THE DEVELOPMENT AND APPLICATION OF THE USE OF ENCASED VOIDS WITHIN THE BODY OF GLASS ARTEFACTS AS A MEANS OF DRAWING AND EXPRESSION.

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Abstract

This practice-led thesis is based on a study of the use of encased voids or bubbles in glass. The study is grounded in practice and draws out through antecedents in philosophy, psychology and epistemology, a methodology called Reflective Risk. It shows that through a rigorous analysis of practice, using video and personal reflection that new insights emerge. The study is framed by craft practice (the word craft here used as a collection of 'genre' of which glass is part). The thesis uses experiential learning as a tool and a means of understanding the practice of creating and controlling encased voids in glass in the context of contemporary applied arts practice. The framework, Reflective Risk, is constructivist in approach. It is based on Experiential Learning Theory (ELT), but it also draws on epistemological theories of tacit knowledge. The thesis shows that through an understanding of technique and material qualities, process can be deconstructed to reveal new insights. The thesis documents how an understanding ELT and a range of self-regulatory antecedents can influence the cognitive process of craft practice through praxis. The results of this study, on the one hand, are directed to glass practitioners and on the other, to provide a theoretical approach appropriate for the reflective practitioner working in other media by adopting a parallel method of enquiry.

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EXHIBITION

This thesis is submitted under Regulation 6 (8.1.2) of the Higher Research Degrees PhD and MPhil regulations of Heriot – Watt University. The thesis and its accompanying artefacts are the result of "Practice – led Research Study".

The results of this of this study comprise.

- Thesis – this Volume
- DVD – DigitalVideo Disc – this thesis in Adobe Acrobat form with movies and pictures.
- An Exhibition of work by the candidate. This exhibition comprised the following works (7th June 2001)

Title

'Shoal Bowl 2'

'Purple Sea'

'Glimpses'

'Diver'

'Bio–cycle 1'

'Bio-cycle 2'

'Bio-cycle 3'

'Cyberclone'

'E -Zone'

'Pointy Heads'

INTRODUCTION

The practice described in this thesis was formally initiated when the researcher registered as a Master of Design candidate at Edinburgh College of Art in 1994. It draws upon experience and reflection on practice since the researcher began working with glass at The Royal College of Art in 1968 and training at Orrefors Glass School in Sweden in 1972. Since adopting an experiential learning approach, some important previous glassmaking events have been recalled to feed into current developments; specifically the outside casing method used in the Czech Republic and the trials undertaken at Orrefors to test the feasibility of this method. (See section 2.5. p. 38 and43). The application and refinement of this Czech casing method is an original use of this technique in the context of encapsulating drawn images within the wall thickness of blown glass vessels. Much of the practical research activity involved testing the potential of this method. This required much practical experimentation to achieve consistent results in larger scale pieces. It became necessary to regulate the research activity and to identify a formal structure from which an appropriate methodology might emerge.

The idea of the reflective practitioner was introduced by the leading social scientist Donald Schön (1983) when exploring how professionals employ skill and judgement to complex situations. So through *'Reflection on Action'* as identified by Schön, new insights emerged into ways of creating imagery by testing different encapsulation methods. These methods are illustrated by using photographic images and video recordings of the practical research activity. Having been introduced to '*experiential learning theory* ' through the work of David A. Kolb (1984), then Schön's definition of reflective practice, the researcher was able to identify a methodology and apply a framework, which could formally exemplify his own approach to *practice through doing.*

As a teacher responsible for undergraduate and post-graduate learning, and a practising artist craftsman, the researcher aims to analyse formally how practitioners generate their work. In addition, he aims to define a suitable research method using his practice as the site of that enquiry. There is a clear need to explore learning strategies in the applied arts/craft area that will provide a suitable methodology (or to deconstruct existing practice) which through research, can enhance the status and quality of the artist craftsman's work. Primarily the researcher aims to demonstrate an original development and revitalisation of the use of encapsulated voids as a means of decoration and drawing in glass. This is the primary research question and in the *doing* this becomes the site of enquiry into the processes of '*experiential learning*', '*reflection*' and' *self regulation*', which drives the thinking and tries to answer the question *how?*

- **How might the researcher formally engage in a research project in the field of Art and Design, particularly from the point of view of an 'Artist Craftsman'?**

The word research has been used extensively in the Faculties of Art and Design in Higher Education for some time. The researcher believes in this context the word 'research' has been misused and actually means 'professional practice', making work to exhibit in prestigious venues to score on the Research Assessment Exercise. The researcher prior to this project sought to work at the cutting edge of innovation in the field of Applied Arts / Craft and to embrace the full breadth of possibilities glass can offer as a medium in a creative environment. This practice created a personal style recognised nationally and internationally and the work is represented in many public and private collections. (See Figure 1 and Appendix 3, Screen 11).

Figure 1

' Greenpiece'

The work refers to the bio-diversity of the oceans alluding to evolution and preservation of the environment. The fecundity of the oceans and of life has been a recurring theme in the researcher's work and carries over into this research project.

A constructed piece using lead crystal and flat glass bonded with silicone compound. Motifs are sandblasted inside (through the green casing colour) and on the out side. The edges are cut and polished on the lathe.

Victoria and Albert Museum
London 1990.

Although his previous work was not formally identified as research, the researcher was aware of a reflective process being essential to progressing thoughts about sources of ideas and techniques. He chose to draw on past experience to find a topic that has the potential of becoming an advancement of previous knowledge and becoming an original contribution to knowledge.

- **What for a glassmaker is intriguing enough to justify a particular study where a deeper insight into a technique will in turn be the vehicle for the extension of ideas?**

In the history of glass, there are many examples of the use of encapsulated bubbles or voids, which have been employed for decorative effects. In the case of the Orrefors technique of '*Ariel*' attributed to Edvin Öhrström, the potential for shaping these voids to form drawn images within the section of vessel forms, is realised. There is no evidence of the technique being used or further developed currently and therefore, there was an opportunity for further study. The manipulation of voids was chosen as the topic for research. This provided an open-ended learning experience and one that had the potential to generate new possibilities in the craft of glassmaking; working with techniques to create transparent and silvery images. These would extend the researcher's previous themes derived from the natural environment and be the inspiration for the development of a new theme which could become part of the new practice and refer to a topic of current significance. The idea of '*cyberspace*' was chosen as a parallel theme because the imagery could be developed in a dialogue between idea and technique. As part of the project, the researcher was motivated to analyse how the relationship between thinking and doing (idea and realisation) worked.

- **Where will the knowledge come from to pursue a course of action which will be seen to be an original contribution to knowledge?**

The researcher trained as a glassmaker at Orrefors Glass School in Sweden in 1972. This followed his introduction to glass through Sam Herman[1] at the Royal College of Art in 1968 shortly after the inception of what later became known as 'The

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[1] Herman was a student of Littleton who started the Studio Glass Movement in early 1960's USA

Studio Glass Movement'.[1] These two events represented two opposing views about the nature of creative glass making. The studio glass movement was about chaos; anything goes - forgetting history and seeing what happens by simply '*doing*'.
On the other hand, the training at Orrefors Glass School was structured. Theory and practice were taught in an environment where innovation was introduced into the structure in the form of design. The tradition was established where the designer with a sound theoretical understanding, through close contact with glassmakers, would speculate with design drawings on an idea for a glass product. The glassmakers would interpret these proposals in terms of their own glassmaking experience and considerable skills. The outcome was a workable compromise often producing products of a very high quality, evidenced by the reputation of excellence enjoyed by Swedish glass manufactures. Against this background, the researcher's motivation was in the *doing* as well as the *conceptualising;* a partial return to the philosophy of the Studio Glass Movement and Harvey Littleton *et al.*. It was necessary to have an idea to make something and then work towards practical realisation of the idea, in simple terms to have ownership of the idea and its execution. This is described by the term *'designer craftsman or artist craftsman'*. [2] In Chapter 2.4 - Contemporary Developments, the detail of the research in Sweden in 1995 is described and most significantly identifies the Czech '*casing'* method as a means of achieving images that are more detailed and working on a larger scale. The successful development and application of this method, the researcher holds, is an original contribution to glassmaking, and new pathways emerge from this knowledge. These particular instances are described and illustrated in Chapter 3 - The Practice and are:

Examples	**Page**
• Sand blasted discs - Video & Photographs	97 - 100
• 'Millennium Grubs' "pick up" technique - Video	96
• Laminated float glass multi-layer technique - Photographs.	104
• Multi-layer casing *'shoal'* series.	94

[1] See Section 2.2 General Historical Context p. 12 .
[2] See Section 2.6 p.44 The Creative Impulse - for definitions of making/workmanship etc..

- **What means will be used to describe and communicate these processes and outcomes?**

Finished pieces, colour photographs, stills from video, edited video, QuickTime movies and text. Originally, this was going to be a simple descriptive presentation to support the practical work and photographically recorded material, but it has now become the mainstay of the argument and defence. **The style of writing and 'voice' in the text changes to the active mode in 'Chapter 3 - The Practice' to give a temporal urgency to the practical issues, and highlight reflective and experiential learning.** The thesis will be presented as an illustrated hard copy and will contain a DVD containing a PDF (Adobe Acrobat) copy of text including Photographs, Diagrams and QuickTime Movies. Jennifer Moon (1998) a current expert on reflection and reflective techniques, suggests that a specified method of representation (e.g. the format for a thesis) is likely to influence the form of learning. Additionally she notes that the notion of a specific *'outcome'* to experiential learning is misleading as the outcome can be construed differently by the learner or the observer. Therefore, a research project that is grounded in practice may be orientated to the particular nature of that practice and raise questions of epistemology.

In the context of this research, questions have been framed that can only be fully answered by the practice of glassmaking through active experimentation and reflection. If this study is to be practice-led, then this determines the means of representation, necessarily challenging convention in order to represent the work clearly. This study of practice is dependent on visual experiences and the use of photography as a documentation tool is essential. From the beginning of this research project, it was noted that the use of video is an essential tool for observation and reflection as well as being an accurate record of events. Therefore, these various media are seen to be an acceptable means of representation of the body of work, which in future may become reference for learner / practitioners.

- **Will the act of deconstructing this process constitute a significant contribution to knowledge?**

With the introduction to Kolb (1984) and the experiential learning cycle as a construct for reflective practice, it is clear how this process works in a number of ways with the researcher's practice. Schön's (1983) reflection *'in'* and *'on action'* shows how the process of *'doing'* informs action through knowledge gained from previous experience and observing that the '*knowing*' may change theoretical assumptions. Add to these the Cowan and McAleese (See Cowan 1998, p 36) thinking *'for'* action and Cowan's further interpretation of Kolb's hypotheses, and a model of action and reflection emerges. (See Chapter 4 Methodology). This model may be used to describe how, through reflection, practical skill is informed by aesthetic aims and objectives in relation to the interpretation of an idea. Reference is made to these claims in the chapters dealing with the practice and theory.

CHAPTER – 1 Aims, Objectives and Rationale

1.1 Aims and Objectives of Research

1.1.1 Overarching Aim

• To show through a study of the use of voids or bubbles in glass as a means of drawing and decoration, how, with a rigorous analysis of practice and reflection, new insights emerge, by framing and exploring particular methods.

• To demonstrate how practitioners in crafts / applied arts can through reflection *in*, *on* and *for* action; develop a methodology appropriate for the advancement of innovation and creativity in their practice. Also, how such a study can, with critical reflection, serve as interpreter, mediating between the artefact and the audience.

• To demonstrate how artistic endeavour can drive technical innovation and how reflection on that process can generate new pathways, that stimulates further development.

1.1.2 Objectives

• To demonstrate how, through a rigorous study of practice, gain new insights which emerge by a framing and exploration of particular techniques driven by the dialogue between idea and process.

• To document the sequence of work procedure through text, still, and video images in a way which makes the work accessible for scrutiny by a wider public and also of particular value to glass practitioners.

1.2 Rationale

1.2.1 External

The use of controlled air bubbles in glass has a long tradition. This study seeks to advance previous practice and demonstrate an original and new contribution to knowledge in this area. It also seeks to identify the role or position of technique within the making of a piece of work and to reveal how intimate, tacit knowledge of particular techniques and material qualities can be deconstructed to reveal new possibilities. As this study is practice-led, the means of presentation will utilise glass pieces, time based and still images as well as text to describe thematic imagery and technique. The results of this study on the one hand, are directed to glass practitioners and on the other to provide a theoretical approach appropriate for the reflective practitioner working in other media by adopting a parallel method of enquiry.

1.2.2 Personal

This study seeks to show how, through an appropriate methodology, the relationship between practical skill and creativity is the means by which new pathways can be generated. The researcher has through visits to Venice, Scandinavia, Germany, the Czech Republic and the USA accumulated, as a teacher and practitioner, a considerable body of knowledge grounded in practice. Therefore, he is able to bring to bear an overview of making procedures drawn from a sustained enquiry into methods of manufacture.

As a teacher, the researcher is concerned to demonstrate means of communicating craft-based knowledge and experience. Using new technology, information can be disseminated to a huge audience Gates (1996) p.208. CD –ROM's, DVD's and the Internet can make available image-based material as vital as the workshop demonstration to students in craft-based disciplines as well as collectors and the public. Photographic images of artefacts have a currency of their own in our new information-rich environment and this work seeks to demonstrate these as a rich secondary outcome.

1.2.3 Self-Study Research.

Of necessity, the researcher uses his own practice as the source of insight into testing and externalising his methodology. This presents some difficulties of appropriate ‘voice’ when dealing with biographical and temporal issues. In addition, it is the researchers view, that in some instances, the research process can be most effective from reflection on personal knowledge as long as the effort is framed in a way that ensures authenticity.

> "The aim of self-study research is to provoke, challenge and illuminate rather than confirm and settle."
>
> (R. V. Bullough, Jr. and S Pinnegar 2001 p. 20).

Although the above refers to educational research methods it resonates well with practice – led research.

1.3 Characteristics of Research Practice

The work is grounded in the crafts and as such is not intended primarily to influence industrial production methods although because of the open ended nature of the research practice this does not preclude this possibility. Clarification of the meaning of 'craft' is necessary to place the work in a contemporary context.

Paul Greenhalgh explores the etymology and history of the word 'craft' and in the course of doing so holds that:

> "Craft is an empire. It is a constituency within the late modern system of the arts, a naming-word and a major class in a professional world that is underpinned by a rigorous classifactory structure. For some time it has stood alongside two other classes, of design and fine art". Greenhalgh (1997)

For many people the word craft infers the acquisition of practical skill as applied in a conventional way. Consequently it is only the doing element of art and design, or represents a tradition indigenous to a country or region and therefore of lesser status in terms of artistic endeavour. However as Greenhalgh states the word *craft* in a contemporary context, for the want of anything better, defines a very particular area of creative activity. Peter Dormer (1994)[1] has studiously explored the territory of *the crafts* and uniquely reveals the issues defining craft practice and its place in contemporary society.

There is no doubt that Dormer's decision to apprentice himself in calligraphy and clay portrait sculpture, to gain a first hand insight into learning skills through

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[1] Dormer (1997), Notes the difference between the word 'craft' and 'crafts', the latter referring to art-craft, design-craft and studio craft and the former to skill.

experience, was an essential element of his research. Guided by masters of their craft Ann Hechle and Neal French it was possible to acquire '*craft knowledge'*. But the authority of personal professional status in practice would remain inevitably with the masters because he would in the fullness of time need to show independence, bringing to bear his own interpretation of this acquired knowledge. Dormer's (1997) observation that if *tacit* or *craft knowledge* is not passed on through practice then it will be difficult to regain as it often defies description and can only be experienced, reinforces Polanyi's assertion:

> "To learn by example is to submit to authority. You follow your master because you trust his manner of doing things even when you cannot analyse and account in detail for its effectiveness. By watching the master and emulating his efforts in the presence of his example the apprentice unconsciously picks up the rules of the art, including those which are not explicitly known to the master himself. These hidden rules can be assimilated only by a person who surrenders himself to that extent uncritically to the imitation of another. A society which wants to preserve a fund of personal knowledge must submit to tradition'.
> Polanyi (1958 p. 53)

1.4 David Pye

David Pye, teacher, designer, writer and craft practitioner, originated the notions of the *'workmanship of risk'* and the *'workmanship of certainty'* where he unravels the very essence of reflection on craft practice. Pye (1968) defines the character of interaction between the maker, his tools and his understanding of material quality, fitness for purpose at the appropriate level of *'regulation'* i.e. the degree to which work should be finished. He also engages in the characteristics of visual perception. His definitions of the workmanship of risk and the workmanship of certainty outline with great clarity how artefacts are conceived and produced. Glass making was not an activity well known to Pye, or perhaps his intimate understanding of wood served him best to substantiate his argument. In his book, there were few references to glass the only example being a mass produced glass storage jar, surprisingly in the context of the '*workmanship of certainty'* made by machine, when glass made by hand exemplifies the application of manual dexterity and judgement in the '*workmanship of risk'*. In the chapter in his book on critique of ' On The Nature of Gothic' from Ruskin's 'Stones of Venice' Pye refers to Ruskin's example of rough workmanship in Venetian glass. Here he cites this as a rare example where Ruskin, referring to workmanship, as the creation of the whole object and not the design and execution of ornament which he argues is Ruskin's misguided understanding of workmanship. In spite of the minimal references to glassmaking, the application of Pye's reasoning applies directly to the glassmaker where it might be said the glassmaker works at the threshold of catastrophe.

- **From the perspective of this study, the workmanship and the '*management'* of risk defines the researcher's approach to practice.**

1.5 The Role of the Crafts.

Historically, craft skills have passed through generations by apprenticeships, and practical know-how was often passed down through generations of the same family. This is particularly the case in, glassmaking where, in addition, secrecy abounded in glassmaking communities notably in Venice. See Polak (1975). Our own technological age is driven by volume-production, marketing, economy of scale, unit price and competitiveness. The artist craftsman, far from being an anachronism, fulfils an essential human desire to exercise his ability to make objects that carry a personal identity. Greenhalgh's identification of 'craft' being a classification standing alongside design and fine art clearly anchors the researcher's position and the presence of the Crafts Council and the nature of its work exemplifies this classification. The practice is undertaken in a workshop and studio environment and is dependent upon a triangular relationship between material quality, manipulative skill and concept. The researcher is adopting a position of critical self-awareness reflecting *in*, *on* and *for* action, and visually recording key elements of the practice for reflection and communication, (See Chapter 4.0 – Methodology). The work is placed in the contemporary cultural context, has been tested in the public domain through exhibitions and through these, has been exposed to peer-group analysis. (See Appendix 3 for list of exhibitions).

CHAPTER 2 - Contextual Review

2.1 Overview

- **How will a contextual review reveal the background and purpose of this study?**

This section outlines the background to the potential of using encapsulated voids within the section of glass vessels and places this work in the context of contemporary craft practice. Looking at aspects of the history of glassmaking and identifying instances where voids have occurred or been induced, reveals how the phenomenon of gaseous voids typically occur and are characteristic of the nature of glass and can be controlled and placed to construct images. It also traces and locates the researcher's history, key people and their work in relation to the research project.

2.2 General Historical Context

- **Why is an historical context important and how is it related to the application of voids in glass?**

In order to trace how voids in glass have been exploited it would seem essential to survey the development of glassmaking and note important developments in the evolution of skills and techniques.

The most significant period for the introduction of glass artefacts was the expansion of the Roman Empire. Glass casting and lapidary techniques were well established and the introduction of glassblowing made possible for the first time a more rapid production of functional ware. Blowing the molten glass on the end of a metal tube, made possible free-formed vessels and ones blown into ceramic moulds. Examples of glass found at the start of the first millennium indicate that glass-forming techniques during this period laid the foundations for almost all current glassmaking practice. This was demonstrated in the exhibition 'Glass of the Caesars' at the British Museum in 1988. See Harden (1987).

The migration from the Mediterranean to Northern Europe, the growth and spread of the art and craft of the glassmaker, establishes a tradition of workmanship equivalent to pottery, metal-smithing, textile-weaving and all kinds of utilitarian and ritual artefacts. Ada Polak (1975) traces this movement which reveals, in common with other crafts and technologies, evidence of lifestyles and social conditions at the time and place of their production. Her diligent study extends beyond descriptive observation about date's, places and techniques, but gives insights into the people who made or used the products. This ability of objects to carry evidence or information about their time and place of production must be important to contemporary applied artists as trends and fashions become increasingly compressed in time as the pace of life increases.

Surprisingly in this age of new technology, the handmade production of glass survives as an industry - small though it is - alongside the machine mass-production technologies now producing glass. However, the development of the *Studio Glass Movement,* which grew from the Toledo experimental workshops in 1962, and the work of Harvey Littleton and Dominic Labino, also later at the University of Wisconsin USA, gave rise to a revival of interest in glass as an expressive artist's medium, Frantz (1989). The English potter Bernard Leach (1940) introduced making pottery as a personal philosophy. Was it possible to set up a small studio or workshop for the making of glass, as was the case for Leach making ceramics? The main difference was that Leach's philosophy had roots in Japan, steeped in tradition, and Littleton's exercise was open-ended in spite of two thousand years of glass blowing history. The only real common ground between them was that they were both conduits for many other kinds of practitioners to locate in newly defining roles. Much of the initial glassmaking activity in the 1960s revolved around the development of small furnaces and working with molten glass. Influential alliances were formed, particularly that of Littleton and Eisch (1974), where an exercise of personal discovery was being shared by a ceramicist and a painter. In the 1970s a new 'art glass' community expanded rapidly via the university campus in the USA and then across to Europe by first generation students: some gaining access to what was thought to be the impenetrable glasshouses of Venice and others to awaken the new enthusiasm for glass in the British Art Schools as well as many important centres in continental Europe. The influence of this movement, or recognition of it, is shown in Corning Museum of Glass's catalogue of the exhibition 'New Glass, A Worldwide Survey' (1979). Thomas Buechner's opening paragraph in the preface to the catalogue reads:

> "This exhibition is about a profound change that is taking place in the history of glass: after thirty five centuries of utilitarian use -from containers and window panes to television tubes and laser transmitting fibres - glass has become the amorphous substance from which functionless art is made. Suddenly, and in addition to its evolving roles in science, industry, housewares and the crafts, glass has become a medium of the fine arts, a material in which to conceive and create - often directly for purely aesthetic purposes."

This statement indicates the difficulty of the world of museums and collectors and similar agencies at the time to place this diverse body of work in the conventional pigeon holes of art,craft or design. The national collections were buying to avoid the risk of missing out. The influences are well documented in the works of Susanne Frantz (1989) and Dan Klein (1989).

- **Why did Harvey Littleton and his students spark off such an interest in glass and how did this relate to glassmaking practice at that time?**

Figure 2

"Technique is Cheap"

Blown glass portrait of Harvey Littleton by Ervin Eisch.

The 1960s, the era of a hippie culture, blowing glass was a new and exciting thing to do on the North American art school campus. Littleton (1973), and his followers resolved to rediscover glassblowing. In the early 1970s his remark that "technique is cheap" captured by his friend and colleague Ervin Eisch (Figure 2) consolidates his view that there are more important issues of artistic significance, dismissing the mystique surrounding the traditional skills of glassblowers and perhaps ties with applied arts conventions by calling it art. Klein (1989) noted much later that the American painter and art historian Darby Bannard described this phenomenon as "art envy". Was this because a cultural shift might be attributed to blowing glass? This was the 1960s and 70s when new liberal idealists were looking for potential missions in the name of peace.

In the history of applied arts, the late 19th Century Arts and Crafts Movement of John Ruskin, William Morris, gave rise to a philosophy which revered fine craftsmanship and denigrated the cheap mass-produced products of the industrial revolution. Many of the roots of contemporary craft philosophy lie here. The traditional glass centres including Venice, Bavaria and Czechoslovakia and, more recently, Sweden remained initially indifferent to such developments, continuing to make glass in contemporary styles grown out of their own traditions. The university campus is where the new glass phenomenon was emerging initially in North America - surprisingly isolated from the market economy in the early days. Then later in Europe, Australia and Japan, awakening new interest through Conferences to exchange ideas [1]. Sam Herman, one of Littleton's first generation graduates from the University of Wisconsin, introduced the researcher to glass and Littleton's philosophy at the Royal College of Art in London in 1968. The potential for a small glass studio was immediately apparent to the researcher, but the need for some technique quickly became a matter of urgency. Having already made one study-visit to Sweden on a travelling scholarship to visit ceramics and glass makers and designers, the researcher was keen to attend the newly established Orrefors Glass School, and joined 1972.[2] In this factory environment, knowledge and experience was openly passed on to the community of students, some of whom were to work in the factories and others to study design for production. The teaching was by example of method, the learning by following the example. This was in direct

[1] British Artists in Glass, Glass Art Society of America, Aus Glass etc.

[2] Orrefors Glasskolan was established in 1970 to train glassmakers for the local industry. It is administered by Nybro Åkrahällskolan. a nearby technical school.

contrast with the intentions of the North American ideology, a kind of *tabula rasa* for glass art.

Svenska Slöjdföreningen (The Swedish Society of Craft and Industrial Design) was established in 1845. The influence of this movement had both practical and social implications, passing through so called “Swedish Grace” in the 1920s to “Functionalism” in the 1930s. These developments revolutionised Swedish Design and marked Swedish Modernism. In this environment, artists were employed by industry to nurture innovation, quality and taste. The social structure and team - spirit that characterised the Swedish glasshouses was an enviable model for art and design-led manufacture. It was in this environment of artistic endeavour and technical innovation at Orrefors Glassworks that artists Edvin Öhrström and Vicke Lindstrand in the middle 1930s, in close co-operation with glassmakers Gustaf and Knut Bergqvist, began to work with voids through inducing gaseous bubbles or trapping air. (See Figure 3)

Figure 3

The first *'Ariel'* vase made in Orrefors, signed Ariel No. 2 1937

- **What other source material can the researcher draw from to inform this contextual revue?**

The researcher undertook a search of literature including the Victoria and Albert Museum, London; Corning Museum of Glass, New York, as well as other leading centres and including the Internet. This was to ensure that no resource in terms of literature (text and images) which might provide additional information on the decorative or artistic application of bubbles or voids glass was missed. (See Bibliography of Sources, Appendix 4). The literature however in this area has proven to be an impoverished resource, making this chapter an important contribution in this area which can provide a springboard for further enquiry.

The role of the contemporary glass practitioner working in the landscape of contemporary craft practice, or indeed defining its development, is also an important signifier for this study. (See 1.3, Characteristics of Research Practice p.9).

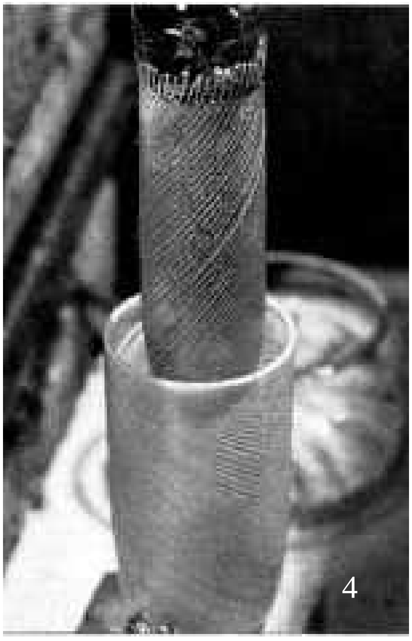
2.3 The Nature of Glass and Emergence of Bubbles.

Glass is a synthetic material consisting primarily of silica normally found as sand with the addition of fluxes and stabilisers, and these vary widely: soda, lime, silica glasses being typical, See Tooley (1984). Gaseous bubbles are generated during the founding stage and are normally driven out of the molten glass mass during the final stages of the melt. This was difficult to achieve in the ancient world, as high temperatures were hard to sustain over a suitably long period. Consequently, gaseous bubbles or *'seeds'* were common in glass when melted in primitive furnaces. The presence of seeds in glass enhances the character of ancient objects in the eyes of the connoisseur, while their presence is unacceptable in most contemporary manufactured glass products as they are considered imperfections. This might indicate structural weakness or, in cut crystal, undesirable optical qualities.

There is no evidence of the controlled induction and manipulation of bubbles in the pre-blown glass era, because glass in the ancient world was translucent or opaque. Pre-cast glass *ingots* were traded throughout the Mediterranean and were used for *casting*, indicating that glassmakers worked with prepared glass, the founding process being a separate activity requiring higher temperatures than re-melting ingots to cast in moulds. See Cummings (1997). These undoubtedly contained seed from the original founding. Cast glass vessels made in the 1st

Century AD were finished on a lathe, which revealed the presence of tiny bubbles exposed at the surface. The development of glass blowing was made possible by an improvement in furnace technology allowing the glass-working temperature to be maintained over a longer period at a consistent level. This created a viscous liquid with both plastic and ductile properties that could be free-formed, creating a thin wall section allowing greater transparency and making the presence of bubbles more apparent.

