synthetic varnishes to create a thick, solid base. The surface is rubbed, scratched, cracked, and modelled to create matter-accidents which constitute the basis of his painting (Pellegrini, 1966).

In a similar vein, the work of the Italian painter, Alberto Burri, exploited the expressive qualities of burlap sacking and plastic films which lacerated, mended, and burned:

The essential element in Burri's work is a kind of opposition between the coarseness of the basic material, tortured and lacerated, and the severe structural scheme and almost geometric character of the composition. This schematization reduces the material to its elemental and pure forms and permits the use of accidents, of tears and holes, incorporating them in a coherent wholeness. (Pellegrini, 1966)

I have found certain aspects of the Dadaist movement influential, namely, their use of chance and natural forces in their retreat from traditional techniques. Kurt Schwitter's collages incorporated refuse, old theatre tickets, and discarded paper wrappers as the basis for his creations. Max Ernst's rubbings and frottages taken from natural and man-made objects made use of 'found' surfaces and textures. Jean Arp's compositions were arranged according to chance by letting bits of paper fall to the floor and attaching them exactly as they fell. Arp's use of chance had a spiritual premise:

Chance as a plunge into chaos was the phenomenon by which the artist could glimpse a universal, acausal harmony that transcended any humanly conceived notion of chaos or rational order. (Watts, 1980)

These artists whose styles were based on accessing the unconscious by using chance and accident as technique, appealed to the instinctual side of my personality. Some of the works included in my thesis exhibition were predominantly motivated by a similar impulse. In one series of bronze reliefs, the three initial wax sheets were formed by using different degrees of physical ordering. The first sheet "Fragmentary" was made by tossing random shards of broken wax against the wall. The fragments bounced off the wall and landed in a pattern arranged by chance after the manner of Arp's compositions. In the second sheet, "Still Life", a higher degree of control was exercised. Wax shards, destined for remelting, were randomly selected, then formally arranged in the vein of Kurt Schwitters. Unlike ticket stubs and paper wrappers, these scraps of material were highly similar. Being made of a wax of identical composition and being formed by the breakage of larger sheets, these separate similar elements were melded to form a new whole. The third sheet, "Testament", was based on an accidental tear that was the result of the premature removal of a wax sheet from the plaster slab used for making sheet wax. While the sheet was still warm, I folded it and scratched and modelled the surface after the manners and sensibilities of Tapies and Burri. In another series of works, of which "Intersect" is an example, a textured surface was made by applying progressive layers of molten wax with a brush over a smooth plaster slab. As the laden brush is drawn across the surface, progressively less wax is deposited throughout the

movement and duration of the brushstroke. As a result, the wax surface becomes very much like a landscape with minute hills and valleys. As subsequent layers of wax are deposited, the high points receive additional wax and the valleys, not making contact with the brush, do not receive any. In this manner, a texture grows in an upward direction in a pattern determined by the contingencies of the process. There are similarities between my preoccupation with surface and texture and the frottages of Max Ernst. His rubbings, however, were concerned with found surfaces and my textures were process generated.

Whereas the imagery, in my work, is in many respects similar to the sensibilities of some of the Dadaists and Abstract Expressionists, the techniques used in generating this imagery is more closely related to Constructivism. Fundamental to the Constructivist idea is that:

... the work is the product of the simplest of actions. It is not a reduction to a simple complex scene before us, it is the building by simple events of an expressive whole. (Martin, 1979)

Similarly, my work is founded on systematic methods of hypothesis and experimentation. The focus of my empirical approach is concerned with the many facets of process in bronze casting. A reductivist approach permits isolation and analysis of each state and stage in the process and fosters a more complete understanding of the unique characteristics and tendencies. It further permits a restructuring of the discrete fragments and tendencies into a new original whole.

PRACTICAL APPLICATION

My predisposition to scientific method undoubtedly influenced my choice to become involved in bronze casting. It is an exacting process which demands meticulous attention to detail in its many different stages.

For me, the casting process functions as a model of reality, a symbolic representation of life itself. The particular method I use is the lost-wax, block mould investment process. It begins with the production of the wax pattern. Wax possesses a variety of different characteristics according to its relative temperature and constituent ingredients. This flexibility makes wax a highly versatile material for use in the casting process. The wax pattern may be modelled, carved, constructed from wax sheets or reproduced from another object with conventional plaster or rubber moulds. The cross-sectional thickness of the wax is usually from four to ten millimeters, therefore, most three-dimensional forms will be hollow and require coring.