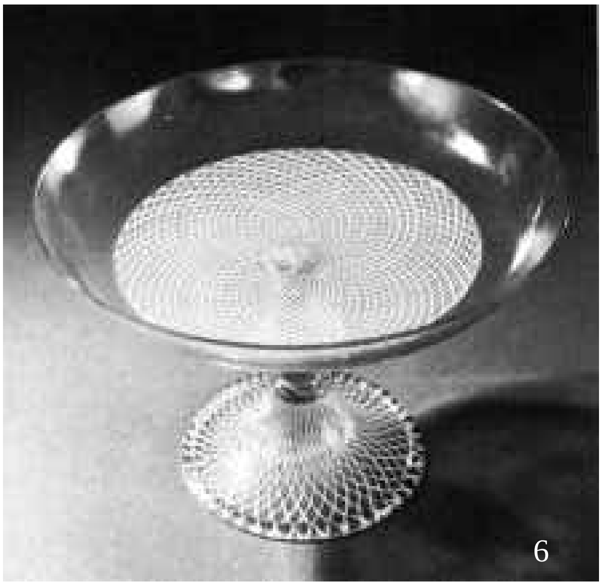
The deliberate inclusion of bubbles in glass artefacts appeared with the production of *Vetro Filigrana*[1] in Murano in the early 16th Century. Glass vessels were constructed by the hot fusion of clear glass coated white canes, laid parallel, then rolled to form a cylinder, and constricted at the open end to enable blowing and further forming. The incorporation of variations of white threaded designs characterised many products of 16th and 17th Century Venice in the form of vessels, drinking vessels and platters. In one of these patterns described as *vetro a reticello*, a spiral pattern of lines was cup-cased with the lines spiralling in the reverse direction. As the white glass was slightly harder than the clear *crystalo* this created a slight ribbing effect so that, when the second layer was inflated into the cup, a regular pattern of air bubbles was trapped, placing an air pocket in the middle of each diamond of the criss-cross (as described by Tait (1979) p.49). (See Figures 4 – 7 and Diagram 1 p. 23).



Figures 4 and 5

4 -A tube of glass with canes spiralling in an clockwise direction is positioned over a tall glass cup with canes spiralling in the opposite direction,
5 - The tube is lowered down into the pre-heated cup and rapidly inflated.

[1] *Vetro filigrana,* Venetian glassmaking - threads of white glass are incorporated to form twisted designs.



‘Vetro a reticello’

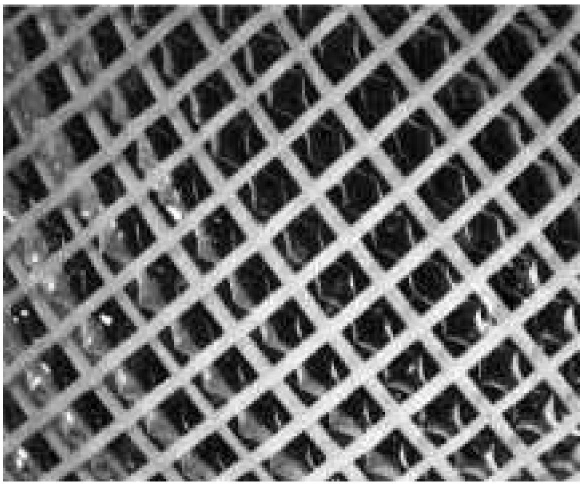


Figure 6 Tazza, late 16th century.
Vetro a reticello showing air bubbles trapped between layers.

Figure 7 ‘Flacon’ and Cover, 17th century.
Vetro a reticello showing air trapped ribbons.

In 18th Century England wine and cordial glasses had stems incorporating 'cotton twists' similar to canes of *filgrana,* but also the Jacobite glasses, famed for their fine engraving, were made with *air twist* stems. These appear to be the first example of controlled manipulation of air bubbles in glass. The technique of making air twists is well known to glassmakers and is achieved by gathering over indentations or creases pressed into the glass surface. Symmetrically arranged air bubbles are created and can be elongated and twisted during the forming of a wine glass stem. The simplest tool for creating air traps is the opposing blades of the *pucellas* which are used to make four creases along the cylindrical form of hot glass over which a second gather is made with the resulting four elongated bubbles. Other tools exist employing nail-like spiked rings with up to a dozen points that are injected into the hot stem bit and, after receiving a flattened gather to seal in the air, the stem is then drawn and twisted. (See Figure 8).

Figure 8

An Irish Wedding Goblet with two engraved family crests. The large bucket shaped bowl is supported on a double knopped air twist stem.

In all cases, the glass must be formed rapidly as any re-heating will induce the bubbles to become spherical because there is a natural tendency for gases within a liquid to seek a state of equilibrium.

Glass making in the 19th Century became hugely diverse and inventive with greater understanding of glass technology driven by the increasing wealth of a bourgeoisie keen to posses extravagant examples of the glassmaker's art. Imitation of classical styles gave way to the Art Nouveau movement and later in the 20th C, to Art Deco, Arwas (1977). Undoubtedly one of the greatest experimenters in glass techniques during this period was Frederick Carder who began his working life in Stourbridge, West Midlands, and in 1903 founded Steuben glassworks at Corning, New York. In his book 'The Glass of Frederick Carder' Gardner (1971) describes and illustrates a number of pieces employing what he called 'Air Trap' effects. He states:

> "Decoration in which a pattern was produced by enclosing air between two layers of glass in a controlled design was very popular while Carder was working in England in the late 19th Century. He continued this decorative technique at Steuben. The process is similar to controlled air bubbles. The parison is placed in a dip or two-part hinged mould that has a protruding pattern of diamonds, circles, or some other design for air trap shapes. After these patterns are impressed on the semi-cooled parison, a second gather locks the air in the indentations and forms the air trap pattern."

In the late 19th Century the North American glasshouse, The Mount Washington Glass Company, New Bedford, Massachusetts developed the technique which created a mother of pearl effect by encapsulating air between layers of glass and finishing with a satin etch. The ware was characterised by a peach colour - 'Peach Blow'. This was achieved by an inside casing of white or ivory coloured opaque glass, which was dip-moulded then cased over with transparent pale ruby. Both Thomas Webb & Sons and Stevens and Williams employed this technique under licence in the UK, the latter being where Carder generated a new interest in coloured glass. All examples confirm the use of *dip or hinged moulds* to create the regular patterns of which there are many illustrated in 'Art Glass Nouveau', by Grover (1975), (Figure 9 and 10).

9

10

Figures 9 and 10

9 - Mother of pearl vase herringbone design.

10 - Mother of pearl vase flower and acorn design.

Figure 11

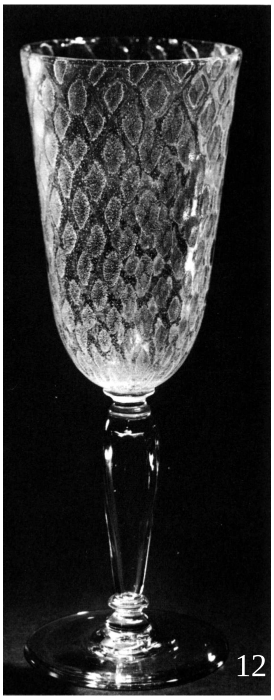
Gold Ruby Satin Glass Bowl with air trap decoration, 1905

Figure 12

Crystal 'Silverina' air trap goblet, 1920s.

Frederick Carder - Steuben

11



12

Significant for this study is the application of *flashing*, a layer of clear glass gathered directly from the furnace, or *casing*, the inflation of hot glass into a prepared coloured cup held at a temperature high enough to prevent cracking from thermal shock (Diagram 1)

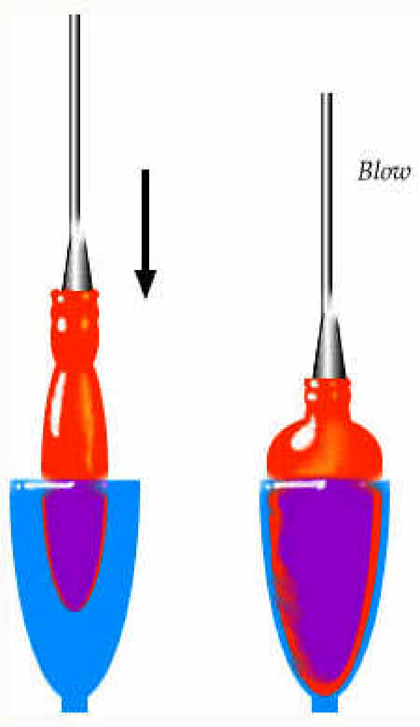


Diagram 1

The diagram shows a hot parison being inflated into a transparent blue *cup*. There is a small hole left in the bottom to prevent accidental trapping of air. Cup casing is a standard method of adding a layer of colour to the exterior surface of the glass and is well suited to working on larger scale pieces.
This method is unsuitable for creating controlled voids because the parison in this case has to be hot and inflatable to fill the cup.

Roman cameo glasses were the first examples of blown vessels employing either of these methods (which remains the subject of some debate), The Portland Vase late 1st Century BC being the prime example. (Figure 13)

Figure 13

The Portland Vase. 1st Century AD
The white exterior cup has been carved away to create this finely modelled cameo effect.

The British Museum.

There are many late 19th and early 20th Century examples of the revival of the cameo technique[1] which emerged in a different guise as it extended into the Art Nouveau period when Emile Gallé introduced a much fresher and more dynamic approach to manipulating layers of coloured glass. Gallé's style enjoyed wide recognition and was copied widely in France and other European glass centres. This popularity extended to Sweden where the Kosta and Orrefors glasshouses produced vases and lighting in the Art Nouveau French style. Orrefors, under new management in 1913, changed its production from hollow ware and widow glass to concentrate on this *cased* ware in the French taste. In 1916, Simon Gate was employed as a designer, and later Edward Hald. These artists, in conjunction with Gustaf Abels the engraver and Gustaf and Knut Bergqvist master glassblowers, were set to establish a new meaning for Swedish glass products with the development of the *graal* glass in 1916 (Figures 14 and15)


Figures 14 and 15

Covered Goblet

Made by Knut Bergqvist from a design by Fritz Blomqvist.
The parisons show stages in the decorating process.

[1] John Northwood Studio and the work of Tom and George Woodall; also Carder designed cameo pieces for Stevens and Williams, see 'The Glass of Frederick Carder.

Interestingly, Frederick Carder was experimenting with a technique he called *'Intarsia'* in the same year at the Corning Glassworks, New York. In his book 'Art Nouveau to Art Deco', Victor Arwas (1977) claims that the work was executed by Johnny Jenson, a Swedish glassblower apparently trained by Carder. In his section on Designers and Makers, he lists products of Steuben Glasswork.

> "**Intarsia glass** is very similar to 'Graal' glass produced at Orrefors in Sweden. To make it a clear crystal parison was flashed with a layer of coloured glass. After annealing the design was drawn on the vessel and the superfluous sections of coloured glass etched away with hydrofluoric acid. The vessel was then very slowly reheated, then when malleable, it was blown into an outer envelope of clear crystal and the whole vessel blown to its final shape. Where appropriate a stem or a foot or appliqué crystal decoration was added. The coloured glass decoration appeared floating in mid air between the clear crystal layers. Carder introduced the technique in 1916 and intarsia vessels were made until 1923. All were designed by him, and the internal designs were all drawn by him while the physical manipulation was carried out by a Swedish glass-worker called Johnny Jensen, who had been trained by Carder."
> (Arwas, 1977 p.200). See Figure 16.

Figure 16 Intarsia glass by Frederick

However, the technique of annealing and decorating a coloured parison, which is later reheated and further worked at the furnace, is normally referred to as 'graal' by today's commentators.

2.4 Contemporary Developments.

The graal technique is, then, an extension of cameo. Instead of the finished blank being cut, engraved, etched etc, the parison with *overlay colour* is removed from the blowing iron and is then worked on after annealing. After re-heating to 500˚ C the reheated *parison* can be worked as normal[1]. It might be gathered over with clear glass to increase the size. Further inflation would make the design expand but if over inflated the process would render the design less dense in colour and possibly distort images if the parison were formed longer or shorter in relation to the original proportions.


17

Figure 17 – S. Gate, Orrefors, 1917
Graal bowl showing the distortion (laterally) of the floral motifs.

Figure 18 – E. Hald, Orrefors. 1917
Graal vase with fine decoration and thin blown section.

Both pieces were blown by K. Bergqvist


18

[1] The holding temperature for the pre-heated parison will depend on the glass composition, 500˚ C would be typical for 24% lead crystal.

Figure 19

Hald, Orrefors 1918, Footed Bowl. In this piece and Figures 17 and 18 were decorated with the acid resist technique probably painted on to achieve the delicacy of the bowl 12 cm diameter.

The wide range of colours, transparent and opaque, available to glassmakers is obtainable in the form of rods or crushings[1]. The use of coloured glass rods makes possible the addition of colour to clear crystal by layering or casing. A suitable amount of colour is melted on the nose of a blowing iron. A casing of clear crystal is gathered over the colour which, when inflated, creates a layer of colour on the inner surface of the bubble. This is described as inside casing. If, however, an external casing is required then this can be achieved by inverting or turning inside out an *inside cased* bubble thereby moving the colour layer to the exterior surface of the glass, described as overlay. (See Diagram 2, p. 28).

[1] Crushed coloured glass is available in sievings from 3mm to fine powder.

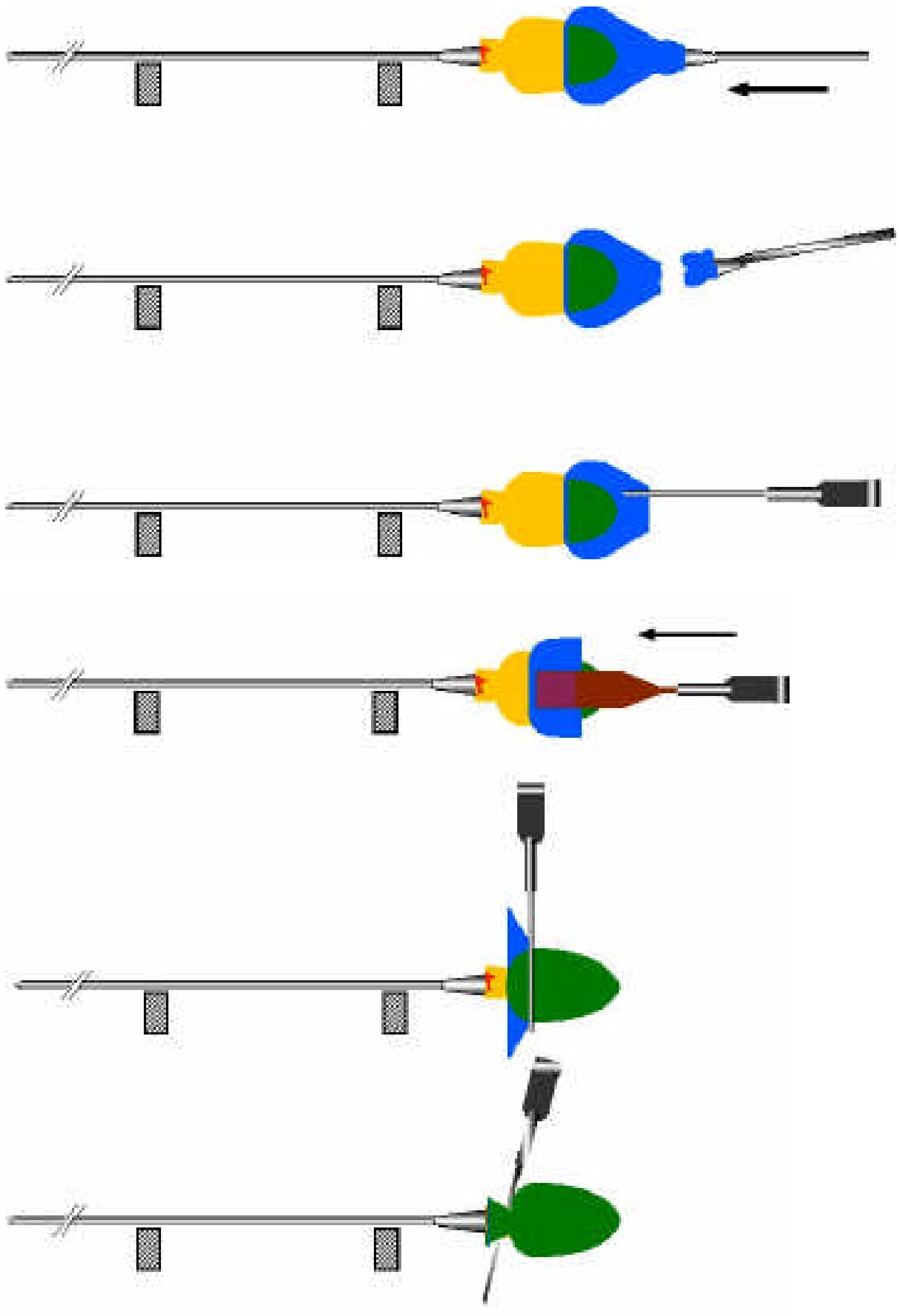


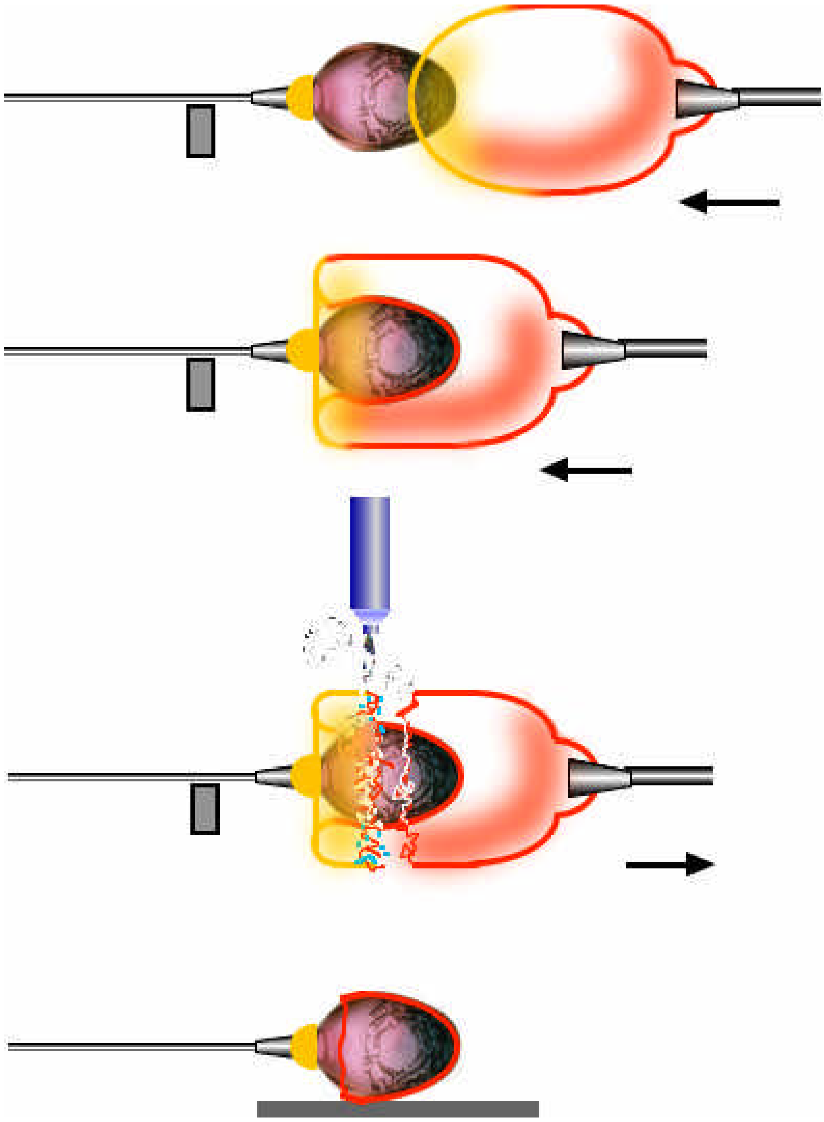
Diagram 2

Casing - overlay, the outside casing *blue* bubble is turned inside out over the first parison, inside cased yellow. If these are transparent colours then the resulting colour will be green. If the blue exterior colour is removed in part, then the piece will appear to be yellow and green seen from the outside. More than one colour may be included in a layer and more than one layer used to create multicoloured designs.

This method of outside casing is preferred in Scandinavia. The alternative is the cup casing method where clear glass is blown into a prepared coloured cup shape in order to place colour on the outside of the glass. (Shown in Diagram 1, p. 23). The *overlay* method creates a very thin, even layer of colour on the outside of the glass; ideal for acid etching . This is because a thicker and more uneven layer would require a longer time in the acid, to burn away the thickness and potential unevenness. Reflection on these outside casing techniques led the researcher to explore other options of overlaying in the practice. (See Chapter 3.0).

Diagram 3

The sandblasted parison has been pre-heated in a kiln and is picked up on a blowing iron. A large clear casing bubble is prepared and pushed over the parison creating voids where the *'Shoal'* design has been sandblasted to a depth of 4 mm. The previous casing method (Diagram 2) limited the size of the prepared parison, as forcing the casing bubble back with *casing tools* was too difficult. A squeezy bottle squirting a jet of water around the casing bubble, *crizzles* the surface where it then can be cracked off, tapping off loose bits of glass before re-heating and *marvering* the edge.
See the video clips of the casing technique.



To see Video Clip of the casing process click the green button CLICK HERE
to go to page 79 where the Video *'Purple Sea'* is located. NB click the
red button on that page to return to this text. Green button out, red return.

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This red button is not live.

Diagram 3 shows the method of casing over a large parison developed by the researcher based on the casing method used in the Czech Republic. (See p. 38) The aim here is to encapsulate air in the sandblasted parison. Central to this research practice and reflection, was the work of Edvin Öhrström who joined Orrefors in 1936. His work was the first serious attempt at incorporating controlled air inclusions to enhance a drawing or image rather than an overall pattern effect characteristic of 19th Century mother of pearl effects. In 1937 Öhrström designed the first piece of glass using controlled air bubbles which he called 'Ariel' from the "airy spirit" of Shakespeare's last play "The Tempest", and thereafter 'Ariel' was used to describe Orrefors Glass with the inclusion of air or voids. (Figure 3 p.17) Öhrström and Vicke Lindstrand went on to explore the potential of the technique, as did other designers at Orrefors in subsequent years. (See Figures 20, 21 and 22).

Figure 20.

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'Eagle's Nest'

Signed E. Öhrström 1939
Orrefors Sweden ,Ariel.

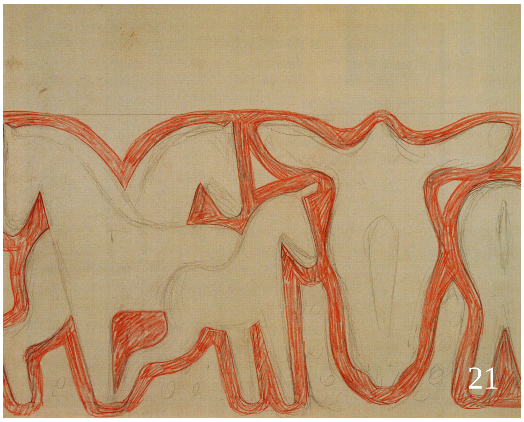

Figure 21

Preparatory drawing for Zebra Vase by Vicke Lindstrand. The red areas indicate where the voids are placed.

Figure 22

The finished piece signed Vicke Lindstrand 1939, Orrefors Sweden Ariel.

Returning to the influence of Art Nouveau from France, and to the decorative potential of bubbles in the glass, special mention is deserved here of the work of the French Fauve artist Maurice Marinot who began working with glass in a small factory in 1913 at Bar-sur-Seine. Marinot chose to work directly with glass because of his fascination with the drama of working at the furnace. In the context of the *Studio Glass Movement*, he proved to be the pioneer of a new spirit of enquiry[1], creating his own language in the making of glass vessels. One of the many features of his work was the introduction of small bubbles into his pieces. This was probably achieved by the application of metallic oxides in conjunction with soda or potash, which in contact with hot glass creates tiny pockets of gas. These materials would have been *marvered* in between gathers. (Figure 23)

[1] Re: Studio Glass Movement and the idea of individual artists working in small studios, freed from the constraints of traditional manufacturing methods.

Figure 23.

Bottle and Stopper by Maurice Marinot incorporating chemically induced bubble effects. This piece also shows a trail of molten glass added at the shoulder as well as the deep acid rotting at the neck and on the main body of the vessel.

Marinot’s style was characterised by his use of the deep *acid rotting* in conjunction with the bubble effects. The style was taken up by other French glass manufacturers and in Scandinavia , the Netherlands and the USA.

Vicke Lindstrand at Orrefors in 1936 designed pieces with fine internal bubbles. These were achieved by painting powdered carborundum onto the surface of the parison, perhaps using epoxy resin to help adhesion; then, after pre-heating, casing over with clear glass. (Figures 24 and 25 show examples).

Figure 24

'Horses'

Figure 25

Parison with painted carborundum.

Vicke Lindstrand, “Mykene” , Orrefors 1936

The technique is called "Mykene". Another method of encapsulating air - as a drawing - may be seen in the work of Bengt Edenfalk at Växjö Museum (Figure 26). The researcher speculates that a figure was constructed of added *bits* on to the exterior of a free-blown form, then subsequently gathered over, catching air in the creases. The undulations of the exterior of the form indicate this method, as the final gather does not disguise the relief form of the figure underneath. Also the great Dutch glass designer from the Leerdam glassworks in Holland, Andreas Dirk Copier, used air inclusions in his work in conjunction with veils of colour. (Figure 27). So here are many significant instances of how voids have been used and methods of casing have been identified.

Figure 26

Bengt Edenfalk
Sweden.

Figure 27

Andreas Dirk Copier
The Netherlands.

2.5 Significant Research Connections.

The practice of designing and making glass is heavily dependent on tacit knowledge and, whilst this study has been undertaken in recent years, the process of reflection draws upon a personal practical history to inform future strategies.[1] The researcher's first experience of working with glass awakened a new kind of challenge. As a teacher of ceramics and of product design, the concept of designing and making dissolved into chaos when the substance (glass) in one instant flowed and in the next was solid. Following Herman's example, a simple furnace was constructed at the then Guildford School of Art[2] and after much experimentation and self-learning, with equally enthusiastic students, the researcher elected to try for

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[1] A more detailed account of the approach to methodology is given in Section 4 Methodology.
[2] The researcher was part - time lecturer at Guildford School of Art where he taught ceramics and a basic design course for interior and product design students. Two small furnaces were built here where the researcher and his students experimented with glassblowing between 1968 - 1975.

a place at the new Glass School in Orrefors. The course provided training in the practice of furnace made glass and cold finishing techniques supported by studies in glass technology. The purpose of the course was to provide designers and skilled craftsmen for the glass industry in Småland and, later, the whole of Scandinavia. Following the publication of 'Studio Glassmaking', Flavell (1973), in which the researcher introduced the idea of "studio practice", he was invited to work at Stevens and Williams[1] Glasshouses at Tipton and Brierley Hill in the West Midlands. It was at the Brierley Hill glassworks (Royal Brierley Crystal) that the researcher first conducted experiments to find ways of controlling air bubble shapes, voids within the wall thickness of the glass, that would work as a drawing in clear crystal.

The training at Orrefors provided the researcher with a basic understanding of the Graal technique and the importance of outside casing to achieve the best results. Initial experiments with Graal showed that if the sandblasting was too deep when removing surplus colour, air bubbles resulted if the *parison* received a further gather. These would appear in small pockets where air was accidentally caught by the action of gathering from the melt. Although undesirable in Graal pieces, the potential of controlled air bubbles became apparent. The very thin layer of colour achieved by the overlay casing method is very important in Graal pieces because the surplus coloured area can easily be removed by hydrofluoric acid or light sandblasting to provide a smooth *fire polished* exterior surface. The thin layer ensuring that no deep relief would cause accidental air inclusions. (See Figure 28).

Figure 28

Vicke Lindstrand
Acid etched parison for graal.

[1] Where Frederick Carder worked as a designer before he established Stueben Glass in New York.

A deep relief was necessary, however, to create voids, and gathering directly over the relief (although this looked promising with the graal trials) allowed molten glass to fill in most of the relief. So to facilitate more complicated images the researcher reasoned that it was necessary to add a further outside casing using an overlay to seal in the relief shapes created by the sand blasting or acid etched relief.[1] At Royal Brierley Crystal the researcher met Sam Thompson, a metal plate engraver and an expert in acid embossing techniques. At the turn of the Century, Stevens and Williams excelled in acid etching technology and, although this no longer featured in their current production, the expertise and facilities were still available at the time of the initial trials. They achieved decorative finishes by employing various dilutions and mixtures of hydrofluoric acid. The design was effected by a method of applying the acid resist Brunswick Black a bitumen based paint transferred from an etched or engraved plate, to the surface of a glass vessel. This was then immersed in hydrofluoric acid where the exposed areas were etched. Using this method, tests were undertaken to see if this technique might be used to create voids of sufficient depth and clear definition by deep acid etching. During the same period, the researcher trained glassmakers at the factory in the *'overlay casing'* technique. (See Diagram 2 p. 28). This was necessary because the *'cup casing'* method used traditionally by Stevens and Williams could not be used to encapsulate air in the voids. The outcome of the most successful of these trials using deep acid etching is shown in Figure 29. The result of this trial was compared with voids created by sandblasting, Figure 30 and whilst the acid etched result was not a failure the sand blasting produced a stronger and more clearly defined result.

[1] It wasn't until some years later that the researcher’s speculation on this detail (a further overlay) was proven correct. Indeed no 'Ariel' *parisons* were available for study by the researcher in Swedish museums, but were discovered in his literary search in the closing stages of writing this thesis.

Figure 29 Acid-etched parison.

Sandblasted parison. **Figure 30**

The small scale of these experimental pieces limited their potential and the complicated making procedure made these products unattractive to a production environment and, as a result, no further development time was spent on this project at Royal Brierley Crystal.

Below is a sequence illustrating the method of casing larger pieces which the researcher recorded in the Czech Republic in 1985. This later to facilitated a new insight into working on a larger scale, and this complicated making procedure worked as well in the *studio workshop* as in the factory.

Figure 31

Shaping a spherical parison.

Figure 32

The conical form has been pushed over before cracking off.

Figure 33

Water is being sprayed on to remove surplus glass.

Figure 34

Overlay after heating.

Figure 35

Placing in lehr.

The researcher found this method of casing interesting and photographed the process without, at the time, being aware of its future potential. This happened during the International Glass Symposium at Novi Bor in 1985, but was incidental to the more exciting glassmaking activities of the international glass community.
The potential for the research project, then, was being shaped by these events. The original inspiration had come from Öhrström's 'Ariel' glass and the intention was to extend and improve the possibility of making new images with voids creating either transparent windows or mercurial liquid forms in the glass section. Working with voids seemed largely neglected; the last important exponent being Ingeborg Lundin at Orrefors. (See Figures 41 and 42). The 'Graal' technique on the other hand has been adopted and developed in many personal styles, notably by artists Gunner Cyren and Eva Englund at Orrefors and many artists in studios around the world including Aneka Sandström and David Kaplan, Jan Mares and Gillian Mannings.

Figure 36

E. Englund, Orrefors. 1987

Figure 37

J. Mares, 1991, Czech Republic.

Figure 38

G.Cyrén, 1989

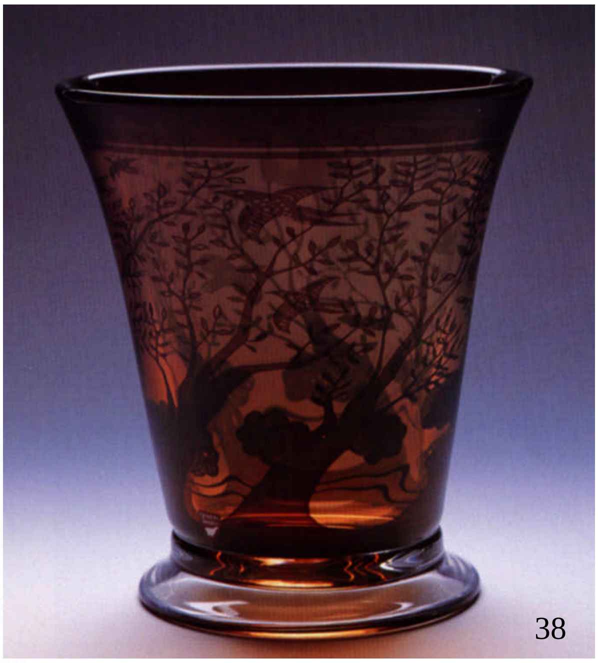
Graal goblet thinly blown having similar character to earlier work by Hald.

Figure 39

G Mannings, U.K.

Figure 40

D. Kaplan and A. Sandström. 1986. U.K.



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With the co-operation and help of Lars Hellsten, a senior designer at Orrefors Glass Factory, the researcher formalised the research project, and was able to organise a study visit to Sweden in 1995. Visits were arranged to the factory archive and Smålandsmuseum which holds collections of glass from the region. Examples of Öhrströms designs could be seen in both museum collections. At the Smålandsmuseum in Växjö, the researcher was introduced to Keeper of Glass, Claus Bengtner and gained access to many examples of early Graal glass pieces made by Knut Bergqvist. These were light in weight and thinly blown, unlike the contemporary work employing this technique. A visit to the Orrefors factory archive under the guidance of the keeper Mona Engström, was equally valuable where I saw some earlier pieces of 'Ariel' glass including the work of Vicke Lindstrand and Ingeborg Lundin as well as Öhrström's drawings. There were no detailed record of the method of production available for the researcher to see at the time though images attributed to Orrefors glass museum showing parisons for 'Ariel' were published in the catalogue for the exhibition "The Brilliance of Swedish Glass 1918-1939: An Alliance of Art and Industry" .[1] In most instances, the pieces depended on other elements of design, like colour to carry the imagery and the air inclusions were secondary to the more successful Graal method.

Figure 41

Vase 'Horses' by Ingeborg Lundin Ariel1962.

Figure 42

Detail of 'Horses' showing Orrefors silhouette of horse and deformed void.

[1] Published for The Bard Graduate Center Arts, New York Yale University press.

In some Ariel pieces, detail was missing from the original drawing in the glass, due to overheating. (See Figures 41 & 42). In this detail, the bubble has withdrawn from the original outline, (the paler silhouette). Interesting though it is, the form of the void plays a secondary role to the Graal drawing. This occurs through overheating and the natural tendency for the void to become spherical as the tension of the entrapped air in the viscous glass mass tries to achieve equilibrium. A further example of this problem is demonstrated in a piece designed by Ronald Stennett-Willson, (Figure 43), Stennett-Willson was involved in setting up a glassworks, Kings Lynn Glass Ltd. whose products had a distinct Swedish Style.

Figure 43

In this example the voids have withdrawn from the shapes cut through the blue and green background.

Piece designed by Ronald Stennett-Willson for the Wedgwood Studio Collection at the Kings Lynn Glass Works.

It is tempting to speculate if this was an attempt at the 'Ariel' technique; the bubbles appear in parts of the decoration which is characteristic of overheating. These examples then raise the question of how much flexibility there would be in controlling the glass temperature during the making procedure. Observing the relationship between time and temperature as the longer the glass remains at high temperature the greater the risk that fluidity will destroy the image.[1] If overheating could be overcome, then, the drawing could be more detailed. Here was an

[1] Time is mentioned here because at the working temperature glass can be moved around in this viscous condition, however, over time deformation of detail will take place therefore fast efficient work will prevent loss of detail.

interesting possibility to explore. If more control of working temperature of the glass were possible then more detail in the drawing might be achievable. As part of the researchers visit to Orrefors, Lars Hellsten arranged a short workshop session with the master glass blower Ronny Fagetlund and his assistant. The purpose of the session was to test the feasibility of the a casing method used in the Czech Republic (See p. 38) to apply colour over larger parisons, which would have the advantage of sealing the glass from outside and not inside (as would have to be the case with cup casing). After a few trials, it was clear that this method could be made to work. (Figures 44 and 45).

Figure 44 **Figure 45**

Trial in Orrefors Glass Works of casing using a large casing bubble instead of casing tools.

Now, with better information from highly skilled practitioners, the researcher was able to test the idea on a much larger scale with the assistance of glassmaker Derek Walls in the glasshouse at Edinburgh College of Art which was to be the venue for all further glasshouse production in this study. With Derek's skills in working on heavier pieces, the method seen in Novy Bor, and tested in Orrefors, was further developed, constantly refining the timing and temperature of the fusion of the *prepared parisons*, (parisons with sand blasted images) and the laminating outer *casing bubble* (the large softer bubble that seals in the air). Control of the working temperature proved to be the most important element in retaining all the detail of the original art work (sandblasted into the surface of the parison) and this facilitated greater control over the imagery (See Section 3, The Practice.)

2.6 The Creative Impulse

- **What characterises the role of the craft practitioner, and what purpose does the work serve in contemporary society**.

The motivation for making is an inherent part of our being. Primitive men and women learned to enhance their activities by being able to make tools, vessels and clothes. The ownership of these influenced their status amongst peers and later in civilised society, these artefacts were not only functional but also at best masterful demonstrations of the understanding of the nature of materials. This is the researcher's understanding of aesthetic sensibility; the realisation of an object that enriches the lifestyle of the user, whose purpose may be functional or ritual. These objects may be further embellished, identifying their function, place, and purpose. Objects of our making surround us, though often we are distanced from their method of manufacture. We are often surrounded by a totally man-made environment from landscape to cyberspace. The nature and quality of these artefacts and surroundings influence people on a daily basis and, although they may not be conscious of the influence of art, craft and design, their wellbeing and mental disposition are influenced by them. Those of us who make things do so for primitive reasons but reflect the society of which we are part and comment on the issues of today. The role of the craftsmen (as stated by Greenhalgh's definition in Chapter 1 – Aims ,Objectives and Rational, p. 9) in contemporary society has shifted from the essential provider to one who restates, through chosen materials and processes, the celebration of an individual's exploration of an idea. The source of this idea in this post post-modern 21st Century, where craft blurs on the one hand with fine art and on the other with design, may arise out of passion for a concept or the command of a process, as innovation or reflection.

The researcher would suggest that a prime characteristic of the work of the contemporary 'artist craftsman' is the application of reflection *'in'* and *'on'* action. This definition of reflection was the result of the work of Donald Schön (1983) in his understanding of professionals as reflective practitioners. His observations have no specific connection with craftsmanship or making but, in the researcher's view, establish a familiar application of reflection which can be associated with the assembly of complex experiences from which alternative solutions may be drawn.

This reflective process and its place in learning through experience as expressed by David Kolb (1984) form the basis for a theoretical model by which the researcher's practice is framed and, together with insights from David Pye(1968) and Michael Polanyi (1958), have defined the researcher's methodology of *Reflective Risk* (See Section - 4 Methodology). Historically many trades and crafts were taught through apprenticeship which now seems inappropriate, as access to knowledge is so diverse. The eloquent definition of Pye's' *workmanship of risk'*, in which the quality of the result is not pre-determined, but depends on the judgement, dexterity and care which the maker exercises as he works, contrasts with what he calls *'workmanship of certainty'*. This in the last few generations, derived from machine technology has insured a predetermined outcome. Pye's thesis shows how good workmanship imparts diversity to our visual environment, how there is honesty to method and material, and appropriateness to the quality of workmanship required. Pye at the time of writing in 1968 was surrounded by design idealism for which he was able to show equal sympathy and understanding given that an appropriate philosophy might prevent environmental disaster.

An insatiable desire to express ideas using skill and judgement in the making of artefacts is difficult to explain, but a compelling drive to exercise both tacit and focused knowledge in the act of making is characteristic of the craft practitioner. The researcher's learning about craft began by studying ceramics where a passion for making was driven by the many levels of engagement in the subject, were totally absorbing. There was the practice (earth and fire) technology (how) the history (when and where) and the product (why and what for), but it was the permanence of the result; *on the table* to be used or cherished or discarded, only to be resurrected under new ownership. Later, when studying product design the researcher became intrigued by manufacturing techniques and materials including plastics[1]. This was brief experience in the world of *'the workmanship of certainty'*. The first contact with working with molten glass at the furnace could be characterised as the *'management of uncertainty:'* a complete re-assessment of working methodology was called for. In learning to throw pots in ceramics, the possibility of forming a hollow vessel with plastic clay, was a formidable task. Using water as a lubricant, centrifugal force on a rotating wheel against squeezing and pulling upwards to form and control clay

[1] Plastics are mentioned here because plastics moulded products exemplify the workmanship of certainty. An injection or compression moulded synthetic material. Although the technology developed to create the *certainty* was achieved (as Pye points out) through the workmanship of risk.

required the acquisition of considerable skill and judgement. The possibility of gathering molten glass on the end of a blowing iron and inflating it to form a vessel was not only challenging but also dangerous. However, the acquisition of manipulative skill on its own has no artistic value unless it is driven by the need to say something, to deliver a personal perspective.

As part of this contextual review, it is vital for the reader to appreciate the complexity of reflecting in action to *enable* the acquisition of knowledge. Working with glass directly at the furnace involves timing and dexterity. Glass at the working temperature around 1100˚C is fluid yet viscous and to some extent elastic. Reflection on the nature of it is essential to predicting and anticipating its likely behaviour in the next instant. It lies as a perfectly homogenous mass in the ceramic crucible in the furnace. By immersing the tip of a *blowing iron* and rapidly rotating it in the surface, raising it - then slowing down the speed - withdrawing it from the furnace chamber a *gather* is effected. The natural forces at work on this gather govern the means of manipulation.

While the iron is held horizontally, gravity is pulling the glass downwards; rotation of the blowing iron induces centrifugal force to balance this, retaining the whole in a state of equilibrium. Before the pressure of air inflates the glass it can be further shaped and chilled forming an exterior skin of more viscous glass. This is achieved by the application of a damp paper pad, a wooden *block* or rolling on the *marver.* The form of the glass prior to blowing is of critical importance, as this will determine the wall thickness required in the finished product Flavell (1976 p 18). This would now be inflated to form the *parison* or pre-form. The glassmaker must also take into account the increasing viscosity of the glass as it loses temperature, and re-heat the piece to render further ductility to achieve the required form. From the onset of the process, the glassmaker must know the size, weight, and shape of the proposed product in order to predetermine a sequence of procedure that will result in the final form. These procedures are the result of accumulated personal experience, much of which can be taught through demonstration, but equally must be experienced through rigorous practice.

The concept of the traditional master-craftsman is determined by the accumulation of personal practical experience. This fund of detailed, complex procedures and know-how, much of which is unconsciously brought to bear in the form of tacit knowledge is acquired over time. In addition, the master-craftsman will have access to jigs, tools and mechanical devices, which have evolved through generations of use. Peter Dormer (1994) explores the idea of '*craft knowledge '* and, in his discerning analysis, creates a name for the maker's interpretation of tacit knowledge, (See Chapter 4 - Methodology). He ascertained that practical knowledge (the knowledge required to make something work) is not the same as the principle behind it, and that it is possible to apply this knowledge unknowingly. Dormer's essay addresses issues about contemporary *plastic arts* [1]; particularly definitions between the fine arts, the applied arts and their relationship to craft, and - most importantly - the characterisation of the maker.

In The 18th Century, 'The Age of Enlightenment' laid the foundations of Modern thought and through, Denis Diderot and the Encyclopopédie project, the importance and value of trade and craft was identified.

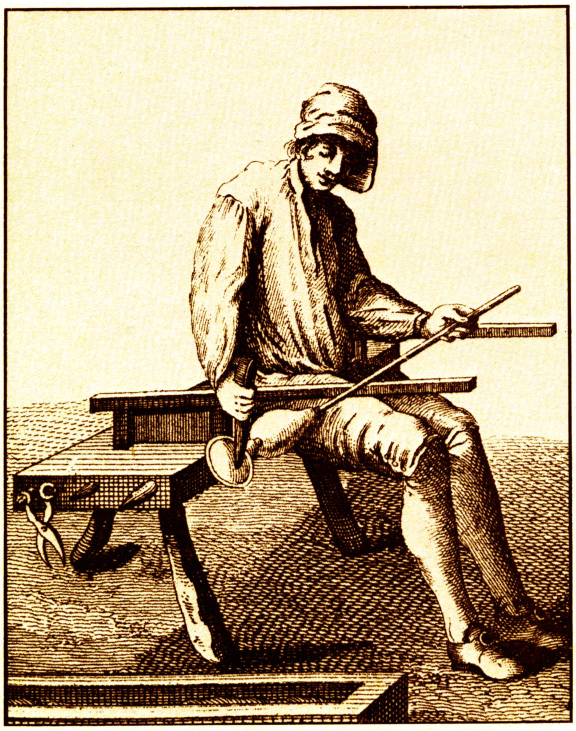

Figure 46

A glassmaker from Encyclopédie des Arts et Métiers, Paris 1772.

Here, at the beginning of the 21st Century, the notion of the apprenticeship becomes a dogmatic methodology, and the researcher's position is to adopt a constructivist approach. Constructivist learning as decribed by Piaget, (1970), is the notion of constructing personal knowledge by testing ideas and approaches based on prior knowledge and experience. In addition to the context of *making* in this study, the

[1] Dormer resurrects the term *plastic arts* that refer to painting, sculpture and studio crafts.

creative impulse is driven by the relationship between idea / source material, and the unique character of encapsulated air - voids - with their silvery mercurial quality. These mercurial images have an illusive presence and this, in conjunction with a solid material which is transparent, provides an extraordinary ‘canvas’ on which to explore enigmatic themes. (See Chapter 3.2 The Practice).

2.7 Summary

The key factors then that locate the background to the practice are:

- the variety of ways in which voids occur in glass
- the historical development of the use of layers or casings of glass as a decorative tool.
- the cultural climate in which these glassmaking techniques were evolved and the movement of the 'craft' of the glassmaker *through reflection* into the world of contemporary applied arts.
- the relationship of the researcher to these events.

CHAPTER 3 – The Practice

3.0 Introduction

- **What are the factors that contribute to the current practice?**

These are made up from a number of contributory elements growing out of previous experience and reflection on that experience. These contribute to the central aim of developing the potential of image-making by the encapsulation of voids.

The contributory elements can be listed as follows to construct points for reflection:

- the acquisition of craft skill which has been built from both formal training at Orrefors Glass School and offset by more open liberal attitudes growing out of the '*studio glass movement*' and the development of a personal style.[1]
- a sensitivity to the history of applied arts and contemporary crafts.
- the recognition of previously unconnected experiences which together form important elements of the study. These being my initial trials with working with voids at Royal Brierley Crystal and the outside casing method noted in Novy Bor in the Czech Republic.
- the formalisation of the research project and, for it to be practice-based utilising, text, photography and video as well as finished glass pieces.
- recognition of the concept of the reflective practitioner after Schön and subsequent introduction to Kolb (1984) *et al.*, on experiential learning.

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[1] See Gallery/Appendix

- the identification, through reflective practice, of Pye's *'workmanship of risk'* and the subsequent emergent methodology of *managing risk.*

Therefore the sequence of events in this section will reveal how, through reflection, the artefacts evolve.

3.1 Framing the questions.

- **How should the practice proceed?**

I needed to frame particular issues about methods of making in relation to my ideas and scenarios about the ocean as a medium for life and cyberspace as the abstract environment of digital artefacts. (See Ideas, source material and techniques this Chapter 3.3)

- **What did I know before embarking on the means of creating and positioning voids in the section of glass vessels?**

I knew that by using the outside casing it was possible to encapsulate voids. Sandblasting was the best means of obtaining controlled results. I needed to determine what profile the parison should have, and to establish what surface area was available to construct the sand blasted imagery. I also needed to find the best resist for sandblasting and see how a flat stencil-cut silhouette image translated into a silvery three-dimensional form.

3.2 Initial practical course of action.

Parisons were made with a conical form and rounded end so that the large *casing bubble* could envelope it and at the same time drive out extraneous air and also provide a suitable surface area for drawing and stencil cutting.

Figure 47, numbers 1 to 7 show a pictorial documentation of the first trial piece. These photographs show the preparation and development of the imagery.

1

2

3

4

Figures 47
Numbers 1 - 4

Preparing Parison's for Stencil Cutting.

Masking tape is used here as the resist. It has the ability to stretch slightly when being applied to the glass. However, it is important that the masking is flat and even. Although a small variation in thickness is acceptable, folds must be avoided so that a clean cut can be achieved with the scalpel blade. The most effective means of fitting the masking tape to the parison is cutting in from the edge then making a slight overlap rather than a crease. Numbers 1,2 and 3. Two layers of masking tape are necessary to protect the glass surface. The images are drawn directly onto the masking tape and shapes cut out with a scalpel blade. `I found that as long as the blade was sharp it took little pressure to cut through to the glass but as the blade lost its edge it was more likely to scratch the glass and more difficult to control. The cutting tool that holds the scalpel blade needs to be round in section so that cutting curved lines is more manageable.

5

6

7

Figure 47

Numbers 5 to 7

Number 5 shows the masked and stencil-cut parison after sandblasting, the masking tape being blackened by the silicon carbide grit. Number 6 shows the parison after removal of the masking tape and the depth of the sandblasted motifs here being between 2 and 3 mm. In this first trial it was important to establish how images might be constructed the degree of detail achievable and the potential scale of the pieces. Number 7 demonstrates how the image, although a little distorted, worked well and details like the face translated from the flat into three dimensions and gave a hint of the potential. The piece stood at 210-mm high and weighed 7 kg, which proved to be a substantial body of glass to manage. The piece was transferred to a punty and opened in the glory hole. This finishing method can be seen in the video clip *'On the Punty'* p.86 . I later abandoned this method in favour of cold finishing techniques which allowed the exploration of the optical qualities achievable through cutting and polishing.

See other parison designs in Gallery - Appendix 1 Screens.

In the piece illustrated, I experimented with developing images from animal and biological sources used in previous work for example chromosome outlines to form textures, cephalopods and unicellular forms. Constructing a face from lips, chin and cheeks, iris and eyelids showed that flat shapes become three-dimensional and have the potential of *modelling*. The images are drawn in pencil directly onto the parison prepared with masking tape. I prefer to work directly so that the composition and placement of the void motifs will relate to the final form of the glass vessel. Therefore at the drawing stage I have an idea of the final form of the piece but leave some flexibility for cutting and polishing at the rim. This allows for experimenting with the possibilities of reflection and distortion in the heavy section of the glass. By taking into account the result of each drawing and stencil-cutting, subsequent results will, through reflection on the outcomes, advance both design and practical skills.

3.3 Ideas, source material and techniques.

- **So how do I embark on exploring this new medium and what should the work be about?**

Firstly, I must return to positioning my enquiry in terms of artistic validity. I am working as a glass artist in the field of applied arts. I am planning to make glass vessels whose primary function is to become, as has been shown through historic example, vehicles for carrying visual material, which convey ideas to an audience. The nature and quality of glass material is an essential agent of this communication . If I were a painter, the craft of applying pigment to a suitably prepared surface would be seen as insignificant compared with the idea behind the painting. However, in glassmaking, the acquisition of manipulative skill can become almost an end in itself with the risk of losing sight of artistic development. Therefore, in the face of the necessity for technical innovation, the artistic merit of the work must be the driving force behind it. So, in the first instance, I wish to continue working with ideas about life-cycles and survival of organic life forms, particularly related to the medium of water. The transparency and fluidity of glass and the possibility of suspending shapes within it provides an ideal medium for this kind subject. The use of fronds of kelp-like seaweed or the tentacles of cephalopods, for example, allows the possibility for the drawing to express rhythmic fluidity. (See Figure 48).

Figure 48

Detail of sandblasting on a parison with shadow. This gives an example of the way motifs can describe a rounded transparent form and draws attention to the importance of light in glass.

Fish are symbolic of the fecundity of the oceans as individuals, but particularly as shoals. Our ability to fish on a massive scale threatens the future of some species and this exemplifies our need to play our part in preserving an ecological balance in the environment. I think reference to shoals of fish would be a worthy theme, being represented widely in the history of art and still being full of design potential.
See Figure 49.

Figure 49

Detail of sandblasted parison describing the movement of a shoal.
This parison is inside-cased with pale pink and green, which provides a background.

The preoccupation with the definition of life and awareness of the environment which supports it must be a significant contemporary issue. This environment of macro and micro instances of life share equal beauty and meaning. From spirals of DNA and our understanding of the structure of life through genetics and the history of "*TheSelfish Gene* "Dawkins (1976), and evolution provides a constant source of ideas and images.[1] So these ideas carry forward from previous work and are suited to this revived technique of encapsulated air. A new theme would provide a

[1] The work of Darwin and the popular writing of Richard Dawkins have been a vital inspiration in this area.

different challenge. This is the imaginary human environment - to balance the imagery of nature I decided to try to describe the electronic world created by us through the digital revolution and enter the medium of cyberspace. Exploring glass as a metaphor for the medium of the sea - for the natural world - and the medium of cyberspace - to describe the digital world - provides an unlikely but interesting comparison. So, what characterises the world of the personal computer? A whole new language has grown to describe this world where words take on new meaning in the parlance of *'nerds'*. In the history of art an icon was likely to be a Byzantine style saintly image, now it gets you into your *'Hard Drive '*and the “**@”** symbol is no longer exclusive to book keeping and accountancy. It is notions of this kind that identify cultural change and to which artists may respond. The notion of the icon at the interface between ourselves and *virtual* space, (behind the *monitor screen)* seems for me an interesting point of departure. The letter “**e** “for electronic is essential in anything seen to be forward looking. So my idea is to use typographic data to float through the ether and be placed and directed by icons that personify a function. The ether being, in my interpretation, the glass vessel forms. (See Figure 50).

Figure 50.

'e-world'
Crafts Council Collection, London.

Detail of the first finished piece working with the idea of *'e-world'* showing graphic design orientated motifs with letter forms and iconographic heads. The vessel form is inside-cased transparent pink with cut and polished, contoured rim and mat finished hollow cut.

See Gallery / Appendix, Screen 25

CLICK HERE

The use of computers in graphic design and publishing, advertising etc. has made the glossy magazine an even more visually exciting medium. The relative ease of cutting, pasting and layering text and images of very high quality is due to the power of the computer. This and data streaming on the world wide web is what people are most aware of, rather than number crunching in a laboratory. However, there is a sinister side to computers, emerging from people's insecure perception of science and the potential of artificial intelligence. The establishment of a *'cyberculture'*, a digital underground of obsession with silicon chips, lasers and ideas about robotic extensions to human beings, described by Mark Dery (1996) in his book Escape Velocity, makes for a dynamic mix of source material. So, my medium of silvery suspended *'graphics'* should serve to describe these ideas in glass. Therefore I aim to capture the idea of my perception of the digital revolution for my audience through a series of pieces I shall call *'e-world'*.

These ideas, then, are important factors, which condition and drive my practice, but the ideas can only grow with the process. The technique of casing, to encapsulate air and create voids, is an important learning experience dependent on teamwork at the furnace. The following sequence of photographs records in series the making of a piece called *'Cyberdrone'*. Many of the first collection of parisons I worked on were made in clear glass, and I found some of the imagery difficult to read. To overcome this I tried both inside and outside casing of very thin transparent colour on the parison. The '*Shoal'* series parisons(Figure 49 above) are inside cased and the fish float over the colour becoming mirror like at certain angles in the finished piece (Figures 55-56, p 72- 73). In the '*e-world'* series piece (Figure 51) and *'Cyberdrone'* in the following sequence the parison was outside-cased. Sandblasting through the layer of colour gives a greater emphasis to the edge of the image, even though in these instances the layer of colour is a barely perceptible greenish tinge. The drawing sets out to describe *'users'* in a dreamlike state surrounded by cables and connections and floating graphics; the scenario being dominated by '*Cyberdrone'*, half machine half '*native'* (referring to special software applications). He is the imagined link, the interface between *e-world* and reality.

I have used a comic-strip, illustrative style of drawing in order to develop the use of crisp imagery uncharacteristic of previous 'Ariel' glass techniques from the 1950s and 60s. However, a subtlety of the *graal* technique was to allow the glass to move (twist or stretch slightly when hot) in a way which distorted the drawing a little.

This adds a glassy character to the drawing . Because distortion of the image is only possible at a temperature where detail would be lost, I have drawn the distorted letter forms to create this kind of movement. (See Figure 50, p. 56). This further emphasises the viscous quality of the glass and enhances the idea of floating images.