The coring process consists of preparing a water-based slurry of plaster, ceramic grog and previously fired, finely crushed investment. This slurry is poured into the wax pattern. Bronze core pins or common nails are then pushed through the wax into the core with about five centimeters remaining above the surface of the wax. They function as anchors to hold the core stationary inside the mould after the wax has been melted out. At this point, with the coring in place, complete with pins, the gating system can be designed and attached.

The gating system is comprised of a series of wax rods which will make channels in the mould, providing access for the molten metal to the cavity left by the melted out wax pattern. Channels are also provided to permit the escape of air and other gases generated by the casting process. The core is likewise vented, so that any gases entering the core can readily escape to the outside atmosphere and avoid being trapped in the molten metal. After the gating system complete with pouring cup has been attached, the wax pattern is invested in a refractory mould.

The refractory moulding material is of similar composition to the coring. Plaster functions as a moulding material to reproduce the surface of the wax and as a binder to hold together the other ingredients of the mould. Ceramic grog or silica sand is the refractory element which enables the mould to withstand the thermal extremes of the wax burnout and the entry of the molten metal during the "pour". The third moulding ingredient is recycled, finely crushed investment from previously cast moulds. This material, containing refractory elements and inert plaster, contributes to the mould's porosity and acts as a soft filler. Moulds containing substantial proportions of this recycled investment (more than one-third), are somewhat less durable, but much easier to remove from the completed casting than the normal mixture.

The first step in investing a wax pattern is the application of the primary layer of moulding or "face coat". This consists of preparing a slurry of fine refractory materials and plaster with no additional recycled investment. The function of the face coat is to accurately record the surface of the wax and to provide a durable surface to resist erosive action caused by the flow of molten metal. This area of the mould is subject to extremes in temperature and hydrostatic pressures. Failure in this area will compromise the faithful reproduction of the wax surface as mould material will be eroded and the subsequent surface of the metal will be marred with these inclusions. The face coat is made by combining two parts fine refractory material and one part plaster, in a suitable amount of water, to make a thin slurry. The wax pattern is dipped into this slurry to achieve a uniform coating. The slurry can also be poured over or flicked onto the wax surface.

As the remaining slurry begins to thicken, it can be applied manually, building up the thickness of the face coat.

After the face coat has set, additional investment, containing recycled finely crushed mould material, is manually applied over the face coat to build up a total thickness of about eight centimeters over the wax surface. The mould is shaped into a cylindrical form or block, for stability and ease of handling. The top of the mould is levelled before the investment hardens, as the moulds may be inverted and stacked one on top of the other in the burnout kiln.

The mould can also be made by pouring a slurry of investment into a suitable form containing the wax. In this manner, the whole mould can be made in a single operation. A slightly weaker mould results, since the additional water required to make the slurry weakens the bonding action of the plaster. However, the mould can be reinforced with chicken wire or metal mesh.

After the mould has reached an adequate hardness to permit safe handling, it is inverted on bricks in the burnout kiln. The kiln is fired to 700°C until all of the wax has run out and any residue burned off. On completion of the burnout, the kiln and mould are allowed to cool down to around 200°C , at which point the mould is ready for pouring.

While the metal is being melted, the mould is taken out of the kiln. If the mould appears to have excessive thermal cracks, it can be reinforced with burlap strips dipped in a plaster slurry, making a "plaster jacket". The mould is embedded in sand to give it additional support and to contain any molten metal that might escape through cracks in the mould. Once the metal

has reached pouring temperature, it is removed from the furnace, the impurities are skimmed off, and it is poured into the mould.

After the metal casting has been allowed sufficient time to cool, the mould is chipped away. The casting is cleaned with a wire brush and by sandblasting. The gating system is cut off and the core pins are driven out with a punch or drilled out. Subsequent holes are welded shut or threaded and fitted with metal plugs. At this point, the casting can be polished or patinated, if required. Patination involves the application of chemical fumes or solutions to the metal surface which produce a limited variety of colours.

The foregoing has been a simplified version of the lost-wax block mould investment process. It is evident, however, that many steps are involved in the process of transforming a series of raw materials, each with their own specialized functions, into a metal casting. There are many contingencies in these various stages. The production of the wax pattern, coring, gating design, venting system, investment of the wax, and composition, temperature and pouring of the molten alloy all contribute to the successful reproduction of the wax pattern.