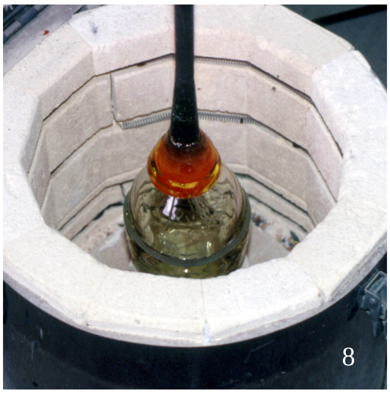
The sandblasted parison is positioned vertically in a top-loading kiln and raised to 500˚, C over a period of two hours. This is then picked up on a blowing iron with hot glass *'blown through'* so that blowing can take place during further manipulation.[1] This is then centred on the iron and heated through in the glory hole, taking care not to over heat and lose the form because the taper is essential for good contact when the large hotter casing bubble is pushed over. Derek Walls my assistant has many years of production experience working with large heavy gathers for mould blowing. So together, we discussed ways of preparing the large casing bubble, which proved to be the most critical element of the making procedure. Figure 52 c Numbers 23 - 30 p. 62, show Derek's method of gathering and inflating this large form, which needed to be a minimum of 20-cm diameter by 70 cm long to accommodate the sandblasted parison of 12-cm diameter. The principal difficulty is for the bubble to be hot and therefore ductile enough to be pushed over the relatively cool parison but stable enough not to collapse out of control. (See also Diagram 3 p. 29 and Video Clips).

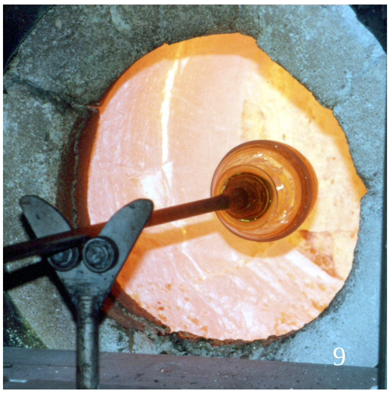
[1] See the first few frames of the Video Clip ‘Cyberclone’ Chapter 3 p.84.

Figure 51.

'Cyberclone'

The above numbers 1,2 and 3 illustrate the parison covered with masking tape with the images cut through, 4 and 5 with the tape removed after sandblasting. The step at the top of the form shows an outside casing layer of pale green, through which the image has been sandblasted.





'Cyberdrone'

Figure 52 a

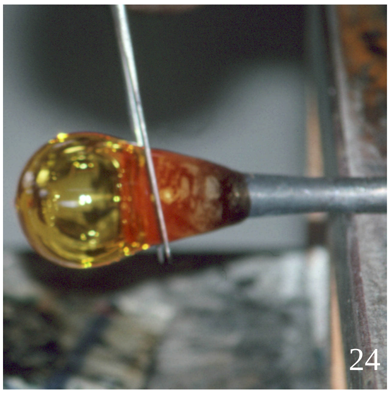
This sequence shows the making of an *'e-world'* series piece called *'Cyberdrone'*. Including picking up the parison from the kiln on a prepared gather, 6-10. After preheating in the glory hole, a second large parison is pushed over to encapsulate air in the sandblasted areas. Numbers 11 and 12 show how the bubble folds back and needs enough space not to stick to the inner wall of the second bubble.

(See video clip 'Stuck" to see how this can happen)

'Cyberclone'

Figure 52 b.

After the blowing iron is removed 13, the surplus glass is broken away by chilling the glass with water 14 -15, causing hairline cracks to weaken it before striking at the open end 16. After re-heating a further gather is made - 19 and shaped with a damp paper pad before annealing.



'Cyberclone'

Figure 52 c.

This shows the build up of 3 gathers 23 -26 and inflation of the final gather into shaped newspaper 27, to concentrate the thickness and retain temperature for blowing and shaping 29 – 30. Pushing over the prepared parison is shown in 31.

32

'Cyberdrone' **Figure 52 d.**

Numbers 32 and 33.

The finished piece after cutting and polishing. The detail below shows how the suspended voids are mirrored and distorted - giving an extra dimension to the space in which they are suspended.

33

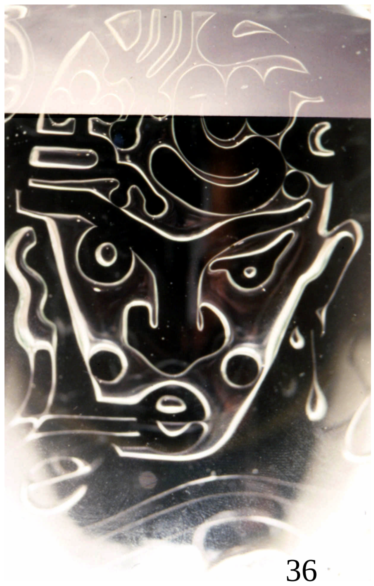
'Cyberdrone' **Figure 52 e.**

Number 34 to 36

Below, the *icon* 'Cyberdrone' at the three stages of processing, number 34, the cut out stencil, number 35, the sandblasted image with the masking tape removed and number 36, in the final form as a void inside the thick section of glass. The lighter area at the top of 36 is the angled, polished rim of the piece as shown above.

34

35



36

In order to transfer the weight of the final gather to the back (the end furthest from the blowing iron) of the bubble, a wad of wet newspaper was formed to the required diameter and the bubble inflated into it (a metal bucket was used to support the paper). As the blowing iron was being rotated in a more vertical position, this resulted in the hotter glass flowing down to the bottom providing more glass for the longer form. This can be seen in Figure 52 c ,p.62 numbers 29 and 30 ,where the orange and yellow colour gives an indication of the temperature. When looking at Figure 52 a, number 12 p. 60, the importance of the angle of taper on the parison, the temperature and the length of the casing bubble is apparent. When the joined glass becomes firm, the blowing iron from the casing bubble can be '*cracked off*'. The casing technique I saw in the Czech Republic employed the use of water to break off the surplus glass (See Figures 31 to 35 p.38). This was liberally thrown over the area of glass to be removed and broken away. Our experience of doing this resulted in fragments of glass adhering to the - still hot - interior form. Our casing bubble needed to be thicker to provide a stable layer over the voids, and to retain its heat and ductility longer.[1] It was clear that removing the surplus glass required the shattered glass to burst outwards. This was achieved by weakening the casing bubble at the thinnest section, and striking vertically at the open end, Figure 52 b number 16. Derek and I spent time practising with blank parisons to improve our skills in doing this. If the casing bubble were too cold then it would not cover the sandblasted drawing completely, and if too hot was too unstable to control it causing the inside form to stick. We later learned that looking at video footage of our technique aided the process of reflection, which enabled us to identify particular problems and find solutions.

Applying an even layer of glass over the sandblasted parison creates the voids, and a further gather adds depth to the *drawing* and aids the fire polishing which removes the mat texture from the sandblasting. The exterior form of the piece can now be achieved using a damp newspaper pad. The piece was then knocked off the blowing iron and placed in the annealing kiln. Having completed the furnace work on the piece, the next stage was to evaluate the result of the hot work, and plan cutting and polishing to finish. As the final gather created a very thick section, I was keen to see how a flat polished rim would allow a view into the thickness of the glass, and how the voids might reflect on inside and outside surfaces. So, after

[1] The purpose of casing in the Czech tradition was to apply a thin layer of colour or colours for bevel cutting.

sawing off the spare glass above the drawing / voids I decided that a flat polished face would look too mechanical. I should think more about the contour and cut at a slight angle to gain more surface area for seeing in, raising the contour slightly over the image of '*Cyberdrone*'. (See Figure 52 d, nos. 32 and 33. P. 63). Further details of cutting and polishing techniques will be dealt with later in this section.

- **What did I learn from this accomplishment at an early stage of the research.**

Primarily that careful monitoring of the working temperatures during making will permit complicated and detailed imagery to remain. The three stages of processing in Figure 52 e, p. 63, numbers 34, 35 and 36 show a slight change between the sandblasted image and the void. There is a slight spread from the glass contact area, or shrinkage of the void. In some of the earlier trials I fire polished the sandblasting to remove the grainy texture but, in doing so, softened the edges of the sandblasting and lost detail. I learnt that it is better to leave the grainy texture, as this normally gets fire-polished out during the process, and can serve as an indicator of the temperature during the making procedure. If it goes quickly, then the parison has become overheated early in the process, or the casing bubble that was too thin allowed more rapid heat absorption. In the rare cases where I had been too cautious, then, the mat texture was apparent at the *iron end* of the piece. This, then, needed correcting by re-heating in the glory hole between chilling the bottom with compressed air so as not to overheat this area and deform the image.

As in many craft based activities the knowing is in the doing. There is no method of knowing the exact temperature of the glass when it is on the iron and, although knowing the temperature is of interest, judgement for its manipulation is more dependent on look and feel. How is it moving? Shall I re-heat? What is the temperature of my assistant's work in relation to mine if they are to be brought together? The greatest risk is that at the lower end of the working temperature range (400˚C approx.) if it cools much more it will crack, and at this temperature there is no heat colour or apparent movement, so time (for temperature loss to occur) is another factor. So, timing of the two elements to be brought together is critical. The prepared parison will lose its sandblasted detail if the casing bubble is prepared too late, and the former has to be constantly reheated to sustain a working temperature. The casing bubble must be soft and malleable at its lower half to push over the parison but too much re-heating results in an uncontrolled temperature range along its length. Therefore, the work procedure begins with building up subsequent gathers for the casing bubble. I decided that the ideal timing to pick up the sand blasted parison from the kiln was immediately after Derek's final gather for the casing bubble. This would allow time to remove any bits of ceramic fibre blanket stuck to the piece, then re-heat and centre on the iron if necessary, and to chill the moil with compressed air to firm it on the iron. He, at the same time, would be blowing up the casing bubble and re-heating before pushing over the parison. So, the start time is worked out in relation to the moment of joining. An added bonus turned out to be that if there happened to be stones or other impurities in the final gather of the casing bubble - more probable as you increase the volume of glass - then this could be aborted before picking up the prepared parison from the kiln. This proposed time scale eventually worked when our glassmaking became more efficient (some of the initial stages went more smoothly after more experience.) Another important lesson learned from earlier training sessions was that we should lower the glass working temperature in the furnace. For most purposes, we worked the glass at 1120˚ C but found larger gathers easier to control at 1110˚ C and this in addition lessened the risk of overheating the imagery and losing definition. So, reflecting on the success of '*Cyberdrone'* provided a framework and time-scale of action to refine the techniques. A later piece in the series called *'VR Tech.'* is recorded photographically in sequence.

(See Gallery / Appendix, Screen 6) CLICK HERE

Our tacit knowledge supported the focus on addressing new questions and in turn grew with our experience (See Section 4 Methodology).

3.4 Case histories.

As this study is grounded in glassmaking practice, a key element of this chapter is to show how a rigorous process of reflection *in on* and *for* action can enhance and generate new knowledge. I illustrate this process by using still and video images, enabling this work serve as an interpreter, mediating between artefacts and the audience. As shown above I am keen to establish how my themes of the medium of the sea and life within it and the medium of cyberspace drive the practice. To insure that each piece is a move forward both artistically and technically, bearing in mind that the numerous failures provided invaluable knowledge through reflection on cause and effect. So, the description of each piece will reflect on particular issues about idea and making. Not every piece illustrated in this study was recorded on video but most were. The recordings were totally spontaneous; the intention being both to document the work and to enable my assistant, Derek, and me to reflect on each workshop session.

See Appendix 2 for movie player instructions.

'Blue Parison'
Clip 1 - 4:00

3.4.1 'Blue Parison'

The *'Blue Parison'* was an early piece inside cased blue, that included a variety of motifs to analyse how they looked floating over the blue background, and how deep sandblasting would work (See Gallery / Appendix - Screen 1) CLICK HERE However, the video entitled *'Blue Parison'*, shows a number of problems arising in the casing process. Having pre-heated the parison in the kiln (on a ring of ceramic fibre blanket with the open end facing upwards) I prepare a gather of glass into a conical form, blowing through the glass. So that the bubble pops through easily, I create a thin spot by denting with a point where the bubble emerges, then open the hole with the tools and reshape with the paper pad. The base of the conical form is the contact area to which the pre heated parison sticks and, although the temperature difference is high, the colder form in the kiln 500˚C and the red hot glass on the iron say 1000˚C will not crack with thermal shock. However, the sandblasted parison must not be allowed to cool too much, otherwise cracking is inevitable. For this reason, and because I wanted to fire polish away the graininess from the sandblasting, much of the detail in the sandblasting was lost through overheating in the glory hole. At this stage, I was not aware of the degree to which the surface of glass heated up, although the overall form remained stable in the region of 500˚C. The rather 'wet' appearance of the parison in the video indicates the loss of detail. The *sofietta* is being used to chill the glass on the nose of the iron to stabilise the parison. In the following sequence it can be seen that the casing bubble is far too thin, causing folds as it covers the parison and *'freezing* 'after contact, thereby not making an effective seal. We continued to see whether there was any redeemable feature to the piece, but there was little left of the drawing. So, we needed to pay attention to a number of problems about timing, the weight (thickness) and form of the casing bubble. The sequence of *'Cyberdrone'* above illustrates the means of controlling the weight and form of the casing bubble. This can be seen in the case history of *'Diver'* where, in a *real time* sequence, Derek is preparing the casing bubble as I begin my gather to pick up the parison from the kiln.

3.4.2 'Diver'

'Diver'
Clip 7:42

This video sequence of Derek's technique of blowing down into the paper form (in the bucket) shows how the hotter glass builds up at the bottom. This has the effect of transferring the weight (and heat) down to enable further blowing and shaping in the area that will envelope the parison, while remaining cooler and firmer at the *iron end,* to maintain the form which will accommodate the parison. At the point (in the video) where Derek is aligning the two forms to push the casing bubble over, movement can be seen along half its length as it is turned for correction. Following this, as the casing bubble is pushed over, the ductility of the far end (from Derek's position) and the rigidity of the near end is important to prevent the casing bubble from collapsing and sticking to the inner form. However, in this particular instance, the casing layer was thin, as it stretched so much when pushed over, and this in the end resulted in some loss of detail. (See Figure 53, Numbers 1, 2 and 3 showing the difference between sandblasted parison and finished piece).

From the design point of view *'Diver'* combined two further developments for consideration. The first idea was to adopt a more literal drawing style. This includes a diver carrying an oxygen cylinder and a serpent - less iconographic - more viewing in perspective.

Figure 53

On the left 1, the cut masking tape stencil. In the centre 2 – after sandblasting with the masking removed and on the right 3, the finished result with a notable loss of detail. The idea of the diver's glass mask doesn't read - an effect of working with *positive* and *negative* outlines.

This carried over from the *'e-world'* series of the illustrative comic strip style of drawing. The nautilus motifs, however, worked best in this piece. The '*gothic'* diver less so because the image doesn't read well, (Figure 45, number 3). The second idea was to explore the effect of layering further. In this piece I *marvered in* a mixture of transparent blue and green glass chips (2 mm sieving) onto the first gather of the parison, then covered with an outside casing of transparent blue. The sandblasting was through the blue layer, and the images were to float over the texture of blue and green. As the blue and green texture was on the first gather, it fused and spread into the glass, becoming quite soft in appearance. The blue re-appeared in the finished piece in the reflections of the motifs on the inner wall of the glass (See Gallery Screen 2) CLICK HERE Here was another effect for the '*palette'* of techniques.

3.4. 3 Pink 'e-world' parison combined problems.

This video confirms much of my reasoning with regard to the form, section and temperature of the prepared parison and casing bubble. Here the piece was to consist of two casing layers of voids to develop a more three-dimensional depth to the drawing, the first being sandblasted through a strong ruby overlay; but, as can be seen, the casing failed.

Pink 'e-world' Parison
Clip :35

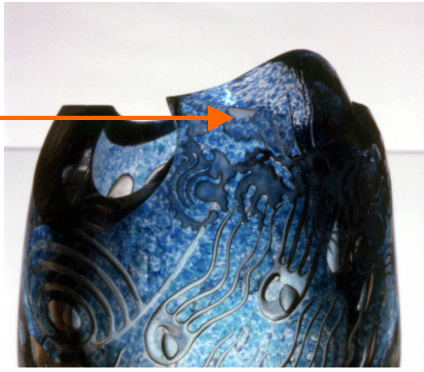
The sandblasted parison was overheated in the kiln and deformed. This was due to the thermocouple in the kiln being accidentally pushed out of the kiln chamber, causing a false reading on the pyrometer. I decided to heat the parison more, to marver it back to the correct form; but as the close up of the parison shows and comparing with the original form, all the detail has been heat-softened away. The casing bubble here is thick on the end and too thin on the tapered sides, resulting in puckering and folding. So, although the problems in this workshop experience were extreme, it did confirm the greatest areas of risk, and that any one of the problems in the making procedure, even at a much lesser degree, is likely to have a negative result on the final outcome. This double layer idea is applied successfully in later work using the *'Shoal'* theme,(Chapter 3, p. 94 - 95).

3.4.4 'Green Scene' with textures

A further development of the mixture of transparent, blue and green was introduced in *'Green Scene'* and a number of other pieces later in the project. Here the blue and green mixture was picked up on the exterior surface of the parison to produce a strong texture through which octopus and fish images were sandblasted. Here the silvery voids become windows through the coloured texture which, while being transparent, had more of an obscuring effect, adding further interest to the subject. When the parison for this piece was made, the amount of coverage of the casing bubble was not yet established, so the cephalopod outline goes well beyond the widest point of the parison. In this piece the casing bubble reached the shoulder of the piece leaving the tentacles uncovered, and the final gather was made without covering this area. This I left exposed in the finished piece as a suggestion of the surface of the sea, in combination with strong curved and polished surfaces.
(See Figure 54 below and further details In Gallery / Appendix Screens 4 and 5)

CLICK HERE

Figure 54
Here interesting possibilities with some areas of imagery encapsulated and others exposed.



3.4.5' Shoal Bowl' 1

'Shoal Bowl' 1
Clip 5:12

'*Shoal Bowl*' is one of a series based on the idea of a shoal of fish whose movement describes the form of the piece. In the *'Shoal'* series the design objective is to create movement around the form using the fish motifs, then to explore how differing cutting and surface treatments enhance the idea. '*Shoal Bowl 1'* began as a large parison (16 cm diam. x 20 cm long) inside-cased with pink and green. In the video sequence, it can be seen that the casing bubble only just covers the sandblasted area of the parison and it required re-heating to smooth out the casing bubble. This caused a loss of form in the base of parison, which can be seen in the marvering sequence. In turn, this resulted in some loss of detail in the fish. This was caused by overheating due to the thinness of the casing layer, allowing too much heat transmission from the final gather. (See Figure 55).

Figure 55

'*Shoal Bowl 1*' showing detail below of fish motifs overheated (at the lower end). In this case the effect adds interest to the piece.

(Detail of the drawing and parison and the placing of individual bubbles can be seen in Gallery / Appendix, Screens 9 and 10). CLICK HERE The diameter of this piece was also at the limit of size because the mouth of the furnace was a minimum dimension of 22cm. So the margin for pulling the gather through was tight at around 5 cm., 10 cm. would be a more realistic margin. The completed piece however, worked well; particularly the reflections in the polished rim, multiplying the fish in the shoal, giving the illusion of greater numbers when viewed down into the section rather than from the side elevation. Unlike *'Blue Parison,'* where the overheating destroyed the encapsulated voids completely, fish in the lower part of *'Shoal Bowl 1'* have deformed. This is reminiscent of what we see in a fleeting glimpse at the periphery of our vision but the detail and focus are retained at the centre of vision. The fish seen in the rim and reflections are in sharp focus becoming less defined in the lower regions. (See Figure 55 above). Here is an instance of artistic serendipity. Having worked hard at achieving consistent temperature control to retain the detail of the drawing, and having rejected other pieces when it has been lost, here I learn through unplanned circumstances how overheating may enhance the imagery, given the appropriate conditions.

3.4.6 'Shoal Bowl' 2

A second piece of this series, using the same inside casing colours pink and green, was made and on this occasion gave more emphasis to the flow of fish motifs flowing round in a circular movement, In *'Shoal Bowl 1'* the rim was contoured at more or less right angles to the section of the bowl. Here I wanted to experiment with exterior and interior surfaces. To cut and polish the bevel at the rim at a near vertical angle, defining the change in angle with the unpolished hollow cut. The interior surface is flared out slightly and a reflection of the shoal can be seen on the inside of the rim. This involved cutting and polishing within a few millimetres of the voids. (See Figure 56, Numbers 1 and 2).


1

Figure 56

'Shoal Bowl 2' – Number 1, shows the circular movement of the shoal and the silver reflection near the foot.

Number 2, shows reflections of fish when viewed through the inside of the rim.


2

3.4.7 'Shoal Bowls Blue and Green'.

Returning to the textured parisons like *'Green Scene'*3.4, I continued here to work with the shoal theme. The imagery is easily read and provides the basis for variation in techniques. The previous two pieces had the pink and green transparent background with the fish motifs floating above the underlay colour, and in this case the fish are sandblasted through the granular colour. The '*Blue Shoal Bowl*' worked very predictably in the making, and is cut and polished at the rim with a simple contour, revealing the blue textured layer through the heavy section of the piece.(See Figure 57 below).

Figure 57

The parisons here are almost identical in size and shape but translate into different proportions. See Figure 58.

'*Green Shoal Bowl,*' on the other hand, was an extension of learning and reflection. Because of the clarity of the fish images defined by sandblasting through the blue textured colour, in the next piece I decided to sandblast the exterior. I felt at the time this would have the effect of softening the images of the fish, as if seen through deep waters. I decided not to pursue the possibility of overheating the bottom of the piece to make - as in *'Shoal Bowl 1'*- some fish lose their definition.

The video entitled *'Stuck'* became a deviation from this plan, as a salvage operation was necessary to save the piece. One of the main difficulties in controlling the casing bubble is the weight factor. Derek and I had learned that the casing bubble must be thick enough in section (at least 5 mm) to prevent the heat of the final gather penetrating through to cause loss of definition. The weight of this large bubble proved difficult to control at the point of pushing over and rotating, to keep it centred on the prepared parison. We tried introducing various means of support for the casing bubble iron, the most successful being the simple double roller bearings shown in this video. In spite of this, I was working too near to the end of the arm of the chair, resulting in the piece rolling off momentarily, and the internal bubble stuck to the external one.

'Stuck'
Clip 2:48

In the initial learning experience, the potential for sticking was very great, particularly when the casing bubble was too hot, and there was no resistance. As there was up to twelve hours work already invested in the preparation of each parison, Derek had reasoned that it was worth trying to save the piece. The offending lump of glass was removed with a tungsten chisel, and the damaged surface fire polished with the gas torch. As can be seen at the end of this video, the fish motifs remained perfectly formed, demonstrating the need to apply a substantial layer over the sandblasted images to ensure greater control of the temperature at the level / depth of the voids. We also discovered at this point that the marvered-in, coloured granules of glass were slightly more viscous than the base glass adding greater stability to the silhouette of the voids. This newly discovered stability also enabled further inflation of the piece. This would almost certainly have caused loss of detail in clear glass, or inside-cased colours, so here was the potential for thinner blown, lighter pieces with the possibility of finer detail. See *'Bioform'* series p. 54. Like '*Blue Shoal Bowl*' the layer of colour emerged as a prominent line at the rim, where in this case I created wave like contours. So, as planned, I sandblasted the exterior surface, excepting the polished, bevelled rim. This produced a very opaque surface, which finger-marked very easily[1]. In order to make the glass less opaque, and to control the amount of translucency, I used brush-polishing. (See Figure 58).

Figure 58
The exterior surface was sandblasted then brush polished.
The fish appear quite clearly when viewed on the inside.

[1] Grease from the skin leaves marks on the sandblasted texture, a common problem with sandblasting.

Brush-polishing is achieved by applying pumice to a rotating brush mounted on the lathe[1]. The video *'Brush-Polishing '*shows pumice powder in a watery slurry being applied to a coarse bristle brush wheel, and the work-piece worked up and down with gentle pressure. More brushing resulted in greater transparency, and so it was possible to control the degree of transparency in this process.

Brush-Polishing
Clip 0:15

The softening of the silhouette of these well-formed fish by matting the glass surface has the effect of creating depth. The appearance of the piece changes under different lighting conditions. With back lighting, the fish cast shadows on the matt exterior surface, whereas reflected light from the front hints at the silvery surface of the fish, shaped voids. As the fish were sandblasted through the marvered layer of green chips, they can be described as windows through the colour layer which produces the clear definition when viewing the piece through the mat exterior surface. The contoured, polished rim draws the viewer to the interior where the fish are clearly visible against the translucent background.

At this stage, it occurred to me that having progressed this far in the creation of images within the section of the glass, I should look even more closely at the possibility of surface treatment. The application of sandblasted drawing characterises my work, and distinguishes it stylistically from that of other practitioners. (See Gallery / Appendix Screen 11) CLICK HERE So, the potential of working with the exterior surface of a piece, in the context of the medium of the sea, is deserving of more attention.

[1] Pumice is a volcanic rock that is pulverised and used in polishing glass.

3.4.8 'Purple Sea'

In the making of *'Purple Sea'* the design objective was to combine the internal voids with external surface treatment. In this case, though, I returned to inside-cased, transparent colour in order that the internal voids and external surfaces can be seen on both foreground and background vessel walls when viewed in elevation. The purple coloured inside casing was incorporated into the parison, so that the colour was more intense in the bottom than at the rim, in order to enhance the possibility of the voids appearing silver against a dark purple ground at the base of the piece.

Having shown that the *marvere- in* green and blue chips provided a more viscous layer in the glass - making the outline of the images more stable - my intention was then to test the increased wall thickness to see if the heat transferred less and the detail in drawing was preserved. (See Figure 59)

Figure 59

'Purple Sea'

This detail shows how depth can be created in the piece by the use of surface treatment – here sandblasted wave pattern flow over fish.

The linear effects were created by fixing thin wire to the glass surface as a resist.

RETURN TO TEXT

'Purple Sea'
Clip 3:58

The video *'Purple Sea'* shows the main events in the hot-glass processing of this piece. The opening sequence shows the parison with stylised, sandblasted motifs showing fine detailed lines against a purple background. At the point of picking up the parison from the kiln, Derek had made the final gather for the casing bubble and, as previously noted, this enabled him to check for impurities in his final gather, before the prepared parison was taken from the kiln. The main concern here was to make sure that the *moil* was cool enough for the parison to be firmly centred on the iron, and the whole warmed over in the glory hole after chilling the moil with compressed air. Slight movement of the parison on the end of the iron can be seen prior to the blast with compressed air. 'Swinging out' elongated the form that was then carefully reheated to a little over half its length. The casing bubble in this instance was applied at the ideal temperature, as can be seen with the final blowing, to force the two layers of glass into close contact at a temperature where the glass combines perfectly, but is rigid enough at the other end to prevent sticking. The roller bearing provides support during the final stages of inflation of the casing bubble. When the spare material is burst off the parison, a more consistent thickness of glass can be seen, which successfully prevented loss of the detail, even allowing for further manipulation and blowing. The detail of the images can be seen at the end of the sequence.

It is apparent in this video that both Derek and I appear to be working with greater fluidity and confidence. We have, with new experiences, extended our tacit knowledge by resolving, in practice, problems identified through reflection, speculating on hypothetical solutions, which then are tested by practical experimentation. This methodology is interpreted in Chapter 4, but it is important to mention here that, in the act of reflection, (and here the video is seen as a reflection tool), we must embrace the three aspects of reflection *in*, *on* and *for* action, attributed to Schön(1983) Cowan(1998) and McAleese(1996). There is no intention here to isolate one aspect of a problem as a *test* solution, but to continue to develop each piece of work as a *real* practical solution. The execution of each piece becomes a platform for further development; *'the workmanship of risk'* enabling the individual character of each piece to emerge. So, in finding the solution of increased wall thickness in the casing bubble to retain a more detailed image, I can accommodate the potential for further external surface sandblasting. In this way, my hypothetical speculation is informed by active experimentation as I progress to the next piece. *'Purple Sea'* then, demonstrates how the thicker casing bubble preserves the detail and provides the basis for the new design objective: to introduce surface effects over the internal silver images. In this example, my stylised fish were viewed looking from above (having previously been viewed from the side). This provided the opportunity to create wave movements over a shoal, giving the impression of looking down into water but, in this piece, allowing the fish forms to emerge into clear water as they moved to the bottom of the bowl and into the darker purple colour. Masking tape protected large surface areas and steel wire was used to create lines and swirls. The silvery effect can be seen in the darker areas near the base, enhancing the effect of foreground and background when viewing through.

(See Galley / Appendix Screen 12). CLICK HERE

3.4.9 Bio-cycle series

In this series the imagery becomes more stylised and is suggestive of simple animal and plant forms and their reproduction; life forms surviving and evolving in a medium. The nautilus shell is a typical symbol of fossilisation. The remainder from one step in the evolutionary progression of life. Selections of these images, with a greater emphasis on delicacy, have been worked into larger, lighter bowl forms.

'Bio-cycle 2'
Clip 2:40

In order to retain detail, the imagery has been sandblasted through a layer of marvered pink and green chips and the video *'Bio-cycle 2'* demonstrates how much the form can be elongated and inflated without loss of the delicate detailed voids. (See Figure 60 , Bio-cycle 2)

Figure 60

'Bio-cycle 2'

Reflecting on the potential for greater inflation, (because of the more viscous layer of red and green chips that are marvered on to the parison), I chose to create a more elongated, ovoid form. This, in turn, could accommodate a variation in the vertical axis of the finished piece as it stands on a surface, and make the cut off line at the rim parallel to the horizontal plane. The rim would then have a simple bevel, revealing the layer of colour. (See Figure 61).

Figure 61

'Bio-cycle 1'- showing the use of an inclined central axis to give a floating appearance to the piece. The drawing style here is more fluid and delicate, softened a little by inflation in the hot making.

The video shows both Derek and me monitoring the effect of blowing and shaping - reflection in action - responding to conditions in the moment, having considered the results of previous experience, to comprehend the likely outcome related to both the internal voids and the external form. (See design solutions 3.5 on p. 84). The slight axial asymmetry of the ovoid form, apparently just touching the surface, was to give the impression of the form ascending from that surface to give it lightness in *'Bio-cycle 1'* and *'Bio-cycle 2 '*; with *'Bio-cycle 3'* having quite different treatment (See Gallery / Appendix Screen 13). CLICK HERE

3.4.10 'e-world' Series

In **3.3** : Ideas, source material and techniques, of chapter, I explain the reasoning behind my *'e-world'* ideas and refer to the graphic nature of the images I use to convey those ideas. The video '*Opal Inlay'* shows the practical execution of the process, building on previous experience of cutting letterforms to create a visual interpretation of cyberspace. In this case I have used an outside casing of opal white through which the images are sandblasted. My aim here is to create an opaque layer through which mercurial drawings will be formed.

'Opal Inlay'
Clip 2:44

The video opens with the parison covered with masking tape and an outline pencil drawing being cut out with a stencil knife using a scalpel blade. It is clear how important it is to apply the adhesive tape carefully, with no wrinkles or unevenness, and how necessary it is to change the scalpel blade regularly to ensure a clean cut. I found that two layers of masking tape were necessary to resist the blasting, and that this also provided the right degree of resistance to the scalpel blade, preventing the risk of slipping on the curved glass surface.

Unlike layers of the marvered-in colours shown in previous examples, this layer of opal white is not going to allow any blowing of the parison other than to retain,form and volume following the final gather. The aim, therefore, is to retain the imagery accurately. This means that interesting distortion or perspective effects must be drawn into the imagery as can be seen in the E's and bent time pieces etc. The parison is next taken to the sandblasting cabinet where at first the whole surface area is blasted lightly to bed down the masking tape. Then all areas to be blasted are worked over methodically to a depth of between 2 and 3 mm at 60 lbs. per sq. in. air pressure. The masking tape having been removed, clear glass shows through the opal layer, then after casing with hot glass the same details show as reflective silvery images. The video *'White opal e-world'* shows the casing process of the same piece, and here it can be noted that the large casing bubble was applied as soon as hot glass set on the nose of the iron, cooling being aided by compressed air. After the large casing bubble is applied, the opaque texture of the sandblasting remains on the parison and the heat transferred from the final gather has the effect of fire polishing away the granular texture. Also in this video can be seen the first attempt at providing some support for the heavy casing bubble. Here we built up the height of the marver to that of the arm of the chair to prevent losing centre and sticking.

'White Opal e-world'
Clip 2:55

The detail and definition shown on video *'Cyberclone'* was more effective with the opal layer being slightly more translucent. The continuation of this piece is seen in the video *'Cyberclone smoothing and bevelling'* this Chapter, Section 3.5.2 p.89

'Cyberclone'
Clip 2:04

3.5 • How do design ideas and solutions arise out of reflection on practice?

Having previously analysed some of the thinking about the choice of source ideas for the study, I now wish to explore design options and solutions in completing each piece. This draws my attention to the question of what an observer sees when viewing these heavy glass vessel forms. Looking in elevation, parallel to the ground plane at eye level, you would be looking through four surfaces, exterior, interior then interior and exterior, providing the opportunity to work on four surfaces. Gaining access to work on the inside of the vessel is problematic (overcome in previous work by sawing vessels in half, but inappropriate for this work. (See Gallery / Appendix, Screen 11). This, then, effectively leaves two surfaces available for cold worked surface-erosive techniques, but the introduction of casing creates the potential for overlays of different colours and textures which can be incorporated within the section of the glass. With the possibility of graal, and in the case of this study, the encapsulation of voids, the application of layering becomes part of the vocabulary. These characteristics are unique to glass, so in creating the imagery, the background (the other side of the piece) needs to be taken into account, as it becomes an integral part of the composition or design. In the case of vessel forms, however, a more typical viewing angle is looking slightly down into them and, for this reason, I chose to cut and polish a wide bevel on the rim of many of the pieces. This is to take the eye into the section and, at the same time, enable the viewer to see some of the exterior and interior. As these pieces are *vessel* forms, they inherit many historic conventions. The primary ones being that they can stand on a horizontal surface and that they define an inner space or volume. I make this point as it identifies traditional values about objects described as the applied arts or craft as opposed to objects, which exist only to convey an idea or concept, which characterises fine art and sculpture.

- **So, reflecting on these issues about the nature of my glass vessels, what further observations can I make, and how might these inform the way I intend these objects to be viewed by my audience?**

Primarily, the objects are a canvas for the ideas previously discussed, but they are also *vessels,* which invite questions about conventions. The natural laws that govern glass forming, as stated in the Contextual Review, are gravity and rotation (centrifugal force). The combination of these defines the simplest form of the blown glass object. The presence of the encapsulated voids within the section of the glass limits the potential for deforming the original parison shape because of the risk of loss of definition in the sandblasted imagery. This can be seen clearly in the videos where a wet newspaper pad is used to control the exterior glass form, and further blowing might only be possible under certain conditions.[1] In most cases, the base area of a piece is left rounded so that the foot can be ground flat to enable the piece to stand. The obvious solution to the completion of the pieces was to make them stand vertically. But because the pieces are heavy, they could be cut to stand on a different axis which would change the relationship between the horizontal surface and the form - suggesting instability, or in contradiction to reality, lightness. As the forms are, as it were, frozen in an inflated tension, the cutting and polishing process defines the finished piece. So, the hot glasswork at the furnace needs to retain clean , simple ovoid forms from which contours could be cut at the rim and a shift of the vertical axis from the foot can be made. The placement of the sandblasting on the parison determines where the rim will be cut and allows for the contours; as can be seen in the shoal series. (See Figure 55 p. 72). Cutting the bevelled rim close to voids creates reflections on the interior surface of the pieces; the steeper angle reveals more of the reflective surface. The risk of the forms looking 'chopped off' was largely overcome by bevelling. As stated previously the convention of finishing the work on the punty at the furnace presented a number of problems; primarily overheating and, therefore, deformation of the voids at the rim. Normally the hot glass is sheared at a small diameter then opened out to size. But the inclusion of voids prevents this because of deformation through heat. The video shows the problem of shearing a very open form in an attempt to retain the detail of the voids, and this results in a rounded fire-polished rim with much less opportunity for shaping. So I concluded that cold finishing techniques provide a wider range of possibilities.

'On the Punty'
Clip 1:55

Using hollow or bevel cuts following the contour of the rim, is an example of how effects of reflection and distortion are achieved. Also, leaving the finish from the

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[1] When a coloured layer of a slightly harder glass supports the edge of the sandblasting.

smoothing stone with a mat surface to contrast with the transparency of the polished surfaces has enhanced the depth of the imagery. (See Figure 50 p. 56). In other instances, breaking into the body of the vessel with deep *punty* cuts reveals the layering of the voids and colours that generate a greater illusion of depth, the piece *'V R Tech'* being a good example. (See Gallery / Appendix Screen 8). Sawing, cutting and bevelling can be seen in Videos *'E-Zone'* and *'Cyberclone.'*

3.5.1 'E-Zone'

In this piece, I incorporate a number of new design elements. The parison is inside-cased blue and outside-cased pink, making a purple colour. When the imagery is sandblasted through the outer pink colour, blue will show through. In addition in this piece, I wanted to explore again the idea of images being softened when seen through a sandblasted surface, which here is achieved by contouring the rim by giving it a rounded section and mat, brush-polished finish instead of a polished bevel. (See Figure 62, below and Gallery / Appendix Screen 21).

Figure 62

1 – The parison before sandblasting showing a looser drawing style with treatment of the floating hair.

2 - Soft, rounded rim, brush-polished.

Drag magnifier box to enlarge.

2

1

CLICK HERE

The *'E-Zone'* video begins with the piece as it comes from the annealing kiln, and shows the surplus glass being removed by cutting through with a diamond saw disc mounted on the lathe. As I cut the top off free-hand, the glass is not entirely cut through. Small amounts of glass are left to prevent the top falling off unpredictably; a wooden wedge being used to crack off the top safely. A paint marker is used to mark out the contour line of the rim, and a large carborundum wheel fed with water is used to rough out the shape. Next, a smaller flat, faced carborundum wheel is used, first for finishing the contour of the top, then shaping the curve from interior to exterior. The pink casing-layer can be seen in the middle of the glass thickness. After working with the coarser green carborundum wheels mounted on the cutting lathe, I then go on to use finer silicon-carbide from a flexible linisher belt mounted on a small wheel to create the final form of the rim and surface finish. This final operation is executed on the intaglio lathe.

'E-Zone'
Sawing and Shaping
Clip 4:36

The sound track in this video is important as sound provides a great deal of information about cutting glass. It is very clear to the operator, and in this case to the reader, when the process is working safely and correctly. The wheels must be running true and the carborundum wheels properly *dressed* so that they cut the glass efficiently. A milky whiteness can be seen in the video, on the glass in front of the point of contact with the wheel. This, and the abrasive sound, indicate that the wheel is cutting efficiently. The movement of the work-piece against the wheel must be firm and directed at the central axis of the revolving wheel or the glass will skid off. To do this, I must take account of the rotational force of the wheel and adjust the wheel speed accordingly. It is fundamental to understand that r.p.m. (revolutions per minute) are not as important as the peripheral surface speed of the wheel, and that large wheels run much slower than small ones to achieve the same surface-cutting speed.

Like working with molten glass, I can only gain an understanding of the cutting process through focused practical experience and the development of tacit knowledge. The video shows clearly how the glass is worked methodically over a moving abrasive surface in order to make an even cut. Any hesitation in one place will result in an uneven surface.

3.5.2 'Cyberclone', Smoothing and Bevelling'

The video *'Cyberclone: Smoothing and Bevelling'*, shows further finishing techniques, including smoothing the contoured surface of the rim with a red sandstone in preparation for the final polishing with pumice and then cerium oxide carried by cork wheels.

'Cyberclone: Smoothing and Bevelling'
Clip 4:45

The red sandstone is the traditional smoothing wheel used before polishing, but this does not always remove completely deep scratches left by carborundum wheels, usually when the surface is not flat - i.e. contoured. When reflecting on this problem, I thought about the soft and easily polished surfaces produced by the combination of *copper wheels* and fine carborundum grits used by copper-wheel engravers. The mechanics of this relies on carborundum grit becoming temporarily embedded in the soft copper carried, in a light oil medium. When the wheel is applied to the glass surface, the carborundum grit abrades the glass in the shape of the copper wheel profile. It seemed to me, then, that if I hammered a piece of copper pipe flat and made a carborundum paste, then applied this like a file with a rotational motion, this would facilitate a hand working finishing method to remove any deep scratches often remaining from the roughing-out stage. This I found worked well using 400-aluminium oxide grit. As with many other pieces, in this one

I felt a form of cutting following the contour of the rim would enhance the imagery. Previously I had used hollow cuts but, in this case, I felt that quite hard bevel-cutting would strengthen the form, adding a little distortion but not hiding the imagery. As can be seen in the video, a line has been drawn with a gold paint-marker that is then marked with a "V" wheel. This is then cut deep into the glass, taking care not penetrate the voids or the opal casing. A 2-mm space of the glass surface is left to avoid chipping with the roughing wheel and, allows for smoothing and polishing. A second bevel cut is then added, again taking great care to follow the contour and to avoid chipping where the second bevel is close to the first. A matching sandstone smoothing wheel is then mounted on the lathe, and this finer surface, removes the rough texture left by the carborundum wheel. The sound generated by the different wheel textures I find very telling, it informs the quality of cutting and smoothing. It can be seen in the video how a rhythmic movement "fits" the smoothing wheel into the shape, rendering the surface almost transparent. The final polish in the bevel cuts for *'Cyberclone'* was achieved with a "V" shaped cork wheel using pumice, then cerium oxide. (See Figure 63 and Gallery / Appendix, Screen 14). CLICK HERE

Figure 63

'Cyberclone' - is one of a series that explores the opaqueness of the cased layer, which has the effect of emphasising the encapsulated images. The cutting and polishing allows the images to float underneath.

3.5.3 Bio-cycle 3

In contrast with the highly polished and reflective surfaces of '*Cyberclone'* and Bio-cycles 1 and 2, Bio-cycle 3 presented the opportunity to experiment with surface modelling over the rim by sandblasting and, again, exploring the idea of the imagery emerging from under a translucent surface. After sawing off the top, the rim was rounded in a similar way to E-Zone (pp. 87/88). The rounded rim was then covered with masking tape, again taking great care to avoid creases or air pockets. A wavy texture was then drawn onto the tape.

'Bio-cycle 3'
Clip 3:40

The relief texture is achieved by sandblasting to an edge of the cut masking-tape by concentrating the blast along the edge. In order to do this, the stencil-cutting needs to be done before any blasting. Because the surface of the masking tape becomes damaged by the abrasive grit becoming rubbery and blackened, any further drawing or cutting becomes very difficult. The video shows the first area to be blasted exposed, and in this case, an application of dots of PVA glue is added as a resist to create raised dots. PVA has a rubbery quality when it is dry that protects the glass surface from abrasion, is water-soluble, and can be removed after soaking. The sequence shows how the blast nozzle is held at around 10 cm away from the surface of the work-piece giving a broad spread and even abrasion over the exposed area. Later the sequence shows an area of masking tape being removed with a scalpel blade. The blast nozzle is then applied within very close proximity to the stencil edge with roughly half of the nozzle diameter being exposed to the glass surface, concentrating the blast to the edge. A further area of glass is exposed and the process repeated; ultimately creating a rippled texture. The whole sandblasted area is finally brush-polished. (See Figure 64, p. 92).

Figure 64

'Bio-cycle 3'- with sandblasted and brush- polished rim.

3.5.4 Conclusions about finishing options.

Above I have shown many ways of cold working the unfinished glass pieces and that the character of the finished work is influenced by the choice of cutting and surface treatment in relation to the encapsulated images. I have been working within the tradition of the decorated vessel and have chosen to explore complexity as opposed to taking a reductionist or minimalist view. In many of the vessels, I have upset their apparent stability to distinguish them from being functional containers and to draw attention to their orientation and content; sometimes relating the vertical axis to a motif or to encourage the viewers eye to be drawn inside. In spite of their complexity, the pieces are visually held together by the tension of the forms. (See Figure 65, Numbers 1 and 2)

Figure 65

1 – '*Webmaster*' and
2 – '*Shoal Bowl 2*'
demonstrate the use of the inclined axis, and 1 shows how elements of imagery can suggest vertical stability.

(See Gallery / Appendix, Screens 17 and 18) (See Gallery / Appendix, Screen 19)

CLICK HERE

In all cases, the blown form is kept to a very simple sphere or ovoid. The tension in the forms are the result of the process of inflation; this being frozen in as the glass cools. Cutting the rim and flattening the base, even breaking into the outer surface with hollow, bevel and punty cuts, does not appear to disturb the tension originating in the hot forming process.

As an artist craftsman, I would normally have more than enough material to work with in pursuit of subtle variations of the pieces already resulting from this research. Where I have persisted with some aspects of the process, working with white opal being an example, I have tried, through reflection to conceive of new territory, drawing on experience. So, having arrived at a point where further refinement of ideas and techniques would be a logical course of action, I choose to enter a higher cognitive phase and to hypothesise on variations of the process of encapsulation of voids.

3.6 New pathways

In this part of Section 3, I wish to reflect again on my learning and acquisition of knowledge via experience, and show, through hypothesis and experiment, how practical knowledge is progressed.

- **So, through exploring ideas about media of the sea and cyberspace, and in so doing addressing the practical problems of encapsulating voids, are there alternative techniques that can be applied to achieve or advance the process?**

3.6.1. More layers

Achieving a satisfactory level of consistency with the encapsulation of voids by casing one layer of imagery, ultimately begged the question, can voids be made one behind the other? The next development in the shoal series, then, was to try to encapsulate a further layer of fish. (See Figure 66, Double Layer Shoal, p. 94).

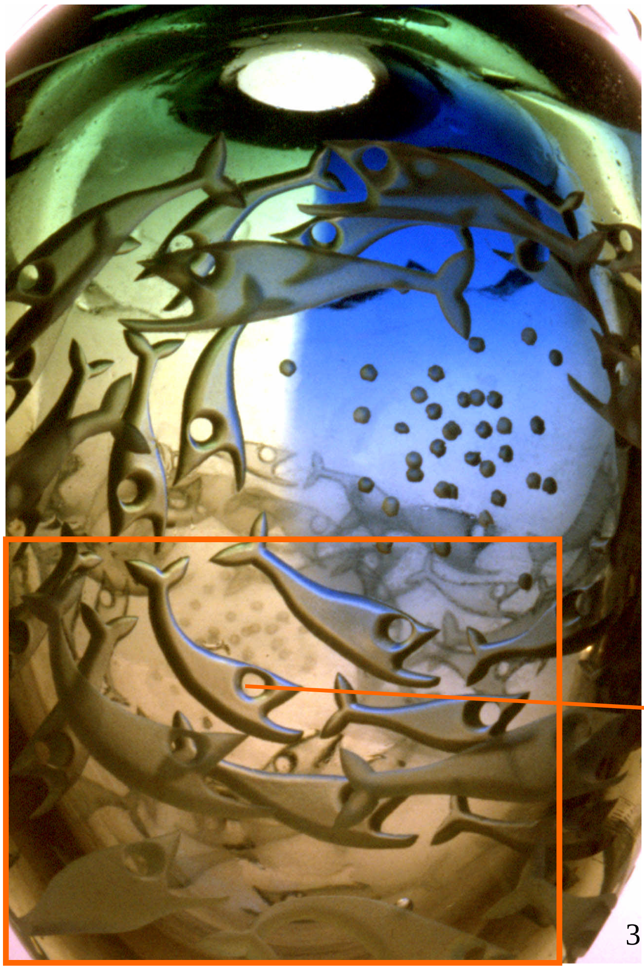


Figure 66

'Double Layer Shoal' **-** shows a sandblasted parison inside cased with transparent green and blue – no. 1. A further casing layer has been applied . over this on which new fish motifs have been sandblasted – no. 2. Fish motif's have been placed to follow the flow and movement of the first layer – no. 3. In no. 3 the layers can be related to the finished piece - no. 4.

'Double Layer Shoal Bowl'
Clip 5:38.

'Double Layer Shoal Bowl'

The video shows the application of two casing bubbles and a final gather; the hot glass process being interrupted twice in this case to accommodate masking, stencil-cutting and sandblasting. After the first casing, the parison was removed from the blowing iron as soon as possible to retain as much detail as possible from the first layer, in this case resulting in the fish motifs remaining mat. This was to avoid the fist layer becoming overheated or, rather, losing detail as the result of getting excessive exposure to heat during the application of the second. As can be seen in the video, both layers fire-polished evenly, which is happening as we watch, following the final gather before shaping with the paper pad. We are observing the grainy texture of the sandblasting disappearing. Had the texture remained, then the piece could have been further heated in the glory hole.

3.6.2 Reflecting on casing or layers.

So far, I have been limited to the idea of encapsulating air by inverting a large hot casing bubble over a relatively cold sandblasted parison. The important elements here are the first layer, being relatively cold, holding the image and the second being hot and flexible to effect the seal[1]. I knew through early experiments that gathering directly onto the cold parison in the furnace caused the sandblasted images to fill in as the glass mass was very fluid. So I thought about rolling the parison over a gather poured on the marver after cooling down and becoming more viscous. (See Video Preparation of Blue Disk p. 99). This would provide a favourable thickness of glass

[1] I use the word relatively because hot glass in contact with cold glass will thermally shock and crack cold glass.

through which the images would be seen and magnified; as facilitated by the final gather in the previous work. However, this poured ribbon of molten glass, picked up on the side of a cylindrical preheated form, would prove unmanageable in terms of further processing. So, I thought about how a circular disc of glass might adhere to a flattened blown circular form. This flattened form could be annealed then sandblasted, reheated and picked up from the small kiln as before. Instead of receiving a large casing bubble, a cast disc can be picked up from the marver, and again for the other side of the glass.

'Millennium Grubs'
Clip 3:43

3.6.3' Millennium Grubs'

The Video *'Millennium Grubs'*, shows the prepared parison this time; a flattened spherical form, inside-cased black, with images sandblasted on each flattened face. The flattened faces needed to be slightly convex so that they would expel any surplus air when being 'cased / sealed' by a cast disc poured onto the marver from a gathering ball and allowed to cool a little before picking up. The marver needed to be heated by a gas flame (which can be seen flickering under the marver) in order to reduce chill marks.[2] To ensure a good contact with the sandblasted parison, I pressed the parison onto the cast pad starting from the top and working back to the iron. Immediately after picking up, I reheated in the glory hole to minimise any further chilling and returned to the bench to make sure the cast disc was covering the image area before picking up the second disc. Even with the marver being heated, some chilling was evident on the picked-up pads, but this was fire-polished out quite easily. The application of the two discs produced a very different result in

[2] Chill marks are caused when molten glass is exposed to a cold metal surface, and look like ripples.

terms of form; the discs being a dominant feature. The voids worked well, with no loss of detail or definition. Earlier trials of this method showed that a dark background colour was important to show up the imagery. As expected Derek and I had to practise the timing; Derek to ensure that the weight and size of both discs were balanced. The cast disc then suggested a method that produced a good, even thickness of glass and ensured control of the glass temperature for retaining the detail of the images. The next trial, then, was to work on the cast disc with a sandblasted image onto which a large hot bubble was applied after pre-heating in the kiln. This, then, might be formed into a shallow dish or bowl form.

'Clear Disk'
Clip 2:06

3.6.4 'Clear Disk'

The video 'Clear Disc' shows the first trial. On this occasion, the imagery is sandblasted onto the annealed disc and a large bubble is to be pressed down onto it, the bubble having sufficient thickness to enhance the appearance of the encapsulated voids. The preparation of the large bubble is similar to the casing bubble in previous trials but with greater emphasis on the thickness at the bottom, the contact surface with the disc. The disc placed on a stainless steel plate and is heated to 500˚ C in the annealing kiln. When the large encapsulating bubble is ready, the pre-heated disc is removed from the kiln and placed on the floor where the temperature is maintained with a gas torch, the casing bubble is then pressed on to it. It is essential that the large bubble is hot and therefore soft enough to spread from the centre; driving out the air and, at the same time, sealing in the voids as it progress outwards to the edge of the disc. Unlike previous trials, the problem here is to get the disc hot enough to fire-polish the sandblasted surface inside the voids. The heat is also necessary to swing out, or gently blow, to the desired bowl form, and fire-polish away the remaining chill marks from the marver casting. The added trail of hot glass is to prevent the moil cooling too much and the piece cracking off the iron. The video also reveals that the diameter of the glory hole determines the maximum diameter of the bowl; in this case 45 cm.

'Blue Disc 1'
Clip 2:35

3.6.5 'Blue Disc 1'

In order to make the cast disc thin enough, it is necessary to raise the furnace temperature to 1200˚ C so that a ladle can be used to pour the glass onto the marver so that it can flow to form a circular disk which, after cooling, is placed in the annealing kiln. Images are then cut and sandblasted before re-heating, in this trial to 520˚C, so that the torch would not be required to hold the temperature and prevent cracking from thermal shock when the larger bubble laid over it. In spite of this precaution, the large disc was not hot enough and, as can be seen in the video, the disc remains quite flat when Derek swings to see if it would deform to form a bowl shape. Two parallel cracks appeared near the edge and can be seen catching the light as the piece is rotated on the bench before re-heating in the glory hole. After a relatively long period of re-heating, the disc was pressed with a paddle to increase its area of contact with the large bubble, applied earlier, and in so doing, 'healed' the cracks. The piece was eventually heated through enough to fire-polish the sandblasted texture away from the voids, and to swing out and blow to form the shallow bowl form. Again, much depends on the form, thickness and temperature of the large bubble applied to the disc.

' Preparation of Blue Disc'
Clip 3:24

' Preparation of Blue Disc'

This video shows how subsequent gathers are built up to obtain the weight and volume of glass and how, by blowing and turning in a prepared newspaper mould, the weight is concentrated in the area where it will be in contact with the pre-heated disc. The bubble flattens to match the diameter of the disc when rapidly rotated in the glory hole. The major problem arises from the temperature of the disc, which needs to be much hotter, and, unlike the blown parisons of the previous method, there is no risk of deformation due to higher temperature because the discs are flat, and supported on the flat stainless steel plates. In the next trial, the kiln temperature was raised to 600˚C and a much better area of contact was achieved between the preheated disc and the sealing bubble. The heating-through time was much reduced by this increase in temperature. (See Figure 67 – 68)

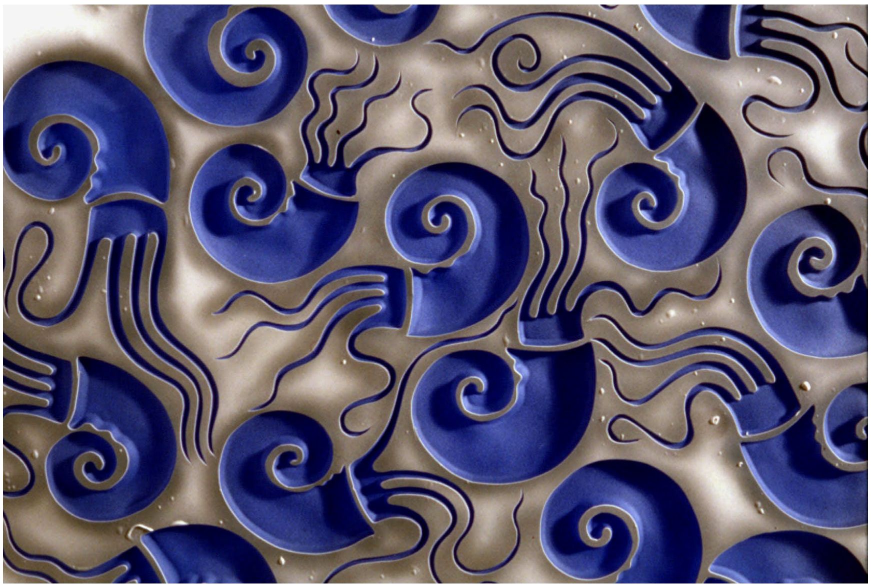


Figure 67

A nautilus motif sandblasted onto cast, transparent blue disc using self-adhesive plastic film instead of masking tape. This resist works well on flat surfaces but is difficult to stretch onto a form.

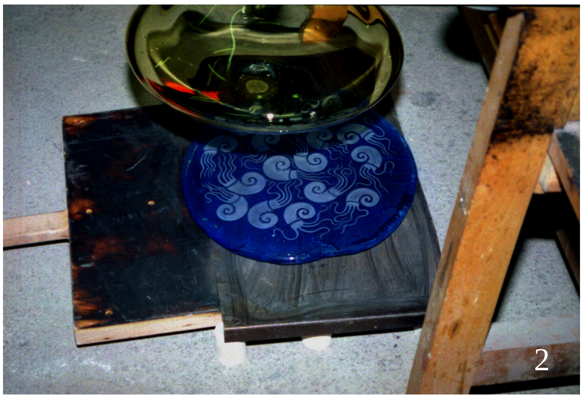


Figure 68

After removing the resist material and cleaning, the cast disc is heated in the annealing kiln on a stainless steel tray (stainless steel doesn't scale when heated). The large casing bubble is prepared and while this is still soft the cast disc is removed from the kiln – 2, and the casing bubble blown on to it – 3. After further heating in the glory hole – 4, the disc is 'swung out' to make a large bowl form - 5

The resulting bowl form was larger in diameter as a result of the increased contact area, and deeper because the disc in this instance was much hotter and responded to 'swinging out', i.e. swinging the disk like a pendulum to exert centrifugal force to create the bowl form. A greater volume of air space inside the large casing bubble was drawn in through the open tube of the blowing iron. An alternative to this would be to blow, and therefore exert internal air pressure to inflate the form, but we were concerned that this might, on this much larger scale, cause the internal casing layer to push into the deep sandblasted motifs.