Process Orientation and Chance in Casting

The many contingencies in the various stages of the casting process can contribute to conditions which may cause an irregularity in the perfect reproduction of the wax pattern. In industrial applications, such an irregularity is known as a casting defect. However, I prefer not to interpret such an irregularity as a defect, but rather as a welcomed reminder of my interaction with a reality greater than myself.

In my work, I do not carry process orientation to the extreme where the focal point becomes the event and no object remains as such. My use of process orientation is to the extent that the process often determines the forms or aspects of the forms I use, and the process is made evident and documented in the object produced. For instance, when reproducing a wax pattern from a plaster piece mould, thin, horizontal flow lines result along the vertical axis of the form as the level of the molten wax progressively rises in the mould. Although this phenomena is not intentional, nor is it truly a chance event, since it will predictably occur whenever the mould is of a certain temperature relative to the wax, it is a function of the process. I interpret flow lines in the wax as a reflection of the implicate order in all things, and as an aspect of the process which should be preserved in the final metal object. They show how the molten wax solidifies on the surface of the mould, as it fills up the mould cavity. This peculiarity is unique to this method of reproducing wax patterns and contributes to a fuller understanding of the process, a richer visual experience of the resulting metal object, and a more truthful representation of reality. Thus, there is a philosophical, logical, and aesthetic justification for retaining the flow lines. In a casting of a portrait head, however, the removal of the flow lines would understandably be justified.

The unique characteristic of the many stages of the casting process contribute to the infinite variety of deviations that occur when a wax pattern is transformed into bronze. Although these deviations are the result of the contingencies and causal factors in each individual case, they are more often conveniently classified as the products of chance. There are

basically two mutually exclusive views which attempt to define the concept of chance. One view describes chance as the lack of prior specification of an event before it occurred. The other defines it as the lack of an assignable determining cause (McKay, 1978). The first definition is more concerned with the lack of the ability to predict the event than it is with the causes of the event. When causality can be established, the rules of precedent are "logically sufficient to determine the specification of the event in every detail, including its timing, before it occurred" (McKay, 1978). Finding, classifying, and attributing causality are processes of ordering events. Chance is a convenient classification of events for which man has been unable to find or attribute a measure of causality: ". . . the equivalent of ignorance in which we find ourselves in relation to the true cause of events" (Ernst, 1948).

The use of chance as a technique in my work is inextricably interwoven with process orientation. My limited ability to predict the consequences of the contingencies involved in the many stages of the casting process results in events of limited predictability. The causality of this type of event is not in question, only my limited ability to attribute causality. It is only to this extent that I use chance in my work.

Organizational Systems

The topic of organizational systems that I use in casting has two categories: casting configurations; and gating systems. The configurations of wax patterns that are invested are determined by the most economical use of time and materials. Wax patterns are organized and attached to each other to form a configuration which will produce a more stable mould. For

example, two thin wax sheets are attached back to back by means of a common gating system and pouring cup. Two wax sheets can be invested, using the slurry method, with the same materials and time that would be required for one. Needless to say, wax sheets are invested two at a time. Gating design is also an organizational system used in casting. It determines hydrostatic pressures inside the mould, the volume and rate of flow, and the distribution of molten metal to the various areas of the mould. The gating system is normally removed after it has served its function, but I often leave it, or parts of it, intact as apart of the completed sculpture.

Organizational systems used in the installation of the exhibition to a limited extent, use mathematical and geometrical systems. For the most part, I prefer to use an intuitive arrangement. This is a reflection of my model of reality; an undivided, pluralistic, organized whole, which contains many complementary, albeit divergent, highly ordered, abstract systems within it.

CONCLUSION

Aspects of my art function as myth, model, and metaphor. My creative activity is a symbolic representation of my personal processes of individuation, identification with cultural and societal wholes, and integration with ultimate reality.

Always present in my work is a sense of collaboration with materials, processes, and scientific principles. The approach of process orientation directs attention to the interaction of materials and processes. This interaction produces a rich imagery that generates many forms and ideas in my imagination. Throughout this stage, I endeavour to maintain a high level of

analytical concentration on the physical interaction before me. By attending to the integrity of the materials and processes, and by balancing self-assertive with participatory activities, I attempt to achieve a higher level of moral awareness and integration with all of existence. In this manner, I act out my participation in the process of reality and reinforce my theological model of reality.

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