3.6.6 Lizards

If the acquisition of skill and technical development is driven by a theme or idea (Contextual Revue 2.6, p. 44), then, deviating from my chosen themes might influence change to advance the technique. In this study, I have been working with two related themes. Here I move to another source and idea, temporarily, to see how I might use technique to enhance a different idea. I was thinking about reptiles and their shiny scaly skins, and how the void motifs might suggest that kind of quality. Also the complexity as mentioned above in 3.5.4, can be achieved by repetition of the image closely packed suggesting a close repeating design like a wallpaper or textile. This repetition refers to nature’s ability, through the ‘selfish gene’, to repeat itself; yet each individual remains unique.

So here, instead of piercing the image through, or suspending the motif in front of a layer of colour, my idea is to reverse the appearance of the encapsulated void. This might be achieved by painting enamel on the interior of the void. Enamel colour is a glassy substance whose melting temperature can be adjusted by fluxes. The fused materials are poured into water – a process known as fritting - then ground to fine powder. Enamels are available in a wide range of colours and firing temperatures, and are normally painted or printed onto glass or ceramic surfaces; being carried in a medium which fires away in the kiln. Typical firing temperatures for glass enamels range from around 500˚C to 600˚C (dependent on the softening point of a glass in the kiln), and up to 800˚C on ceramic glazes. So enamel colours can be used in the voids - but a number of factors would have to be taken into account. The firing of the enamel would be affected during the heating up process prior to picking up out of the top-loading kiln. This, in itself, takes the temperature up to 500˚C. The parison, when picked up, is further reheated in the glory hole, normally running at 1150˚C. As stated previously, the temperature of the parison should not achieve red heat or the sandblasted detail will be lost. The parison should be flashed in and out of the glory hole to maintain temperature until the casing bubble is applied. So, a maturing temperature for the enamel would need to be middle 500's˚C. The time and temperature in this free hand glassmaking process are difficult to control and be consistent with each piece. Enamels are usually fired under accurately controllable conditions, so ceramic enamels with a higher maturing temperature are chosen for the trial ***'Lizards'***. At an early stage of development, 'Lizards' shows the potential of the technique. (See Figure 69 and Gallery / Appendix, Screen 20) CLICK HERE

Figure 69

'Lizards' – demonstrates a complex design idea of covering the entire surface of the parison with the lizard motif – the complexity defining the transparent form.

In this example, the transparent green enamel was fired evenly over the internal void surfaces and pooled slightly in the more confined places like the fingers, which added character to the image. The pink enamel, on the other hand, became over fired in the glory hole and gathered into dark brown globules. From the design point of view, the pattern value of the lizards, with the foreground and background overlay is complex, but is unified by the simplicity of the ovoid form. The coloured enamel is painted on the original inside parison; the outer casing bubble layer is transparent – therefore, only the undersides of the lizards have been painted, but the colour appears to cover the entire interior surface.

3.6.7 The shoal and multi-layers.

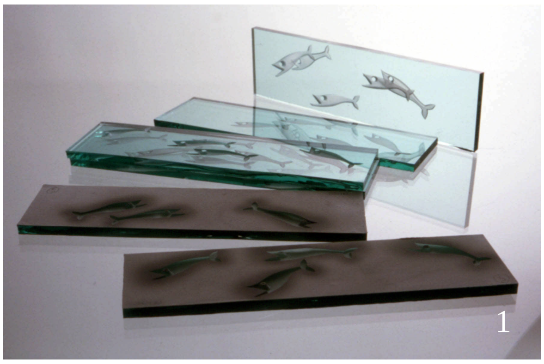
My practice so far has been driven by the relationship between the potential of the encapsulation of voids as a means of drawing and the development of ideas related to the medium of the ocean and the medium of cyberspace. The practice is grounded in the tradition of the working of glass at the furnace and cold-working techniques as described above, and can be seen to be an extension of these traditions. When reflecting again on the idea of making images between layers or laminations of glass, like *'Double Layer Shoal Bowl'*, I gave consideration to the potential of multiple casings - more layers. But there is a limit to how many it would be practical to apply, taking into account the problems of size and weight. However, drawing on previous experience of working with flat glass, including sandblasting, cutting and polishing, it occurred to me that here I have ready-made layers which can easily be fused together in a kiln.

- **So how might I transfer my accumulated knowledge about encapsulating voids using lead crystal glass at the furnace, to laminating window-glass in a kiln?**

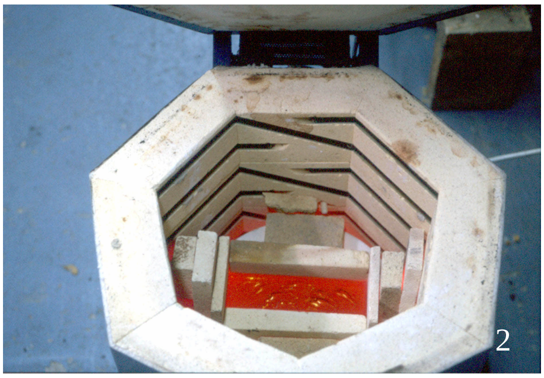
Immediately the context for the resultant work will change, although the same qualities in terms of the appearance of the voids should be sought. In the case of all the previous work in this study, the tradition of the vessel was deliberately followed. The vessel is the vehicle for carrying the ideas and imagery, placing it firmly in the context of the applied arts. Even at the hypothetical stage, the laminated flat glass version had many different possibilities; particularly its potential in an architectural context, windows, walls, screens etc., but also the potential of scale.

Float glass can be obtained in a variety of thicknesses and, because of the method of manufacture, is perfectly flat. The first successful trial was achieved with a green tinted glass 6 mm. in thickness. This was fired in a small top-loading electric kiln; each lamination being 20 cm x 6 cm. (See Figure 70)

Figure 70

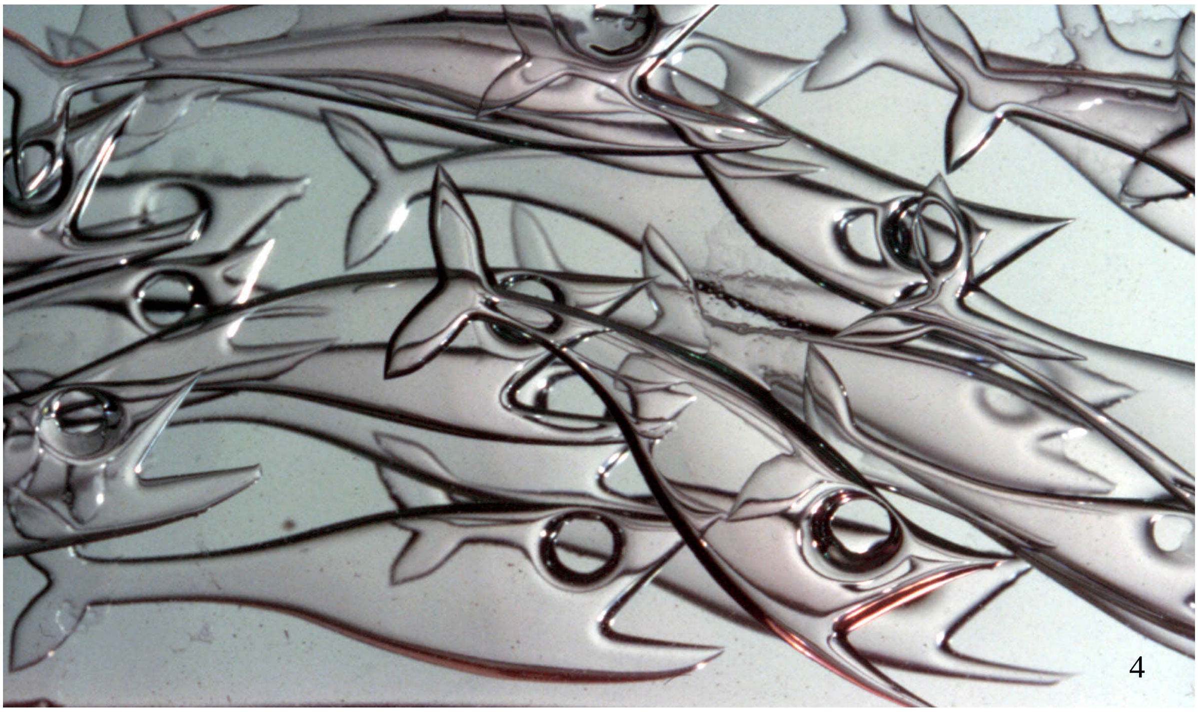


1 - Flat glass with sandblasted images on both sides, except the outer ones.



2 – Top-loading kiln at soak temperature of 800˚C. When the mat texture of the sandblasting becomes glossy, the kiln is crash cooled to 550˚C to begin the annealing programme.

3 and 4 - Finished trial after polishing the glass surface.



The potential for the incorporation of voids in kiln-fused, laminated glass would seem to me to have great potential as a technique that might provide new opportunities in the making of pieces and, significantly, architectural installations. This new pathway has many possibilities for the future.

A notion that is central to my thesis is that if I had not been intrigued by the possibility of multiple layers of fish, suggesting the idea of shoal. I would not have made the conjecture that working on both sides of flat glass would provide the possibility of creating images in many hidden layers of solid glass[1]. This came about as the result of reflection *'for'* action, as described by Cowan and McAleese.

- **How many layers would it be practicable to apply?**

What if it were possible to sandblast an image both inside and outside a cup shaped parison, then heat this in a kiln, inflate a bubble into the cup, then add a further casing bubble before a final gather. If, then, thinking this through from current practice, I consider the idea of images on both sides of the layer (inside and outside surfaces) this might equally be on each side of a sheet of float glass.

- **What would happen if I sandblasted images on both sides of float glass then laminate them by fusing with heat in a kiln?**

The shoal of fish idea was a serendipitous connection to the encapsulation of voids in laminated flat glass. This is a new experience from which a reflective observation arises and further abstract concepts can be developed, leading to a further concrete outcome. This experiential learning model as defined by Kolb (1984) has a meaningful bearing on my approach to learning and the significance of risk.

[1]‘ Hidden’ is used here because there is no visible evidence of layers when looking through clear glass.

3.7 Summary

In this chapter I have undertaken to reveal, how, after framing particular questions, the act of reflection can generate new insights into the understanding of the physical properties of glass, and solutions to technical problems arising out of aesthetic goals in its manipulation.

It shows that, with rigorous analysis of praxis, advancement of practical skills give rise to new pathways. Although there may appear to be some duplication of methods in the video sequences, the intention here is to demonstrate how progress is sequentially identified and how error and misjudgement, through reflection, can aid development or even, through serendipity, effect a shift of emphasis or source a new direction. Here perhaps *'the workmanship of risk'* for the innovative glassmaker becomes *'the* ***management*** *of risk'*. The more I know about glass, the more reliable is my speculation about how it behaves and how I may influence its behaviour. Some of this *knowing* is the outcome of reflection, and is the result of a hypothetical course of action. This is informed by practical experience, and further by reflecting on an ideological notion and subjective idea acted upon for aesthetic impression. This notion is looking ahead, and can be described as - *reflection for action.* This hypothetical action is tested in practice bringing to bear previous experiential and tacit knowledge - *reflection in action*. Then *reflection on action* – will, in the first instance, assess the qualitative outcomes against predetermined criteria, and in the second, assess responses to unexpected outcomes and spontaneous solutions to potentially catastrophic events characteristic in the working of glass and expressed in the notion of the management of risk.

The practice in this study was not designed to achieve a specific outcome, but to explore and reveal from experience, how deconstruction serves the practitioner, and reflection on both creativity and means of realisation through practice, can define artefacts in a contemporary cultural environment. My preoccupation with the manipulation of voids is derived from a thread of the history of glassmaking, and my own involvement in very recent history with this study aims at progressing knowledge and influencing its potential development.

CHAPTER 4 – Methodology

4.1 Introduction

This section of the thesis examines the contribution of a number of published sources to the emerging methodology of - **Reflective Risk.** The methodology adopted is situated in on-going practice, but has a number of important antecedents. Each of the antecedents offers a challenge to the practitioner, and each suggests a key question. From each of the questions emerge, a message that is part of the Reflective Risk methodology. (See Table 1 below).

Antecedents to Reflective Risk	**Questions**
Zimmerman (1989) *Self-regulation.*	How can self-regulation improve performance in a creative environment?
Pye (1971) *The workmanship of risk.*	How does risk contribute to creative action?
Schön (1983) Cowan (1988) *Reflection –* *In, on and for action*	Why is reflection an essential element of creative practice?
Polanyi (1958) *Tacit knowledge.*	How important is tacit knowledge to the practitioner?
Dormer (1994) *Craft knowledge.*	Is “craft knowledge tacit”?
Kolb (1984) Piaget (1970) Lewin (1951) *Experiential learning theory*	How do theoretical models of experiential learning contribute to the generation and refinement of new ideas?

Table 1.
Summary of antecedents to Reflective Risk and the questions they raise in relation to this thesis.

This KEY section of the thesis will take each of the facets of Reflective Risk and examine the ideas put forward by these authors which contribute to the researcher's work.

In order to locate Reflective Risk in a broader framework, the first part of this Chapter examines the wider context of practice within glassmaking and the creative arts.

4.2 The Wider Context of Practice.

The rationale is derived from broad history of glassmaking and the influence of western philosophy on the art of making. Chapter 2 - Contextual Review, refers to the particular developments relevant to this study. 'Craft knowledge' (Dormer, 1994), as learned and known by craftsmen is shaped by the social conditions in which works are made as well as the physical properties of materials and techniques employed to create them. The artist craftsman, fulfils an important role in contemporary society. His use of materials and techniques is driven by ideas that engender thoughtful response. Practical knowledge is inherited (much of it tacitly) from the trades through generations of practitioners. Diderot (1772) [1]gave credence to the knowledge of making through his recognition of practical solutions to ideas and the needs of society. This was highlighted by the encyclopédie project where, for the first time, useful arts were described. Enlightenment thinkers embraced arts and science practice; the crafts, and skills of the trades that supported them, and on which these depended, they confer equal significance. The enlightened were the educated classes of society. While manufacturing methods were carefully and thoughtfully described and illustrated, *craft knowledge* (See Section 4.3.5) was transferred through practice and observation. The learner was being instructed by "masters". Creative and manipulative skills and knowledge have been characterised by social history. The origination of mass-production was made possible by the Industrial Revolution. The introduction of mechanisation and the division of labour gave rise to depersonalised work. Reactions against these conditions formed the basis of the Arts and Crafts Movement, with the particular idea that creating and making by an individual enhances the pleasure of artefacts. This pleasure should be manifest and embodied in the work for both the maker and the user to realise.

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[1] Encyclopédie des Arts et Métiers. Paris 1772.

At this point, Germany played an essential role in the development of both design and the crafts. The ideas behind the Arts and Crafts Movement can be seen as having influenced the establishment of a number of German institutions. Indeed Nikolaus Pevsner (1960) tracks the unfolding of The Arts and Crafts Movement into Modernism and the philosophy of the Bauhaus. By bringing together the best representatives of art, industry, crafts and trades, the foundation of Deutcher Werkbund led to the establishment of the Staatliches Bauhaus in 1919.[1] Here the students were trained as apprentices aiming for high quality being taught by the most reputable artists and designers. This mode of teaching became an influential model for art education subsequently and is apparent in the best faculties of art and design today, including those within British Higher education.

The emergence of *studio crafts* as a late-twentieth century phenomenon placed the maker in a new role. The establishment of the Crafts Advisory Committee in 1971, that later became the Crafts Council in 1979, reinforced the concept of a contemporary creative culture of craft. The Crafts Advisory Committee organised touring exhibitions of high quality craftwork to be displayed in schools, colleges, libraries and arts centres. Work could be purchased from the makers for resale from these venues. However, some works were purchased by The CAC and became the basis of what is now the national collection of crafts held by the Crafts Council[2]. Among items in this collection are works by David Pye[3]. From the researcher's point of view, his book 'The Nature of Workmanship' and definition of the *workmanship of risk* is a paradigm that demonstrates the most powerful understanding of the nature of practice in craft. From his perspective of *workmanship*, Pye defines a holistic precept for the making of things through his workmanship of risk and workmanship of certainty. As suggested in the Introduction 1.4, Pye's description of the *workmanship of risk* defines the character of practice in this study. He suggests the need of the creator of a work to demonstrate appropriate skills and knowledge through praxis. The question in the thesis is how risk is managed in the context of the production of glass vessels, employing the encapsulation and manipulation of voids. Practice shows how, through *reflection*, ideas and practical solutions are

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[1] It was Pevsner who identified these pioneers who were thoughtful teachers as well as designers. His first edition originally entitled 'Pioners of the Modern Movement',Faber 1936, became the standard work on the subject.

[2] The Crafts Council collection is housed at, 44a Pentonville Road, Islington, London N1 9BY.

[3] See 'Building a Crafts Collection' Crafts Council Collection 1972-1985,(p. 106-108).

advanced and reference is made to theoretical sources applied to enhance the cognitive process.

4.3 The Antecedents to Reflective Risk.

In the deconstruction of the practice, the researcher seeks to gain a deeper awareness of cognitive processes giving rise to the methodology adopted which can be summarised in the term *'Reflective Risk'*. The antecedents that contribute to this position and the questions they pose are expressed in Table 1 p. 107. This section will take each of these antecedents and draw out of each the significant contribution to this study and wider significance in epistemology. Examples of action from the work on *'Reflective Risk'* will exemplify the contribution with regard to the making of glass artefacts.

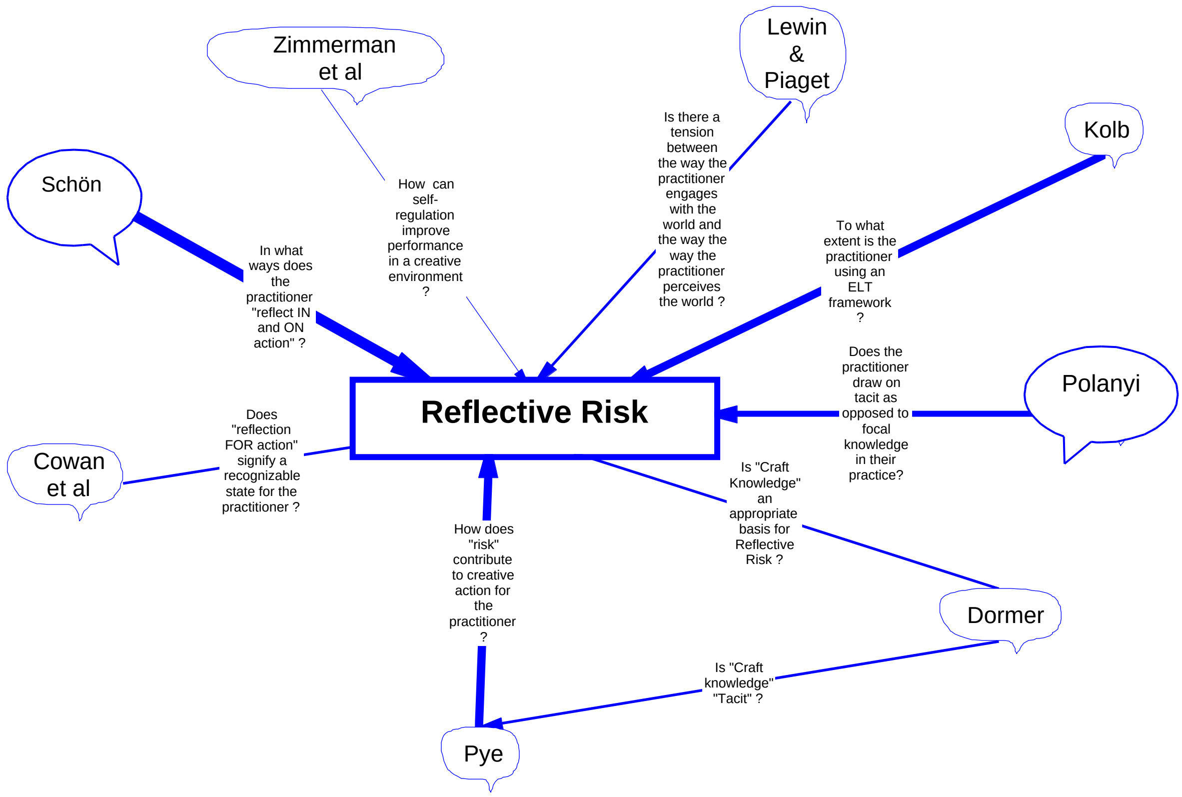

Figure 71

The above is a summary of the points covered in Chapter 4 using arrows to indicate the weighting of the contributory questions posed by the work of the antecedents to the notion of Reflective Risk.

McAleese (2001)

4.3.1 • How can self-regulation improve performance in a creative environment?

By exploring alternative means of making and finishing, new possibilities emerge. (See Chapter 3 - The Practice 3.5 p.84 and 3.6 p.93). The desire to find new possibilities is driven by the ambition to set new goals that must serve to direct a systematic and controllable level of achievement. This can be attained through *self - regulation.* Zimmerman's (1989) study identifies constructs and models of motivation and learning through what he calls self-regulation. In any learning environment, efficacy can effect performance. Bandura (1977) defined *self-efficacy* as the perceived ability to implement actions necessary to attain designated performance levels. Zimmerman holds that self-regulated learners are not merely reactive to their learning outcomes; rather they proactively seek out opportunities to learn. Self – regulation, therefore, can be seen in this study to orientate and establish objectives in the work programme. In the words of Bandura (1986),

> "Self-efficacy is hypothesised to influence choice of activities, effort expended and persistence".

This study is grounded in self-orientated research and self-observation, self-judgement and self-reaction, tested in the public domain[1]. An alternative study method might have been to make comparative analyses of the work of other artist craftsmen from the point of view of establishing a methodology. Dormer (1994) makes a valuable contribution to knowledge. Through placing himself in the role of the maker (Dormer (1994) p. 40) he experiences and describes the apprentice's view. This study seeks to reveal a more personal perspective focused on a particular thread of *professional* experience sequentially. Self-regulation becomes part of the learning strategy and is an antecedent to *Reflective Risk.*

4.3.2 • How does risk contribute to creative action?

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[1] See catalogued work in Appendix 3.

In the making of glass, the management of risk becomes an inherent part in the execution of a piece of work, and this determines the making procedure at every stage of the process. The qualitative outcome of the action of *making* and the management and manipulation of materials are dependent on what Pye (1971) called " the workmanship of risk". The underlying definition of this idea is that through accumulated experience, workmanship is executed at a level of regulation[1] appropriate for the purpose. At any moment work can be ruined or lost through error. In the case of the *artist craftsman,* individual character may signify the acquisition of skills. These are gained through training and experience in techniques and placing them in a contemporary cultural context.

In this study, the development and complexity of the imagery within the glass was incrementally developed based on best results and likely possibilities. An example was the variation occurring in fish motifs in the *shoal series*, in contrast with the importance of retaining detail of the letter forms in the *e-world series*. In the execution of this body of work, the researcher was seeking variation in each piece. Variations in the preparation of the parisons in scale, image and content guaranteed uniqueness. However consistency in the encapsulation of voids was desirable and the variation in the parisons increased the risk, in controlling the overall form and the encapsulated voids. These variations extended the experience of dealing with risk and therefore expanded the vocabulary of the casing technique. The cold-working stage was characterised by the management of risk where effects of distortion and reflection are achieved by cutting deeply into the surface of the glass, close to the voids, to create reflections. (See VR Tech. in Gallery / Appendix, Screen 8). Sometimes working at the cusp of catastrophe leads to it, but indicates through experience a new threshold. The management of risk then becomes a creative tool.

4.3.3 • Why is reflection an essential element of creative practice.

The application of the concept of reflection is fundamental to this study. Schön's identification of the process of reflection is central to the advancement of professional practice and, particularly his concept of how professionals think '*in'* action, is a defining factor of the researcher's approach to practice-led research. Schön gathered evidence to show that in the world of practice, text book solutions

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[1] Pye uses the word *regulation* to describe the degree to which work is finished i.e. rough or smooth etc.

rarely equip the professional in solving real problems. Although his work was directed at the professions generally, his often cited examples of professional activity flow easily into art and design practice. An example of this is a conversation between an architect and his student during a review of progress on an architectural project. It is revealed that the student, in answering the brief, has created problems that she can't resolve. The professional resolves this design issue through visualising with drawing and dialogue with his student, projecting himself into the environment that the student and professional are creating, talking through the issues visually testing potential solutions and drawing on experience, Schön (1983 p. 95). Associated with this, Schön constructs a table of design domains; clusters of factual data that summarise a variety of constructive, descriptive and normative functions. His paradigm for dealing with uncertainty, instability and uniqueness through reflective conversation with a given situation, was applied to both the inception and the continuity of this study in glass. The rigorous enquiry associated with research in the sciences can equally be applied to the arts. However, the application of *technical rationality* and *positivist* doctrines, do not serve the domain of cultural experience and practice of the artist craftsman.

Schön suggests:

> "Technical Rationality is incomplete, in that it fails to account for practical competence in " divergent" situations, so much the worse for the model. Let us search instead for an epistemology of practice implicit in artistic intuitive processes which some practitioners bring to situations of uncertainty, instability and conflict."
> (Schön, 1983, p. 49)

Reflection-in-action in the context of planning for, and the execution of, glass-making is a constant feedback loop. In the instant of *doing* is the continuous feedback / reflection on previous knowledge and continued re-evaluation in a constantly changing situation. Theoretically, the working environment might be the same but, in practice, that unexpected situation might arise to challenge know-how. (See Video "Stuck" Chapter 3 p. 75) The concept of reflecting *on* action is to look back on action contained in past experiences, with the potential of being informed of non-standard situations which later can be applied *'in'* action. The concept of reflection, *'on'* action in the context art, craft and design practice, must be central to the evaluation and judgement of the aesthetic value of a work. Cowan (1998), when exploring the ideas of Schön within the overall context of reflection and experiential learning for university teachers, recognised the need for premeditated performance. This identified plans for activities that lay ahead and became reflection*' for'* action. In this further dimension of reflection, new pathways can emerge feeding from the other reflective practices. The idea of the fusing of flat glass in the kiln resulted from this dimension of reflection. (See Chapter 3 p. 104)

Schön has shown how every working situation is unique; using Eric Ericson's words (Schön 1983 p. 108) "a universe of one" ; and how a ‘conversation’ with an action will reveal the issues. The concept of thinking *in* action as constructed by Schön is a non-formulaic creative approach to problem-solving. He suggests:

> "When a practitioner reflects in and on his practice, the possible objects of his reflection are as varied as the kinds of phenomena before him and the symptoms of knowing-in-practice which he brings to them. He may reflect on the tacit norms and appreciation's that underlie a judgement, or on the strategies and theories implicit in a pattern of behaviour. He may reflect on a feeling for a situation which has led him to adopt a particular course of action, on the way in which he has framed the problem he is trying to solve, or on the role he has constructed for himself within a larger institutional context. Reflection-in-action, in these several modes, is central to the art through which practitioners sometimes with the troublesome "divergent" situations of practice".

Reflection *in* action in this study refers to *focal awareness* and draws upon *tacit knowledge* in the context of making. (See 4.3.4). Reflection *on* action is framing the overall outcome, taking into account particular divergent situations - *managing risk* - in making. Here, reflection and action appear to be a circular process in need of a forward momentum. Cowan's idea of reflection '*for'* action aptly named by McAleese (1996) is a vital extension of Schön's thinking actions and gives forward momentum to the Kolbian cycle. (See 4.3.6)

4.3.4 • **How important is 'tacit' knowledge to the practitioner?**

The application of *tacit* knowledge is fundamental to the understanding of practice. The notion of tacit knowledge was developed by Michael Polanyi (1958). He reveals in his book, 'Personal Knowledge, Towards a Post Critical Philosophy', how knowledge is understood on different levels. Knowledge that is objective, about an artefact or action / phenomenon that is in focus - *focal knowledge.* Knowledge that is a tool to effect what is in focus - *tacit knowledge* the latter being dynamic. He illustrates the duality of our conscious and unconscious knowledge or the more dynamic *knowing,* in the following analysis.

> "When we use a hammer to drive in a nail, we attend to both nail and hammer, *but in a different way.* We *watch* the effect of our strokes on the nail and try to wield the hammer so as to hit the nail most effectively. When we bring down the hammer we do not feel that its handle has struck our palm but that its head has struck the nail. Yet in a sense we are certainly alert to the feelings in our palm and our fingers that hold the hammer. They guide us in handling it effectively, and the degree of attention that we give to the nail is given to the same extent but in a different way to these feelings. The difference may be stated by saying that the latter are not, like the nail, objects of our attention, but instruments of it. They are not watched in themselves; we watch something else while keeping intensely aware of them. I have a *subsidiary awareness* of the feelings in the palm of my hand which is merged into my *focal awareness* of my driving in the nail."
> (Polanyi 1958 ,p.55)

Polanyi adds a crucial dimension to the application of knowledge by defining these two forms of awareness. The practice of making glass described in this study draws continually on *subsidiary awareness* as described in the above analysis but this knowledge, though hidden, has been learnt through experience and can be identified through reflection. An example of this can be seen when the researcher and assistant are undertaking the method of encapsulation by enveloping a sandblasted parison with a large casing bubble (See video ‘Bio-cycle 2’ p. 81).

Through repetition of this risky manoeuvre, new knowledge is gained or *apprehended* [1] through experience. Here the *focal awareness* was to achieve the aim of sealing together two layers of hot glass and in so doing creating voids where the sandblasted motifs were placed. Through repeating this process, our *subsidiary awareness* was being developed, equivalent to the feelings within the palm and fingers and presumably, the muscular control associated with action, resulting in improved skill[2]. However, it is clear that in this realm of action, we may not have the means of describing tacit knowledge.

"…. we can know more than we can tell".

Polanyi (1966 p.4) explores the example of human facial recognition and our ability to recognise one face in a million. In the making of something, we externalise an idea by manipulating a material substance. If this were clay then we can manipulate this directly with our hands; but if the material is molten glass, we need tools. Polanyi invokes the notion of a tool being an extension of the body. In Section 2.6 The Creative Impulse, there is a textual description of handling molten glass and in videos Chapter 3 - The Practice - a visual description. All of this activity is undertaken with tools. An example is the blowing iron as an extension of the body functioning through *subsidiary awareness*. Molten glass at its end is balanced by rotation. Tactile sensations of molten glass are transmitted through the round steel tube as well as there being visual monitoring to sustain control. The *focal awareness* might be attaining any number of objectives in the sequence of making. Therefore, with this knowledge it must be possible to intervene in both focal and tacit knowledge by reflection on these precepts. From the point of view of this study the researcher identifies some important concepts in Polanyi's study, that bear upon a true understanding of practice.
Svielby (1997) records:

> "Polanyi maintains that craftsmen "makers", use the same kind of methods as other practitioners "doers". They both follow rules and exemplars and they rely on experience for making judgements in their

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[1] c.f., “prehension” (Kolb).

[2] This acquisition of skill can be observed in the QT Movie sequences by comparing early videos e.g. 'Shoal Bowl I' with 'Purple Sea'.

> work just like scientists have to in their work. Polanyi makes no clear distinction between practical knowledge and other kinds of knowledge, like theoretical propositionary knowledge. Polanyi therefore makes no difference in principal between the analytical skills of Bertrand Russel or the blind mans rod. The process of knowing is the same".

Makers in a creative environment impose another level of communication through their *doing.* Pye developed a fluting engine; a jig that created repeating flute-cuts to his wooden artefacts an integral feature which spoke about carving with sharp tools as well as fulfilling the function of containers, lidded boxes, bowls etc. Some artist craftsmen's work deals with reference to process/technique: others employ these to refer to a theme and for them these preoccupations drive the process (as is the case with this study). So, tacit knowledge can have many facets: indeed Polanyi holds that *all* knowledge is constructed from tacit knowledge. The artist craftsman has accumulated personal experience that provides the basis for ideas about the world through primary sources. A person may also be socially informed about the wider world through secondary sources provided by information-based systems. The artist craftsman is a maker with material and manipulative faculties. If the researcher sees the world through Palanyi's eyes, then experientially apprehended tacit knowledge enables the maker to focus the *particular* from the hidden and random. Can this be a definition of skill? Pye (1968 p.52) chooses not to use the word because in different crafts there are different definitions and therefore ambiguities of meaning - and this is borne out by Polanyi's (1966 p.49 to 65) whole chapter devoted to it. So Polanyi's study and understanding of the complexity of knowing are an essential component of this study, and form part of the researcher’s own awareness through practice.

4.3.5 • Is "Craft Knowledge" Tacit?

Peter Dormer has been one of the few writers to comment explicitly on the relationship of Polanyi and Pye (Dormer, 1994), in a publication that sought to define the practice of making art, craft and design. Dormer suggests in his chapter entitled 'What is Craft Knowledge' that:

" Tacit knowledge is the preferred phrase for *craft knowledge* among academics. Both senses of the word 'tacit' are relevant: a) implied without direct expression, *understood*: b) *silent*". (Author's emphases) (Dormer, 1994, p.13)

Later (Dormer, 1994, p.20), with direct reference to Polanyi, identifies further elements of "tacit" knowledge: - *'unknown'* knowledge, and *'forgotten'* knowledge.[1] The researcher feels the true significance of these constituents of tacit knowledge have not been fully revealed in the context of Dormer’s intention to define *craft knowledge*. The researcher holds that the acquisition of tacit knowledge needs comprehension as well as definition. This can only be achieved by experiencing. Polanyi (1958) notes:

"the apprentice unconsciously picks up the rules of the art, including those which are not explicitly known to the master himself…"

This defines *unknown* tacit knowledge acquired in the doing. The experienced practitioner uses *forgotten* or *lost* knowledge in the action of making. In the video ‘Cyberclone’ (Chapter 3 The Practice p. 89), the researcher is operating a '*tacit sensual loop'*. Visual, auditory and haptic information coming in with co-ordinated muscular effort going out. There are number of instances of this in the video sample[2] This then can be described as knowledge in the course of action. Dormer as a commentator on craft practice demonstrates discomfort with the Pye's idea that making is in the hands of the *doers* and not the *designers.* This is set in the context of designing being separate from making. The point he does not make is that an artist craftsman is in the moment of making, dealing with origination and realisation. He goes on:

" …. if we have to rely on other peoples tacit knowledge, then we want some assurance that their knowledge is real. There is a great deal of mythology associated with craft…"
(Dormer, 1994, p.14)

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[1] Unknown knowledge being the “tacit sensual loop” and forgotten knowledge acquired through experience.
[2] See 2'.15" into the clip.

- **How important is Dormer's criticism of Pye, and is he correct in his use of Polanyi to support his case?**

On balance Dormer is wrong. He fails to identify a number of important points: Firstly, that Pye's thesis was derived from experiencing and being a *professional* maker. Dormer appears to follow the idea of regulation in terms of *craft knowledge,* but not the concept of risk. Risk, and being at the cusp of catastrophe, draws upon tacit knowledge and is the phenomenon that defies definition, other than in the language of action. This, Dormer suggests, is mythology in both craft and professional practice generally. (Dormer 1994, p. 14)
Secondly, in the experience of the researcher, embodied in the notion of *Reflective Risk*, tacit knowledge is present only in the action of doing. The researcher asserts that tacit knowledge exists in the moment of action, and reflection *in* action reveals this. Thirdly, he argues that:

> "If knowledge is to be useful (for it to count as knowledge) there must be ways of subjecting it to public scrutiny. Craft knowledge may be hard to define but it is not ineffable."
> (Dormer, 1994, p.15)

Polanyi's exposition of tacit knowledge is "real" and can be measured in the outcome or *artefact*. In simple terms, the action is transferred and is manifest in the artefact. Therefore, the definition of *Craft Knowledge*, if it is capable of description through language, embraces a wider subject.

This raises a major question for Dormer’s understanding of Polanyi's meaning of tacit knowledge, and of the writer's definition of Reflective Risk.

On reflection, there are a number of serious worries, as his claims do not always resonate well with the researcher's experience. His chapter on learning a craft, whilst an admirable attempt at getting inside the experience of doing, is the work of an excellent commentator informing connoisseurship rather than establishing the authority of the master.

Turning from the issue of craft knowledge to a much larger issue, the work of Kolb and Experiential Learning Theory has to be taken into consideration.

4.3.6 • To what extent is the researcher using an Experiential Learning Framework?

Kolb (1984) is mainly associated with a synthesis of Piaget and Lewin, and is famed for 'experiential learning'. His work has made significant impact on education, training and management practice over the last twenty years. Before judging Kolb's contribution to the application of Reflective Risk as a methodology for craft practice, note should be taken of Kurt Lewin (1980) and the Swiss psychologist Jean Piaget (1970). Lewin was a social psychologist who worked in the field of organisational behaviour and who evolved a model for the integration of theory and practice. Piaget, working in the field of child psychology, evolved a theory that described how intelligence is shaped by experience. He has shown that abstract reasoning and the power to manipulate symbols arise from coping with the concrete environment. Kolb provides an explanation of what he terms a "theory" of experiential learning[1]. His experiential learning consists of two orthogonal forces that provide a dynamic cycle. Experiential Learning is based on the way humans perceive the world; and the way humans engage in the world. (See Figure 72)

[1] Theory may be too strong a claim - his framework is a valuable synthesis of a wide range of experimental data and hypotheses.

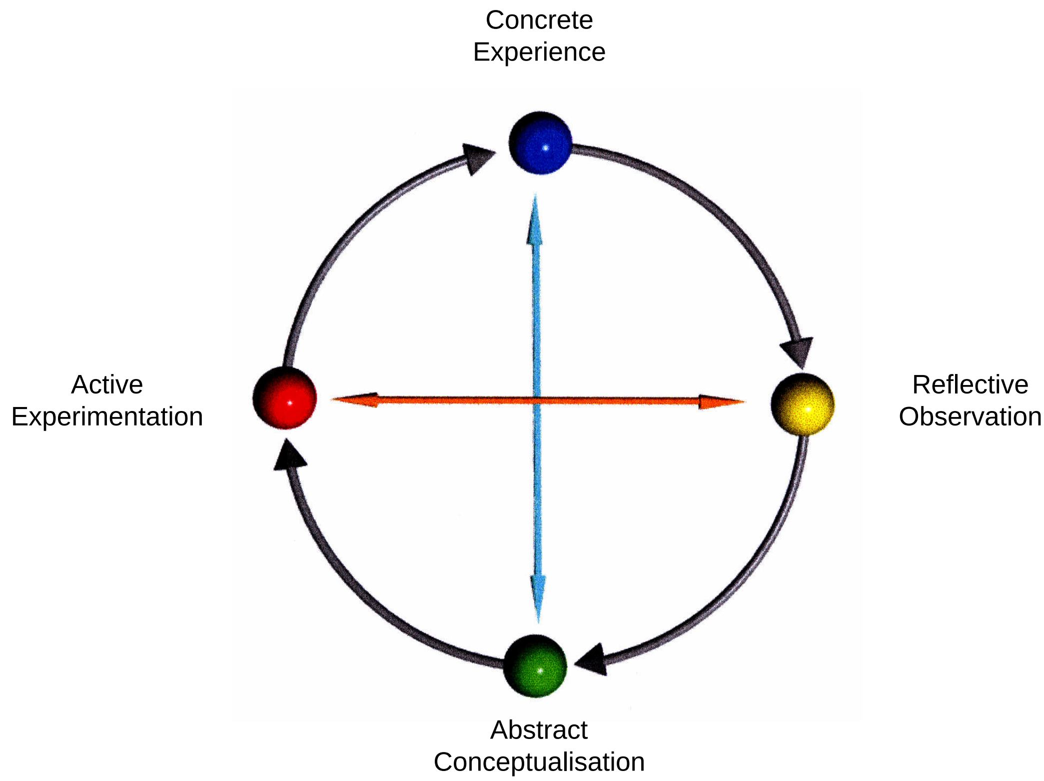

Figure 72

The Kolbian Experiential Learning Cycle

The researcher has observed that experience precedes reflection and demonstrates a workable foundation for the cycle. In a creative environment, abstract concepts might also initiate the cycle, which through testing would generate a concrete experience from which the cycle progresses. The impulsive nature of ideas would typify themes of artistic origin, exemplified by themes like *'cyberspace'* and *'sea life'* chosen by the researcher. These initial *whims* acquire impetus, and the intervention of observation in the cycle lies behind the tacit execution of action. The introduction of the sense of *aspiration* gives momentum to ideas and experimentation.

In this study, the transformation of experience has been viewed from the differing perspectives of Polanyi, Schön and Pye, all of whom contribute to the construct the researcher has made in defining his practice method. These contributions however become more meaningful when informed by Kolb's (1984) model of experiential learning. Kolb describes this as a four-stage cycle involving four adaptive learning modes. These are *concrete experience*, *reflective observation*, *abstract conceptualisation* and *active experimentation*. In order to assimilate the idea of *adaptive* modes, they can be expressed simply in the context of this study. (See Figure 71 above). Kolb's diagram allows the possible adjustment of words suitable for recognition in different *landscapes* of experience.

An even more significant component of Kolb's model is the importance of the transactions between these modes. In the above model, Experiencing / Theorising and Doing / Reflecting are two distinct dimensions, each representing opposed orientations. These dialectically opposed adaptive modes generate the cognitive energy that drives the cycle. The researcher sees this model as being two-dimensional, and would wish to draw out the adaptive elements particularly at the point of *experiencing* with the cycle moving to *new* experience. If the model becomes three dimensional, then it can accommodate the adaptive elements, and its forward momentum or *recursive* spiralling must accommodate new experience[1]. (See Figures 73 and 74 below).

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[1] In discussion with McAleese (2001) the notion of the "vicious circle" and the "virtuous circle" were explored. The former being locked into a fixed continuum the later being a spiral. The recursive momentum of the 3-D spiral model seems essential to ELT.

Figure 73

The researcher's version of Kolb's Experiential Learning Cycle

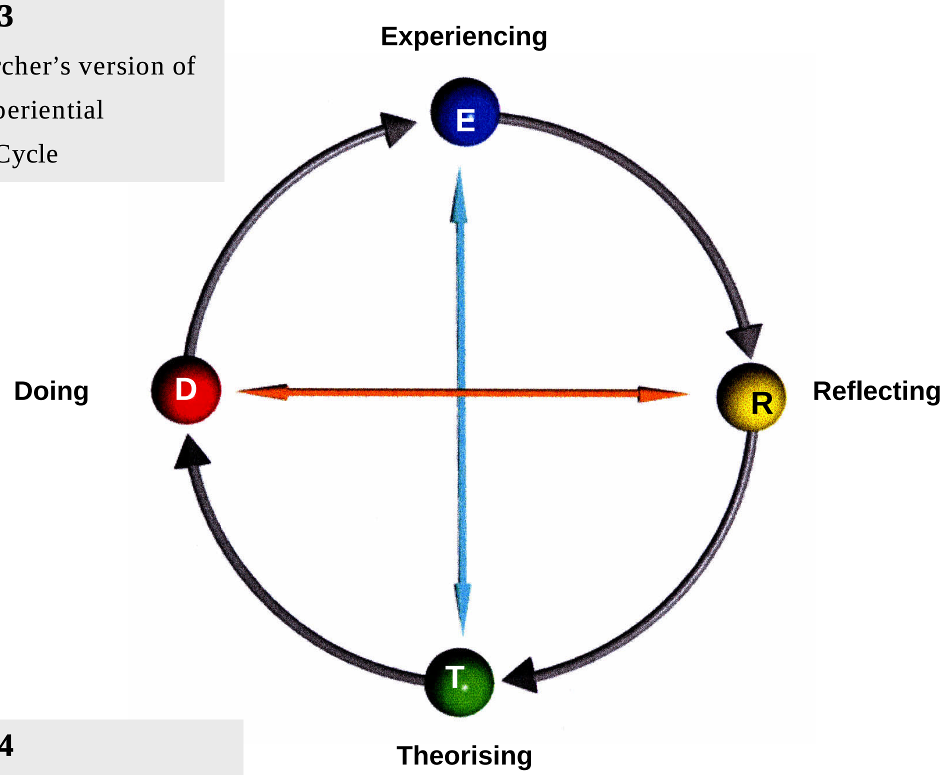
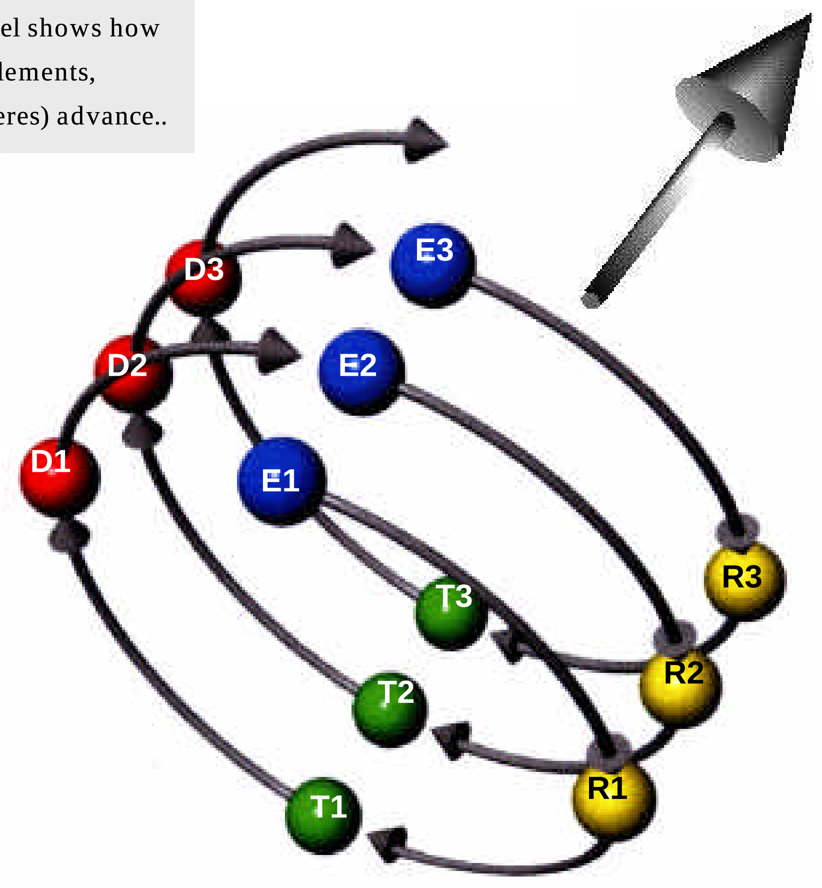


Figure 74

This three-dimensional recursive model shows how the adaptive elements, (coloured spheres) advance..



Kolb's hypothesis also shows the workings of 'prehension' in the form of apprehension and comprehension in the dialectic between *concrete experience* and *abstract conceptualisation*. (See Figure 75).

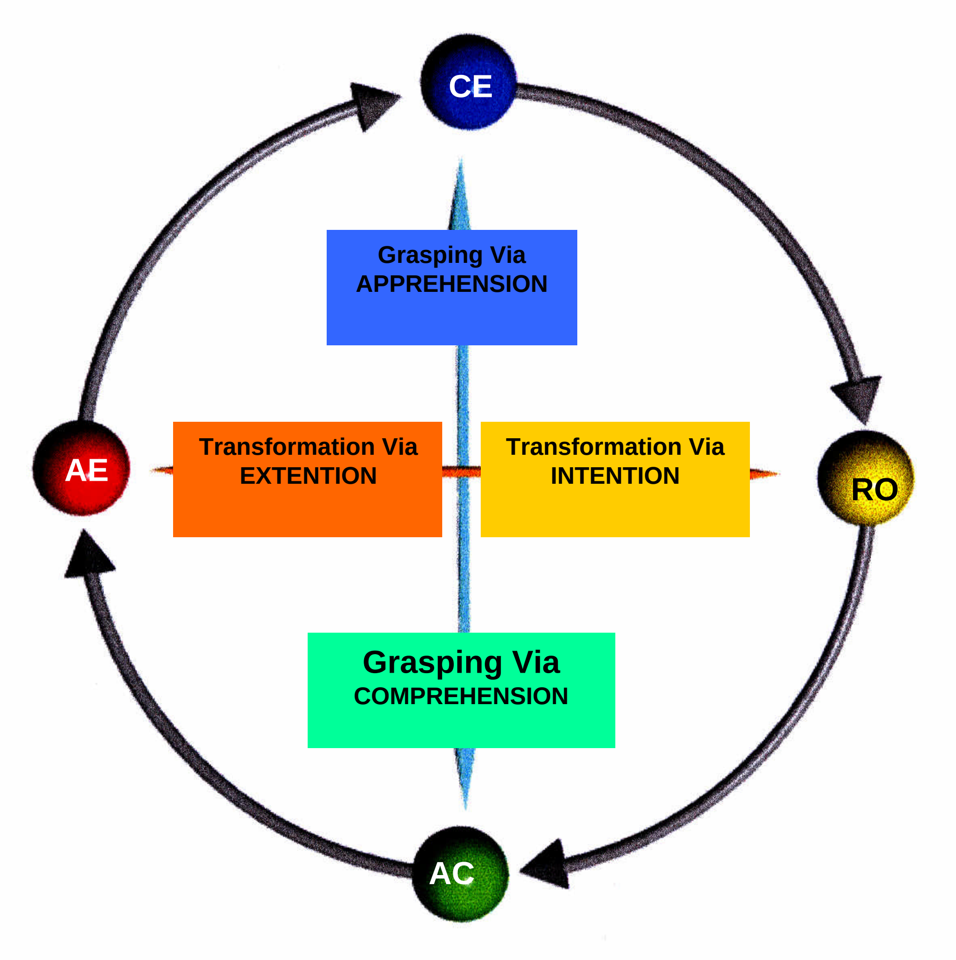


Figure 75

Kolb's cycle showing the orthogonal dialectics.

He additionally includes the concept of 'transformation' as the second orthogonal force in the dialectic between *active experimentation* and *reflective observation* demonstrating how, through reflection, ideas become extended into action and that the actions become the subject of reflection. These ideas inform the practice methodology and resonate well with the concept of **Reflective Risk** associated with the making of artefacts as illustrated in this study.

4.4 Endnote

- **Where there any unanticipated results that emerged from the analysis of Reflective Risk?**

Video and still images were used to capture practice and to inform subsequent analysis. The use of video clips, to observe action, and high resolution still images that can be magnified to view detail, allowed the researcher to *re-engage* with the practice and the process, and to unpack the experiences in detail. Unpacking or *experiorising* of experiences in this context is a form of what Kagan *et al.*, (1963) called “stimulated recall”. An experience was revisited by the researcher enabling further cycles through the experiential learning cycle that is described as *recursion*.

In this context, the cumulative effect of video clips is evidence of the acquisition of skill and judgement. The video facilitates the revisiting of experiences and results in recursive analysis of elements of technique (See Figure 74 p.123). In the course of reflection on practice, the researcher was able to apply this recursive model through the use of video as a reflective learning tool. This element of the thesis is available to others to observe in the context of glassmaking, but can be seen as a model of practice which may be applied to a wide range of action orientated study. Additionally, the facility provided by this interactive presentation (on the DVD) to link and scrutinise still images through magnification, further helps the researcher to participate intimately in observation.

APPENDICES

'Blue Parison'

Experimental trial piece using inside cased colour grading from transparent into almost opaque blue at the bottom. The intention here was to see the voids against a transparent and an opaque background. Also to observe how much detail could be retained.

The casing technique was not fully resolved at this stage of the project and the detail was lost in the making.

See Video Clip *'Blue Parison'*

RETURN
TO
TEXT

'Diver'

Right – Reflection of motif appears blue because it was sandblasted through a transparent blue casing.

Below – Detail of sandblasted motif. Right - after cutting through resist on the parison and left - after casing on the finished piece.

RETURN TO TEXT

'Diver'

'Green Scene'
Parison

The above shows the parison after stencil cutting. This reveals the blue-green chip texture underneath the masking tape.
To the left above – the parison after it has been sandblasted shows the depth of cut.

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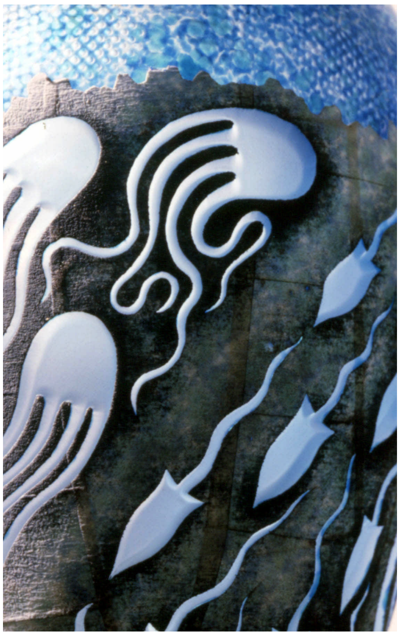

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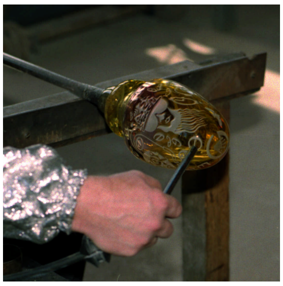
'Green Scene'






Above is a mixture of pink and yellow casing overlaid on a clear parison with images sandblasted through. A short sequence shows the casing process and below the finished piece.



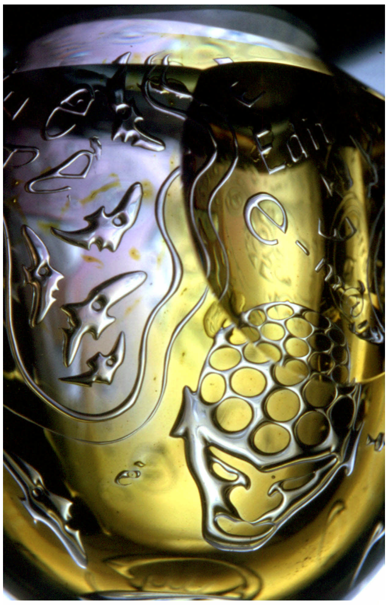
‘VR Tech.’

RETURN TO TEXT

Virtual reality is experienced by viewing through special glasses – a mixture of the activity of the brain and computer generated imagery.
Right above shows a detail sandblasted and below after casing with clear glass.
Above - the same detail in the finished piece.

'VR Tech.'

A *punty* wheel is used to make this deep hollow cut which after polishing becomes a reducing lens. It also creates reflections and distortions.



'VR Tech'

Above can be seen the depth and detail after blasting.
To the right, the detail after removal of the masking tape.

‘Shoal Bowl 1’

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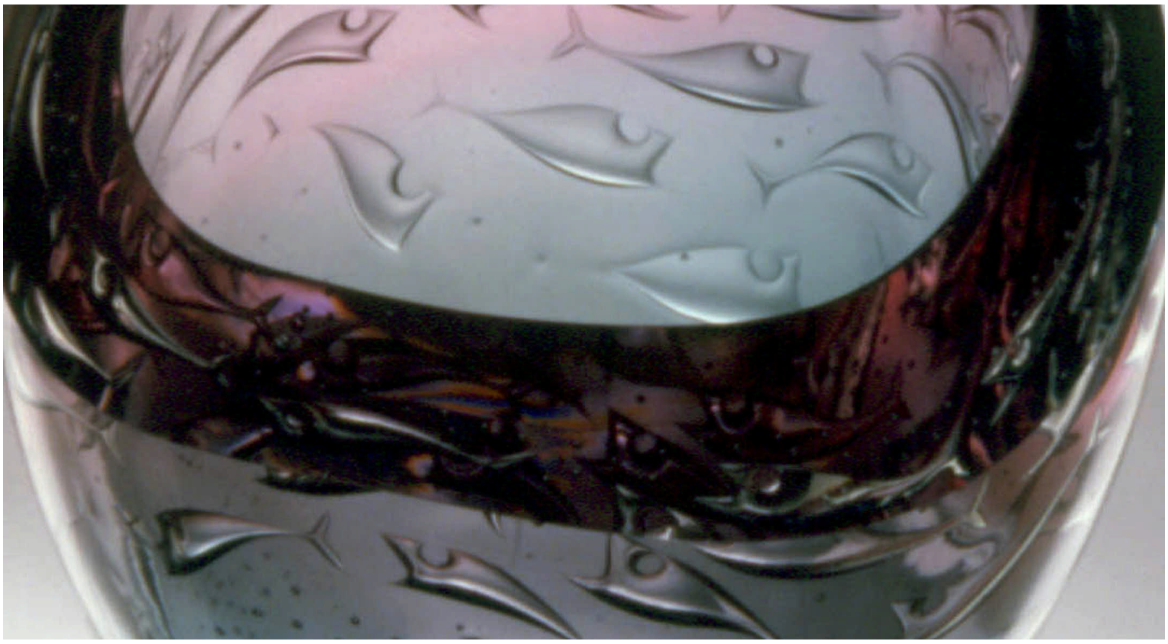
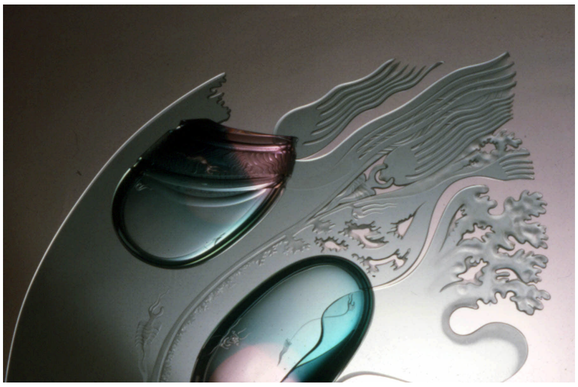
‘Shoal Bowl 1’

The polished and bevelled rim allows a view into the section of the piece and shows how the shoal grows in number as there are two visible reflections of each fish.





Examples of the researcher's previous work employing cutting and sand blasting, In these pieces the blown glass forms were cut in half to gain access to the inside casing layer and some are sandblasted both inside and out. The blown forms are mounted on flat glass.

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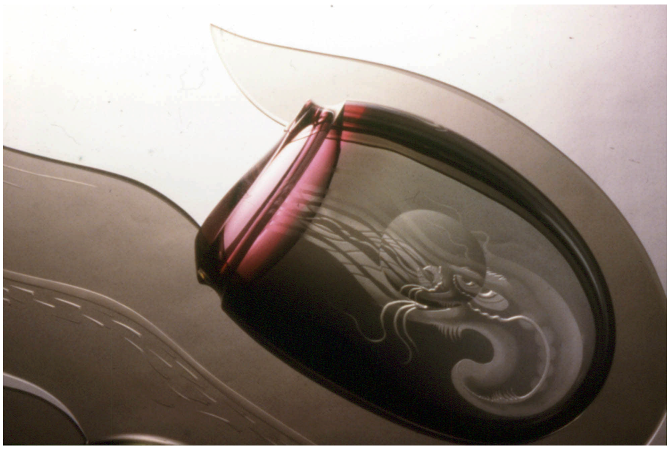


‘Purple Sea’

In this piece, the rim has been cut to a round profile giving equal emphasis to the exterior and interior of the form. The most important feature is the use of sandblasting on the exterior surface.

RETURN TO TEXT

The three parison's above result in delicate imagery made possible by a viscous layer of colour and the forms being more dilated.

RETURN TO TEXT

'Bio-cycle'

In this piece, the imagery is sandblasted through a translucent overlay of opal glass giving the appearance of inlaid mercury. The piece is best viewed looking in and through the reflections created by the contoured rim and bevel cut rings.

The drawing of keyboards and monitors in perspective creates a sense of foreground and background space.

‘Cyberclone’

RETURN TO TEXT

'Cyberclone'




More *‘e-world’* Parison’s


'Webmaster'

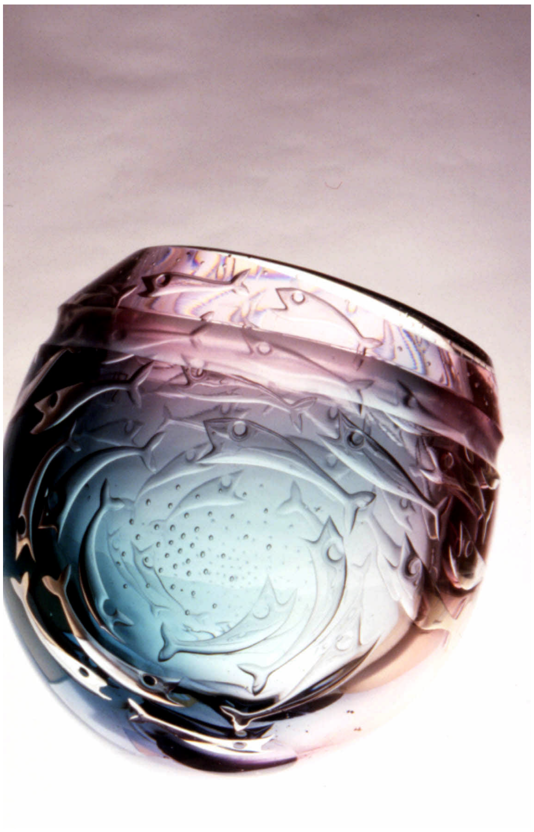
⊕.

‘*Webmaster*’ - started with underlay yellow with an opal overlay creating a misty acid green effect. The drawing here attempts to construct a more three-dimensional figurative quality in contrast with other symbolic floating images.
Drawing with this illusive medium of transparent and sometimes silver voids depends on the silhouette. Where a transition of tone is needed to create form, some kind of shadow effect is required. Here I have tried to construct a face using *black and white* contrasts in the stencil cutting.

See also Screen 17 for finished piece showing tilted axis.

RETURN TO TEXT

'Shoal Bowl 2'



'Lizards'

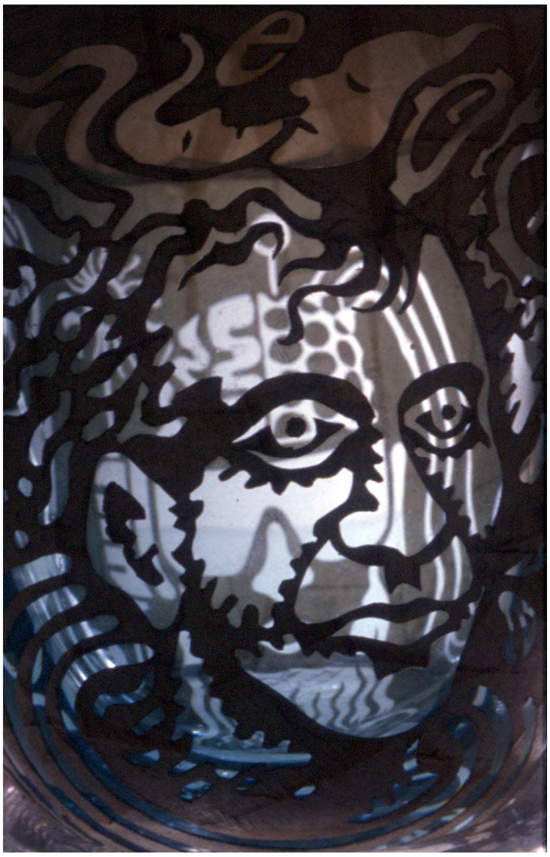
RETURN TO TEXT

The parison has a blue underlay with a pink overlay. This is sandblasted through, leaving blue motifs on a purple ground.
The rim is finished with a rounded profile and a soft mat surface.

See Video *'E – Zone'*

RETURN TO TEXT

‘Pointy Heads’



'Pointy Heads'

The images are sandblasted through a transparent blue overlay.
The piece has been finished on an inclined axis with the rim parallel to the ground plane. This gives an impression of lightness and movement - the suggestion of the piece lifting from the surface.

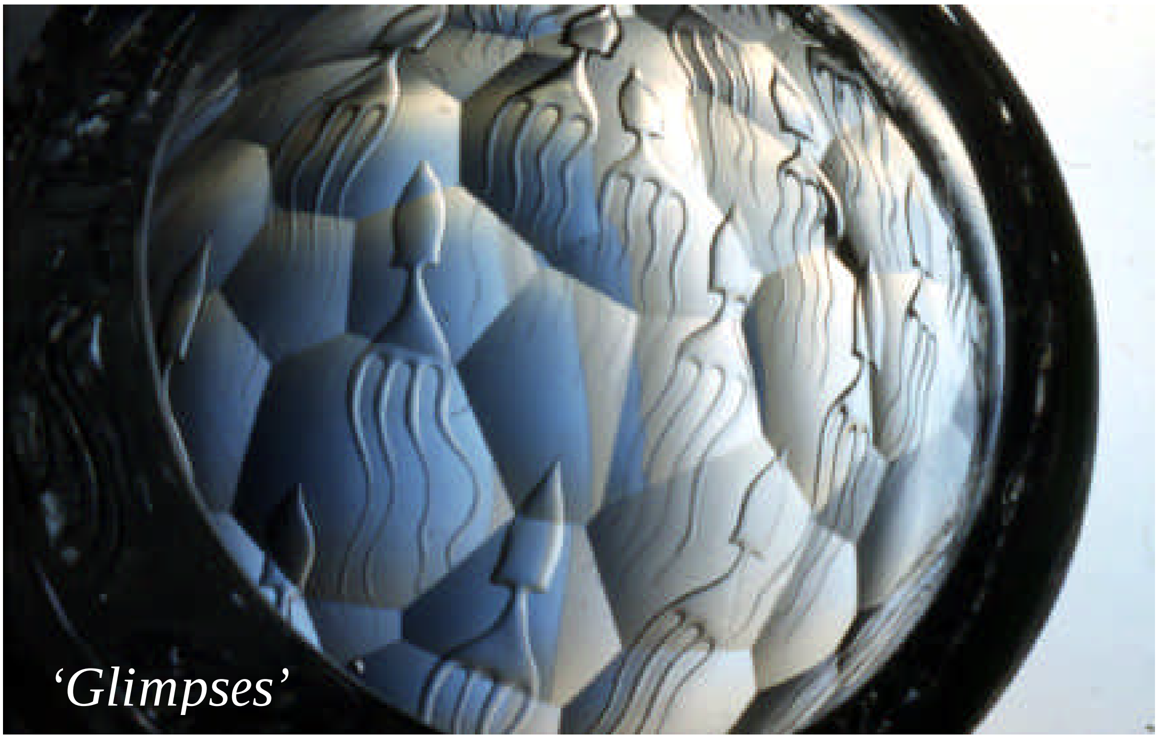
Another opal overlay parison developing symbols, graphic imagery and letter forms.

'e – world'

'e – world' **-** was the first successful combination of idea and technique and gave rise to an appropriate solution to finishing the rim including the use of the unpolished flute cut.

RETURN TO TEXT

‘e-world’



'Glimpses'

'Glimpses'

Many of the early pieces in this research project have no colour and consequently only worked in particular light conditions. 'Glimpses', combined the cephalopod motifs, polygonal facet's with mat surfaces. This is a relatively shallow bowl that can rest on any of the facets drawing attention to inside and outside surfaces. The motifs stand out clearly against the background of facets when looking into the bowl. From the outside the motifs appear and disappear behind the flat surfaces which have varying degrees of transparency.

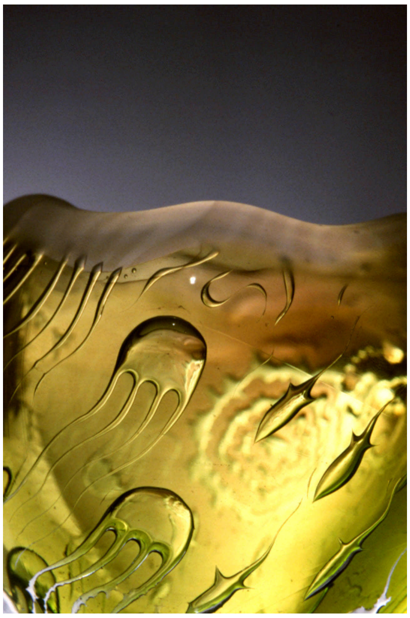
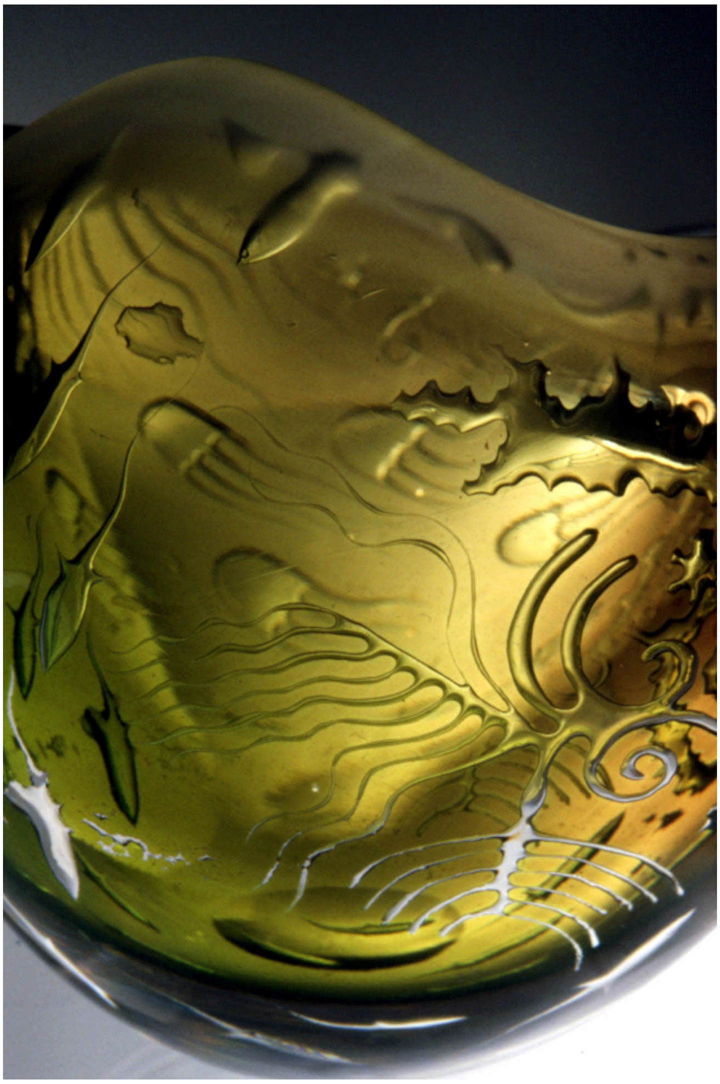
See Screen 27.

'Yellow Sea' – has a yellow inside casing and an overlay with a concentration of pink to one side through which motifs have been sandblasted. In this piece the casing bubble did not cover the whole area of sandblasting having the effect of *'cutting off'* the voids but in the finished piece leaving a ghostly pink outline where the drawing had been.

Drag the magnifier across the unpolished contoured rim. See Screen 30.

'Yellow Sea'



‘Yellow Sea’

'Interface' – has an inside cased red and green background and is overlaid with a thin layer of green through which the imagery is sandblasted. The final gather is very heavy in this piece creating space between the voids and the background colour. Deep oval cuts are placed over internal images changing the angles of reflected light sometimes increasing the mercurial effect.

Below can be seen the sand blasted parison and on the left, the same details after casing. The highlights show how the void becomes slightly inflated giving form to the faces.

See Screen 32

'Interface'

'Interface'

'Sea Change'

These are some of the early sandblasted parisons using no colour. A number of pieces were lost in the making while developing the technique. They are examples of fantasy sea forms.

Appendix 2

Reader Information and Movie Player Introduction

RETURN TO TEXT

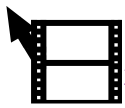
Click or drag magnifier around an image to see detail.

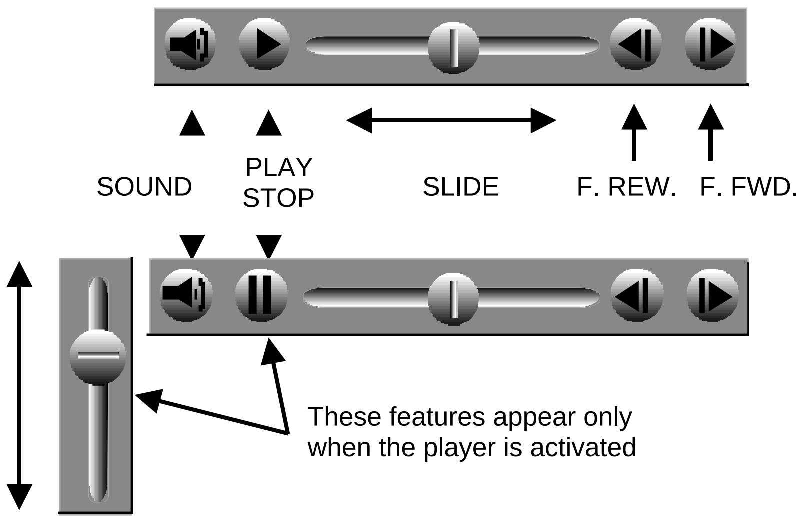
Click **green** and **red** buttons for links and returns.

CLICK HERE

The video clips are activated when the cursor arrow crosses the Movie Frame. The video clips can be viewed as a continuous movie or in part. The slide can be used to find particular sequences see diagram below for other controls. The title and duration of each clip appears on the right of the movie frame as minutes and seconds. This also indicates when a picture is a video clip.

'Sample Picture'
Clip 18 - 4:20

When the arrow cursor crosses a QuickTime Movie, an  icon appears. Click this and the movie begins to run displaying the *movie player* below the image.



Appendix 3

References

Arwas, V. (1977) Art Nouveau to Art Deco, , Academy Editions, London.

Bandura, A, (1978) “The Self System in Reciprocal Determinism” American Psychologist.

'The Brilliance of Swedish Glass 1918-1939: An Alliance of Art and Industry - Published for The Bard Graduate Center for Studies in the Decorative Arts, New York 1996 by Yale University press.

Bullough, Jr. R. V. and Pinnegar, S. (2001) Guidelines for Quality in Autobiographical Forms of Self-Study Research, Educational Researcher, 30, 3, 13-21.

Cowan, J. (1998) On becoming an Innovative University Teacher. Reflection in Action. SRHE and Open University Press, Buckingham.

Cummings, K, (1997) Techniques of Kiln Forming Glass, Black. London.

Dawkins, R. (1976) The Selfish Gene, Longman, London.

Dery, M. (1996) Escape Velocity, Cyberculture at the end of the century, Hodder and Stoughton, London.

Dormer, P. (1994) The Art of the Maker, Thames and Hudson, London.

Dormer, P. (1997) The Culture of Craft, Manchester University Press.

Flavell, R. (1976) Working with Hot Glass, conference paper, ‘Glass Blowing from The Furnace', Royal College of Art, London.

Franz, S. (1989) Contemporary Glass, A World Survey from The Corning Museum of Glass, Abrams, New York.

Gates, B, (1996) The Road Ahead, Penguin, London.

Gardner, P. (1971) The Glass of Frederick Carder, The Corning Museum of Glass, New York.

Greenhalgh, P. (1997) The Culture of Craft, Manchester University Press.

Grover, R, (1975) Art Glass Nouveau, Charles e, Tittle Co, Inc Japan

Harden, D (1987) 'Glass of the Caesar's' Roman glass in the Imperial Age (100 BC to 500 AD) Olivetti, Milan.

Kagan, N., Krathwohl, D. and Miller, R. (1963) Stimulated recall intherapy using video-tape: case study, Journal of Counceling Psychology, 24: 150-2.

Klein, D. (1989) Glass: A Contemporary Art, Collins, London.

Kolb, D. (1984) Experiential Learning, Experience as the Source of Learning and Development, Prentice Hall, New Jersey.

Leach, B. (1940) A Potters Book. Faber and Faber, London.

Littleton, H. (1974) A Search For Form, Van Nostrand Reinhold New York.

Lyricism of Modern Design, Swedish Glass 1900-1970, (1992) Hokkaido Museum of Modern Art, Japan.

Moon, J. (1999), Learning Journals, A Handbook for Academics, Students and Professional Development. Kogan Page, London.

McAleese, R.(1996) via Cowan J, (1998) p. 36 . On becoming an Innovative University Teacher. Reflection in Action. SRHE and Open University Press, Buckingham.

McAleese, R.(2001), Reflective Risk, Figure 71, ‘Personal Communication’.

'New Glass, A Worldwide Survey' (1979) The Corning Museum of Glass, Corning, New York.

Pevsner, N, (1960) Pioneers of Modern Design, Pelican, London.

Piaget, J. (1970) Genetic Epistemology, Columbia University Press, New York.

Polak, A. (1975) Glass its tradition and its maker, Putnam, New York.

Polanyi, M. (1958) Personal Knowledge, Towards a Post Critical Philosophy, Routledge and Kegan Paul, London.

Pye, D. (1968) The Nature of Workmanship, Cambridge University Press.

Schön, D. (1983) The Reflactive Practitioner, How Professionals Think In Action, Maurice Temple Smith, London.

Tait, H. (1979) The Golden Age of Venetian Glass, British Museum Publications, London.

Tooley, F. (1984) The Handbook of Glass Manufacture, Ashlee Publishing, New York.

Zimmerman, B.(1998) Self-Regulated Learning and Academic Achievement. Springer, New York.

APPENDIX 4

BIBLIOGRAPHY OF SOURCES AND ILLUSTRATIONS FOR CONTEXTUAL REVIEW - CHAPTER 2..

Appendix 5

Glossary of Terms

acid rotting **-** the use of concentrated hydrofluoric acid to erode glass leaving a distinctive surface texture.

air twist - a series of regular air bubbles which have been pulled into elongated shapes and twisted to make cork screw like twists of air, usually in the stems of drinking glasses.

'ariel' **-** the Orrefors glassmaking technique where an annealed parison has been decorated by acid etching or sandblasting. This is reheated again and a second bubble is inverted over it encapsulating air in the motifs.

bit **-** A gather of glass added to work in progress e.g. a handle or decoration.

block **-** wooden hemispherical tool used for shaping glass before blowing.

blowing iron **-** steel tube normally 150 cm long, on which glass is gathered and blown.

bubble **-** a gaseous bubble of a spherical form generated by founding or the addition of chemicals.

casing **-** the addition of a coloured layer of glass to the interior or exterior of a piece. Casing inside a bubble *underlay*, is achieved by the addition of a piece of coloured glass being melted on the nose of the blowing iron then clear glass being gathered over. The colour then expands as a lining as the whole is inflated to the clear glass making it appear coloured. If the colour layered is required on the outside *overlay* as it is with graal the underlay method is repeated but then inverted over a clear bubble prepared on another iron bringing the colour to the outside.

casing tool- a spring tool , like pucellas with wooden blades flattened in order to facilitate pushing and turning to turn a casing bubble inside out.

cracking off – A means of removing the surplus glass using a fine gas flame around the circumference of a piece causing it track around this area by thermal shock.

casting **-** molten glass pored into a mould or heated glass, filling mould in a kiln.

cold working – Grinding and polishing.

crizzling **-** crackled surface of glass resulting from contact with water.

crystal glass **-** a glass composition containing at least 24% lead oxide.

dip moulds - pre-moulds made from cast iron that create a relief design on the exterior of a parison form, these may be single piece or have multiple hinged sections.

fire polishing - smoothing by heat at the furnace or glory hole.

flashing - like casing, a term refers to an additional coloured layer. Most common usage in relation to stained glass work where cylinders of blown glass or 'muff' have been flattened for use in windows.

flatting mill – a large revolving iron disk fed with carborundum grit in water.

founding - the term used for the application of heat to melt the glass forming oxides. Like smelting metals, making glass is a foundry process and traditionally in the West Midlands, molten glass is referred to as *metal.*

furnace – a glass founding facility which contains a ceramic crucible or tank fired with usually with gas.

gather - the result of the rotational action by which molten glass from the furnace adheres to the preheated nose of the blowing iron or previous gather.

glory hole - furnace for re-heating work in progress. The diameter of the working hole can be varied according to the size of the piece to be reheated.

graal - the Orrefors glassmaking technique where an annealed parison with an overlay of one or more colours, has been decorated by acid etching or sandblasting. This is re-heated again and re-attached to the blowing iron where the surface is fire polished. The piece may be further blown and shaped - a further gather may be taken over creating an internal layer with images created by etching or sandblasting. Orrefors name.

hot working – working with glass directly from the furnace.

ingot - a cast block of glass typically circular tablet shaped, which can be re-heated and reformed.

'intarsia' - as graal Steuben name.

kiln – an intermittent heating facility for pre-heating or annealing glass.

knop - swollen knob-like details in stems of glasses.

Lathe – a machine for mounting grinding and polishing wheels.

lehr – an annealing facility like a kiln with a continuos moving belt cooling

linisher- an abrasive belt machine.

lapidary - cutting, engraving and polishing using abrasive wheels etc. like gem cutting.

***marver* -** polished steel plate used for chilling and shaping glass during making (*marvering*).

***moil* -** glass coating on the nose of the blowing iron that is left behind when the piece is cracked off.

***parison* -** the dilated glass form on the blowing iron in the initial stages of the making of a blown vessel.

***pucellas* -** the two bladed spring tool used by glassmakers to manipulate molten glass, often called' jacks'.

punty – from pontil, bridging tool for transferring blown vessels to heat and work the open.

***punty cut* –** deep hollow cut Spherical in form having a reducing lens effect.

***pyrometer* –** device for measuring heat**.**

***sandblasting* -** the erosive effect of silicone-carbide grit carried in compressed air.

***seed* -** small bubbles generated in the founding process, which sometimes become elongated when the glass is blown or formed.

sofietta- a conical shaped blowing tool that air is blown through the point of the cone.

***vetro filigrana* -** Italian :- the style of glass making emerging from Venice where elaborate inclusions of white glass cane were incorporated into vessels making filigree patterns.

***void* -** an air pocket trapped between layers of glass.

Appendix 6

List of Author's Published Exhibitions

1974 *Creative Crafts* Volume 1, No.6 issues 5 & 6.

1976 *Surrey County Magazine,* article on ,Wealden Glass Workshop.
'Crafts' magazine No. 22 Sept / Oct.
Modernes Glass - exhibition catalogue, Museum fur Kunsthandverk, Frankfurt, Germany.

1977 F*lavour of the 70's British Crafts,* Southampton.
Craft Buyer International Magazine.
Coburger Glaspries - exhibition catalogue.

1978 *Present* -German magazine, Feb.

1979 *Arts Review* - No.9 May 11th.
New Glass Review - Corning Museum of Glass.
Glass Now - Portsmouth Museum catalogue.
Life Magazine USA , April.

1982 *Techniques of Glass Engraving* - book by Matcham and Dreiser.
Glass Studio - magazine USA, cover photo and article, issue No. 31.
G*lass Now '82,* The Yamaha Glass Show, Tokyo, Japan.

1983 *British Studio Glass* - Sunderland Arts Centre exhibition catalogue.

1985 *International Glass Symposium* - catalogue Novy Bor Czechoslovakia.
Kunstsamlungen de Veste Coburg, Glasspreis - catalogue.

1986 *Arte em Vidro* (Art in Glass), Sao Paolo Museum of Art , catalogue.

1987 *Clear Through to the Wood* , Fitzwilliam Museum Cambridge contemporary glass and furniture.
Christie's British Decorative Arts, catalogue.

1988 *Contemporary British Glass* - British Council / Crafts Council Exhibition catalogue for the National Museum of Art ,Kyoto, Japan.
Christie's British Decorative Arts catalogue.
Antique Collecting magazine. Vol 23, No.3 :
'The Contemporary Glass Market', July / Aug.'88 Contemporary British Glass - Kuala Lumpar; catalogue.

1989 *Neues Glas,* Corning Museum Glass Review 10.
New Art Forum - Chicago Exposition Catalogue.1989
Chistie's British Decorative Arts, Catalogue.

Glass, A Contemporary Art, Dan Klein. Cover photograph and text.

'The Glass Cone', newsletter of the Glass Association; interview and photograph.

1990 *Christie's British Decorative Arts,* catalogue.

World Glass, Japan. (world survey of glass). Edited by Helmut Ricke, Kunst Museum Düsseldorf.

1991 *International Contemporary Glass*, Wrexham ; catalogue.

Christie's British Decorative Arts, Catalogue.

Nomades del Vidre , Barcelona 1991/92; catalogue.

1992 *Grani Maestos del Vetro per l'UNICEF*; catalogue

Victoria and Albert Museum , Report of the Board of the Trustees; photograph.

Christie's British Decorative Arts, Catalogue.

1993 *'The Glass Show'*, Crafts Council, London; catalogue.

1994 *Burlington magazine*, May ' Recent acquisitions of glass at the V&A.

Christie British Decorative Arts Catalogue.

1995 Millers Collectors Guide.

Neues Glas, issue 4/95 , Ray Flavell a biographical survey by Dan Klein Eight pages with five illustrations.

1996 *Venezia Aperto Vetro*, International New Glass, Arsenale Editoriale Venezia.

Illustration of piece of work from above publication in Arsenale Editrice

1996-1997 Publishers.

1997 Illustration of piece in *'Glass Art'* Peter Layton A & C Black 1997

1998 Inaugural Exhibition of the new National Glass Centre, Glass UK British Contemporary Glass catalogue.

1999 *Engraved Glass*, illustrations on three pages.

Vision – 50 Years of British Creativity, Thames and Hudson, London.

Appendix 7

List of Author's Work in Public Collections

1976 Lincolnshire and Humberside Arts

1977 Kunstsammlungen der Veste Coburg, Germany.

1979 Victoria and Albert Museum, London.

Portsmouth City Museum.

1980 Broadfield House, Kingswinford, West Midlands.

1985 International Glass Symposium, IGS Collection, Crystalex, Novy Bor Czechoslovakia.

1986 Victoria and Albert Museum, London.

1988 Royal Ulster Museum , Belfast.

National Museum of Art ,Tokyo.

Crafts Council Collection, London.

1991 Victoria and Albert Museum, London.

1993 Royal Scottish Museum, Edinburgh.

1995 Broadfield House Glass Museum, Kingswinford West Midlands.

1997 Crafts Council Collection, London.